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MISSING

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

La Loutre Dam Across St. Maurice River Completed

Site Up River 50 Miles From Nearest Railway Caused Transportation Difficulties.—Construction Finished Before Contract Time With Twenty Six Billion Cubic Feet of Water Stored During Construction

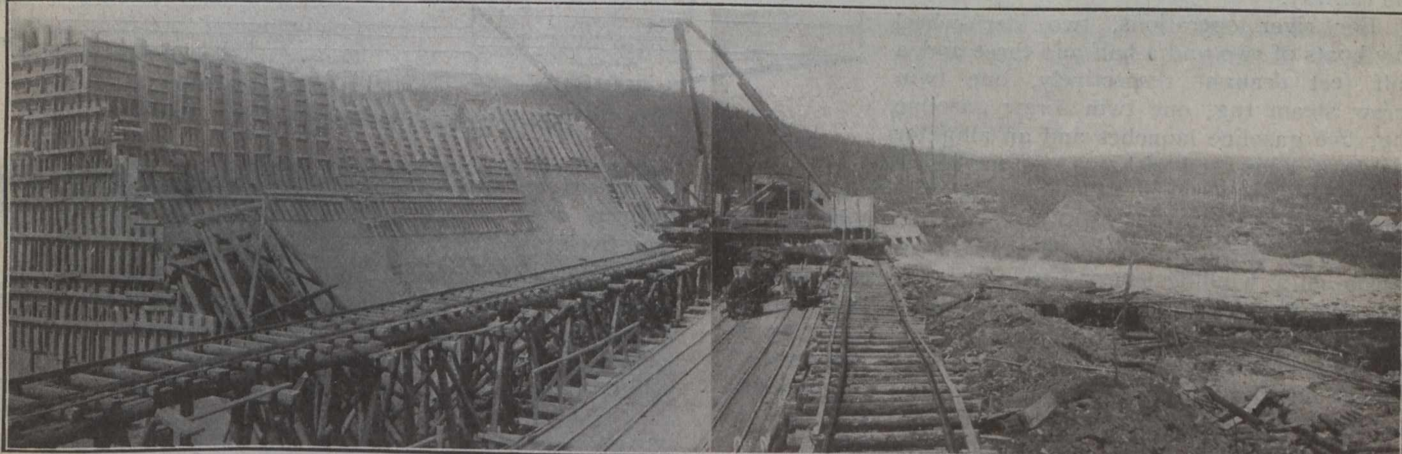
By CHAS. LUSCOMBE, A. M. Can. Soc. C. E.

Resident Engineer for the Contractors

THE cyclopean masonry dam across the St. Maurice River in the County of Champlain, P.Q., has been completed, including the gate-hoisting machinery and gate houses on top of the dam with the electric heating system, and is now in operation. Cofferdams have been removed and there has been about twenty-six billion cubic feet of water impounded during construction.

This dam is for the regulation of the flow of the river and for that purpose, creates a reservoir larger, it is said, than any other in the world, having a capacity of about one hundred and sixty billion cubic feet between average low-water level, and the elevation of the spillway of the dam. The lack of a uniform flow of water the year round has long been a source of inconvenience to the many great power developments and industries between Three Rivers and La Tuque, and of regret at the waste of so much water in the spring time which, if retained, would be so valuable in the low-water season. Not only the existing, but other possible and contemplated developments will be more valuable by means of the water control and regulation made possible by the construction of the dam with its gates, tunnels and spillway.

The site was decided upon by the Quebec Streams Commission after the usual and necessary information had been obtained with regard to the varying flow of the river and precipitation for a period of several years, and the decision was undoubtedly a good one, the site being upstream from any possible future power sites, and at the foot of a chain of lakes and widenings of the river where the greatest and best results could be obtained in storage. The construction work, however, in this "out of the way" region with its short summer seasons and severe winters, at a distance of fifty miles up the river from the nearest railway (the Canadian Government Transcontinental), the first thirty miles up the river navigable but with shoals and rapids, and the remainder unnavigable by reason of the many rapids in a total difference of elevation of one hundred and thirty-five feet in the fifty miles, entailed obstacles in the way of transportation which called forth considerable ingenuity and skill in addition to the construction of a fleet of power boats and scows on the lower thirty miles, and twenty miles of standard gauge railway by the upper twenty miles.

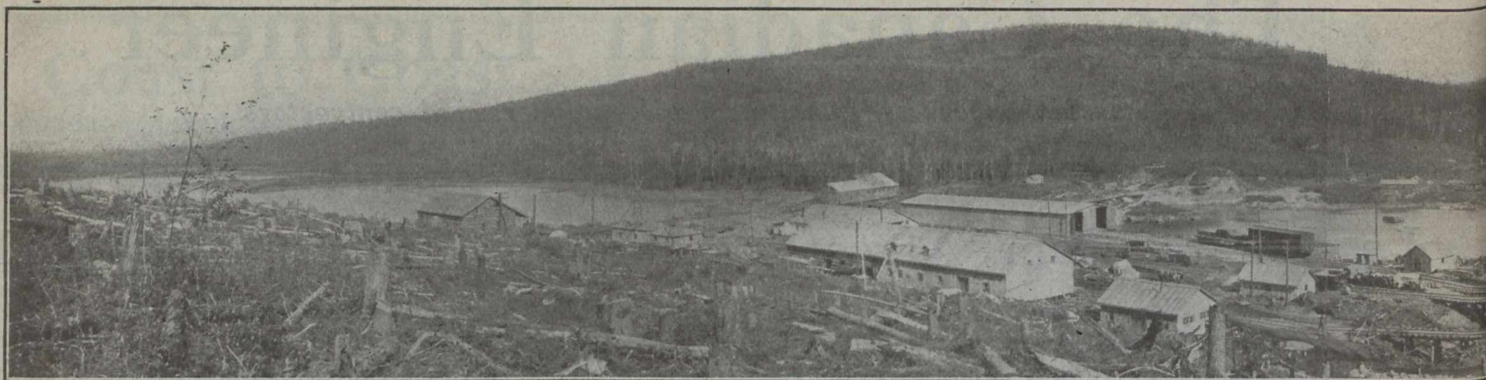


Concrete Forms and East Channel Temporary Sluiceways, Looking East

At Weymontachingue Hudson Bay Post on the river near the Transcontinental Railway the contractors made their base, constructed a terminal with tracks, wharves and boatways, some storage room and camps for the operation of the terminal, and temporary accommodation for employees passing to and from the dam. A ten-ton guy derrick was erected to handle material and construction plant from the cars directly to the boats, a thirty-five-ton dinkey handling the cars. The base was named Sanmaur.

At the foot of Chaudiere Rapids, about thirty miles from the base, a transfer connection was made with similar conveniences to transfer from the river to the railway then to be constructed from there to the dam site.

The construction of a standard gauge railway through the mountainous forest for the necessary rapid transit of heavy materials and plant involved some fairly heavy grading and a large number of trestles over deep ravines and tributaries to the St. Maurice. The maximum grades



Panorama from

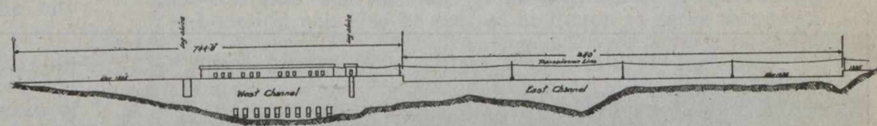
were three and a half per cent. (uncompensated) and seventeen degree curves. Sixty-pound rails were used. The railway equipment included two dinkies of twenty-seven tons and three twenty-five tons each, respectively. Thirty flat cars, a number of which were converted into temporary box cars, and two standard box cars. For summer fuel for locomotives (wood fuel was used in winter) a standard fuel oil tank car supplied stationary wooden storage tanks along the route, thirty-five six-yard side-dump cars and two sixty-ton steam shovels which were used for the stone quarry and sand pit supplying material for the dam after the completion of the railway.

For river operations, two stern-wheel tow boats of two and a half and three and a half feet draught respectively, one twin screw steam tug, one twin screw gasoline tug, five gasoline launches and an alligator tow boat were used with twenty-four scows averaging twelve feet beam and seventy-five feet in length. The alligator with its five thousand feet of cable was used to tow the scows through a long rapids in a winding course at a point about midway between the terminals, and for dragging the scows through shallow water over a long sand bar at the foot of the rapids when the water was very low in the dry season. A large number of skips were used for cement, each holding three tons loaded at Sanmaur and transferred by derricks from boats to cars without rehandling.

A telephone line was constructed from Sanmaur to the dam site. The line was on a specially cleared right-of-way thirty miles to the Chaudiere Falls, then followed the railway right-of-way to the dam. The telephone line was a part of the contract and will be used in connection with the operation of the water control.

In addition to railway and river transportation, a very large amount of material, supplies and plant had to be hauled by teams on winter roads which had first to be made, and with difficulty kept open owing to the very heavy snowfall and windstorms prevalent.

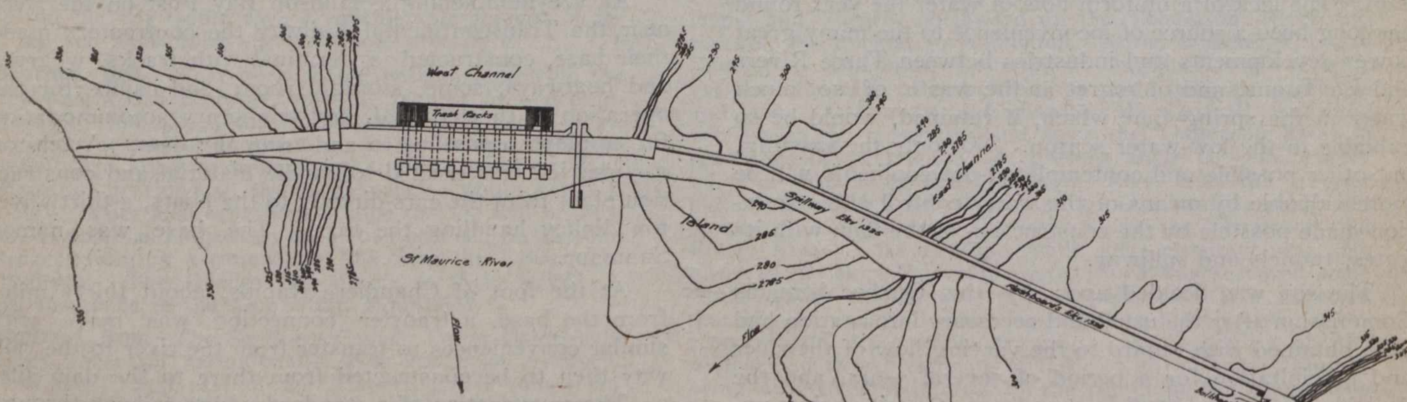
The contract was let in the early autumn of 1915 and by the time river equipment was brought up, channels marked out and handling facilities and wharves erected, the amount of supplies and equipment which could be taken up the river thirty miles to the point of proposed railway construction before the "freeze up" was comparatively small.



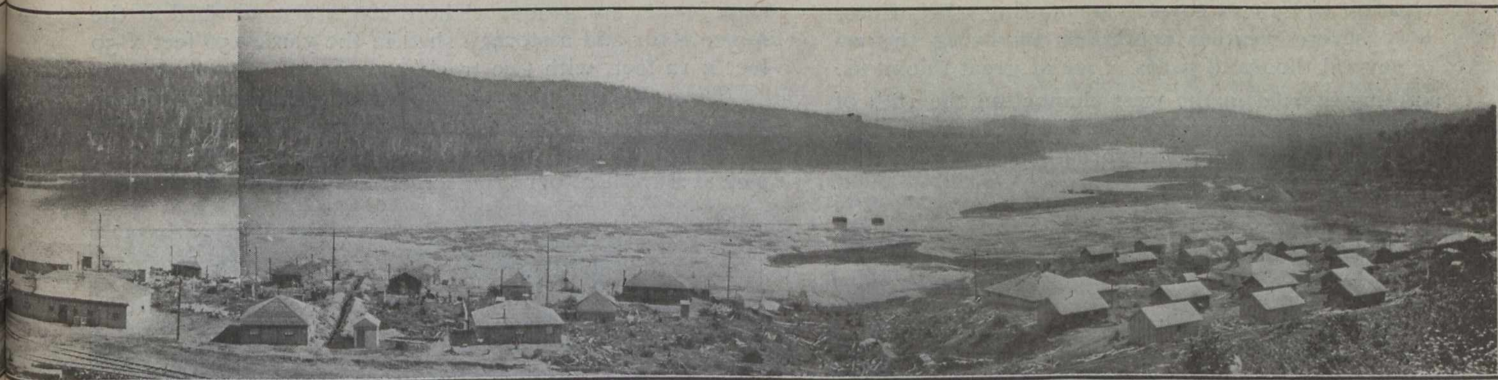
Downstream Elevation

At the same time, the construction of a power house was started two miles below the dam site at La Loutre Rapids to provide power for the operation of construction plant. The structure was of reinforced concrete for two 350 k.v.a., 2,400-volt, 3-phase direct connected horizontal shaft units under 18-foot head. The material and machinery for this power house was hauled in by teams, also all kinds of plant for the railway construction, and to the dam site for the following summer before the railway could reach there.

While the railway construction and the power house



Plan

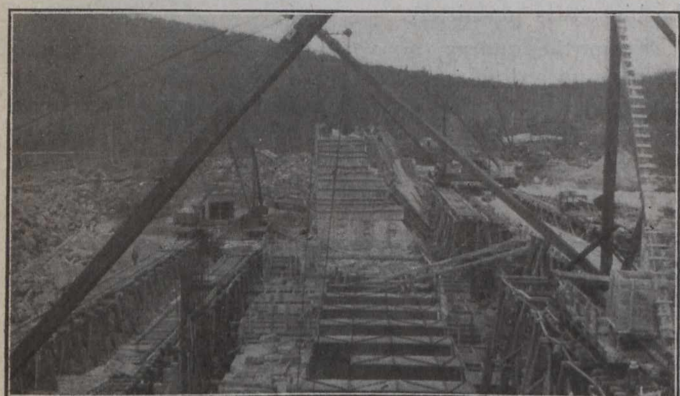


...om ...ntain, Showing Layout

were proceeding in the winter and spring of 1915-16, the various plant foundation works, camps, stores, sawmill and concrete trestle erection and east channel cofferdams were carried on. About three and a half million feet of logs were cut and hauled to the river above the dam site and boomed there.

By August, 1916, the power house and transmission lines were completed, giving power and light to the dam site, also the first railway train arrived there. The east channel cofferdams were pumped out and excavation for the dam started, and concreting quickly followed.

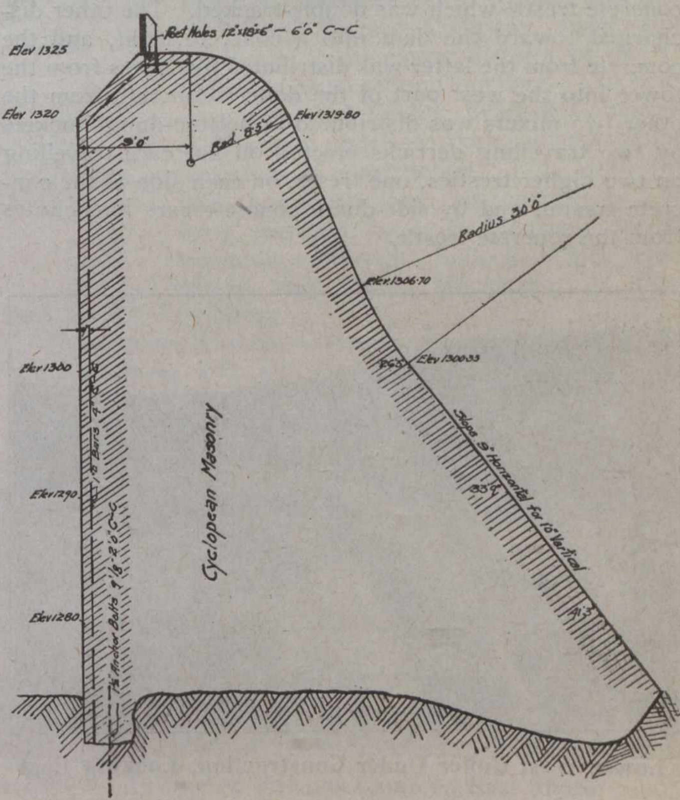
The west channel cofferdams were next started. The log cribwork was built for both upstream and downstream coffers, leaving a gateway about eighty feet long in the centre of each. The river rock bottom was chiefly overlaid with gravel and sand which varied in depth from two to five feet, but this was



Dam, Looking East

not removed. At some points huge boulders only were found on the bed rock. At these, as at other points, care was taken to have the cribwork scribed to fit the river bottom when commencing the crib, careful soundings having been taken every two feet in the direction of the stringer courses, and under each course. The logs were on an average of nine inches diameter, well notched and drift pinned and about seven and a half feet apart in each direction. The "keys" were next built near shore and floated to position where they were sunk by the weight of logs increasing their height above water while anchored a few inches upstream from the final position, then were cut loose and jammed tight to the splayed abutments by the current. The first sheeting was of two-inch lumber driven down into the gravel and spiked to the cribwork by divers. The second sheeting was of one-inch lumber, but before the key sections were sheeted the east channel concrete was in place to elevation thirteen hundred, and five temporary sluiceways of dimensions twelve feet wide by twenty feet high each were left open and the cofferdams there removed, permitting some relief from too great a head of water pressure against the upper west coffer until the cribs were sufficiently filled with rock to resist it. The coffer cribs were thirty feet wide, filled, and then widened on the back with rock and gravel. The front was toe filled on "dryer felt" spread on the bottom with one edge fastened to the cribwork.

The length of the upstream coffer was six hundred feet, the alignment straight and the final head of water against it over forty feet. The leakage was so small that, when once pumped out, it was handled by one of the ten-inch centrifugal pumps working at about one-half the capacity of the pumps. The pumps were on the down-

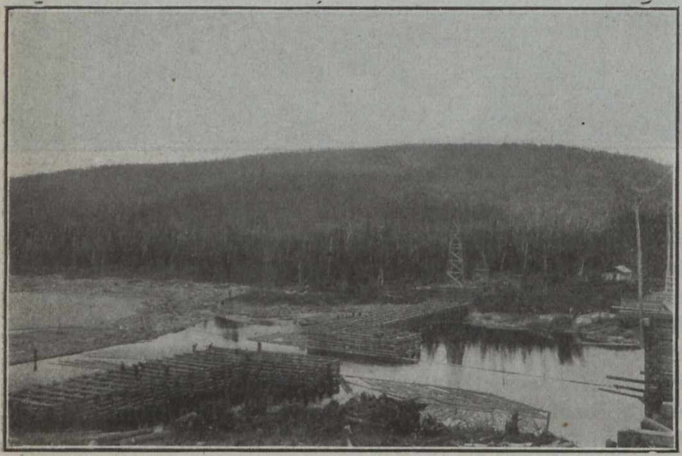


Type of Spillway Section

stream coffer, two on each of two stages. A small secondary coffer near the upstream coffer formed a small reservoir for the leakage from the large coffer, and the water was conducted from the reservoir by an eight-inch pipe through the dam site proper to the pumps at the downstream cofferdam.

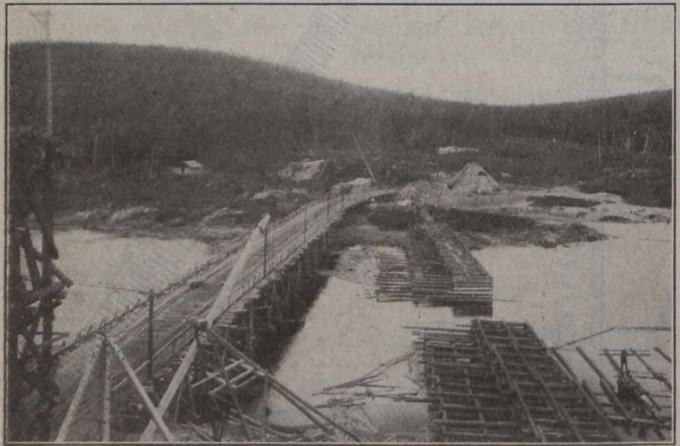
Excavation work was carried on during the winter under very severe weather conditions involving the removal of several thousand yards of ice of great thickness.

Concreting started in the west channel on the 18th of April of this year, having stopped on the 1st of December, 1915, at which time 7,400 cubic yards had been placed in the east channel.



Upper West Cofferdam Under Construction, Looking East

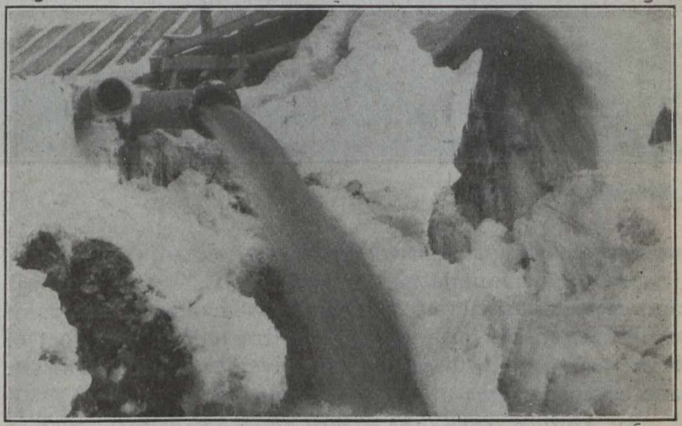
The mixer plant was on the west shore of the west channel with its back toward the dam and on the downstream side. Three mixers of one yard (of concrete) capacity were used. Two of these discharged toward the concrete trestle which was double-tracked. The other discharged toward the dam into a concrete hoist, and the concrete from the latter was distributed by chutes from the tower into the west part of the dam. Concrete from the other two mixers was distributed in bottom-dump buckets by two travelling derricks erected on flat cars travelling on two higher trestles, one trestle on each side of the concrete trestle, and by side-dump concrete cars into chutes from the concrete trestle.



Lower West Coffer Under Construction, Looking East

At the top of the mixer plant, stone and sand bins were on a level with the railway yard tracks; sand and cement were delivered into the plant directly from trains. Crushed stone was brought from the crusher plant by two six-yard standard gauge side-dump cars on a double track, a distance of 650 feet down a three per cent. grade. The cars were attached to a cable passed around a loose sheave at the crusher plant. The loaded car descending pulled the empty car up grade. There was a cement shed at the mixer plant and a storage shed in the yard, 150 feet x 50 feet x 12 feet, with two tracks.

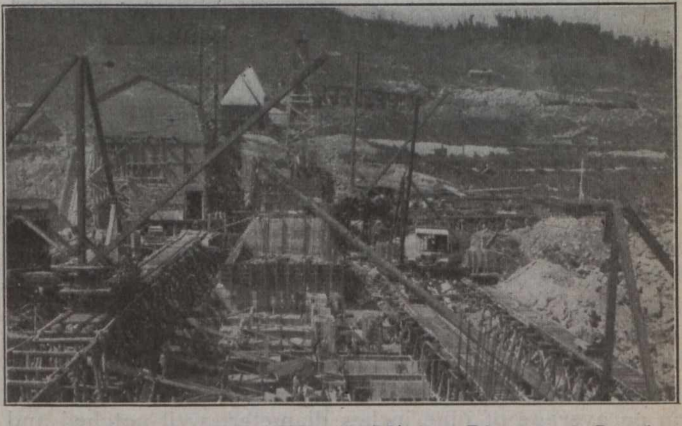
The crusher plant consisted of a 54-inch x 36-inch Buchanan jaw crusher discharging into a No. 7½ Telsmith gyratory crusher. From the latter there was a 16 feet x 4 feet Telsmith girder type screen from which, when used,



Downstream Side of Lower Coffer. Small Discharge from 10-inch Pump Handling Total Leakage of Coffers

the stone was carried by an 80-foot link-belt bucket elevator to the storage bins. The screen rejections passing first through two smaller gyratory crushers, No. 3 and No. 4 Austin. The storage bins were above the tracks leading to the mixer plant and discharged through bottom hopper gates. The screen was not used long, as run-of-crusher, carefully mixed by drawing from various parts of the bins, was permitted.

From the quarry, six-yard side-dump cars conveyed the rock up an inclined trestle and were hauled by a hoist driven from a flywheel of the jaw crusher. The jaw crusher was driven by a 150-h.p. electric motor. The No. 7½, with back gear driving the screen, was driven by a 75-h.p. motor; the No. 4 crusher by a 35-h.p. and No. 3



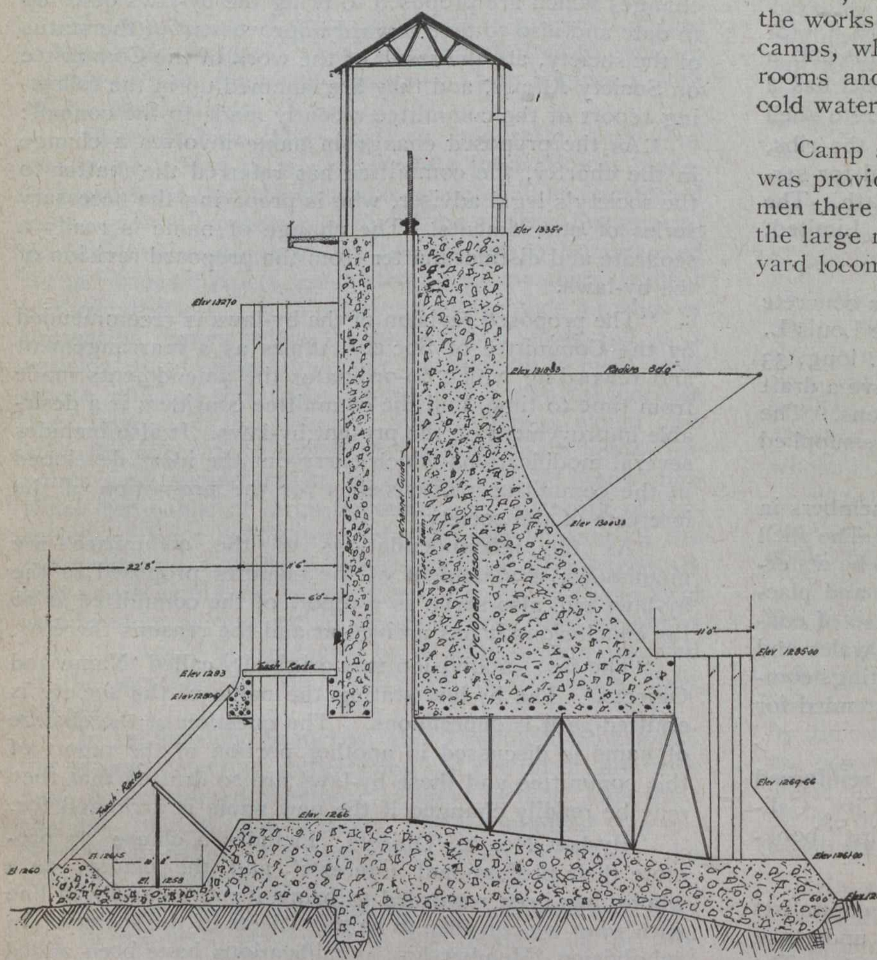
Gate Section (Looking West); Mixing Plant and Crusher in Background

by a 25-h.p. The elevator was driven by a 35-h.p. motor.

An air compressor of 1,100 cubic feet capacity at 100 lbs. pressure, and driven by a 200-h.p. electric motor furnished power for drills, blacksmiths' oil forges and other pneumatic machines, and the cableway engine.

A cableway of 550 feet span was used to great advantage in the construction of the upstream west cofferdam crib construction above water, and afterwards erected over the dam to handle the gate section forms and steelwork and assisted in its erection and that of the gate house above.

For the placing of "plums" in the dam and for excavation, there were two stiff-leg derricks on flat cars on



Section at Sluice Gates

trestles on the upstream side of the dam similar to those on the downstream side. The lengths of derrick booms were from 60 to 75 feet. Six guy derricks were used on excavation and other work. There were two stone quarries; one at a low elevation supplied cofferdam filling loaded by steam shovel, and hauled by 27-ton dinkies in six-yard side-dump cars onto the cofferdam, and later, "plums" were loaded by guy derricks in the same quarry.

A quarry at a higher elevation close to the crusher plant supplied rock for the crushers. A sixty-ton steam shovel was used there for loading.

Sand for concrete was hauled from a point six miles distant on the railway. A steam shovel was used for loading.

A large plateau at the foot of the mountain, and at an elevation of about 50 feet above the river, formed a good site for a yard with railway tracks for the various purposes. Blacksmith and machine shops equipped for all kinds of locomotive repairs and other machine repairs, cement store, commissary and repair part and other stores, electrical work shop and riggers store, compressor house, offices, hospital, large kitchens and mess rooms, while the camps for engineers, foremen and other camps were spread over suitable sites adjoining.

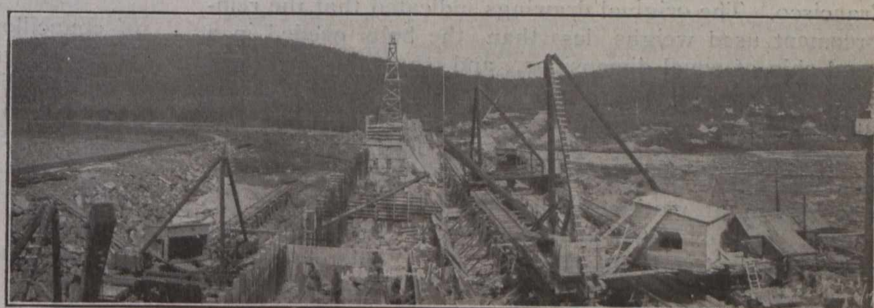
A 4-inch x 4-inch centrifugal water service pump, direct connected to 50-h.p. motor, supplied works and camps. Standard fire hydrants, properly equipped with hose and nozzles, were placed at convenient points to command all the works and camps. Water service was laid into the camps, which for engineers and foremen contained bath rooms and lavatories with complete fittings for hot and cold water, etc.

Camp accommodation for five hundred and sixty men was provided at the dam site. There were not so many men there in the winter time, but the providing of fuel for the large number there and for other purposes, including yard locomotives and steam shovel, was a considerable item. A portable electrically driven saw outfit and a wood-splitting machine operated on the mountain side, with teams and men felling and hauling birch trees. The cordwood in lengths for all purposes was sent down by chutes direct from the machinery to the firewood dump or to railway cars.

The concrete forms were of cantilever type and were made in the carpenters' shop adjoining the saw-mill and proved very satisfactory.

The contractors were the St. Maurice Construction Company, with Julian C. Smith, vice-president and chief engineer of the Shawinigan Water and Power Company, as president. C. E. Fraser, president of Fraser, Brace & Company, supervising engineers, is managing director of the St. Maurice Construction Company. This company employed Fraser, Brace & Company, of Montreal and New York, as supervising engineers of construction. J. J. McCarthy was superintendent in charge of all work, assisted by J. B. Menzies, master mechanic; George Bullock, chief electrician, and J. R. Mackenzie, A. Post and C. P. Howrigan.

The Quebec Streams Commission, a provincial conservation body, with Mr. O. Lefebvre chief engineer, designed the dam and had it constructed. Mr. J.



View Looking East; Quebec Streams Camp on East Shore

B. D'Aeth was resident engineer representing Mr. Lefebvre.

The bridge of the Brocade Girdle, built in the sixteen hundreds, a mass of pegs and crude joints, is one of Japan's most interesting monuments of antiquity. There is not a nail of metal in the entire length of seven hundred and fifty feet, and it is as good to-day as when built.

CONCRETE SHIP CONSTRUCTION

The new booklet, "Concrete Ships," just issued by the Portland Cement Association, Chicago, contains the following brief description of the concrete boat which was built at Montreal last summer:—

"There is now under construction at Montreal a 125-ft. single screw steamer having structural steel ribs and a keel and a hull of reinforced concrete. This vessel has a beam of 22 ft. and a depth of 13 ft. The concrete shell varies in thickness from 3 to 5 inches between the ribs, which are 27 inches apart. The boat is intended for service on the lakes and was launched November 14th. The boat is being built by the Atlas Construction Co., Limited, Montreal."

The booklet above mentioned also describes a concrete barge which is being built near New York by the Louis L. Brown Co., of New York. The barge is 112 ft. long, 33 ft. beam and 10 feet deep. When light it will have a draft of 3 ft. 4 ins. Its carrying capacity is 700 tons. The following information regarding the barge was supplied by the contracting company:—

"The frame consists of reinforced concrete members in which deformed rods are used as reinforcement. The shell is reinforced with wire mesh. The concrete is to be waterproof in itself by proper proportioning, mixing and placing. The rail, bulkheads and deckhouse are also of concrete, the wood used being that for the fender, wales and gunwales. This barge will have all the usual fittings common to floating structures of its kind, and is intended for use in the harbors and inland waters."

A large ocean-going cargo vessel built of reinforced concrete is under construction at Redwood City, California. Regarding this boat, the "Concrete Ships" booklet says:—

"Early in 1917 a group of San Francisco capitalists formed the San Francisco Shipbuilding Co., to undertake the construction of sea-going vessels of concrete. The company is now building an ocean-going cargo vessel of nearly 5,000 tons, that will be about 330 feet long and 46-foot beam. In constructing this vessel the reinforcement was welded together, thus reducing to a minimum the quantity of steel required, by avoiding laps that otherwise would have been necessary. Plans for this work were developed by Allan McDonald, of McDonald & Kahn, San Francisco. The original drawings indicated that the reinforcement used weighs less than the bolts needed in a wood ship of equal dimensions, and that the hull will weigh less than that of a wood ship. 2,500-horse-power turbine engines, equipped with reduction gears, will be used as motive power. Progress in the construction of this, the largest concrete vessel yet to be built, has recently been shown at motion picture theatres throughout the counry. It is expected that work will be finished and the vessel launched early in 1918."

TO ROLL PLATES IN HAMILTON

The Steel Company of Canada, Limited, are arranging to roll steel plates at their Hamilton plant. This will be the second rolling mill in Hamilton to manufacture plates, as the Dominion Steel Foundry Co., Limited, of Hamilton, began rolling plates in that city a couple months ago.

CANADIAN SOCIETY OF CIVIL ENGINEERS REVISION OF BY-LAWS

CHANGES in the by-laws of the Canadian Society of Civil Engineers are now being submitted to the membership by the council of the society. The changes which are proposed to bring the by-laws quite up to date and also to tend toward improvement of the status of the society, are the result of the work of the Committee on Society Affairs, and they are summed up in the following report of the committee recently made to the council:

"As the proposed change in name involves a change in the charter, the committee has referred the matter to the society's legal adviser, who is preparing the necessary series of amendments. The change of name is really a separate and distinct matter from the proposed revision of the by-laws.

"The proposed revision of the by-laws is recommended by the Committee of Society Affairs as a rearrangement and rewording which co-ordinates the amendments made from time to time, and the committee considers it a desirable improvement on the present by-laws. It also includes several modifications which carry out the ideas developed in the committee's discussions for the promotion of the interests of the society.

"As the recommendations of the committee are unanimous, a statement of the changes proposed in the by-laws will also serve as a report of the committee as to the conclusions it has arrived at and the reasons therefor.

"The first subdivision was originally called 'Name and Objects.' The by-law stating the name of the society is omitted as it is superfluous. The question of the change of name is discussed in another portion of the report of this committee and these by-laws are so drafted that they may be readily changed if the new name is arranged for.

"By-law No. 1, 'Objects,' includes a clause 'to promote their professional interests' and the clause, as a whole, has been reworded to bring it more closely in line with what we consider to be the objects of the society. In subdivision 'Membership,' qualifications have been added for 'professional charge' and 'professional responsibility,' which will define the position of university professors more accurately.

"Under 'Titles', an associate member will be designated 'A.M.Can.Soc.C.E.'

"By-law No. 5 is re-drafted to permit of the organization of a Montreal branch without further alteration.

"Under subdivision 'Officers', a change in the number of councillors corresponds to the change which is made in the geographical districts, which it is proposed to call 'electoral districts'. The method of filling vacancies is changed and vacancies will only be filled until the next annual election.

"Under subdivision 'Management', the secretary, who is now a salaried officer, will hold office at the will of the council and his duties are clearly defined, it being specified that his time shall be devoted solely to the interests of the society.

"The duties of the Publication and Papers Committee are more closely defined. Attention is called to the Papers Committee being composed of representatives from the branches; *i.e.*, of men in touch with the membership as much as possible, who will endeavor to obtain papers, and the Publication Committee being composed of another set of men who will be selected on account of their competence as judges.

"It is hoped that the acceptance of papers for advance publication or for printing in the Transactions will be regarded as an endorsement of merit and a recognition of the author.

"In subdivision 'Admission, Transfer and Expulsion of Members', a clause is introduced to agree with the law in the province of Quebec, and slight changes are made in wording which are considered an improvement on the present by-laws.

"In subdivision 'Fees', no change is proposed except in the clause 'Arrears', which has been drafted to conform to that of the American Society of Civil Engineers with slight modifications.

"In subdivision 'Meetings', an important and, your committee believe, a most promising innovation is made. It is proposed that the annual meeting shall be considered as the general business meeting of the society, but general professional meetings of the society are to be arranged for in various districts, conducted by the members resident in those districts. Such meetings will provide a means of presenting papers before the society as a whole and, it is anticipated, of encouraging our membership to meet, visit works, improve their acquaintance and in general increase their interest in the society. Such meetings would also have the effect of bringing the society more before the public and should assist in increasing the knowledge which the public at large possesses of the work of this society. Your committee feels that, on account of the great extent of Canada, meetings could be advantageously held which would not be restricted in any way to the local membership, as they would be open to the membership at large but would be conducted by its local officers, assisted by the secretary of the society so as to ensure their success.

"In subdivision 'Branches' and 'Provincial Divisions', the by-laws referring to branches and provincial divisions must be considered together, as they include important changes in the constitution. This committee has endeavored to define an organization which will meet the following requirements:

"1.—The society should be equally desirable and valuable to engineers belonging to any branch of the profession.

"2.—Without discussing the question of whether the society would best promote the interests of its members by working for an open or a closed profession, a discussion which the committee recommends should not enter into the consideration of the proposed by-laws, the society should afford a means through which its members may represent the engineering profession either locally by a branch or provincially by a provincial division. The committee considers that the important factor in the development of the society is the branch, and the by-laws are drafted on the assumption that a Montreal branch will be formed and that headquarters meetings of the society will be abolished, although the premises will be available for the annual meeting of the society, any general professional meetings of the society which may be held in Montreal and for the meetings of the Montreal branch.

"No rebate of fees is made to the Montreal branch, nor is any change made in the fees of the resident membership, so that the present financial arrangements are in no way disturbed.

"The sections which previously existed at headquarters are abolished, and in their place the branches may organize sections within themselves wherever such sections can be advantageously established to afford engineers belonging to any branch of the profession an opportunity to meet together and discuss papers or exchange views on subjects they are particularly interested in. The sections may vary in size or enterprise, but to ensure all engineers feeling that their branch of the profession is regarded in the same light as any other, the sections in any branch should be placed on an equality with respect to their organization.

"Apart from the organization of the sections in the branches, these by-laws recognize no difference between engineers, whether mechanical, civil, electrical or belonging to any other branch of the profession. They are all engineers. If elected to office, they are all representative of the engineering profession and not of any branch of it. It is considered that this argument will increase the opportunity for local development. A branch is in position to attract engineers of every kind and afford them an opportunity to meet together with other engineers engaged in the same line of work.

"Apart from their professional meetings, all engineers are on the same footing in the branch and the branch is thus in a position to represent the engineering profession as a whole, and the branches and engineers resident in a province can, through the formation of a provincial division, represent the engineers in their province as a whole.

"The rebate for the branches has been made twenty per cent., as upon investigation this was found to be sufficient.

"In subdivision 'Nomination and Election of Officers', the present geographical districts have been revised and rearranged and called 'electoral districts', as they only exist for the nomination and election of officers. The by-laws are so arranged that the councillors are only elected by the votes in their own electoral districts, although they are nominated by the nominating committee as a whole, which should tend to bring forward the best class of men for the office. Several other modifications in the by-laws, which were considered desirable, have been included.

"In subdivision 'Amendments', a new clause is presented which it is thought will be satisfactory. It provides an opportunity for any amendment to be accepted in the form desired by the proposers, yet prevents amendments being modified in a haphazard way at the annual meeting. This clause is the result of a great deal of study on the part of the committee, and they believe it is worthy of a careful trial.

"In conclusion, the committee earnestly suggest that if these by-laws are approved of by the council, the corporate members be requested not to object to them as a whole on account of any particular clause which may be objected to by any individual member, but that if as a whole they are considered desirable, the corporate membership be requested to adopt them and subsequently introduce amendments to modify any particular clause which they consider should be modified or improved upon."

A successful method of raising sunken vessels was witnessed at Havana recently, when the sixty-ton two-masted barge "Regla" was brought to the surface. Four specially constructed tanks, divided into two sections, one section containing acid and the other water, were attached to the hulk by divers. When all was ready a valve in each of the tanks was opened by means of lines, allowing the water in one section to mix with the acid in the other. The gases thus formed expelled the water converting the tanks into buoys, the lifting power of which was sufficient to bring the craft to the surface and maintain it there. Although only a few feet of one of the masts was visible above the water, the moment the valves were opened the barge began to rise, and within a minute it was floating erect.

GRAPHICAL DETERMINATION OF BEAM DEFLECTIONS*

By Jesse B. Kommers
Assistant Professor of Mechanics, University of Wisconsin.

In this article numerical problems have been worked out for the common cases of beam loading, showing the detailed application of graphic methods which are simple and practical. The general theory of these methods may be found in books on graphic statics, and the theory upon which some particular methods are based may be found in Morley's "Strength of Materials."

It can be proved that when the area of the load diagram of a beam is treated as the load on the beam and a funicular polygon is drawn, the ordinates of this polygon will be proportional to the bending moments; and if this moment polygon is treated as a load on the beam and a

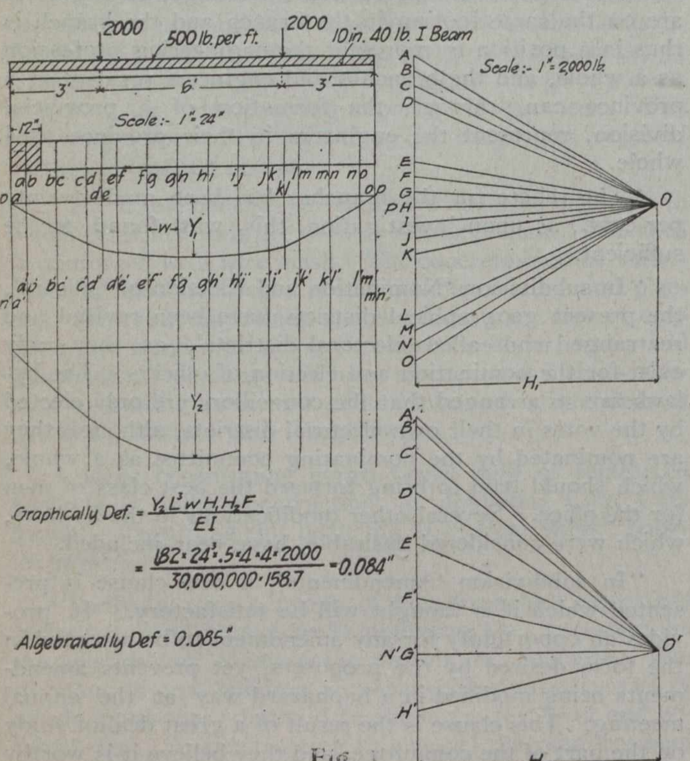


Fig. 1

second funicular polygon drawn, the ordinates of this funicular polygon are proportional to the deflections of the beam.

In Fig. 1 is shown a simple beam carrying uniform and concentrated loads. The uniform load is broken up into equal strips and the weight is assumed to act at the middle of each strip. The concentrated loads act at their points of application. When the first funicular polygon has been obtained as shown in the figure, the area of this polygon is broken up into equal strips and the mid-ordinate of each strip is used to represent the area in the second force polygon. The second funicular polygon is then drawn as shown. Only half of it is completed because of symmetry. The scales indicated are those used in the original drawings.

The following notation will be used to determine the deflection of the beam:

E = modulus of elasticity.
I = moment of inertia of cross-section.
L = linear scale in the two funicular polygons.
F = force scale in the first force polygon.
H_1 = pole distance in the first force polygon in inches.
W = width of a strip in the moment diagram in inches.
H_2 = pole distance in the second force polygon in inches.
Y_1 = ordinates in the first funicular polygon in inches.
Y_2 = ordinates in the second funicular polygon in inches.

The moment at any place in the beam will then be:
$M = Y_1 \text{ I } H_1 F$.

The deflection at any place in the beam will be:

$$\text{Def.} = \frac{Y_1 L^3 H_1 F H_2 W}{EI}$$

It should be noted that if $\frac{Y_1}{2}$, or $\frac{Y_1}{3}$ are used to represent the moment area in the second force polygon, then the result must be multiplied by 2 or 3 respectively. Conversely, if $2\,Y_1$ or $3\,Y_1$ be used then the result must be divided by 2 or 3 respectively. It should also be noted

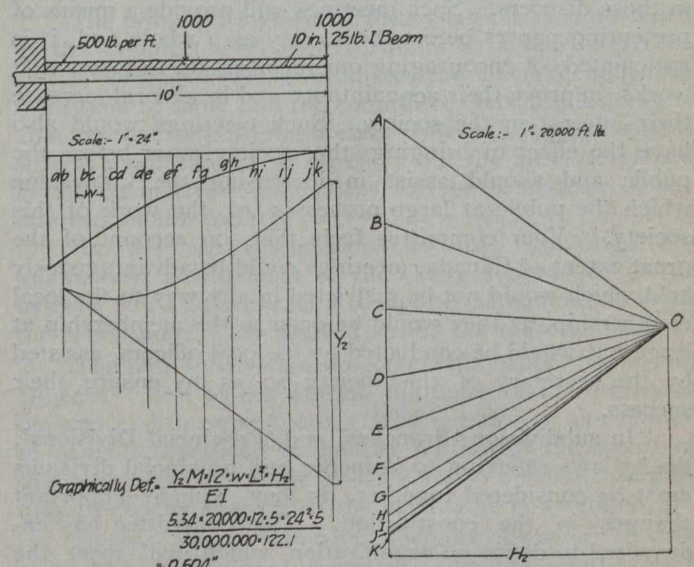


Fig 2

that the true deflection curve will be an inscribed curve tangent to the sides of the funicular polygon.

It may be mentioned here that one of the great advantages of the graphical method lies in the fact that the problem is no more difficult for complicated loading than for simple loading. In the numerical case, which is here considered, a comparatively simple loading was chosen so that the deflection could be checked algebraically, but the problem would have been no more difficult even if the load diagram had been as irregular as one could possibly make it.

When we deal with a cantilever beam we will again need the bending moment diagram. If the loading is made up of uniform loads and concentrated loads, the bending moment diagram is most easily drawn by first calculating algebraically the values of the bending moment, say, for every foot of length. In Fig. 2 is shown a numerical case in which the maximum deflection is found by determining graphically the moment with respect to the free end of the bending moment area. As shown in the figure, the bending moment area is again broken up into strips and a force and funicular polygon are drawn. If M is the scale, in foot-pounds, used in plotting the bending moment diagram, then the deflection, using the same notation as in the previous case, is:

$$\text{Def.} = \frac{12 M Y_2 w L^3 H_2}{EI}$$

Here Y_2 must always be the intercept of the first and last strings in the funicular polygon, on a line drawn

*From the "Wisconsin Engineer."

parallel to the forces through the point in the beam where the deflection is wanted. If the deflection is wanted at some place x distant from the wall, then only the bending moment area between the wall and the point x is used.

If the loading on the cantilever is very irregular so that the algebraic calculation of bending moment would be tedious or perhaps impossible, the graphical method may be employed. The free end of the beam may be taken at the left end, and the load diagram is broken into strips of equal width, as was done in Fig. 1. Each force is assumed to act at the middle of each strip, and a funicular and force polygon are drawn. The moment at any distance from the free end will be proportional to the intercept on a line through this point parallel to the forces, of the first and last strings for all the forces to the left of the point in question, or in other words, to the intercept of the funicular polygon. As in Fig. 1

$$M = Y_1 L H_1 F$$

Fig. 3 shows a numerical case illustrating a beam overhanging its ends. A simple loading was chosen so

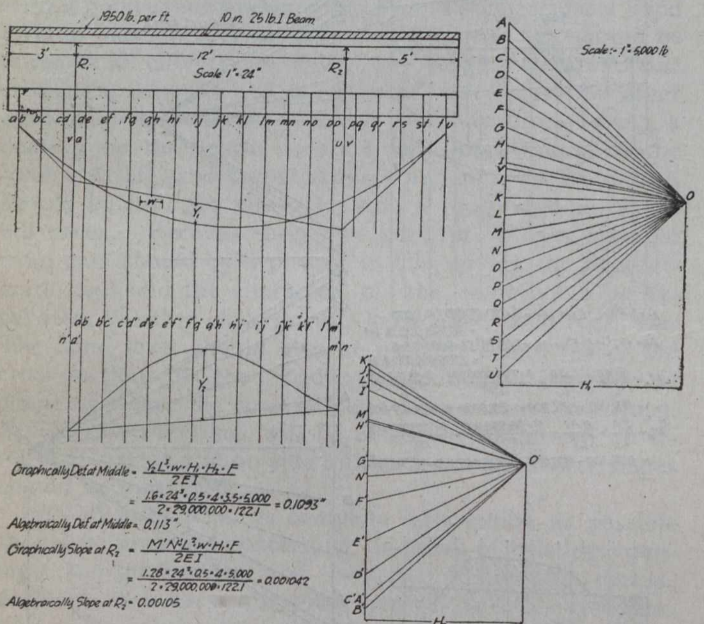


Fig. 3

that the results could be checked algebraically. If we consider only the bending moment diagram between supports and treat this as a load on a beam, a funicular polygon may be drawn which will have ordinates which are proportional to the deflections. Fig. 3 makes the method plain.

For deflections of the overhanging ends, the moment of the bending moment area will be involved as in the case of a cantilever, but here must be taken into consideration the fact that the slope at the two supports is not zero. As shown in Fig. 3, the slope at the supports is proportional to the reaction at each support as determined by the second force polygon in this figure.

$$\text{Slope at right support} = \frac{M'N'L^2 wH_1F}{EI}$$

Here the notation is the same as before and $M'N'$ is the reaction at the right support in inches, scaled from the second force polygon. In the figure the 2 appearing in the denominator of the equation is due to the fact that in drawing the second force polygon the Y_1 lengths in the first funicular polygon were doubled.

It can be seen that if the slope at the right support is positive the effect on the beam will be to reduce the deflection due to the overhanging end, while negative slope would increase the deflection. We know that in a simple beam treating positive bending moment area as a downward load on the beam we would get upward or positive reactions and the slope at the right support would be positive. So, if on this basis the reaction at the right support is positive, we know the slope is positive. Conversely, if positive moment is treated as an upward force, then the reaction at the right support would be negative, and then negative reaction would mean positive slope.

For the part of the beam overhanging at the left end we can see that here positive slope would increase the deflection and negative slope would decrease the deflection of the overhanging end.

It can be seen in Fig. 3 that the first funicular polygon would not give very accurate values of moment. It is better, therefore, to proceed as in the case of the cantilever beam, calculate the moments in the overhanging part algebraically, and thus determine the moment diagram. The moment of this area with respect to the free end is then found graphically, as shown in Fig. 4. This quantity

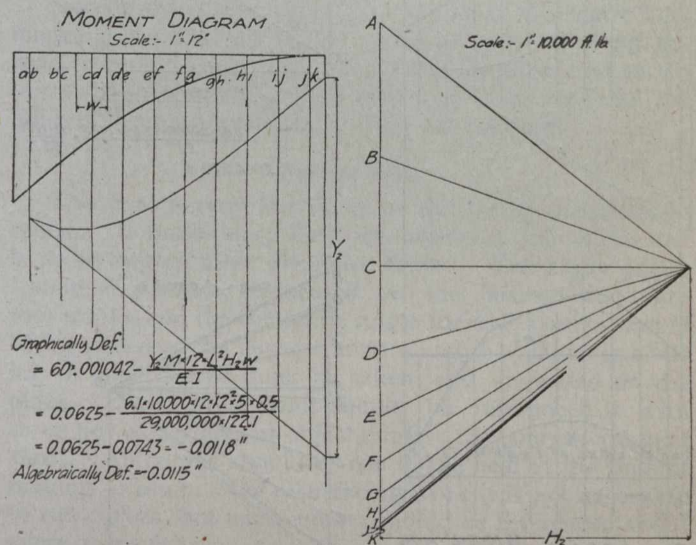


Fig. 4

must have added to it or subtracted from it the product of the slope at the right support times the distance from the right support to the free end of the beam. Since the slope at the high support is positive the effect is to decrease the deflection. Thus the product is subtracted, as shown in Fig. 4.

If the deflection is wanted at any point x distant from the right support, the product of the slope times the distance x is added or subtracted from the moment of the bending moment diagram from the right support to the point x, with respect to the section at x.

Fig. 5 shows the case of a beam fixed at one end and supported at the other. To determine deflections graphically probably the best way to proceed is to determine R, the reaction at the supported end, and then calculate algebraically the moments, say, for every foot of length. The moment diagram can then be plotted and from this a deflection curve may be obtained, as was done in the case of the overhanging beam between supports.

Since in the case before us the supported end of the beam does not deflect, the deflection caused by R must be exactly equal to the deflection caused by the loads on the beam. Or, since the deflection of a simple cantilever beam at the free end is proportional to the moment of the bending moment area with respect to the free end, it follows that the moment of the bending moment area due to the loads, which we will call M_2, is equal to the moment of the bending moment area due to R, which we will call M_1. It can be seen from the figure that

$$M_1 = \frac{RL^2}{2} \times \frac{2L_1}{3} = \frac{RL^3_1}{3}$$

For the general case M_2 can be found most easily by graphic methods. The moment diagram is plotted, using only the loads on the beam, and from this M_2 is found graphically in the usual way. Then, since $\frac{RL^3}{3} = M_2$, the numerical value of R is known. Having found R, the

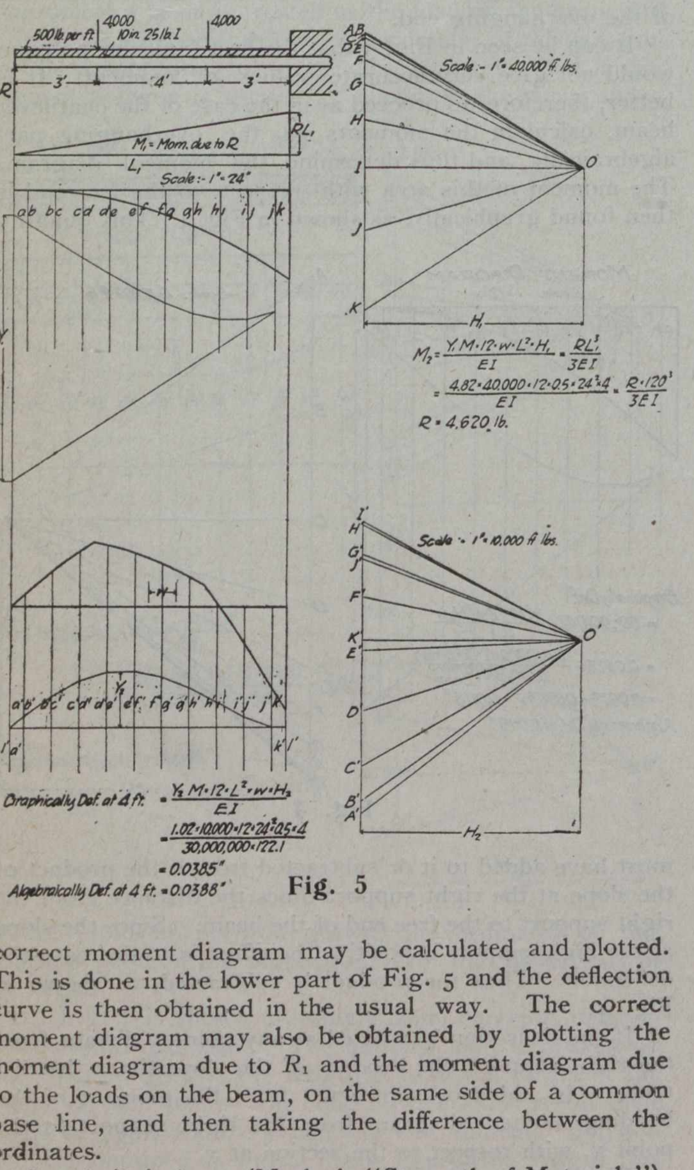


Fig. 5

correct moment diagram may be calculated and plotted. This is done in the lower part of Fig. 5 and the deflection curve is then obtained in the usual way. The correct moment diagram may also be obtained by plotting the moment diagram due to R_1 and the moment diagram due to the loads on the beam, on the same side of a common base line, and then taking the difference between the ordinates.

In a built-in beam (Morley's "Strength of Materials"), the effect of the fixed ends is to produce moments M_a and M_b as is shown in Fig. 6. These moments are in general negative and tend to make the beam convex upward throughout its length. It can also be shown that the value of these moments is as follows:

$$M_a = \frac{6\,A\,x}{L^2} - \frac{4\,A}{L_1} \text{ or } 2\,\frac{A}{L_1}\left(\frac{3\,x}{L_1} - 2\right)$$

$$M_b = \frac{2\,A}{L_1} - \frac{6\,A\,x}{L_1^2} \text{ or } \frac{2\,A}{L_1}\left(\frac{3\,x}{L_1} - 2\right)$$

Where A = moment area due only to loads on beam.
x = distance from left support to centroid of the area.
L_1 = length of beam between walls.

In a numerical case the moment for every foot due to the loads may be easily calculated, and then the moment diagram drawn. The moment of the area, $A\,x$, may then be found graphically or, taking the load diagram, a funicular polygon may be drawn, the ordinates of which will be proportional to the moments at different points in the beam. This funicular polygon treated as the moment area A may be used to determine $A\,x$ graphically. This second method is used in Fig. 6. The area A is easily found from the average ordinate by taking the mid-ordinate of each strip in the moment diagram and dividing the sum of the ordinates by the number of strips.

When M_a and M_b have been determined as shown in Fig. 6, the true moment diagram for the beam is easily

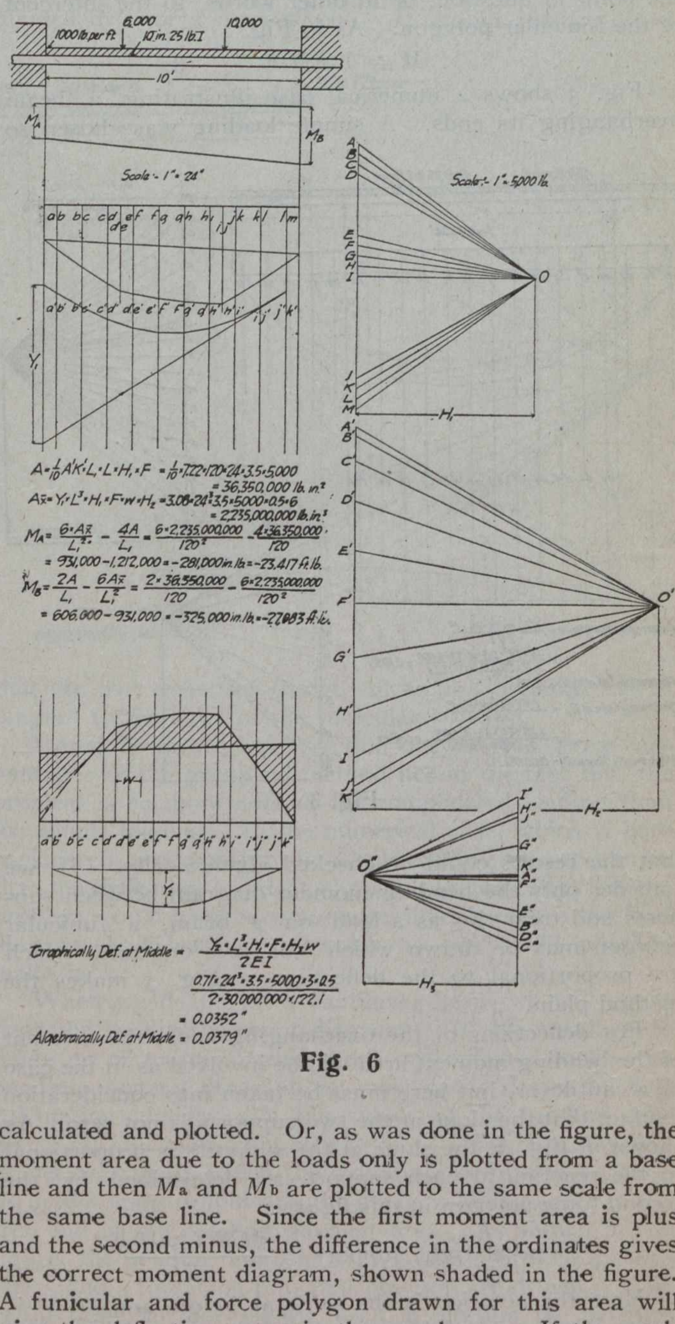


Fig. 6

calculated and plotted. Or, as was done in the figure, the moment area due to the loads only is plotted from a base line and then M_a and M_b are plotted to the same scale from the same base line. Since the first moment area is plus and the second minus, the difference in the ordinates gives the correct moment diagram, shown shaded in the figure. A funicular and force polygon drawn for this area will give the deflection curve in the usual way. If the work in Fig. 6 had been absolutely correct the points A'' and K'' in the last force polygon would have coincided; and then, of course, the corresponding strings would have been colinear. In this problem more nearly correct answers would have been obtained if the linear scale had been twice as large as the one used.

INSTRUCTIONS FOR MAKING SURVEYS OF STATE HIGHWAYS

THE State Highway Department of Missouri has recently issued a bulletin of instructions for making surveys for the construction of state roads. The regulations follow:

Reconnaissance

The reconnaissance is made for the purpose of determining the feasibility of establishing and improving a road as a "state road," and to show where relocations may be made to advantage. After these questions have been determined from the results of the reconnaissance, the final survey must always be made to allow accurate mapping of the road and a precise determination of the quantities to be paid for in its improvement.

Where the location of the road is known at the start, *i.e.*, when a map is available showing the road, or a description of its location is a matter of record, a very good reconnaissance can be made by using an automobile with a good speedometer to measure distances and a hand level to measure slopes. Speedometer readings should be taken at all culverts, bridges, intersecting roads, railroad crossings, deposits and outcrops of rock, gravel or other road-building material, and all other features having a bearing on the proper location and improvement of the road. At all grades over above 5 per cent. the hand level should be brought into play, and a rough profile of the hill taken. Records should be kept of where material from cuts should be deposited in fills, giving the approximate haul and the character of the material to be excavated, whether clay, gravel, loose rock, solid rock, etc. The hand level should also be used in places where the cross-section of the roadway is unusually irregular in shape or where the road is located on a transverse slope. Rough cross-sections will be necessary in case of an irregular surface and on side hill work the transverse slopes should be measured.

At all waterways as complete information as possible should be recorded concerning the sizes of existing openings through bridges and culverts, high-water marks, drainage area above the road, general direction and location of the waterway across the road, and for some distance each side.

If the road is to be practically relocated throughout its entire length, the easiest method to follow will be to make a stadia survey to obtain the required elevations, distances and angles. The line should be tied in to existing monuments and land lines wherever possible.

If a transit with stadia wires is not available, a traverse line should be run and a hand level used as indicated in the case of the reconnaissance where the line is previously known. In all cases, the same information as noted above should be recorded.

After making the field survey, a sketch map should be drawn up or traced from an existing map. This will show the road from one end to the other, intersecting roads, streams, railroads, etc. If the territory traversed was sufficiently irregular that levels were taken throughout a rough profile may also be drawn.

Next the reconnaissance estimate of the cost of improving the road should be made. This will include cost of grading, constructing culverts, bridges and wearing surface, and supervision of the work. The cuts and fills should be balanced, and the grading expressed in so many cubic yards of excavation containing a certain percentage of rock. The number of culverts should be given with their total estimated cost. For all structures of more than 20-foot span, a list should be given with the span and type and estimate of cost of each. The surfacing, after the type has been decided upon, should be given in square yards of a certain depth at so much per square yard. The estimate would then take the following form:

Reconnaissance Estimate

..............................Road	Date..............................191....	
Excavation ....cu. yd. ....per cent. rock at ....per cu. yd........................		$............
Culverts................ ....No.	Total,	$............
Structures over 20′ span............No.	Total,	$............
Surfacing of ....sq. yd. ...depth ...per sq. yd.		$............
	Total	$............
	Supervision, etc., 10 per cent....	$............
	Grand total	$............

Final Survey

If the reconnaissance shows that the road can be constructed to the satisfaction of the State Highway Department, a final survey will be necessary.

In making this survey, it must be borne in mind that it is being made with the purpose of securing the data necessary for making a map, profile and cross-sections of the work to be done.

Survey should consist of the running of the centre line, marking the location of the necessary objects along the road, running levels and taking cross-sections, and securing such information on bridges and culverts and the general drainage situation as may be required.

Survey Line

The final survey line is to be the actual construction centre. If preliminary lines are necessary the centre line is to be located after plans are drawn. The angle points should, if possible, be located on the nearest one-tenth foot marks and the deflection angle for each course should be measured to the nearest minute and the magnetic bearing of each course must be taken and indicated on the plans. Every angle point should be referenced in with three ties to permanent objects unless the courses are very short. All curves should be run in the field at the time of making location. On resurfacing work it is not necessary to run curves, but angle points should be referenced about every 1,000 ft.

Side Locations

In general, a tape survey will give the necessary accuracy in making locations. All significant objects within a hundred feet or so of the finished road should be indicated, but where they are at a greater distance the dimensions, etc., may be estimated. Whenever the position of an object becomes important (as for instance when a stream nears the road embankment or when a house is situated close to a road whose grade it is planned to change to a marked degree) locations should be made to the nearest foot.

Offsets from the survey line to the bordering fences or walls should be made every 100 ft. or oftener if the irregularities so require; dividing property fences should be located by offsets from the centre line, but the direction may be satisfactorily indicated by determining their range intersection with the base line; and when it becomes necessary to locate buildings or other objects accurately it will be sufficient to determine their range on the base line and their rectangular dimensions. Location of materials, quarries, gravel beds, etc., should be taken and it should also be noted where water may be obtained for sprinkling the roads.

Alternative Lines

In case the engineer is undecided which of two possible relocation lines should be followed, he should run a line from each location. These lines to be designated "Line

A" and "Line B." Profiles and cross-sections should be taken along each line and plans of both submitted to the State office with reasons for selection of the route adopted and an estimate of the cost of each also to be furnished.

Alternative lines should be made on separate sheets.

Levels

Profile levels should be taken at least three hundred feet beyond the beginning and end of the proposed road.

A well-adjusted transit-bubble will be sufficiently accurate for general highway work where a closing error of one-tenth foot per mile will be allowed.

Levels should be run forward and backward along the course of the road in order to close the circuit. Bench marks on some prominent object should be taken at intervals of each one-fourth mile and recorded in the notes.

The profile levels of the centre line and bench marks should be run in one operation and check levels run in the same operation with the cross-sections, but do not attempt to do both at one operation.

It is not necessary to run check levels on resurfacing work.

Cross-sections

Cross-sections should be taken at all one hundred foot stations in regular country and at shorter intervals where the ground undergoes a marked change between stations. Where rock is encountered, sections and soundings to determine the elevation of the rock should be taken at such frequent intervals as the surface requires.

At the station points, readings should be taken on the centre line of the travelled way, the right and left edges of the travelled way or of the roadway, at the top and base of each slope and one reading farther out (not less than thirty feet from the centre line of location) at either side to show the slope of the natural surface.

Readings on the ground should be taken at the nearest one-tenth foot.

In general, it will not be necessary to show more of the topography than these cross-sections will reveal. In cases where the location of the road is open for some question, a short topographic survey might be made in order to show on the plans the circumstances which caused the choice of the location to be made.

Take only a few cross-sections to show condition of road on resurfacing work.

Drainage

Complete provisions must be made for the drainage of every road and the plans must show what arrangements have been made and complete data must be furnished for all drainage structures larger than regular standard culverts. Estimates of the drainage area for all structures must be given in all cases.

For culverts the length, width and average slope per one hundred feet of drainage area should be noted and the direction of flow indicated on plan by an arrow.

Ditches

Whenever the road is at a grade of less than 0.5 per cent., the grading of the drainage ditches must be planned by a separate grade. The design of the ditch must be shown on the cross-sections, and all grades of less than 0.5 per cent. should be avoided if possible.

Underdrains

The engineer should take special care to note or to determine by local inquiry any parts of the road which break up in wet seasons and specify underdrains.

Culverts

Small culverts crossing the centre line of the road should be of sufficient length to prevent any decrease in the crown of the road where it passes over the culvert.

Every bridge and culvert within the course of the design should be described in the specified form whether it is or is not intended for reconstruction.

At every culvert which it is proposed to construct or reconstruct, a cross-section should be taken along the proposed axis, and the section taken far enough out to show elevation of inlet and the lowest possible outlet available, even if this involves the construction of a short ditch.

Profiles must also be taken on the centre line of the road, the elevation of the finished roadway noted, and, if the culvert is to be located on a skew, the angle of the skew must be given. Do not try to build culverts at right angles to the road if same should be built on a skew to fit the stream.

Considerable attention should be paid to the angle at which any drainage structure crosses the road, and if they should be built on a skew, these angles must be noted and the length and type of wings should be noted in every instance. Culverts should not be designed askew if possible to economically change the course of stream.

Plans

The plans will consist of a title page, typical cross-section of improvement, plan and profile, cross-sections, and such structural plans and state structural standards as may be necessary to properly show the proposed construction.

All plans or drawings will be on flat sheet, 22 x 36 ins. outside dimensions; boundary lines are to be so placed as to provide a binding margin 2 ins. wide at the left-hand end, and a margin ½ in. wide on the remaining three edges of all plans. On cross-section sheets, the boundary lines may be omitted but sufficient space should be allowed for the 2-in. binding edge at the left-hand end of the sheets. State Highway Department standard sheets showing structural standards may be made a part of the plans and be attached thereto, provided the size of these standard sheets does not exceed the size required for plans.

The plans are to be based upon the surveys described above, and all notation necessary to make the required details clear is to appear approximately throughout the plans. Any information which the local officials may deem necessary for their own uses may be incorporated in the plans in addition to that herein prescribed, provided it does not interfere with their legibility.

The sheets composing the set of plans shall be bound in the following order: Title page, typical cross-section of improvement, road plans, state standards, special structural plans, and cross-sections.

The plan and profile shall be placed on the same sheet; the plan shall be shown across the top of the sheet and the corresponding profile directly below. When the conditions permit without interference or overlapping, two sections of the plan and profile may be shown on the same sheet.

The plan shall be drafted to a scale of 1 in. equal to 100 ft. or 1 in. equal to 50 ft. in the option of the engineer, and the profile shall be drafted to the same scale horizontally as the plan, and to a scale of 1 in. equal to 10 ft. vertically.

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

The Composition of Technical Papers — Part I. General Principles of Expository Writing. By Homer Andrew Watt, Assistant Professor of English, New York University. Published by the McGraw-Hill Book Co., Inc., New York, and the Hill Publishing Co., Limited, London. First edition, 1917. 431 pages, illustrated, 5 x 7¾ ins., cloth. Price, $1.50. (Reviewed by A. J. Meyers, chief draftsman, Board of Engineers, Quebec Bridge, Montreal.)

A careful examination of the contents of Homer Andrew Watt's book on the composition of technical papers will convince the responsible engineer, the leader in his profession, no matter what the branch, that this is a work which it will pay to have at hand and to diligently study on convenient occasion. The great majority of engineers, especially those in responsible charge of engineering undertakings, firms or corporations, in all probability master to a passable extent, after an average amount of experience and practice, the art of ordinary every-day business letter writing or correspondence, but when they are confronted with the task of giving a clear, connected, concrete and comprehensive description of an engineering undertaking in which they have been closely interested, they are frequently at a loss to present and describe their subject in a proper compositional manner.

Mr. Watt has clearly realized this difficulty of even the best engineers, and when treating his subject, describes in logical sequence and clearness of detail the real problems to be met in the composition of papers descriptive of every-day engineering undertakings, and gives in a clear and precise manner the solution of the main problems in analytical English composition, together with numerous examples of good and bad arrangement of the sentence and paragraph, and the skeleton construction of articles.

The work is divided into two parts and its character is clearly indicated by the title. Part I. is devoted to the study and explanation of the laws governing good writing and the fundamental ideas and principles at the bottom of expository or explanatory composition, which is the class of article mainly dealt with by the engineering body of writers. The laws of good general compositional organization are given and explained, together with the principles of construction of the paragraph and the sentence. The chapter devoted to the description of the functions of the sentence has an added value in the definite and clear instructions as to punctuation and the numerous examples given as to when and how to use the many and varied characters of punctuation, some of which are extremely hazy in the mind of the average engineer.

Part II. is devoted to the principles governing the exposition of processes, methods and ideas, and technical descriptions of all kinds. Numerous and varied examples of each type of composition are given and valuable criticism made.

In the final two chapters of the work especial attention is devoted to the method of making technical and practical reports on engineering undertakings, in an interesting, concise and instructive manner. Also the principles of good business letter correspondence are here dealt with, how a real business-getting letter should be written and what it should contain to serve the highest purpose of the writer or a firm employing the writer of a business letter.

The book should be especially valuable as a study in connection with an university engineering course. Probably in the near past it has been the practice to give too little attention to the art of good composition in curriculum of even the most advanced colleges of engineering, and a proper realization of the necessity of every prominent engineer to be able to express himself either written or orally at all times in an acceptable and pleasing manner, would go a long way to accomplishing the desired result. In any such case, Mr. Watt's work could well be used for instruction and guidance.

Power Wiring. By A. T. Dover. Published by Whittaker & Co., London and New York City. 1917 edition. 208 pages, 254 illustrations, 4¼ x 6¾ ins., cloth. Price, $1.50 net. (Reviewed by H. W. Price, University of Toronto.)

Few books of pocket size contain so many line-diagrams of apparatus and plant connections,—about 250 in 200 pages. The intention is to furnish engineers with actual connections of representative control apparatus in all ordinary industrial and power work, excepting electric traction. The apparatus referred to is mostly of English manufacture.

The general plan of the book is best explained by reference to one typical item, *e.g.*, "Automatic Control Systems for Continuous-current Motors." A concise explanation is offered of the essenials of time-limit, counter-emf.-limit, and current-limit methods of control. Then follow eleven excellent diagrams of typical apparatus and connections, each explained in so far as necessary to understand operation. In cases where diagrams of actual connections are complicated, schematic diagrams are added.

The ground covered is: Continuous-current motors and control apparatus, including manual and automatic control of motors for presses, machine tools, elevators, cranes, etc.; generators and balancer sets; switchboard panels for d.c. work, including battery control for relief of generators from fluctuating loads, and other schemes; starting and speed control of a.c. motors, with information on pole-changing windings; power transformers and connections of one, two, three and six-phase circuits, and three-phase transformers; instruments, transformers, and relays for power, power-factor, overload, reverse power, synchronizing, etc.; line and cable protective systems; alternating-current switch-gear and panels; voltage regulators.

A specialist in any line will find the book too general for his benefit. Those who desire typical information in many lines will find it valuable.

Continuous-Current Motors and Control Apparatus. By W. Perren Maycock, M.I.E.E. Published by Whittaker & Co., London and New York City. 1917 edition. 330 pages, 5 x 7½ ins., 150 illustrations, cloth. Price, $1.75 net. (Reviewed by H. W. Price, University of Toronto.)

This book of some 300 pages and 150 diagrams and illustrations contains a large quantity of information on control devices. It is evidently expected that the readers may not have knowledge of the properties of motors, since considerable space is given to elementary principles, and calculations on torque, speed, temperature rise, etc., of shunt, series, and compound motors.

The discussion of control apparatus is interesting. One chapter deals only with devices for starting to rated speed. Others deal with a great variety of appliances for manual, semi-automatic, and automatic starting of motors, control of speed, inching of heavy work to new positions, etc. The diagrams are clearly constructed, and explanations are good. Descriptions cover both the completed apparatus, and the details of magnet switches, circuit controllers, breakers, and other parts. The equipment described is largely of English manufacture. Some attention is given to the choice of resistance steps of starters for specified service.

Throughout the book are numerical examples worked in detail to make plain the author's methods of attacking problems. Numerous problems, with answers, are offered in each chapter upon which the reader may test his skill.

Anyone desiring to acquire working knowledge of direct-current motors and their control will find this book very useful.

A Field Manual for Railroad Engineers. By J. C. Nagle. Published by John Wiley & Sons, Inc., New York City, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. Third edition, 1917. 499 pages, 30 tables, 99 figures, 4 x 6¾ ins., flexible binding. Price, $3. (Reviewed by J. R. W. Ambrose, Toronto Terminals Railway Co.)

It is difficult to condense general engineering data into a handy volume that can be carried in the field. Most engineers find it necessary to have more than one, but the additions made to the above manual have so covered the subject that no other reference should be needed.

Chapters 1, 2 and 3, covering the usual preliminary work, have been expanded and new problems have been added, making the work valuable as a text book.

Chapter 4, on "Transition Curves," is new and is valuable to the field as well as the office engineer, and is a subject heretofore confined to a separate volume. The examples given are practical ones and are so explained that they are easily understood.

Chapter 5, "Turnouts, Frogs and Switches," is of exceptional value to the maintenance engineer, and it is rather unusual for a book of this kind to go into the subject so fully and practically.

Chapter 6, on "Construction," contains more than the usual information for the college student and considerable of the text should have been placed in a separate chapter and headed "Economies of Railway Location." Article 21, on "Overhaul and the Mass Curve," is too little understood by most construction engineers and is here well explained. The subject, to the writer's knowledge, has never before been introduced in a field book.

Among the tables are numerous new and useful ones that are not usually found in previous field books.

This work embodies more information of practical usefulness than any field book the writer has seen.

Graphics. By H. W. Spangler. Published by John Wiley & Sons, Inc., New York City, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. 95 pages, 6 x 9 ins., cloth. Price, $1.25 net. (Reviewed by W. J. Smither, B.A.Sc., Toronto University.)

The aim of this book is to provide students in mechanical and structural engineering with a treatise on the fundamental principles in graphic statics. The subject is presented in short and compact form and the reader is led through consecutive steps to the solution of the problem in hand. Approximately half of the book is devoted to the treatment of trusses and half to the graphics of machines. In the treatment of machines a number of cases are discussed where the forces are not in the same plane. In almost every case the treatment has been restricted to the properties and general uses of the force and equilibrium polygon. The book is printed in a good clear type with a great many diagrams which, by illustrating the text, are of great assistance to the reader.

The Essentials of Descriptive Geometry. By F. G. Higbee, M.E., Professor of Geometry and Drawing, University of Iowa. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. 218 pages, 6 x 9 ins., cloth. Price, $1.80 net. (Reviewed by W. J. Smither, B.A.Sc., University of Toronto.)

In this book the author discusses the essential features of descriptive geometry, which possess industrial utility and which are most important to a draftsman.

The first five chapters deal with the principles of orthographic projection of points, lines and planes, presenting the subject in a clear, concise manner. Chapter 6 deals with the revolution of points and lines, which is a very important operation in descriptive geometry. Chapters 7 to 10 are composed of the discussion and solution of problems on the line, plane and angles. In these problems the typical theoretical problem is not only explained but the practical application of this theory is also clearly shown. Chapters 11 to 17 discuss the generation, classification and development of surfaces, and Chapter 18 is a very interesting treatment of the making of paper models from the results obtained in the problems on plain intersection.

The subject throughout the book has been treated in the third quadrant, and at the end of each chapter a number of practical engineering problems are given on the theory discussed in this chapter. For these reasons the book should be very valuable to the student in engineering and the draftsman, as it points out the way to the application of the subject to the requirements of engineering practice.

The Chemistry of Colloids. By Richard Zsigmondy, Ellwood B. Spear and John Foote Norton. Published by John Wiley & Sons, Inc., New York City, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1917. 288 pages, 39 figures, 6 x 9 ins., cloth. Price $3. (Reviewed by T. Linsey Crossley, of J. T. Donald & Co., Chemical Engineers, Toronto.)

It may be objected that the engineer is not interested in the "Chemistry of Colloids," but when it is remarked that the title could as well have been the "Physics of Colloids" or simply "Colloids," and when it is noted that photography, water supplies, soaps, lighting effects, asphalt paving, inks, electrolysis, mining, agriculture and metal filament lamps depend largely on practical applications of the physics and chemistry of colloids, some knowledge of the subject is necessary.

The book under review, taking for itself the nature of a review, gives a very fair idea of the theory and present knowledge of this important phase in the conditions of matter.

The author and translator are to be commended in assuming that the reader has little knowledge of the present development of the subject. The definitions suffice to make the book available to one who has not specialized. The brief, simple description of the ultramicroscope is sufficient and the diagrams (pages 17 and 18) show readily the very high state of subdivision in colloidal solutions and suspensions, indicating the reason for the turbidity of water supplies and the difficulty of handling slimes in mining operations, such as cyanidation.

The book is divided into two parts of which Part I. is a translation of Zsigmondy's work by Ellwood B. Spear, and Part II. is a brief account of "Industrial Colloidal Chemistry," including smoke, flue flumes, vapors, rubber, tanning, milk, clays and soils, with a short chapter by John Foote Norton on "Colloids in Sanitation."

The chapter on clays and soils is interesting to the engineer, more perhaps by what it suggests than by what is actually stated. The consideration of protective colloids might have a bearing on cases where concrete has failed due to a fine envelope of colloidal siliceous or organic matter on sands preventing the reaction between cement and sand at the contact surface.

Waterworks engineers will also find much of interest in Dr. Norton's chapter on "Colloids in Sanitation."

In some passages condensation would give clarity and make smoother reading. In Part I. the translator has been a shade too conscientious possibly. One instance, on page 106, lower third: "By the gold number we will understand the maximum number of milligrams of protective colloid that may be added to 10 c.c. of gold solution without preventing a change of color from deep red to violet shades by 1 c.c. of a 10 per cent. solution of sodium chloride, where the change would take place if no protective colloid were added." It appears possible to put this sentence in the positive and save some mental labor. It might be suggested that any subsequent editions be more carefully revised and that some typographical errors, such as "hydrols" for hydrosols, "collodium" for collodion, "disenfection" for disinfection, "anistropic" for anisotropic, be corrected, and such passages as this, on page 16, "If the particles are not all visible and the large majority are submicrons, the result obtained represents the lower limits. On the other hand, if the majority of the particles are not visible, the result will be very wide of the mark," and this on page 164, "The want of the characteristic iron taste, or ink taste, is entirely lacking."

The book is, however, a very useful brief of the whole subject and will not fail to be suggestive of useful applications to men engaged in almost any form of industrial technology.

A Practical Book in Elementary Metallurgy. By Ernest Edgar Thum. Published by John Wiley & Sons, Inc., New York City, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1917. 313 pages, 59 figures, 6 x 9 ins., cloth. Price, $2.75. (Reviewed by Dr. Alfred Stansfield, McGill University.)

This is a laboratory instruction book prepared for students working in the metallurgical laboratories of the University of Cincinnati. Explanatory or theoretical matter has been added so that the average engineering student can understand the bearing of each experiment and carry it out intelligently, after reading these instructions, even if he has not had the advantage of attending a course of lectures on the subject.

The work described is divided into twenty-six separate experiments, each of them being arranged for a group of four students. The experiments are designed to give practice and instruction in regard to gas furnaces, refractory materials, slags, pyrometers, alloys, metallography, hardness of metals, electric furnaces, heat treatment of steel, foundry methods, etc. Under each heading is given (a) general explanation, (b) detailed instruction for the experiment, and (c) questions intended to test the student's grasp of the subject. In addition to the above matter, which occupies 224 pages, there are three appendices, (A) of 44 pages devoted to elementary metallurgical calculations, (B) of 22 pages describing foundry practice, and (C) of 9 pages giving detailed instruction in the art of writing reports.

The nature of the experiments included in this book depends, of course, on the equipment of Mr. Thum's laboratory; but this appears to have been well-chosen and the course is wide enough to prove suitable for undergraduate class work in metallurgy in many universities. The course was designed, however, for engineering students and does not include work on the recovery of metals from their ores, which would form an important part of laboratory work for students intending to graduate in metallurgy or mining. The book is well and carefully written and is well illustrated, and will be helpful to instructors in metallurgical laboratories.

Tecnic of Surveying Instruments and Methods. By Walter Loring Webb, C.E., and J. C. L. Fish, C.E. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1917. 319 pages, 59 figures, 4 x 6¾ ins., flexible binding. Price, $2 net. (Reviewed by Tracy D'Lemay, city surveyor, Toronto.)

This book will admirably fill the purpose for which it is intended by the authors; that is to say, it is not to be classed as a text book, but rather as a general guide to the student in familiarizing himself with the many instruments in use by the surveyor, their adjustment, operation and probable error. Part IV., dealing with a railroad survey from start to finish, shows a maximum of detail, leaving nothing to the imagination, and from the point of view of either instructor or student, cannot fail to serve its purpose. The book is of a very convenient size, clearly printed, and should commend itself to any instructor wishing to give his pupils a thorough knowledge of surveying instruments and their uses.

PUBLICATIONS RECEIVED

Coal and Coke.—Report of the production of coal and coke in Canada during the calendar year 1916, issued by the Department of Mines, Ottawa.

New Gurley Booklets.—Three new booklets have been issued by W. & L. E. Gurley, Troy, N.Y., descriptive of their graphic water stage register, army sketching cases and Gurley levelling rods.

Westinghouse Direct-Current Motors and Generators. Catalogue No. 30, being the second of a series of catalogues of industrial motors distributed by the Westinghouse Electric and Manufacturing Company of East Pittsburgh, Pa., and covering the company's complete line of direct-current motors and generators for industrial service.

Hayward Buckets.—Catalogue 44 on buckets for industrial plants, issued by The Hayward Company, 50 Church Street, New York City. A 32-page booklet profusely illustrated and very readable. It explains the operation of buckets by mono-rail hoists, traveling cranes, locomotive cranes, transfer bridges, inclined boom unloaders, mast and gaff rigs, mono-rail cranes, etc.

Standard Forms for Specifications, Tests, Reports and Methods of Sampling for Road Materials.—Bulletin No. 555 issued by the Department of Agriculture, Washington, D.C., giving standard forms for specifications, tests, reports and methods of sampling for road materials as recommended by the first conference of State Highway Testing Engineers and Chemists, held at Washington, D.C., February 12th to 17th, 1917.

"Beaver" Tools.—The Borden Company, Warren, Ohio, has just issued its 1918 catalog of "Beaver" easy-working die stocks and square-end pipe cutters. It is printed in two colors, on high-grade paper, and illustrates in a complete and artistic manner the complete line of "Beaver" easy-working die stocks and square-end pipe cutters. Several new "Beaver" tools are shown for the first time in this catalogue, one of the most popular of these being the new No. 3 "Beaver" junior ratchet die stock, which is built on the unit plan to thread pipe from ⅛ to 1 in., inclusive. While this catalogue is not intended for general distribution, the Borden Company will undoubtedly send a copy to any of our readers who will write a letter or card stating that they are interested in "Beaver" tools, at the same time mentioning *The Canadian Engineer*.

Rural Planning and Development in Canada.—By Thomas Adams, town planning adviser, Commission of Conservation, Ottawa. 281 pages, illustrated, 7 x 10 ins., cloth. This latest report of the Commission of Conservation deals with the important subject of the planning and development of rural districts and small towns in Canada. It deals comprehensively with the social conditions and tendencies in rural areas and the prevailing systems of land settlement and development. It indicates the rural problems requiring solution in order to secure the proper development and economic use of land for purpose of efficiency, health, convenience, and amenity. The great injury which land development in Canada suffers from speculation, neglect of public health, and want of expert business administration of land settlement, is considered. Incidentally, the problem of returned soldiers is dealt with. There are five appendices by competent authorities and the concluding chapter gives an outline of proposals and makes general recommendations to cover the conditions as presented.

CITY MANAGEMENT AS A PROFESSION

At the recent annual meeting of the City Managers' Association a very interesting committee report on city management as a profession was submitted by Mr. H. M. Waite, city manager of Dayton, Ohio. A synopsis of this report follows:—

Commissions have made city management a profession by showing a willingness to go outside of their own communities for city managers. City managers are receiving invitations to other towns and there now have been seven cases of transfer, showing that the tendency is to recognize the existence of professional experience. City managers recognize that a career lies before them in this field and are seriously building up their experience to make it a life career.

The profession can be said, therefore, to have come into existence with every indication of continuance. It is interesting to note from the registration at the city managers' convention this year that out of 25, about 95 per cent. are engineers, indicating that commissioners turn to the municipal engineer for managers.

Qualifications for City Managers

Small cities (under 20,000 population), preferably engineer, executive ability is first essential. Larger cities (20,000-200,000 population), executive ability first essential, engineering less essential. Large cities (over 200,000 population), executive ability prime essential.

The committee believes that city manager qualifications may be from present experience, classified as follows:—

Experience shows that actual experience is considered as most valuable equipment.

The attempt to lay out courses by universities for training city managers is handicapped by the fact that a major requirement is native executive ability, which cannot be taught. A university cannot train a man to be an ordinary business executive. It cannot propose a man to step into the management of a city. It can train him to step into the management of a village. The attempt to lay out a course reveals the fact that the entire field cannot be covered by thoroughness in every branch that confronts a manager.

It is essential, therefore, that rather than give a man a smattering of all the many subjects, that he be thoroughly trained along some one or two lines, such as engineering or accounting, or whatever may be his natural bent, the balance of his time in college being devoted to obtaining a general knowledge of the other fields.

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Principal Contents of this Issue

CONTROL OF PUBLIC WORKS

Control of public works has been partially assumed by the Dominion government.

An order-in-council has been passed under the authority of the War Measures Act and upon the recommendation of the minister of finance, by which new issues in Canada of bonds, debentures or other securities of any provincial, colonial or foreign government, municipality, commission, local government, institution, corporation or incorporated company can only be made or sold with the approval of the minister of finance by his certificate in writing.

This measure, which was forecasted in the editorial, "Regulation of Public Expenditures," in the July 12th, 1917 issue of *The Canadian Engineer*, is necessary if Canada's full strength is to be exerted in bringing the Hun to his knees. It may seem to cause hardship at times to municipalities and others with ambitious schemes, but all Canada will undoubtedly support the measure loyally and be guided by the government's decisions in the common interest. To quote from the above-mentioned editorial:—

"Central regulation of public expenditure is necessary so long as these changed conditions continue. When money flows into Canada again without stint or effort, then regulation can cease, but that time may not arrive for several years to come, and meanwhile regulation is imperative. With Liberty Loans, Victory Loans, Domestic War Loans, etc., dredging the investment market almost to rock bottom, it is hard for municipalities to suck up enough to make it worth while keeping the pumps going. A certain amount of money is still being invested in Canadian municipal issues, and a very generous amount, too, considering the many other imperative demands upon the money sources. Much work is being done with foreign capital and the savings of our own people. But some constituted authority should see to it for years to come that every dollar of investment money raised in Canada, or brought into Canada for other than war purposes, is put to really useful and productive work."

Public issues for provincial and municipal purposes cannot be entirely abandoned. That would not be a wise policy. For instance, it would not be worth while to save two or three hundred thousand dollars on filtration or sewage disposal plants and in consequence let some community suffer a death rate that exceeds the mortality rate of the armies in the field.

The announcement from Ottawa intimates that the minister of finance will appoint a Priority Board to advise him as to the necessity for new issues and the time when they should be made. Such a board should be a nation-wide civilian and engineering organization, capable of passing upon all plans and reviewing all proposed expenditures. This Board should include representatives of the Dominion government, the provinces, the municipalities, the rural districts, the capitalistic and laboring interests and the military authorities, and should be advised by the very best obtainable boards of engineering, economic, chemical, legal and financial consultants. This matter is a very vital one in its effect upon both the armies and the people at home. It will affect thousands of people and hundreds of businesses. It should not be attended to in a haphazard fashion. A big board and a capable one is needed to make the order-in-council effective, or the order may do more harm than good.

OUR TRADE RECORDS

During November Canada shipped abroad a substantial volume of agricultural products and manufactures. In that month, exports of Canadian produce were valued at over $187,000,000 and the excess of exports over imports was $114,000,000. This is another new record in Canadian trade statistics, the best previous total being $177,000,000 of exports in July last, with an excess of $87,000,000 of shipments in our favor. While manufactures contributed much to the November total, the exports of agricultural produce were valued at $78,000,000, the largest total reported for any one month to date. Taking animal produce and agricultural products together, our exports of those items last month exceeded $101,000,000.

One of the pleasing features of the November trade statement was the decrease in imports; they were smaller in volume than in any month since February. This helped considerably to create a substantial and favorable balance of trade. Thrift and economy were not as important a factor in this result as was the increasing difficulty of manufacturers and traders in obtaining raw materials from the United States. This is rapidly becoming a problem for serious consideration. As the war proceeds, we will have to depend more upon the development of our own resources.

The November figures make it possible to compute the value of our trade for eleven months of the current calendar year. At the end of last month, our exports totalled $1,399,000,000, which gives an excess of exports over imports of $455,000,000, compared with a favorable balance of $263,000,000 a year ago and an adverse balance of $233,000,000 for the eleven months period of 1913.

We had a favorable balance at the end of every month this year, with the one exception of April. If the present volume of trade is maintained, the balance in our favor at the end of the current fiscal year in March next should be not less than $500,000,000. High prices for commodities have contributed largely to the record value of Canada's trade as well as increased exports. The figures are cause for much satisfaction but they again bring to mind the problems which must be met after the war in regard to our export trade. Then we will meet keen competition in all our business dealings abroad.

PERSONALS

J. SUMMERHAYES, former superintendent of the International Transit Company, of Sault Ste. Marie., has resigned.

LE ROY FRANCIS HARZA, Sault Ste. Marie, Ont., has been elected a member of the American Society of Civil Engineers.

C. C. WELDON is succeeding Mr. Summerhayes as superintendent of the International Transit Company, of Sault Ste. Marie, Ont.

HOMER MORE HADLEY, Vancouver, B.C., has been transferred from junior to associate membership in the American Society of Civil Engineers.

GEOFFREY PORTER, chief electrical engineer of the British Columbia Electric Railway Company, Limited, of Vancouver, B.C., has resigned to take up private practice as advising and contracting engineer.

COLEMAN MERRIWEATHER, formerly president of the Lock Joint Pipe Co., New York City, is now connected with the engineering staff of the cement products bureau of the Portland Cement Association, Chicago.

R. WINTER, a graduate of McGill University, and son of Mr. W. H. Winter, plant superintendent of the Bell Telephone Company and chairman of the Montreal Electrical luncheon, has joined the Royal Flying Corps.

W. R. HARRIS, formerly managing director of the Canadian Lock Joint Pipe Co., Limited, and formerly president of the Harris Engineering Co., Limited, of Regina, Sask., is now connected with the engineering staff of the cement products bureau of the Portland Cement Association, Chicago.

W. E. MACDONALD, C.E., represented the city of Ottawa throughout the construction of the whole Overland Pipe System described last week in *The Canadian Engineer*. The author accidentally omitted Mr. MacDonald's name in mentioning those to whom particular credit should go for the success of the undertaking.

Lieut. M. B. BONNELL, who has been invalided home suffering from an attack of trench fever, was a student of Toronto University, department of Mechanical Engineering, class of 1904. Lieut. Bonnell was also a sapper in the Engineers' Corps of School of Practical Science, which was organized in pre-war days by Lieut.-Col. Lange. After graduating, he was on the staff of the Patent Office, Department of Agriculture, Ottawa, until he enlisted and went overseas with the 3rd Field Company, Canadian Engineers.

PROF. C. H. McLEOD DIES SUDDENLY

Just as we go to press word comes announcing the death of Prof. C. H. McLeod, who from 1891 until 1916 was secretary of the Canadian Society of Civil Engineers. He passed away last night, December 26th, in his office at McGill University, an institution with which he had

Late Prof. C. H. McLeod

been connected for many years, being vice-dean of the engineering faculty there.

News of his death will be a shock to engineers not only in Canada but in many other countries where Prof. McLeod's work, both as secretary of the Canadian Society of Civil Engineers and as an educationalist was well known.

He is survived by wife and two married daughters and four sons, one of whom is lieutenant in the Royal Flying Corps and another is Norman McLeod, a well-known Toronto contractor.

Prof. McLeod was born in 1851 at Strathlorn, Cape Breton, and was appointed professor at McGill in 1888.

More extended notice of Prof. McLeod and his work will be published in our next issue.

JOSEPH HOBSON, one of the best-known civil engineers on this continent, and designer of the Sarnia Tunnel, died December 19th. Mr. Hobson had a splendid record in the engineering world. Some of his achievements were the replacing of the old Victoria Bridge across the river at Montreal, the replacing of the old Suspension Bridge at Niagara Falls, and being engineer in charge of the building of the bridge across the Niagara River at Buffalo. Mr. Hobson was born near Guelph, Ont. In 1873, after a period of railway and bridge work, he was appointed chief engineer of the old Great Western Railway. On the amalgamation of the Grand Trunk and the Great Western in 1882 he was appointed chief engineer of the lines west of Toronto. In 1896 he became chief engineer of the entire Grand Trunk Railway System. Ten years later he retired, but remained as consulting engineer with the company up to his death. The late Mr. Hobson was a member of the Institution of Civil Engineers, and also a member of the Canadian Society of Civil Engineers.

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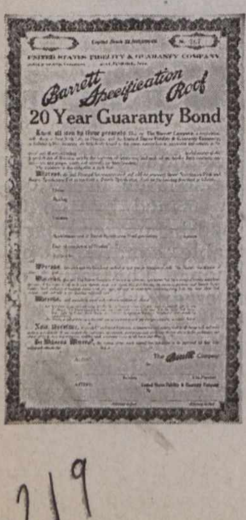
THE following illustrates the working of our new plan to guarantee Barrett Specification Roofs for twenty years:

When the question of roofing is reached in the specifications covering the building the following, or its equivalent, should be inserted in the building plans:

> "This roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall upon completion of the job deliver to us the Barrett 20-Year Guaranty Bond, in accordance with Note 1 of such Specification."

Competitive bids may then be asked for from a number of roofing contractors.

The concern to which the job is finally awarded promptly notifies us regarding the work, asks for our Inspection Service, and the 20-Year Bond.



Our inspectors supervise the job, see that the Specification is strictly followed both as to methods and materials and on its completion certify that the roof is O.K. in every respect.

On this certification the guaranty company issues a 20-Year Surety Bond which *exempts the owner from any maintenance or repair expense to the roof until 1937.*

The Guaranty Bond costs the owner and the roofing contractor nothing.

The service is free in the interest of good workmanship and the good repute of our materials.

How to Get the 20-Year Guaranty Bond

This new Guaranty Bond is issued on all Barrett Specification Roofs of fifty squares or more in all towns of 25,000 population and over, *and in smaller centers where our Inspection Service is available.*

Our only requirements are that the roofing contractors shall be approved by us and that The Barrett Specification dated May 1, 1916, shall be strictly followed.

If you are interested we should be very glad to send you further details or copy of The Barrett 20-Year Specification, with diagrams, ready for insertion in your building plans.

The Barrett Company
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MONTREAL ST. JOHN, N.B. TORONTO HALIFAX, N.S. WINNIPEG SYDNEY, N.S. VANCOUVER

6219

ONTARIO MINERAL PRODUCTION

The Ontario bureau of mines has issued statistics, which appear at the foot of this page, regarding the production of the metalliferous mines and works of Ontario for the nine months ending 30th September, 1917. For purposes of comparison, figures for the corresponding period in 1916 are also given.

Notwithstanding the falling off in the output of gold, silver and copper, the aggregate value for the nine months was some $2,000,000 more than for the same period in 1916. Increased prices for silver, copper and nickel are largely responsible for this increase.

Of the total production, the Hollinger Mine yielded 161,702 ounces; McIntyre, 59,779 ounces; and Dome, 58,978. Gold being the standard of value, and having a fixed price, was the only metal which did not share in the general increase of prices. Indeed, the high price of labor and supplies have, for the time being, lowered the rate of expansion for this branch of the industry. The output for the first nine months of this year was some 20,000 ounces less than for the corresponding period in 1916.

Evidence accumulates that the gold resources of Northern Ontario are extensive. Developments at Porcupine have been satisfactory, and Kirkland Lake shows signs of being a good second. A satisfactory feature is that the newer gold camps are scattered over a wide area of territory.

The average price of silver was 79.758 cents—the low being 71.75 on March 27th, and the high 108.50 on September 25th. The following mines were the leading shippers: Mining Corporation of Canada, 3,831,211 ounces; Nipissing, 2,839,462 ounces; Kerr Lake, 1,708,921 ounces; Coniagas, 976,315 ounces; O'Brien, 925,000 ounces; McKinley-Darragh-Savage, 775,566 ounces; Miller Lake O'Brien, 757,132 ounces.

Both these metals have risen in price, and are valued in these statistics at 25 cents and 20 cents per pound respectively, for the metallic contents of the mattes produced. Nickel is quoted at 50 to 55 cents per pound, and the United States government has now fixed the price of copper at 23½ cents per pound. The mines of Sudbury are now, and have been for some time, working at maximum capacity. The nickel contents of the mattes for the nine months of 1917 were a little larger than for the same period in 1916, but the copper contents were about 1,000 tons lower. The International Nickel Company's new refinery at Port Colborne is well under way, and is expected to be turning out refined nickel before next spring.

In addition to exported ore, 138,808 tons were shipped to Ontario smelters. Of the total of 983,321 tons of ore smelted, only 93,536 tons, or 9.5 per cent., were Ontario ore. The total pig iron produced was 513,232 tons, worth $9,841,438 as compared with 501,410 tons, worth $6,686,965 in 1916 for the corresponding period. This shows an advance of nearly 50 per cent. in the value of pig iron.

		Quantity.		Value.	
		1916.	1917.	1916.	1917.
Gold	ounces	363,955	343,490	$ 7,513,734	$ 6,754,535
Silver	"	16,203,091	15,236,002	9,750,040	12,001,875
Cobalt (metallic)	pounds	172,055	295,866	146,467	433,739
Nickel (metallic)	"	17,435	166,921	7,618	67,499
Nickel oxide	"	54,152	10,831	6,381	3,025
Cobalt oxide	"	378,732	276,769	231,947	323,162
Other cobalt and nickel compounds	"	57,026	276,217	22,890	30,025
Molybdenite	"	15,845	65,827	15,845	83,550
Copper ore	tons	1,715	2,658	21,685	33,419
Nickel in matte	"	31,046	31,064	15,523,000	15,532,000
Copper in matte	"	16,989	15,928	6,285,930	6,371,200
*Iron ore (exported)	"	......	98,757	....	412,401
*Pig iron from domestic ore	"	......	48,820	....	936,118
*Lead	"	......	540	....	136,948
					$43,119,496

*1916 figures are not available for the last three items.

TRADE INQUIRIES

The following inquiries relating to Canadian trade have been received by the Department of Trade and Commerce, Ottawa. The names of the firms making these inquiries, with their addresses, can be obtained only by those especially interested in the respective commodities upon application to: The Inquiries Branch, the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Asscoiation, Toronto, or the Secretary of the Board of Trade at London, Toronto, Hamilton, Kingston, Brandon, Halifax, Montreal, St John, Sherbrooke, Vancouver, Victoria, Winnipeg, Edmonton, Calgary, Saskatoon, Chambre de Commerce de Montreal, and Moncton, N.B. Please quote the reference number when requesting addresses:—

1506. Pig-iron, Steel plates for Shipbuilding, Marine Oil Engines, etc.—A Genoese firm, who are contractors to the Royal Italian Government and to the leading shipyards, engineering companies and shipowners in Italy, are prepared to open negotiations, for after-the-war trade, with Canadian concerns who manufacture the following: Pig-iron, metals, steel plates and sections for shipbuilding, auxiliary machinery, marine oil engines and other materials used, directly or indirectly, in the shipbuilding and engineering trades.

1507. Electrical Equipment.—An importing house in Genoa, Italy, which is thoroughly conversant with the electrical needs of the Italian market, wishes to correspond immediately with Canadian manufacturers of electric motors, transformers, dynamos, turbines, and electrical cable.

1511. Machinery and Metals.—An important firm of merchants and representatives in Italy, with head offices in Genoa and branches in Milan and Naples, would welcome Canadian agencies in metals and machinery, etc., such as agricultural machinery, pumps, railway supplies, machine tools, Diesel and semi-Diesel twin motors, 100 to 400 horse-power.

1512. Marble.—A Genoese exporter of Italian marble is open to correspond with Canadian importers for after-the-war trade.

1513. Metals, Ferrous and Non-Ferrous, etc.—An agent in Milan, Italy, would like to open negotiations with Canadian manufacturers of ferrous and non-ferrous metals, and of metal, woodworking and machine-shop tools.

1553. Machinery.—An engineering firm established in Durban, Natal, are prepared to take up agencies or purchase of any suitable machinery, except centrifugal pumps and agricultural machinery.

1554. Machinery and Mining Specialties.—A firm of engineers invite correspondence re agency or purchase on any line of machinery specialties or mining supplies.

GRAND TRUNK ISSUE OVERSUBSCRIBED

A cable received at Grand Trunk headquarters, Montreal, from London this week, stated that the issue of £1,000,000 three-year 6 per cent. notes, recently issued by the Grand Trunk Railway Company in London, had been oversubscribed, notwithstanding the present unfavorable conditions of the money market, due to the war situation. The result of the issue is another proof of the excellent credit which the Grand Trunk Railway holds in financial circles. There have been but rare instances recently of the underwriters being relieved of responsibility with the offering of a new loan. The new notes were issued at 98½ and replace a maturity of like amount falling due next month.

E.B.