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Volume 30. Toronto, May 11, 1916.

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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

THE ROLLING AND FLOATING STEEL CAISSONS OF THE LEVIS DRY DOCK AT LAUZON, P.Q.*

PART II.

A DETAILED DESCRIPTION OF THE DESIGN, FABRICATION AND ERECTION OF THE FLOATING CAISSON.

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IN a previous article the rolling caisson and its intricacies were described; in this, the floating caisson, while radically different from the rolling gate, will probably be found to lend itself more readily to an easy and understandable description.

The floating caisson of this dock is a large structure designed to be floated to and then swung across the berth entrance, sunk with its bearing pieces against the sills, subsequently, when berth is emptied, to act as a dam against the sea water, and to afford passageway from one wall to the other. It must consequently possess four distinct characteristics: (1) It must be able to float when desired. (2) It must be capable of being submerged at will. (3) It must be strong enough when acting as a stop gate to carry the tremendous hydrostatic loads and transmit them to the sills. (4) While in position it must provide a passageway for light traffic.

The caisson in general outline is shown in Fig. 1. It will be noted that the keel section is straight, likewise the stems, which are, however, flared so that the overall length at elevation of bridge deck is 133 feet 6 inches. The depth of the structure is 50 feet. The cross-section shows clearly the arrangement of the chambers and decks, which are named as follows: Keel, ballast chamber, deck E, air chamber, deck D, tidal chamber, deck B, motor and floor stand space, and deck A (traffic deck).

The ability of the caisson to successfully float or submerge itself as required by (1) and (2) will be discussed fully later.

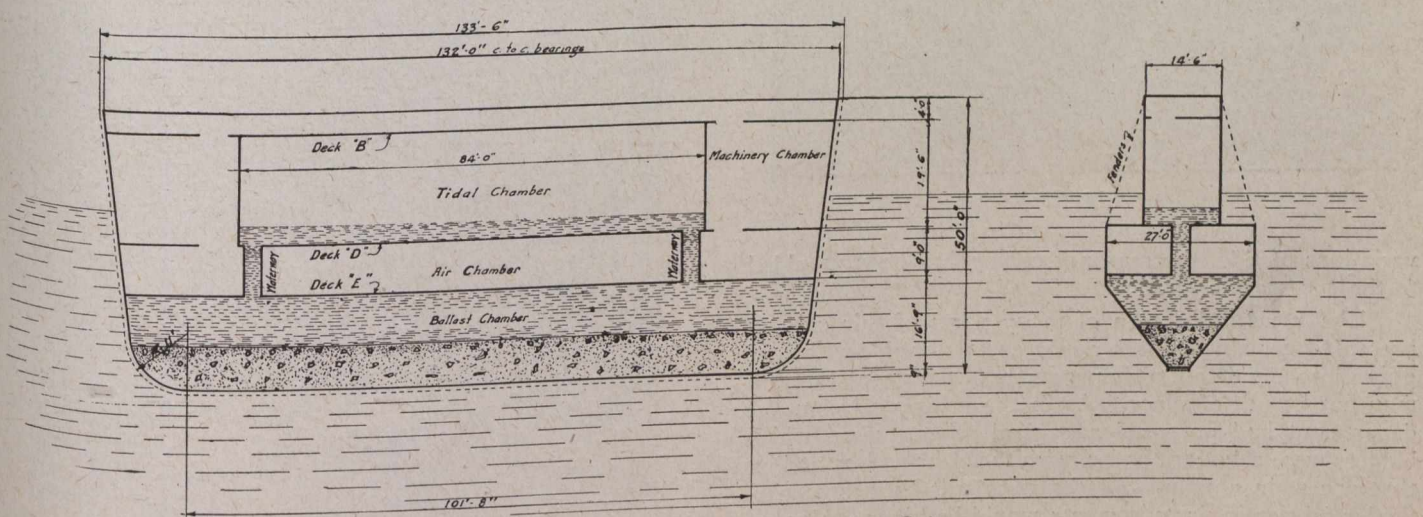


Fig. 1.—Line Diagram of the Floating Caisson.

None of the mechanical equipment of the caisson is shown in Fig. 1, which is only intended to illustrate the general outline of the gate and the arrangement of its decks and chambers, consequently there is no indication given of even the six large 42-inch filling culverts which run completely through the caisson, and through whose agency the berth is flooded when desired.

At the very bottom of the structure is seen the concrete ballast, enough of which is placed to enable the minimum draft of caisson (no water ballast whatever) to be 22 feet 6 inches, thus giving 2 feet 6 inches clear over sills at low water, mean spring tides.

It will be next noted that the tidal chamber does not run the full length of the caisson, but is only about 84

*Extract of part of paper read before a meeting of the Mechanical Section of the Canadian Society of Civil Engineers at Montreal, March 30, 1916.

feet long, leaving a large air space at each end. These spaces are used as machinery chambers, and in them are placed the motors, valves, valve controls, drains, etc., necessary to either float or submerge the gate.

It will be noted that the two ends are tapered to meet the stem pieces—in a somewhat similar way to a ship's bow, but the lines are not at all easy, being straight and rather blunt. This was done, of course, to aid the fabrication of the gate, as very few bridge companies have facilities to handle a large amount of curved plate work—so easily accomplished in a modern ship yard.

Passing now to the top, there is installed within a watertight box, a 15-h.p., d.c. motor used to drive a long horizontal countershaft from which are actuated, through floor stands, the various main valve stems. The motor is controlled from the outside of its box by an extended controller shaft, and it will be at once seen that the operation is practically identical with that of the rolling caisson.

Above the valve-operating devices is located the traffic bridge provided with folding rails. At the ends of this bridge cantilever brackets are used to support its corners enabling the bridge to terminate with its clear width. In order that the gate may swing in to its berth under all

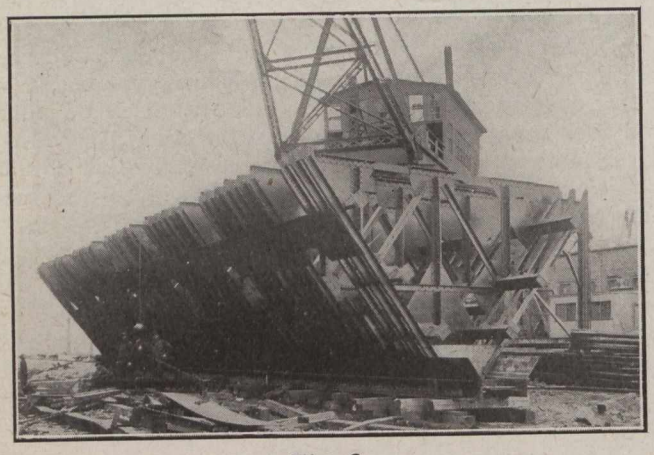


Fig. 2.

variations of tide, the masonry coping has been moulded to the necessary clearance.

The structural design of many parts of this caisson presented certain features rarely encountered, but before going into any detail, a short resumé of the general design may not be out of place. As in the rolling caisson, the department had proposed a general scheme upon which bidders were asked to tender, with the clear understanding that a certain amount of latitude to suit their own particular fabricating requirements would be given. Messrs. M. P. and J. T. Davis, the successful tenderers, submitted a fairly general design of their own; and this design was accepted, after a few changes had been agreed upon, in order to satisfy the requirements of the department of public works. The most important of these changes was the substitution of flared stems instead of vertical ones. On this amended layout the Dominion Bridge Co. then tendered to Messrs. M. P. & J. T. Davis, and on accepting the tender Messrs. Davis required the Dominion Bridge Co. to check all stresses and sections. During the course of this work certain changes were recommended, chief among which may be mentioned the increase of the width of keel and stems from 18 inches to 4 feet. This point will be touched upon a little later.

As in the rolling caisson, the main stress unit required by specification was 12,000 lbs. per square inch; and these specifications also required that the whole gate should be reversible.

The hydrostatic loading against the caisson when acting as a gate was assumed to be triangular with a depth of 46.25 feet, making a unit stress at the bottom of 2,885 lbs. per square foot.

This loading is, of course, applied directly to the skin plates which in turn deliver it to the frames of which there are two kinds—"strong frames" and "light frames"—corresponding to the ribs in ordinary ship construction. The light frames, placed at 1-foot 9-inch centres, pick up their portion of the skin load and deliver it through longitudinal pieces to the strong frames, which load the main

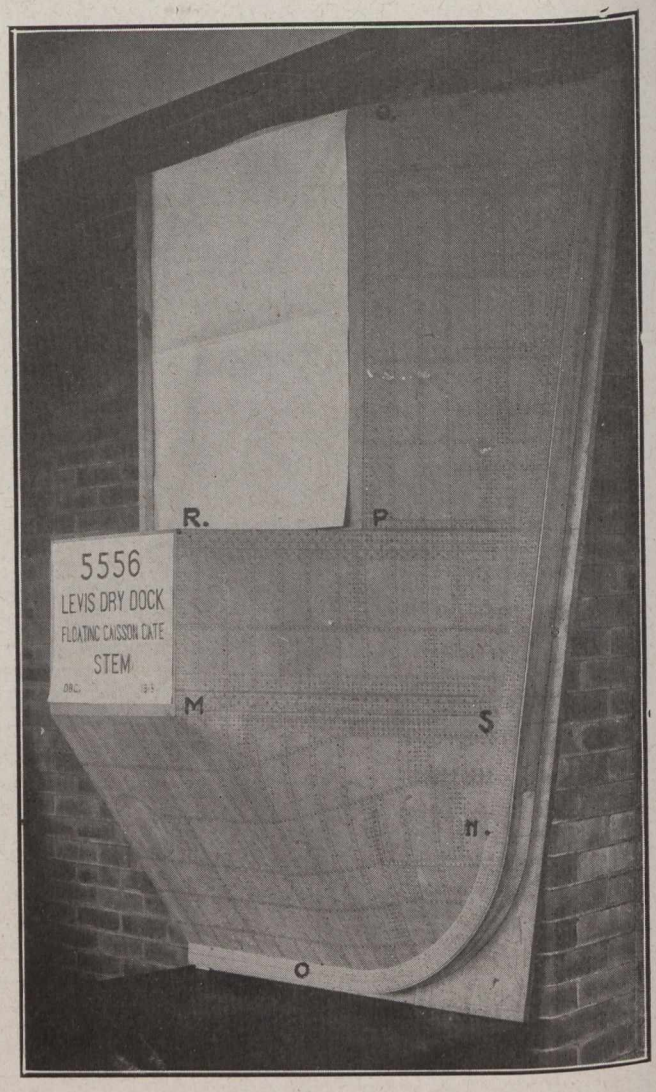


Fig. 3.

horizontal plate girders constituting decks E, D and B. The distribution of the actual loads to these respective girders was accomplished in an exactly similar manner to that used in figuring the loading of the trusses of the rolling caisson, illustrated in Fig. 1 of the article on the rolling caisson. On this basis, then, the loading to deck B is 4,260 lbs. per lineal foot; to deck D, 14,760 lbs. per lineal foot; to deck E, 25,680 lbs. per lineal foot, and the keel sill, 21,900 lbs. per lineal foot.

The design of the stems afforded one of the most interesting features of the whole gate. The reactions of the girders are as follows: B, 281,000 lbs; D, 930,000 lbs.; E, 1,590,000 lbs., and it is the duty of the stem girder to distribute these high concentrations over as much of the

sill area as possible. The necessity for this will be evident after a glance at the following figures. If, for example, the reaction of deck E be delivered over an area of 15 inches x 15 inches (the space immediately under its own bearing pieces) the resulting load on the oak is approximately 7,100 lbs. per square inch. This is evidently the worst case, namely, that in which the stem is not distributing the reactions at all. On the other hand, suppose the stem distributes the load uniformly over 13.13 feet (equals ½ of 9 feet + ½ of 17.25) giving a load on the oak of 840 lbs. per square inch. It is apparent that even under these ideal conditions the load is very heavy and hence the importance of the stem is realized. In passing, it may be noted that the oak bearing pieces are enclosed by steel angles.

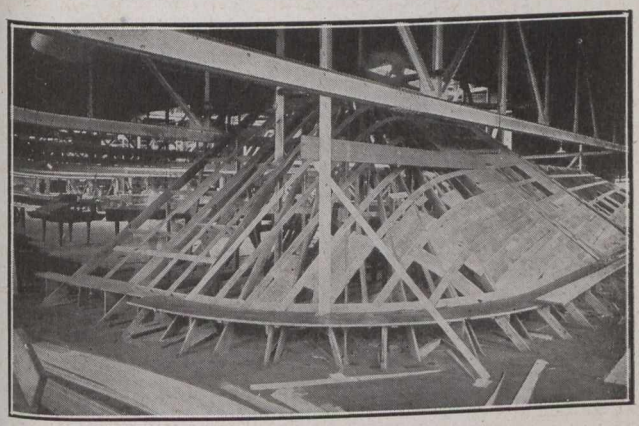


Fig. 4.

The keel was designed to be quite similar to the stems with, however, several changes due to the distinct differences in the duties of the two members. The function of the stem was to receive two highly concentrated loads and distribute them over as large an area as possible. The duty of the keel is, however, to receive and transmit directly to the sills a uniformly distributed load. Hence it is apparent that no bending moment will be developed within the keel, nor will there be any extremely heavy concentrations. It was, therefore, possible to reduce the flange material very markedly and also to dispense with the necessity of bearing between webs and flange plates. All stiffeners, both inner and outer, were accurately fitted by milling to bear against the flange angles, and these became excellent paths for the load distribution. Breast hooks were also supplied at every weak frame, *viz.*, at 1-foot 9-inch centres. These breast hooks are clearly seen in Fig. 2, taken during the yard assembly.

Additional stiffness for the tidal chamber portion is gained by the presence of the heavy diagonal fenders which are stiffened half-way up by 24-inch gussets.

These fenders, besides aiding in a very effective way the sway bracing system, are necessary to preserve the exposed portions of the deck against injury from falling bodies of any kind. They are shod throughout their whole length with 12-inch x 12-inch white oak, which serves as a buffer against contact with berth walls should any local disturbance cause violent rocking of the caisson when floating. Wooden strips are also inserted in the chords of decks E and D. These are 12 inches x 12 inches and, naturally, run completely around the caisson, and act as buffers against injury during those times that the gate is floating beside one of the dock walls.

The bearing strips of this caisson are all white oak. The thickness of these varies from point to point along the stem and keel, depending on the number of flange and splice plates inserted. In addition to these oak bearing strips there are buffer strips to absorb the shock as caisson is settling on to the bottom or oscillating against berth walls. Owing to the lay-out of the keel and stems, the axis of this caisson during contact with masonry may be quite oblique with no danger of steel touching masonry.

The structural design of the rest of the caisson followed along usual lines, and offers no field for any extended comment.

The layout, however, of the traffic bridge possesses certain points of interest that may with advantage be briefly described. As mentioned previously, the floor stands are situated on deck B, which is about 4 feet below the bridge. Consequently, over each floor stand a hatch had to be provided, and each hatchway is large enough to allow space for a checkered plate stairway from the steps of which the attendant may operate the floor stand mechanism. These hatches are well over to one side of the bridge.

In addition to the floor stand hatches there are five others—two main hatches, two ladderway hatches leading to the tidal chamber, and one motor box hatch. The main hatches lead directly into the machinery chambers and are large enough to admit the passage of any of the pieces of mechanical equipment. In order that a motor and pump might not have to be disturbed to give passage, for example, to a 42-inch valve being removed for repairs, the hatchway was offset from the centre line of the motor by about 4 feet 6 inches. It is through these main hatches, also, that the scuttling valves are operated. The ladderway hatches merely give direct access to the tidal chamber, and the remaining hatch to the watertight motor box and controller handles.

The fabrication of the steelwork of the floating caisson presented several problems only met with at very infrequent intervals by a bridge company. Especially was this the case in regard to the ends of the structure, which are similar to ships' bows.

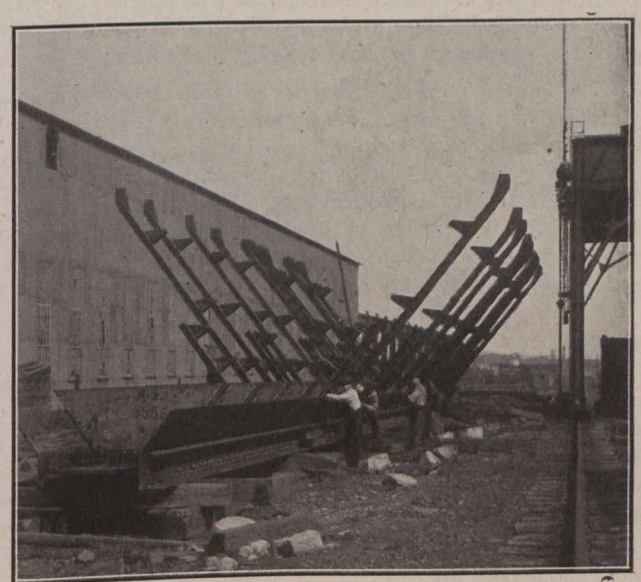


Fig. 5.

In order to simplify as much as possible the lay-out and detailing of these curved portions, an accurate wood and cardboard scale model of one-half of one end was constructed. This was made by the template shop shortly after the main design features were settled; and the scale selected was 1½ inches to the foot. Fig. 3 shows this model very distinctly. The name sheet is fastened to the

wall of the air chamber (5556 being the contract number of the work), while the sheet of plain paper above is on the wall of the machinery chamber.

The photograph of the model shows clearly a number of interesting points which may be named without further

Fig. 6.

comment—shape of skin plates, amount of skin plate included in the shop riveting of the stem portions, the retention of vertical frames throughout (the blacksmith shop taking care of the bent and warped work introduced), the position of the breast hooks, and one of the filling culverts.

The plates were detailed as completely as possible. In certain of the more difficult portions of the bent work the drawing office developed the plates and showed the general position of all rivets, but left the exact location of them to the template makers. In order to insure that the work would go together without loss of time or material, it was decided to assemble the templates in the shop before sending them out, and Fig. 4 shows this assembly. It will be noted that the caisson is, as it were, lying on its side.

As an additional precaution, it was decided to assemble in the yard the whole lower portion of the floating caisson, and the accompanying photographs clearly show the progress of the work. Attention might be called to the immense size of the gate, necessitating its yard assembly by the largest travelling crane in the possession of the Dominion Bridge Co.

The caisson, in order to carry out the service required of it, must be capable of submerging itself, becoming buoyant, and when acting as a gate it must allow ballast water inside to rise and fall freely with all changes of the tide. To submerge the caisson, valves are located in each stem; these admit water until the degree of submergence desired is reached. To become buoyant, two pumping units installed in the machinery chambers at each end of the caisson pump the water out until the caisson floats. Each unit consists of one 100 h.p., 2-hour rating, 1,150 r.p.m., 550 volts, vertical d.c. motor, direct connected to an 18-inch axial flow, Mather & Platt centrifugal pump. The capacity of the pump at about 1,200 r.p.m. is 5,000 gallons per minute against a head of 40 feet.

When it is desired to close the berth the caisson will be pulled across the entrance and fitted to the keel and stem blocks. This will usually be done at low tide. If not, and there is no need for haste to close the berth, the tide will be allowed to fall to its lowest point before any submerging is done. An operator will then go to the swinging valve levers and pull them from vertical position to the horizontal. The caisson will immediately commence to flood its ballast chamber and will naturally begin to settle. As soon as the keel is resting evenly on its keel bed, the bridge ends will then necessarily be in their proper position, and the gate is therefore able to provide a communicating bridge for traffic between the two sides of the berth. The berth is then emptied in the usual way and the gradually increasing pressure against the gate tends to seal it more and more securely against the sills. The rising tide flowing freely through the main flooding valves gradually will fill the whole ballast chamber and thence will find its way through the two waterways to the tidal chamber. This process will be automatic as no attention need be given the valves once they are opened.

When it is desired to flood the berth, the valve motor is started and an operator then engages in succession the clutches that actuate the valve stems of the six 42-inch diameter valves. These admit enough water to quickly flood the berth.

When the elevation of the water on each side of the gate is the same, the two flooding valves are closed by swinging up the control levers. This prevents the entry of any more ballast water. The two centrifugal pumps are then started and the caisson will be gradually emptied of its ballast which will, of course, enable it to float. Once it becomes buoyant it may be towed away from the berth entrance and placed where desired.

The free play of the tide within the caisson is accomplished by the main flooding valves, and the importance

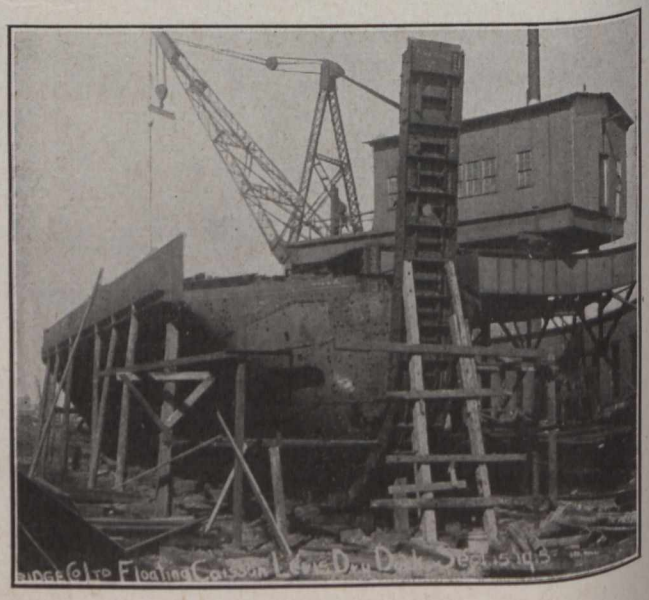


Fig. 7.

of this unrestricted movement of the ballast water cannot be overestimated. The reason for this statement is readily seen when it is realized that the caisson, when berthed, must have increased water ballast for each rise of the tide;

otherwise the incoming tide would tend to lift it vertically, and slide it along the sills. Should this ever happen, it would mean heavy wreckage and probable loss of life within the berth, due to the sudden inrush of water. The only way to prevent this is to allow an increasing amount of water ballast within the structure as the tide rises and thus insure its stability against the hydrostatic uplift. The thing to guard against was, therefore, the closing of the main flooding valve when the caisson is submerged and acting as a stop gate. This point was felt to be so important that it was decided to make the control of the flooding valve of such a nature that it would be humanly impossible to have it closed when circumstances would demand its being open. It will be remembered that when the caisson is berthed it is designed to act as a crossing between the two sides of the dock, there being a communicating bridge on the top. Consequently, if its roadway were artificially obstructed until the main valves were in the open and safe position, it was agreed that there would be small danger of the valves being left closed through inadvertance. The visual effect of a large notice board blocking the roadway, which could only be put out of the way by leaving open the main flooding valves, was thought to be a surer guarantee of safety than any attempted interlocking device between valve stems.

The erection of the floating caisson was carried on simultaneously with that of the rolling, the arrangement effecting a great economy in the use of the derrick car.

The heavy keel section was placed on a series of wedged keel blocks placed approximately at 3 feet centre to centre. These were carefully lined up and adjusted so that the keel came to an absolutely true bearing. The frames were then assembled up to elevation of deck E. From this point on no particular difficulty was encountered.

Messrs. M. P. and J. T. Davis, with Mr. S. H. Woodard as chief engineer, are the general contractors for the whole dry dock project; and all the work in connection with these two steel caissons was given to the Dominion Bridge Company, Limited, Montreal, as subcontractors. Of this company Mr. G. H. Duggan is general manager; Mr. F. P. Shearwood, assistant chief engineer; Mr. A. E. Johnson, mechanical engineer, Mr. P. L. Pratley, designing engineer and Mr. D. C. Tennant, chief draftsman, while to the writer was entrusted the direct charge of the work from its early stages. Changes in design were only made after consultation with the Department of Public Works, Ottawa, represented by Mr. U. Valiquet, supervising engineer, and Mr. S. J. Fortin, structural engineer. They had also the approval of all detail drawings.

By the beginning of September, 1915, without reckoning roads constructed in the region occupied by the field army, work had already begun on the construction of a network of Russian State railways with a length of 3,530 miles, to cost $315,368,000. The construction has been sanctioned of new lines totalling 300 miles at a cost of $26,478,000, and the building was proposed of new railways totalling 1,812 miles, at an outlay of $196,194,000. In all, these new lines and branches have a length of 5,645 miles, and for their construction is demanded about $538,000,000. The realization, however, of proposals for the building of new lines has been postponed till the end of the war.

At Drammen, Norway, new zinc works are about to be started for the extraction of zinc by an electric wet process, invented by a Belgian engineer, M. Sturbelle. Raw materials for the first year, about 10,000 tons, have been secured, and special attention will be paid to ores containing from 8 to 30 per cent. zinc, which have hitherto been considered as really worthless.

SOME SUGGESTIONS PERTAINING TO THE OPERATION OF WATERWORKS PLANTS.*

By John W. Toyne.

THE operation of a waterworks plant is essentially a question of management, and in the present paper I have treated it exclusively from this viewpoint. The management of any utility consists of two distinct features—the management of the physical plant through the utility's operating force and the management of the utility's business relations with its customers. This is equally true whether the utility is privately or municipally owned. Applicable, too, to both, are the several regulations recently adopted by the public service commissions in Indiana as well as other States.

The management of the physical features of a utility is an engineering problem, and I use the term "engineering" in its broader sense, which includes experience, sound judgment and the ability to build and maintain a loyal organization, as well as the essential theories taught us in the technical schools. Any one of these alone is good; all are absolutely essential in order to attain the most desirable results, and as in any line of endeavor really worth while there is no "royal road" to real success.

The questions that continually confront the manager of a utility are: Of what does my plant consist? What is its value? Of what is it capable? Is it rendering the highest possible efficiency? Is it rendering the best service possible? What provisions must be made to meet changing conditions? Is anything being overlooked that is essential? Does it pay?

I am afraid if we were asked these or similar questions a great many of us, at least, would experience some little difficulty in assuring even ourselves that we really knew the answer.

Is it sufficient, from the standpoint of the manager, to sum up one's plant as so many acres of land, so many buildings, certain pumping machinery, so much power generating equipment, so many miles of distribution pipe lines, so many hydrants, valves, meters, etc., enumerating only the physical items? Does not the human element, the operating force, enter as largely into the make-up of a plant as its mere physical properties?

Given the best equipment, the most scientifically designed distribution system and an unfailing supply of water, and still your plant is sadly deficient if this feature has not been properly provided.

A knowledge of the value of the plant, not only in its entirety but by units, is essential in order that provisions may be made for replacements as well as a fair return above maintenance during their useful life. In my own work I have adopted the system of permanent, unit inventory, showing for each unit, wherever possible, date of purchase, manufacture, purchase price, cost of installation, probable life, depreciation annuity and present value. In a great many cases the compilation of an inventory of this character is a really formidable undertaking, owing to the incomplete and inaccurate data of record necessary, but once developed it is of inestimable value to the manager, even though frequent corrections or adjustments must of necessity be made.

Every manager cannot only well afford but cannot afford not to paraphrase Pope into "Know, then, thy plant"; not only its value, either its cost or appraised unit

*Read at annual convention of the Indiana Sanitary and Water Supply Association.

value, but its capabilities, the utmost duty that can be derived from each unit, the percentage load that will render the highest efficiency, taking into consideration the interest charge on the investment, the depreciation accruing and the continual advance being made toward more perfectly efficient machinery by the manufacturers. This can be determined only by actual tests intelligently conducted; and the results, to be of value, must be so compiled as to be available for comparison with performance data in operation, as only in this way can the operation be brought to even approximate the ideal.

The standard by which everything must be measured is the service rendered; this applies not only to the service rendered by the plant to the utility, but by the utility to its customers. The service rendered the utility by its plant is governed entirely by the manager; by his ability to know his plant, to build and maintain an organization loyal to him and his aims, to derive the highest efficiency possible from his plant, to anticipate the demands of changing conditions and make the necessary provisions.

The determination of the value of the physical plant, together with the point of highest operating efficiency of each unit, represents but a small portion of the manager's work in securing the best possible service from his plant.

The work of building and maintaining a loyal organization is fully as important and requires infinitely more ability, judgment and application. It is, in fact, the test of the real manager, as the service rendered the utility by its plant is entirely dependent on this element. Personally, I have had no success with any form of organization having more than one head. This applies not only to the utility as a whole, but to each department and bureau, and in this connection one must always remember responsibility fixed cannot exceed the authority granted. To me, a bureau, department or utility with more than one head, a job with more than one boss, is as ridiculous as a two-headed hen.

In building his organization the manager must know the results desired, the qualifications necessary to get the results, and must be able to judge human values with this in view, otherwise he cannot hope to have a well-balanced, efficient organization. The manager's work is not completed with the building of his organization. To be of real value it must be maintained. It has none of the attributes of perpetual motion other than the constant expense. Its maintenance requires a world of tact, infinite patience, and, above all, absolute fairness, with a real knowledge of his physical plant, its value and possibilities with an operating force properly organized and thoroughly loyal; the service that can be commanded from its plant by a utility is limited only by the ideal.

The service rendered its customers by a utility is equally dependent on the manager for the attitude of his operating force will be largely a reflection of his own. He must always bear in mind that his customers have a right to expect prompt service cheerfully rendered, as well as courteous attention at all times. Absolute fairness is as imperative in the manager's dealings with the customers of the utility as with his operating force, as in no other way can he build up a real "good will" asset.

Standards of service are being established by the several public service commissions. A great many of those prescribed have been exceeded for years by a number of the utilities. Others will, I believe, work a real hardship on the utilities without materially adding to the service rendered the customers of the utility.

Every manager is continually confronted with changing conditions, not only as it affects the physical plant but in the service requirements, the increase in population served, the extended area covered by his distribution, changes in direction of the city's growth; all these intimately affect the utility and must be anticipated by the manager if he would avoid serious embarrassment in serving his customers.

If a manager really knows his plant as outlined he will not only be in a position to know, but will know whether it pays, and how well.

In my own work I have found that a slight change in the method of firing saved tons of coal in generating steam; that apparently slight changes in piping prevent unnecessary waste of energy; that a careful routine saves hours of unnecessary labor in reading meters and delivering bills; that a division of the city into payment districts, while in no way reducing the service to the consumer, saves the utility approximately a thousand dollars per year in office labor.

In the item of permanent records of his plant, a manager can, through careful selection or development of forms and accuracy in their use, save much unnecessary labor and render better service. I have found card systems and loose leaf records more flexible and, consequently, more readily adapted to the requirements of a utility.

To sum up, the manager must be all things to his utility and his customers. He must always be in touch with his plant, with his operating force, with his customers and with his field of work in general, as no utility can exist for itself alone. There is a constant advance in equipment, methods and service, and only by keeping fully abreast can any manager hope to render the best service to his utility, its customers and himself.

RAILWAY EARNINGS.

The following are the railroad earnings for the first three weeks of April:—

Canadian Pacific Railway.

	1916.	1915.	
April 7	$2,482,000	$1,766,000	+ $716,000
April 14	2,577,000	1,701,000	+ 876,000
April 21	2,343,000	1,623,000	+ 720,000

Grand Trunk Railway.

April 7	$1,155,486	$1,008,320	+ $147,166
April 14	1,024,505	864,658	+ 159,847
April 21	1,059,661	869,772	+ 189,889

Canadian Northern Railway.

April 7	$ 677,000	$ 457,000	+ $220,000
April 14	668,900	463,700	+ 205,200
April 21	634,000	442,300	+ 192,000

The Canadian Northern Railway's figures for March are as follow:—

	1916.	1915.	
Gross earnings	$2,607,000	$1,898,500	+ $708,500
Expenses	2,240,600	1,397,700	+ 842,900
Net earnings	366,400	500,800	— 134,400
Mileage in operation.	8,270	7,181	+ 1,089

The company states that the decrease in net earnings compared with last year is due to snow blockades and other interruptions to movement of traffic, which increased operating expenses abnormally.

The March comparative figures of the Canadian Pacific Railway are as follow:—

	1916.	1915.	Inc.
Gross	$10,380,981	$7,852,989	$2,527,992
Expenditure	6,959,651	4,879,974	2,079,676
Net	$3,421,330	$2,973,014	$ 448,315

REVIEW OF 1915 PAVING WORK

ANNUAL REPORTS OF CITY AND TOWN ENGINEERS THROUGHOUT CANADA SHOW THAT THEY ARE DOING "BUSINESS AS USUAL"—SUMMARY OF TOTAL AMOUNT OF PERMANENT PAVEMENTS NOW LAID IN SOME OF THE CANADIAN CITIES.

"BUSINESS as usual" appeared to be the slogan of most of the Canadian cities and towns during 1915, at least so far as paving work was concerned. True, in some cases a falling off in work was evidenced, but, on the other hand, many of the towns did more work in 1915 than in 1914.

Of special interest is the report of the six largest cities in the Dominion. Toronto spent $1,327,108 on new pavements, which was $100,000 more than was spent in 1914. Montreal spent $1,388,967 in 1915. The exact figures for 1914 for Montreal were not reported, but it is stated that the 1915 expenditures compare very favorably with 1914. Hamilton spent only $46,000 less than in 1914. On the other hand, Winnipeg carried out but very little of its 1915 programme, doing nothing that was comparable to the 18 miles of pavement that were laid in that city in 1914; and Vancouver constructed absolutely no new pavements whatever in 1915, confining their entire attention to repair and maintenance. At a cost of $470,040, Ottawa laid 139,068 yards in 1915, as compared with 177,712 yards in 1914.

Table I. shows details of the new paving done in 1915 by a half dozen of the leading Canadian cities. It is somewhat of interest to note that of the 1,639,808 yards laid by Montreal, Toronto, Winnipeg, Ottawa and Hamilton, 86.9% was sheet asphalt or other bituminous pavement, 5.3% brick, 4.5% stone block, 1.6% concrete, 1.0% wood block and 0.7% macadams other than bituminous. The 10,621 sq. yds. of "other macadams" laid in Toronto was chiefly Rocmac; the 200 sq. yds. in Winnipeg was water-bound macadam. 26,808 yards of the stone block laid by Montreal was granite. The stone block laid in Winnipeg was for subway approaches. Most of the bituminous macadam laid by these six cities in 1915 was Tarvia.

Table II. shows the total yardage of permanent pavements as at January 1, 1916. If the 350,000 sq. yds. of water-bound macadam in Toronto and the 5,300,000 sq. yds. in Montreal are not counted, Toronto has by far the largest amount of permanent pavements of any city in Canada. But if the water-bound macadam is counted, Montreal leads by a substantial margin. It is quite probable, however, that those 5,300,000 yards in Montreal represent streets that will sooner or later gradually be replaced with more permanent types.

No untreated wood block was laid in these cities in 1915, but they have 348,222 yards of untreated wood block laid previously.

8,658 yards of the concrete pavement in Toronto are surfaced with Dolarway. The Vancouver figures for concrete in Table II. include some Granitoid.

Most of these six cities have not yet made up their 1916 paving program, as in many cases the extent of the work depends upon the petitions made by the property owners. To date, however, Ottawa has decided upon an expenditure of about $350,000 and Montreal $981,419.

Paul E. Mercier is chief engineer of Montreal. R. C. Harris is commissioner of works for Toronto and M. A. Stewart, assistant city engineer in charge of paving. The city engineer of Winnipeg is W. P. Brereton. F. C. Askwith is acting city engineer of Ottawa, and Andrew F. Macallum is city engineer of Hamilton. F. L. Fellowes is supervising city engineer of Vancouver.

The figures given in this article probably do not represent more than 10% of the paving work that was done in Canada during 1915, yet it is interesting to note what work even a small portion of the towns and cities are doing. We are, therefore, quoting the following figures from the annual reports of some of the city and town engineers:—

Amherst, N.S.—J. E. Parker, city engineer. Spent $45,000 in 1915 for 17,000 sq. yds. of concrete. Total pavements laid to date in Amherst are: 28,800 yds. concrete and 20,000 yds. asphaltic concrete.

Berlin, Ont.—Herbert Johnston, city engineer. Spent $56,033 in 1915 for 21,323 yds. bituminous macadam and 3,061 yds. concrete. Total pavements laid to date are: Asphaltic concrete, 60,459 yds.; concrete, 3,661 yds.; creosoted wood block, 10,740 yds.; bituminous macadam, 6.43 miles; gravel and water-bound macadam, 24.22 miles. It is estimated that about 6,050 sq. yds. of concrete are to be laid in 1916, and a little bituminous macadam.

Calgary, Alta.—Geo. W. Craig, city engineer. Spent $31,760 in 1915 for 12,294 yds. asphaltic concrete and 405 yds. stone block. Total pavements laid to date: Asphaltic concrete, 1,030,176 yds.; brick, 745 yds.; stone block, 14,155 yds.; creosoted wood block, 100,132 yds.; Granitoid, 95,651 yds.

Dunnville, Ont.—S. Shupe, town engineer. Spent $12,500 in 1915 for 5,690 yds. bituminous macadam. Only other paving in town is 11,833 yds. of concrete previously laid.

Edmonton, Alta.—A. W. Haddow, city engineer. Spent $138,000 in 1915 for 4,810 yds. concrete, 27,020 yds. asphaltic concrete and 1,867 yds. sheet asphalt. Total laid to date: Sheet asphalt, 187,175 yds.; asphaltic concrete, 633,197 yds.; concrete, 37,000 yds.; creosoted wood block, 35,947 yds. The 1916 program calls for an expenditure of about $185,000.

Fort William, Ont.—Ray Knight, city engineer. Spent $13,464 in 1915 for 10,916 yds. water-bound macadam. Total to date: Sheet asphalt, 14,613 yds.; asphalt, block, 47,383 yds.; asphaltic concrete, 65,264 yds.; water-bound macadam, 56,117 yds.; Rocmac, 24,523 yds.; gravel, 25.51 miles.

London, Ont.—H. A. Brazier, city engineer. Spent $166,793 in 1915 for 63,517 yds. asphaltic concrete, 2,655 yds. brick, 5,022 yds. concrete, 6,397 yds. gravel. Totals: Asphalt block, 4,242 yds.; asphaltic concrete, 173,754 yds.; brick, 23,520 yds.; concrete, 14,882 yds; gravel, 89,760 yds; and some water-bound macadam. It is estimated that about $150,000 will be spent in 1916, possibly for 60,000 yds. asphaltic concrete, 3,200 yds. brick, 5,000 yds. concrete and 4,500 yds. gravel.

Moose Jaw, Sask.—Geo. D. Mackie, city engineer; W. H. Greene, assistant city engineer. Totals: Sheet asphalt, 6,197 yds.; brick, 5,050 yds.; creosoted wood block, 107,447 yds.

Niagara Falls, Ont.—W. C. Jepson, city engineer. Spent $20,600 in 1915 for 3,340 yds. brick, 3,280 yds. concrete and 5,000 yds. water-bound macadam. Totals: Brick, 22,300 yds.; concrete, 8,600 yds.; water-bound macadam, 207,000 yds.; Westrumite, 6,200 yds.; Glutrin, 4,500 yds.

North Bay, Ont.—H. J. McAuslan, town engineer. Spent $24,414 in 1915 for 31,834 yds. water-bound macadam. Totals: 74,000 yds. water-bound macadam.

Oak Bay, B.C.—R. Fowler, municipal engineer. Laid 13,728 yds. Tarvia in 1915. Totals: Sheet asphalt, 49,000 yds.; water-bound macadam, 42,000 yds.; Tarvia, 109,800 yds.; tar-sprayed macadam, 160,000 yds. Expect to lay 15,250 yds. Tarvia in 1916.

Peterborough, Ont.—R. H. Parsons, city engineer. In 1915 laid 41,102 yds. asphaltic concrete. Totals: Asphaltic concrete, 79,823 yds.; concrete, 975 yds.

Regina, Sask.—L. A. Thornton, city commissioner; D. A. R. McCannel, acting city engineer. Totals: Sheet asphalt, 174,239 yds.; asphalt block, 54,314 yds.; concrete, 31,987 yds.; stone block, 4,682 yds.; creosoted wood block, 47,648 yds.; bitulithic, 276,242 yds.

St. Hyacinthe, Que.—Hector Cadieux, city engineer. Spent $22,000 in 1915 for 10,000 yds. asphaltic concrete and 1,000 yds. bituminous macadam. Totals: Asphaltic concrete, 10,000 yds.; water-bound macadam, 20,000 yds.; bituminous macadam, 1,000 yds.; other macadams, 1,800 yds. It is estimated that about $50,000 will be spent in 1916, which will include probably 30,000 yds. of tar or asphaltic macadam.

St. Lambert, Que.—E. Drinkwater, town engineer. Spent $165,231 in 1915 for 58,411 yds. bitulithic and 406 yds. Scoria block. Totals: Sheet asphalt, 20,049 yds.; bitulithic, 64,412 yds.; water-bound macadam, 3,863 yds. in good condition; asphaltic macadam, 7,100 yds.; Scoria block, 406 yds. 1916 paving will include some bitulithic.

Stratford, Ont.—A. B. Manson, city engineer. Spent $31,450 in 1915 for 16,632 yds. bituminous macadam. Totals: Asphalt block, 30,954 yds.; brick, 30,287 yds.; concrete, 6,404 yds.; bituminous macadam, 53,151 yds.; Westrumite, 40,643 yds.

Sydney, N.S.—B. M. McKinnon, acting city engineer. Spent $34,019 in 1915 for 16,720 yds. Tarvia. Will probably lay 24,000 yds. Tarvia in 1916 at a cost of about $48,000.

Welland, Ont.—D. T. Black, city engineer. Figures for 1915 paving not given. Totals to date: Brick, 49,000 yds.; water-bound macadam, 10,000 yds.; creosoted wood block, 6,100 yds. Among the 1916 paving will be 7,000 yds. of concrete or 3-inch Tarvia X on concrete base.

Westmount, Que.—P. E. Jarman, city engineer. Spent $41,171 in 1915 for 6,826 yds. sheet asphalt, 9,355 yds. of concrete and 933 yds. of asphaltic macadam. Totals: Sheet asphalt, 126,566 yds.; bitulithic, 2,953 yds.; concrete, 18,726 yds.; water-bound macadam, 53,715 yds.; asphaltic macadam, 168,784 yds.; other macadams, 3,700 yds.; stone block, 37,392 yds. Of the 1916 paving work only $21,700 has been authorized as yet.

As stated before, the figures given above probably do not represent more than 10% of the paving done in Canada in 1915, as figures are given for only one-third of the cities and towns which had over 7,500 population at the time of the last Federal census; and, moreover, these figures do not include interurban highways, such as the Toronto-Hamilton Highway, etc., nor the smaller municipalities, such as Montreal South, Longueuil, etc., each of which probably spent from $2,000 to $25,000 on paving work in 1915. Nor do they include the amount spent by the Federal government, by the nine provinces, by the 154 counties, or by the western districts. For instance, Peel County, Ont., spent $21,462 in 1915 for 6,000 yds. gravel, 15,000 yds. water-bound macadam and 20,000 yds. bituminous macadam; and has voted $52,000 for roads and bridges for 1916, of which about $20,000 will be spent for 20,000 yds. gravel, 25,000 yds. water-bound macadam, and 10,000 yds. tar or asphaltic macadam. As another instance of county expenditures, it might be cited that the expenditures in 1915 by the Ontario counties which were reported to the Provincial Government for subsidy claims, amounted to about $800,000. The amounts that will be spent in 1916, according to the reports of the county engineers to W. A. McLean, deputy minister of public works of Ontario, will be $800,000 on new construction and $200,000 on maintenance. It should also be noted that the above figures are not meant to include track allowance paving.

TABLE I.—PAVING DONE IN 1915 BY THE SIX LARGEST CANADIAN CITIES.

1915 Paving.* Square Yards.	Sheet Asphalt.	Asphaltic Concrete.	Bituminous Macadam.	Other Macadams.	†Brick.	†Concrete.	Stone Block.	Wood Block.	*Total Yardage.	1915 Paving Expense.*
Montreal	387,229	73,967	354,839	——	41,363	——	53,775	——	911,173	$1,388,967
Toronto	300,877	74,870	——	10,621	45,319	24,739	——	5,544	461,970	1,327,108
Winnipeg	18,388	——	——	200	——	1,018	2,558	——	22,164	57,311‡
Vancouver	——	——	——	——	——	——	——	——	——	Nil
Ottawa	94,418	——	19,240	——	——	——	17,310	8,100	139,068	470,040
Hamilton	89,707	11,374	——	——	385	1,290	——	2,677	105,433	197,400
Totals	890,619	160,211	374,079	10,821	87,067	27,047	73,643	16,321	1,639,808	$3,440,826‡

*Exclusive of maintenance and repair work and of track allowance paving and some gutters. †Exclusive of gutters built of this material. ‡Does not include cost of the stone block pavement in Winnipeg.

TABLE II.—TOTAL YARDAGE OF PAVEMENTS IN THE SIX LARGEST CANADIAN CITIES.

Total Paving.* Square Yards.	Sheet Asphalt.	Asphaltic Concrete.	Bituminous Macadam.	Other Macadams.	†Brick.	†Concrete.	Stone Block.	Wood Block.	Asphalt Block.	*Total Yardage.
Montreal ...	1,298,990	167,510	441,716	5,300,000	619,957	262,082	53,775	3,455	20,333	8,167,818
Toronto ...	3,373,148	865,687	50,000	410,162	580,526	158,658.	84,053	64,457	92,767	5,679,458
Winnipeg ..	1,919,527	189,512	2,692	428,380	——	59,684	21,354	210,488	——	2,831,637
‡Vancouver.	143,088	493,152	19,008	——	41,184	53,592	73,128	727,320	——	1,550,472
Ottawa	772,417	4,600	136,035	——	——	——	7,083	35,742	——	955,877
Hamilton ...	658,975	85,466	——	——	37,177	2,728	1,541	116,656	——	902,543
Totals..	8,166,145	1,805,927	649,451	6,138,542	1,278,844	536,744	240,934	1,158,118	113,100	20,087,805

*To January 1st, 1916, exclusive of maintenance and repair work and of track allowance paving and some gutters. †Exclusive of gutters built of this material. ‡Vancouver figures were compiled exactly in mileage but not in yardage. Figures here given are approximate. They were calculated upon an average width of 15 yards, as the Vancouver pavement widths vary from 30 ft. to 62 ft.

ROAD AND BRIDGE CONSTRUCTION AND MAINTENANCE IN THE PROVINCE OF NOVA SCOTIA.*

THE Province of Nova Scotia during the past year has expended on roads and bridges some $616,693. Of this total amount about 48 per cent. was for bridges and culverts of permanent construction and 38 per cent. for road maintenance, but this latter also included bridge painting and repairs. After deducting the amount used for bridge maintenance and dividing the remainder (about $167,500) among the 18,000 miles of highway in Nova Scotia the cost of maintaining a mile of road is found to be $9.19.

Road machinery is coming more and more into use each year, and if the demand for more road graders can be taken as an index of their popularity, they are coming more and more into favor, for the demand seems to be increasing. In some of the most rocky and difficult parts of the province the road grader is used very successfully, in other parts, on account of the small farms, it is difficult to get suitable teams for the work. In such places it is hard to get work done economically, as the teams have to be brought from outside districts. Even at this disadvantage, however, the grader proves more economical than any other method.

It is quite impossible from any reports or data furnished by the municipal councils to determine with any degree of satisfaction or accuracy either the nominal or real value of statute labor applied to the roads in the different municipalities. The returns submitted are far from complete. Based on the assessed value of property, there ought to be approximately $225,000, either in cash or commuted labor, or partly in one and partly in the other, so applied in addition to the annual appropriation made by the province. If this substantial item were made available in cash, it alone would average about $12.50 per mile. For obvious reasons there are very many sections throughout the province in which the full benefit of this provision for the maintenance of roads is not made available, or is so indifferently applied that the roads to which it should be applied derive little or no benefit therefrom. It must be apparent that if the full value of this statute labor could be effectively applied each year the results would be far more satisfactory and far more beneficial to the general condition of the roads of the province.

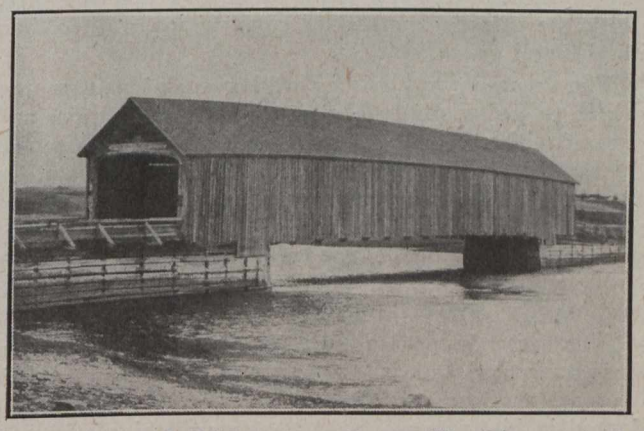
The estimate of 18,000 miles of highway in the province may give an erroneous idea of the condition of these highways. It must not be inferred that these 18,000 miles of highway are completed highways. It must be recognized that the greater part of the road mileage thus given is not improved road, in that it has never been properly ditched, shaped and drained, and often has not even good wooden culverts.

Were the roads throughout the province all properly drained, graded and shaped, with proper culverts, so that all the money provided annually could be expended in maintenance, a fairly good showing could be made. An earth road requires very frequent attention with both the road drag and the road grader if it is to be kept in good condition. At the same time, if the necessary frequent attention is given, earth roads can be kept in smooth condition and fit in every way for such traffic as the average road in Nova Scotia has to carry. A macadam road will cost annually for maintenance from $250 to $350 per mile, including a sinking fund, depending on the width of the metalled portion, and also on the location of the road and the character of the metalling.

The cost of maintaining a good earth road would be from $10 to $50 per mile annually, the cost depending very largely on the nature of the earth composing the prism of the road, earth of a gravelly nature being much less expensive to maintain than the soils in which there is a large portion of clay.

If the maintenance costs given above are correct, and they have been taken from statistics gathered from other places, principally in the United States, where extensive schemes of road work have been carried out, it will be seen that the sum, annually spent per mile in Nova Scotia by the Legislature, is not more than sufficient for the maintenance of the existing mileage of roads.

The installation of culverts and work done under various Acts has done much to improve the condition of the roads in the different counties, and the roads so improved, although they will still require a sum for maintenance, will not need the same amount of annual expenditure as in former years. Where road expenditures have been made out of capital on roads in which permanent culverts have been built, the improvements are, of course, most marked, but even where culverts only have been installed, the ditching done to make the culverts effective has benefited the roads vastly, and the expenditure for maintenance out of revenue should be very much lessened.



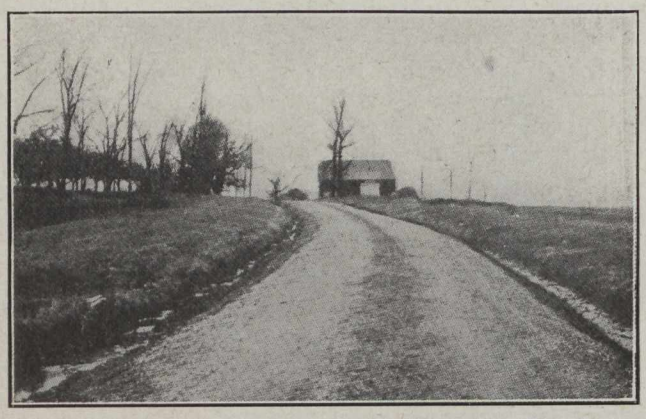
Horton Covered Bridge over Cornwallis River. A fine type of Wooden Truss still doing good service.

The question of road maintenance in Nova Scotia is still a matter of the greatest importance, and one to which close attention must be constantly given, not only for future betterment, but to protect those highways upon which expenditures have already been made. As soon as the construction of a road has been completed, it is necessary that its maintenance should begin. Too often this has not been the case. On the contrary, after a considerable expenditure has been made upon a section of road, the idea seems to prevail that any maintenance is not necessary for some time. This is a mistake. After the construction of a piece of road is completed it will go to pieces in less than half the time it could be expected to last unless proper care is given it annually by way of maintenance. The policy of "A stitch in time saves nine" is most applicable to the maintenance of earth roads in this province.

If a new piece of road after construction is left absolutely without care, and the attention of the roadmaster

*Abstracted from the report of the Highways Division.

is directed to some new section of road to be constructed, the result of this neglect is only what must be expected. In a short time small defects begin to appear, which readily grow serious, and if the neglect continues, it may be only a short time before the road surface goes entirely to pieces and the road begins to be a source of complaint. If the neglect still continues, criticisms of



Clarence Road. A Finished Macadam Road.

the original construction begin to be heard, and the majority of those interested come to believe that the fault is with the original method of construction rather than with the real cause, neglect.

The common way of performing road maintenance work is to get together a gang of men and teams and start out, either before the time for farming work begins in the spring, or after the harvest in the fall, and to attempt to do all the work for the year at one time, and that time a very short period. For the balance of the year the roads receive no attention at all, and the repairs, if any, are intermittent and irregular instead of constant, regular and careful.

There can be no question but that the same system of constant care over the roadbed of the highway as is adopted by railroads is the most economical that can be adopted in highway work. As a general thing, the construction and maintenance work of the railroads of this country has been performed efficiently and economically, and it is, therefore, reasonable to assume that the constant and careful maintenance of railroad tracks and other properties is considered by the railroad simply as good business, and that their judgment in the matter is worth respecting.

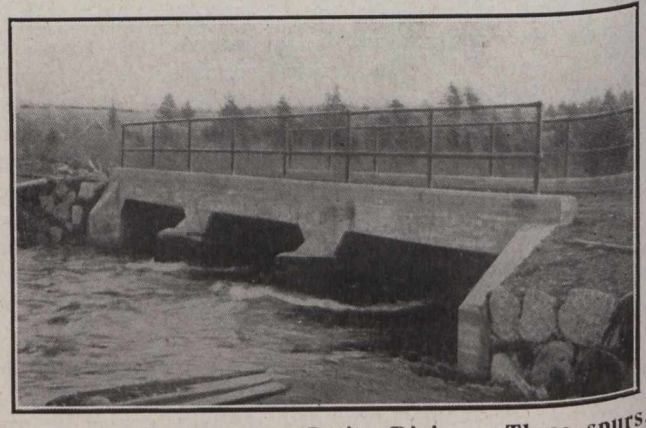
If, instead of intermittent and irregular repairs it were possible to substitute a definite scheme of maintenance, the results, without doubt, would show much improvement in the condition of the highways which are being cared for. An ideal system would be to have a patrol system, which would provide for the permanent employment of skilled laborers or caretakers, well accustomed to road work and repair. Each one of these patrolmen would have charge of a particular section of highway. The patrol system, of course, would not be applicable to all districts. Although the patrol system has been used to some extent as a means of upkeep for the roads in Nova Scotia, yet so far it has not been applied as extensively as could be wished. It is thought, however, that this system can be extended much further with great benefit to the roads.

Serious injury is done to many of the highways of the province by the use of narrow tires on heavily-loaded vehicles. The injury to the roads occasioned by the continued use of narrow tires on heavily-loaded vehicles requires annually the expenditure of a large amount of money to repair the highways on which they are used. This seems most unnecessary. Those who use them no doubt fully appreciate the importance and economic value of good roads for transportation. Nevertheless, evidence is furnished every year to indicate that this continual abuse of the roads will be made with apparent disregard of the serious consequences and the heavy charge upon the maintenance fund.

The Nova Scotia Farmers' Association recently sent a resolution to the legislature as regards the use of narrow tires. This is a move in the right direction, and the principle of this resolution is most heartily commended to the consideration of all those who are using, or rather abusing, some of our highways as above indicated. The benefit to the highways by the use of broad tires can hardly be over-estimated, and the cause of good roads will be much advanced when a proper recognition in some form or other is given to the recommendations of the members of the Farmers' Association.

The work done under the Act to Provide for the Betterment of Highways has, in nearly every case, been performed by labor obtained in the locality in which the work was done. The great difficulty has been in procuring men to do the work except at times best adapted to suit their own convenience. In seed-time, or during haying or harvesting, it has been found impossible to secure workmen in many of the counties to work on the roads when there was anything left on the farm to be done. This has had a tendency to delay much of the work to a later time in the year. While a very considerable portion of the work could be done to advantage at almost any season of the year, it is evident that in many cases the performance of this work late in the season was a decided disadvantage.

The ideal system would be to have all such work done by specially trained gangs. This is being carried out in some countries where special work of this kind is undertaken. In some sections of Nova Scotia the farmers find themselves too busy to permit them to work upon the highways, and there is a growing disposition to justify the roadmaster in employing men who have



Conquerall Bridge over Petite Riviere. Three spurs, 16 ft. each, Concrete Slab.

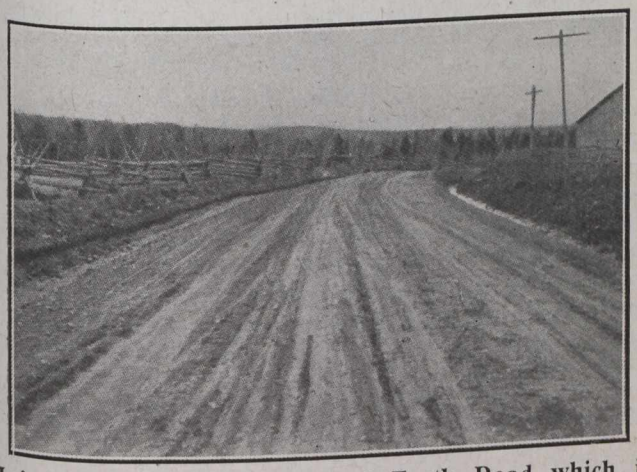
the time and who can devote their attention to this, and become more trained in the work.

In all cases where road improvements were made under this Act, specifications were prepared in the Roads Office, covering the method of executing the work. The work done in many places has been of a very superior order, and is an object lesson to many who have seen,

or who have travelled over the stretch of road so improved. It has been impossible in all cases to surface the road after improvement with either gravel or stone, but it has been the aim in every case undertaken to provide permanent drainage as the first consideration, and then, if possible, to have all the structures made permanent and the road surfaced. The essential point in road construction, and one that is always insisted on, is that thorough drainage shall first be accomplished, and this has always to be done before other improvements are put on the roads.

The Superintendent of Highways has, in nearly all cases, first gone over the ground with the foreman to be in charge of the work, directing him personally as to the execution of the work to be done, and he has besides made inspections as frequently as his time and duties would permit.

The results of the expenditures made under this Act have been the improvement of many bad stretches of road, and, while the magnitude of the expenditures does not permit of very extensive work being done in any one locality, yet the improvements made are very marked.



Main Port Road. A section of Earth Road which is still in splendid condition after being improved two years ago.

If the expenditure under the provisions of this Act could be further extended it would result in a continuance of the betterments already effected. An expenditure of this character seems all the more necessary and defensible because the means available from the ordinary revenues at the disposal of the various inspectors are inadequate to satisfactorily and efficiently maintain the roads as they should be maintained and at the same time do any construction work worthy of the name.

The work done under this Act in the various counties and the nature of betterments effected should have, and, it is believed, will have, a distinct influence towards bringing about better road work in the various districts, as the work serves as an object lesson.

As before stated, the amount of money used for bridge maintenance and construction was 48 per cent. of the total expenditure. The expenditure for repairs to larger bridges has been largely for renewal of the floor system of the bridges, but other repairs have also been made in many places to the approaches. These latter, however, are, as a rule, of much less cost. Two of the largest bridges, where the traffic is heaviest, have been fitted with wooden block floors with creosoted planking and joists. The result so far seems to justify the expectations, which were entertained, that these floors would have much more lasting qualities than the untreated floors, and that, although the cost was much in excess of the single-plank floor, yet the longer life would result in very increased economy.

The system of block paving bridge floors has now been tried by the Department for some five years, and, from the experience gained, it is the intention to further apply this method of construction, at least on the larger bridges where the travel is heavy.

RECENT DEVELOPMENTS IN BITUMINOUS MACADAM AND BITUMINOUS CONCRETE PAVEMENTS.*

BEFORE proceeding with the discussion of the many improvements in the construction of bituminous macadam and bituminous concrete pavements which have been developed during the period from 1914 to 1916, it is advisable, in order to avoid misunderstandings, to quote the definitions of the two types of pavements as recommended by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers.

"Bituminous Macadam Pavement.—One having a wearing course of macadam with the interstices filled by penetration methods with a bituminous binder."

"Bituminous Concrete Pavement.—One composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods."

General.—Certain developments which are common to both classes of bituminous pavements will be discussed prior to considering improvements which specifically refer to each of the several types.

Foundations.—There has been a general acknowledgment of the ultimate economy of constructing adequate foundations to support the amount and character of traffic which the several types of bituminous pavements are able to carry. In the case of bituminous macadam pavements, this development usually has been characterized by the construction of well-compacted and, in many cases, thoroughly filled broken stone foundations. In the case of bituminous concrete pavements, due to numerous failures which have occurred where this type of pavement has been built on old macadam or poorly constructed broken stone foundations, there has been a general tendency to advocate the use of cement-concrete foundations from four to six inches in thickness. It has generally been found that the cost of cement-concrete foundations does not exceed the cost of well-compacted and filled broken stone foundations of equivalent strength. Furthermore, the use of cement-concrete foundations renders repairs and renewals more satisfactory and much easier of accomplishment.

Non-bituminous Highway Materials.—There has been a general recognition since 1914 of the desirability of covering in specifications in more detail and with greater rigidity the physical properties of the aggregates to be employed and the sizes of the particles which compose such aggregates. For example, the 1914 Specifications of the American Society of Municipal Improvements covering bituminous macadam pavements state, with reference to the physical properties of the stone, that the rock employed must meet the following requirements:—

*Presented before the Third Canadian and International Good Roads Congress, Montreal, Canada, on March 10, 1916, by Arthur H. Blanchard, M.Can.Soc.C.E.

"The broken stone shall be subjected to abrasion tests and toughness tests conducted by the Engineer in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the first and second courses shall show a French coefficient of wear of not less than 7.0 and its toughness shall be not less than 6.0. The broken stone used for the construction of the third course and for the first and second applications of No. 1 broken stone shall show a French coefficient of wear of not less than 11.0 and its toughness shall not be less than 13.0."

The necessity for more carefully drawn specifications covering the sizes of the particles of which a given product of a stone-crushing and screening plant is composed is illustrated by the following mechanical analyses of two products obtained from the same plant, both of which products passed over a section of a rotary screen having circular holes of 1¼ inches and through a section of a rotary screen having circular holes 2¼ inches in diameter.

		Sample "A"	Sample "B"
Passing	⅛ inch screen	0.2%	0.1%
"	¼ " "	0.1	0.1
"	½ " "	0.4	1.1
"	¾ " "	2.2	12.6
"	1 " "	8.0	37.5
"	1¼ " "	29.1	40.9
"	1½ " "	27.1	7.7
"	2 " "	32.9	0.0
		100.0%	100.0%

It is hence obvious that for many forms of bituminous construction, in order to secure successful results, greater care must be used in the writing of specifications for products of broken stone. As an illustration of an improvement in specifications covering this detail, there is cited those adopted at the 1915 Convention of the American Society of Municipal Improvements covering broken stone to be used for the aggregate of one type of bituminous concrete pavement.

"Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1¼) inch screen; not more than ten (10) per cent. nor less than one (1) per cent. shall be retained upon a one (1) inch screen; not more than ten (10) per cent. nor less than three (3) per cent. shall pass a one-quarter (¼) inch screen."

It is noted that in this form of specification an attempt is made to cover in the mechanical analysis only the limits of the smallest and largest particles. No attempt is made to secure a carefully graded aggregate but simply a product suitable for the type of pavement in question and uniform in character. For example, the following mechanical analyses show three products used in the successful construction of three different bituminous concrete pavements of the type mentioned.

		Sample "A"	Sample "B"	Sample "C"
Passing	⅛ inch screen	1.2%	2.7%	1.0%
"	¼ " "	4.2	5.6	2.5
"	½ " "	34.7	45.0	30.8
"	¾ " "	40.6	35.1	34.2
"	1 " "	17.3	10.1	23.4
"	1¼ " "	2.0	1.5	8.1
		100.0%	100.0%	100.0%

Bituminous Materials.—There has recently been considerable discussion pertaining to the advisability of the adoption of so-called "alternate type" specifications in preference to the so-called "blanket" specifications for bituminous materials. By alternate type specifications is meant a series of specifications, each of which covers the physical and chemical properties of the most desirable grade of a given type of bituminous cement for the purposes for which it is to be used. On the other hand, a blanket specification covers in one set of requirements, pertaining to physical and chemical properties, all the types of bituminous cement which are to be used in connection with the construction of a given kind of pavement. For example, in the case of specifications for asphalt cement for bituminous concrete pavements, it would be desirable under alternate type specifications to have not less than five sets of physical and chemical requirements, the limits for each requirement being as narrow as the several processes of manufacture would permit, while on the other hand a blanket specification would cover with a wider range of limits the same chemical and physical properties for the five types mentioned. As an illustration will be cited the limits in the cases of Specifications "A" to "E" inclusive under the alternate type specification method for specific gravity, and the penetration at 25° C. (77° F.).

Specific gravity—

"A"	"B"	"C"	"D"	"E"
0.97—1.00	1.00—1.03	1.03—1.04	1.025—1.05	1.04—1.06

Penetration—

"A"	"B"	"C"	"D"	"E"
75—90	90—100	70—90	85—95	140—160

In the case of a blanket specification to cover the same grades of the several types, the limits for specific gravity would have to be 0.97 to 1.06 and the limits for penetration would be 70 to 160. The penetration test, for example, can only be of maximum value when applied to the grade of a specific type of bituminous cement which is most suitable for the type of pavement in question. In the case of the bituminous concrete pavement of the type mentioned, the proper penetration limits for a California asphalt lie between 70 and 90, while for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, the penetration limits should be between 140 and 160. It is evident that to attempt to cover the penetration limits for both materials in one specification is impracticable. In the first place, such limits as 70 to 160 are so wide as to insure but little uniformity in different lots of the same material, and in the second place, an entirely unsuitable material of one class could be supplied under the maximum or minimum test limits of the other class.

The proper use of alternate type specifications allows the contractor to bid to supply so many tons of bitumen which will comply with any one of the sets of requirements. It will be noted, therefore, that the contractor is in exactly the same position as in the case when he bids to supply any asphalt cement which will comply with the requirements of a blanket specification.

Guarantees.—There has been a general tendency to abandon the use of guarantees on bituminous pavements as it is believed that, with proper specifications and efficient supervision and inspection, guarantees are not necessary and that the requirement of a guarantee materially increases the prices bid on a given pavement. The subject of guarantees is too broad to discuss in this paper but it should be noted that under the title "The Economics of Guarantees of Pavements on State and Municipal Highways," it has been admirably treated by Mr. George C. Warren in a lecture in the Graduate Course in Highway Engineering at Columbia University, which lecture has been published under the auspices of the National Highways Association, Mr. Charles Henry Davis, president.

Bituminous Macadam Pavements.—In addition to the improvements noted above, the most notable recent de-

velopment in the construction of bituminous macadam pavements has been in connection with the compaction of the road metal and the distribution of the bituminous materials.

As a result of the numerous failures of bituminous macadam pavements which have occurred due to the improper rolling of wearing courses of road metal prior to the application of bituminous material, there has been a general recognition of the necessity for more thorough compaction of the road metal. This principle has been recognized by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers in its 1915 report, the conclusion referred to reading as follows:—

"An important factor for successful results is the proper compaction by rolling of the road metal before the spreading of the bituminous material."

The above committee emphasizes another improvement which is aimed at the use, in some cases, of an excess amount of bituminous cement in this type of pavement. This conclusion is as follows:—

"Present indications are to the effect that the use of bituminous materials in quantities of more than 2½ gallons per square yard where the upper course of the macadam is to be 3 inches in thickness after compaction is inadvisable under the penetration method."

There has been a general recognition of the advisability of using properly designed distributors in connection with the application of bituminous materials in order to secure uniform distribution economically. Some specifications cover the requirements which a distributor must meet. For example, the 1914 Specifications of the American Society of Municipal Improvements contain the following paragraph pertaining to the pressure distributor:—

"The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the Engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter."

This specification provides for a distributor by which it is practicable, under competent supervision, to secure uniform application of the bituminous material and allows the use of a pressure distributor without danger of rutting of the wearing course of broken stone by narrow tires carrying excessive weights.

Bituminous Concrete Pavements.—The improvements in the construction of bituminous concrete pavements to which attention should be called will be considered under the following classification of the three types into which bituminous concrete pavements generally may be divided. These types are designated as follows—

(*a*) A bituminous concrete pavement having a mineral aggregate composed of one product of a crushing and screening plant.

(*b*) A bituminous concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing and screening plant and a certain number of parts by weight or volume of fine mineral matter such as sand or stone screenings.

(*c*) A bituminous concrete pavement having a predetermined mechanically graded aggregate of broken stone or gravel, either alone or combined with fine mineral matter, such as sand or broken stone screenings.

Patents.—Unfortunately the present status of patent litigation has to be considered in connection with the discussion of the several types of bituminous concrete pavements. The majority of engineers and highway officials are interested in the types of bituminous concrete pavements which may be constructed without danger of litigation rather than in a prolonged discussion of the probabilities of successfully defending suits for infringement. There is ample evidence at hand that bituminous concrete pavements of type (*a*) may be constructed without danger of litigation proceedings provided that the mineral aggregate is of the general character heretofore mentioned in this paper under the section "General. Non-bituminous Highway Materials."

The history of litigation cases indicates that the construction of bituminous concrete pavements of type (*b*) on a large scale will in all probability lead to litigation. The same remarks apply to the construction of bituminous concrete pavements of type (*c*) except in the case of the so-called Topeka bituminous concrete pavement with an aggregate of the type specified either in the 1910 Topeka decree, or of the grading which was adopted at the 1915 Convention of the American Society of Municipal Improvements.

Type (*a*) Materials.—Practice has demonstrated that broken stone, because of the satisfactory mechanical bond secured, makes the most suitable aggregate for this class of bituminous concrete although pavements constructed with gravel have proved satisfactory for light traffic where great care has been taken in the selection of the gravel and in the construction of the pavement. The development of the character of materials used in current practice has been covered in this paper under the title "General." Much more care has been taken in recent years with reference to the quantity of bituminous cement to be used in the mix. There has been a general recognition that the amount used depends upon the kind of road metal and the bituminous material, the character of the aggregate and the climatic conditions. For the product of broken stone heretofore mentioned, it has been found that bituminous concrete mixtures should contain between 5 and 8 per cent. by weight of bitumen.

Mixing.—Many improvements are noted in the methods employed in the mixing of bituminous concretes. There has been a general evolution from hand-mixing methods to the utilization of mechanical mixers especially designed for the manufacture of this type of bituminous concrete. The large contract for thirty-five miles of bituminous concrete pavement of this type around the Ashokan Reservoir, constructed under the direction of the Board of Water Supply of the City of New York, demonstrated the desirability of the manufacture of a plant especially designed for this class of work. The type finally evolved showed that it is practicable and economical to use a self-propelled plant, consisting of elevators, a rotary dryer, weighing devices and a mixer, having a capacity of from 800 to 1,000 square yards of 2-inch wearing course per day. Experience has demonstrated that, except on small contracts and for repair work, mixers which provide for

the heating of broken stone by the use of a flame in the chamber should not be used on account of the danger of burning the broken stone or the bituminous concrete.

Laying.—There has been considerable discussion pertaining to the proper type and weight of roller to be used for the compaction of the wearing course. Experience demonstrates that in order to secure an even surface and adequate compaction by thorough interlocking of the particles of broken stone, a tandem roller weighing between 10 and 12 tons should be used.

Seal Coat.—Many methods have been developed for the application of the seal coat of bituminous material. It has been found that seal coats of from ½ to 1 gallon per square yard of bituminous cement are distributed most uniformly by the use of hand-drawn gravity distributors followed by a squeegee.

Seasonal Limitations.—Experience in many localities has demonstrated that bituminous concrete of this type should not be mixed or laid when the air temperature in the shade is below 50° F. as otherwise it is difficult, under average conditions, to secure an even and well-compacted wearing course.

Type (*b*).—Specifications for this type of pavement have, during recent years, generally stipulated that so many parts of broken stone and so many parts of sand or other fine material are to be mixed with a certain amount of bituminous cement. By the use of this specification, unless employed under unusual supervision, it has been found to be impracticable to secure a well graded aggregate. In many cases the mixture has contained an excess of broken stone with insufficient fine material to fill the voids therein, while in other cases it has contained an excess of sand in which the broken stone exists as isolated particles. It is the conclusion of many engineers, because of the conditions described, that when bituminous concrete pavements are to be employed either type (*a*) or type (*c*) should be selected.

Type (*c*).—During recent years, the bituminous concrete pavements of this type which have been most extensively employed are known as Bitulithic, Warrenite, and Topeka.

Bitulithic and Warrenite—Differentiation.—The general use of Bitulithic and Warrenite bituminous concrete pavements throughout America has brought up for discussion the matter of the fundamental differences between these two types of patented pavements. It is believed that it will be of interest and value to the engineering profession to submit the following statement, prepared by Mr. George C. Warren, president of the Warren Brothers Company, for the information of the engineers enrolled in the Graduate Course in Highway Engineering at Columbia University:—

"Bitulithic and Warrenite mixtures are both made under the provisions of the Warren patents, which the courts have held 'cover the product no matter how produced.' Bitulithic is designed to meet the conditions generally prevailing on city streets, and Warrenite is to meet such conditions as may arise on country roads so as to meet the physical and economic conditions and public demands as to cost.

"Generally speaking, Bitulithic is mixed by a plant which is too cumbersome to meet country road conditions, which provides for combining the materials proportioned by separation of sizes of the aggregate, after heating, and then recombining by weight.

"Warrenite is, generally speaking, mixed by a plant so portable that it may be set up either alongside the railroad; along the side of the road being constructed, or in the quarry or gravel bank from which the bulk of the aggregate is being procured as may be most economical in any particular case. This plant is constructed on the principle of proportioning the several separated sizes by careful measurement by bulk before heating and retaining the batch so measured as a separate entity through the process of heating and delivery into the mixer in which the bituminous cement is added.

"Generally speaking, Bitulithic is mixed by a plant fine aggregate of Bitulithic, while sand predominates in the fine aggregate of Warrenite; also, fine crushed stone and sand respectively are correspondingly used for the seal coat aggregate.

"In the selection of quality of material (whether gravel or crushed stone) for the coarse aggregate a greater latitude is permitted in the case of Warrenite to practically meet the conditions of less opportunity for selections which are liable to prevail in localities considerable distance from railroad centres. This latitude is allowed, because, while the traffic conditions on country road thoroughfares are in point of weight and concentration of traffic rapidly becoming fully as severe as on most city streets, there is the important difference that on country roads generally the traffic is more exclusively of the motor vehicle rubber tire type and consequently less exaction in physical properties of the quality of the stone forming the basis of the aggregate is necessary. Also, unfortunately, many city streets are abused by constant excessive sprinkling or daily scoured by pressure flushing machines, a practice which is more or less injurious to any road surface, while country roads are seldom, if ever, wet except by rainfall; therefore, in cases where the very best quality of stone is unavailable, it would be safe to use stone of slightly lower quality in Warrenite on a country road although the same quality stone might not be safe for use in Bitulithic on a city street."

Topeka.—In many specifications the mineral aggregate for the Topeka pavement specified has been that contained in the decree of 1910, namely:—

Bitumen, from 7 per cent to 11 per cent.

Mineral aggregate,	passing	200-mesh	screen,	from		5%	to	11%
"	"	"	40	"	"	"	18	"	30
"	"	"	10	"	"	"	25	"	55
"	"	"	4	"	"	"	8	"	22
"	"	"	2	"	"	less than 10%			

Many unsatisfactory pavements have resulted by the unintelligent use of this grading. It has been found necessary, in order to secure successful results, to specifically define the character of the sand or other fine material which shall be employed in order to secure a satisfactory grading. Many specifications now cover the sand grading with almost the same care as in the case of sand grading requirements for sheet asphalt pavements. In order to encourage the use of a more satisfactory grading for this type of pavement, the American Society of Municipal Improvements in 1915 recommended the adoption of the following grading:—

Passing	200	mesh	screen					7—10%
"	80	"	"	but	retained	on a	200,	10—20%
"	40	"	"	"	"	" an	80,	10—25%
"	20	"	"	"	"	" a	40,	10—25%
"	8	"	"	"	"	" a	20,	10—20%
"	4	"	"	"	"	" an	8,	15—20%
"	2	"	"	"	"	" a	4,	5—10%

The South Indian Railway Administration will make surveys for a metre gage line from Jayankonda-Sholapuram to a point on the proposed Panruti-Trichinipoly Railway, as close as possible to Trichinopoly, on the north of the Coleroon, a distance of approximately 50 miles. This survey will be known as the Jayankonda-Sholapuram-Trichinopoly Railway Survey.

It is reported from Petrograd that a special commission, composed of representatives of the Government, commerce and industry, will meet shortly to examine the Bill prepared by the Ministry of Commerce to facilitate the development of the use of electric power in works and factories. The Bill has been prompted by the frequent crises in connection with the coal in Russia.

EXPERIMENTS IN CHECKING THE SLIDES AT PANAMA.

A PAPER by Gen. Geo. W. Goethals in the "Canal Record" will be of interest to engineers in general, describing as it does methods which have been used in the attempt to stop slides in the Panama Canal. In this work the engineers have been up against problems which they have never before experienced and the results of their experiments will be of great value in future on similar works. The results of these experiments are summarized in the following:—

The various slides began without any warning, and there were no means of determining the extent to which they would proceed. Various attempts were made to check them, but all without success. There is no question that the excessive rains were responsible in a great measure for most of them and for the difficulties that resulted because of them; yet some of the most troublesome ones occurred during the dry season. Drainage proved ineffective. The rains, which cover a period averaging nine months of the year, so thoroughly saturate the ground that, though the surface may be dried out by the wind and sun during the remaining three months, the ground water remains. Because of the great depth of the cutting surface drainage could not reach the ground water sufficiently deep to be effective, even if the excessive cost involved warranted such a procedure. It has been suggested that artificial heat be applied through pipes, but the cost precluded such a method of relieving the situation; furthermore, the relief would be temporary.

Planting the slopes with grasses and vegetation prevents, to a certain extent, the erosion that follows some of the heavy downpours, but even in places where this has been done the results anticipated were not secured. The trees that have been standing on the banks for years slide down, standing erect in their normal positions, with slides of the second class and in the movements that take place subsequent to the "breaks."

Piling was tried with the hope that with the ends of the piles in firm ground the loose or moving portion might be retained in place. This also proved a failure, and along some portions of the banks are now seen piles projecting at various angles and at different elevations, though originally the piles were driven vertically and they were properly aligned.

Where the moving mass was clayey material loosened up by the movement and by the rains, a covering of heavy riprap was resorted to with the hope that their weight would carry the pieces of stone through the mass to the solid ground below and thus check, if not stop, the movement; much of this riprap was subsequently removed from the prism by the shovels.

It was believed that blasting was in some measure responsible for the slides, on the theory that the shaking up of the banks, caused by the blast, destroyed the cohesion of the particles in the banks, resulting in their breaking down, so that steps were taken to reduce the depth of the holes and the amount of explosive used, in order to lessen, if not remove, any source of trouble on this account.

It was learned that in experimenting with clays for the manufacture of pottery the Bureau of Standards has discovered a means of removing the slipperiness from the clays by inoculating the soils with a simple and inexpensive solution. With the hope that some such method of preventing the slides might prove effective with the soils on the isthmus, samples were sent for experimental purposes along these lines, but it appears that these clays are of an entirely different character, and no method of treatment has yet been evolved to secure the results desired.

The construction of retaining walls to withhold the moving masses was not possible, for access to the sides of the prism where the walls belonged could not be had. When access was possible, the movement had ceased, there was no evidence of any further movement and the desirability of or necessity for walls no longer existed.

Some of the sandstones and shales in the cut when exposed to the air disintegrate, but harden when kept constantly wet. Where disintegration occurred, the resulting soil would grow grasses and vegetation, and steps were taken to protect the slopes and the underlying material in this way, assisting nature to some extent in a country where vegetable growth springs up and expands rapidly.

Experiments were made with cement covering applied to the banks by the cement gun and by concrete held in place by rods embedded in the rock; neither proved successful, and they were abandoned.

When the use of concrete proved a failure, the geologist thought that experiment might develop a solution which, applied to the face of the sandstones and shales, would combine chemically with the substances in these rocks, so as to form a coating of glass. Experiments were made, but no satisfactory solution obtained.

With the breaks, except those which occurred in the vicinity of La Pita Point, lightening the banks, where this could be done, secured good results, as did also the sluicing of the upper portions of the hills around Cucaracha slide into the valley on the opposite side of the hills from the prism; but in all other cases the only effectual method found was to allow the material to enter the cut and remove it. This procedure has resulted in bringing all the slides to a state of rest, and with the exception of those now active none of them has given any trouble since, for there has been no movement of any kind in any of them after all the material that was in motion had been removed or come naturally to rest.

It is certain that the troubles are due to the failure of underlying strata, because these were unable to bear the weight that the banks brought upon them. Under the circumstances it is difficult to understand the impression that has gained credence in some quarters that a sea-level canal would have avoided the difficulties encountered, since the cutting would have been through the same material, but at least 80 ft. deeper.

It is also certain that nothing can stop the movements now in progress until the angle of repose is reached for the materials under the conditions that exist and that this can be reached only by removing the excess amount of material. If experience counts for aught, then that gained in the handling of the slides and the breaks that have occurred along the line of the canal leaves no doubt that the means adopted and now in use will effect a cure in the slides that now close the canal; furthermore, that when cured, no further troubles need be anticipated from slides in this locality.

The construction of the Altai Railway, which connects Novonikolaievsk on the trans-Siberian with Semipalatinsk in the Steppes Provinces, passing through Barnaul, in the Tomsk Government of Siberia, has recently been opened to traffic. This railroad, 500 miles in length, will serve the richest agricultural and mineral regions of Siberia. The Altai region has deposits of gold, silver, lead, zinc and copper, which were worked in the eighteenth and nineteenth centuries, but afterwards abandoned owing to lack of transportation facilities and other causes.

THE LEGISLATIVE CONTROL OF ENGINEERING PRACTICE.*

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THERE is a growing tendency among certain engineers to attempt to remedy some of the troubles in the engineering profession by means of legislation, limiting those who can legally practise to engineers having certain qualifications.

This question has been before the public for at least fourteen years, the American Society of Civil Engineers having published a discussion of the subject in transactions of 1901. Although many bills have been drawn and submitted to the legislatures of the various States, very few have become laws.

The opposition to the passage of these proposed Acts has come from within the profession and not from the general public.

The reasons advanced for advocating the licensing of the profession come under two classes: Self protection, and public protection.

Self Protection.—We are all familiar with the rodman who, having been endowed by Nature with a vivid imagination, a superabundance of self-confidence and a glib tongue, hires an office, hangs out his shingle, fakes his experience and poses as a consulting engineer. On his card we find C.E. after his name, although he has never been inside of a technical school. He claims to belong to some half a dozen societies, the principal qualification for membership in which is the ability of the applicant to pay the admission fee.

Should not the competent engineer be protected from this class of fakers? Doctors, lawyers, and even school teachers are required to have certificates before they can practice. Why not the engineer?

Several States across the line have passed laws licensing architects which are so drawn that a structural engineer cannot practice his profession without taking out a license as an architect.

The Illinois law defines a building as anything with foundation, roof and side walls.

This includes anything from a hog-pen to a thirty-story building and an architect's license must be obtained before designing either.

Should not the engineer be protected from unjust laws of this kind?

Some of the bills introduced have had as their avowed purpose the cutting out of competition. This reduces the profession to the level of a trade union. In fact, if we go before the public asking for special legislation on the grounds of self-protection we lower the dignity of the profession in so doing.

The only grounds upon which we should ask the public for legislative control of the engineering practice is that of public protection.

The public needs protection because they are not in a position to judge of the ability of an engineer.

An engineer's ability must be inferred from either his education, his works or his membership in the strictly engineering societies.

If the problems of engineering design, construction and operation were merely matters of figures the man fresh from college would usually qualify as the best engineer. Many men leave our institutes with this view but soon find that long before the time for applying formulae is reached the scheme must be viewed by an engineer of sound judgment based upon long experience.

Diplomacy, tact and good judgment are so essential in all engineering operations that any attempt to judge an engineer by mere degrees and diplomas is likely to prove a failure.

Can the public judge his ability by his works?

Unfortunately, popular descriptions of engineering works do not find their way into the public press except occasionally and the public does not read the engineering press. An engineer's works do not always indicate his ability. A badly designed bridge may stand for years a menace to the public and finally go down when the critical load comes on it.

A dam may stand until a flood comes.

It takes time to demonstrate the ability of an engineer by his works.

Membership in engineering societies should be a good criterion by which to judge the ability of an engineer. In other words, how does he stand in the profession? What do his associates think of him? They are in a far better position to correctly estimate his ability than the public in general.

The committee of the American Society of Civil Engineers, appointed to consider this matter, while reporting against the general principle of licensing engineers, realized that there were many engineers who favored the idea and that many very inferior acts had been drawn up and submitted to the law-making bodies for enactment. Should some of these pass, licenses would be issued to men totally incompetent, thus deceiving the public instead of protecting them.

The committee, therefore, draughted a Model Bill to be used as a basis for proposed legislation.

The acts which have been proposed come under two classes: (*a*) Those which attempt to license all in the profession; (*b*) those which apply to engineers practising only in certain lines.

Many difficulties are encountered in draughting an act. The first trouble comes in defining to whom the act applies. Especially is this true under the first class of bills. In the Colorado Act submitted to the Legislature in 1910 the definition of the civil engineer was very broad: "A civil engineer, within the meaning of this act, is one who practises any branch of the profession of engineering other than military. Such profession embraces the design, inspection and supervision of the construction of public or private utilities which require experience and the same technical knowledge as engineering schools of recognized reputation presents for graduation, provided, however, that none of the provisions of this act shall apply to the practice of surveying."

You will note that this is so broad that it includes mechanical, electrical, mining and other engineers, and this was probably one of the reasons why the bill was defeated.

In 1914 the proposed definition was modified as follows: "The profession of civil engineering, within the meaning of this act, embraces the design, inspection and supervision of construction, and reports on the safety of public and private utilities which require experience and the same technical knowledge as engineering schools of recognized reputation require for graduation; provided, however, that none of the provisions of this act shall apply to the practice of surveying, and provided, further, that

*Abstract of an address before the Calgary Branch Canadian Society of Civil Engineers, March 16th, 1916.

the provisions of this act shall be limited to the services of engineers in the design, inspection and supervision of construction, and reports on the safety of any structures or works on any of the following kinds or classes of structures and works.

"(1) Bridges 16 feet or more in length or other structures requiring a determination of stresses and strains for their design, on public highways or roads open to the use of the public, or on steam or electric or other railroads.

"(2) Structures built of stone, plain concrete or reinforced concrete.

"(3) Structural steel structures including steel in buildings and similar structures when said buildings or structures are three or more stories in height; also steel in mill buildings, steel in grain elevators, steel in mine and mill structures, steel in industrial buildings, and steel in plants and steel in structures on ditches, canals, sewers, waterworks and power plants.

"(4) Canals, ditches and conduits having a capacity of fifty cubic feet per second or more.

"(5) Sewers and sewer systems and sewage disposal plants; water supply plants for domestic use, and power plants, including power plants for irrigation.

"(6) Dams and reservoir embankments of a height of ten feet or more.

"(7) Mill and power plant buildings of timber, brick, concrete or any combination of these materials and electric transmission lines.

"(8) Timber bridges, trestles or structures for mill, mine and industrial plants, grain elevators, ditches, canals, sewers, waterworks and power plants.

"(9) No maps, plans, designs, reports, statements or filings to be certified or approved by an engineer shall be accepted or filed by any State official unless the certification or approval is executed by a person duly licensed in accordance with the provisions of this act.

"All maps, plans, designs, reports, statements or filings prepared by or under the direction of a licensed engineer shall bear the name of such engineer accompanied by the words 'Licensed Engineer, State of Colorado.'"

In as much as the Canadian Society of Civil Engineers proposed to ask Parliament to define the term "civil engineer," it will be interesting to note an old definition which appeared in Ree's Cyclopaedia, 1st Am. Edition, published in Philadelphia, 1819:

"Civil Engineer—a denomination which comprises an order or profession of persons highly respectable for their talents and scientific attainments and eminently useful under this appellation as the canals, docks, harbors and light houses, etc., amply and honorably testify." It is worthy of note that our ancestors were highly respectable and useful members of society.

The underlying principle in these definitions is construction. Surveying and hydrography are only minor parts of civil engineering.

A man who is exclusively a land surveyor or exclusively a hydrographer is not a civil engineer.

The proposed Alabama Act of 1911 divides the profession into civil engineers, mining engineers and surveyors:

(1) A civil engineer is defined as any one capable of designing and supervising the construction of any public bridge, railroad, sewer, sewage disposal plant, filters, waterworks, ditches, mines, tunnels or works of similar nature.

(2) It provides that all maps for public record must be certified by a licensed surveyor.

(3) Drawings, specifications and estimates for public record must be certified by civil or mining engineer.

(4) No construction work shall be supervised or directed and no public employment as engineer shall be held except by licensed engineers.

Proposed Indiana Act.—Provides (1) no person may design, lay out or superintend or act as chief engineer of any work that may be classed as civil engineering work or hold office as city engineer in that state without obtaining a license.

The next serious question that arises is, What qualifications must an applicant have in order to receive a license.

In the Colorado Act.—The Board of Examiners may issue a license upon examination or upon the record, training and experience of any applicant who has practised civil engineering for a continuous period of not less than ten years immediately preceding. In order to be admitted to examination a candidate must be qualified as follows: (1) More than 25 years of age; (2) good moral character; (3) engaged actively in civil engineering work for at least six years and in active charge of work for at least one year; or (4) graduate of engineering school of recognized reputation and has been actively engaged in civil engineer work for two years with active charge of work for at least one year.

Every act contains a provision known as the grandfather clause. In the Colorado Act this provides that during the first year the board of examiners *shall* accept as proof of the candidate's capacity to perform the duties of a civil engineer, the record, training and experience of any candidate who possesses the qualifications for admission to examination. This means that practically all who have been practising for six years with responsible charge of work for one year would be admitted during the first year.

Licenses and examinations are in three classes: (1) Irrigation and hydraulic engineering; (2) municipal, hydraulic and sanitary; (3) structural engineering.

Under the Proposed Alabama Act.—Licenses are issued as follows: (1) On examination. (2) To all practising in the state at time of passage of the bill (grandfather clause). (3) Graduates of University of Alabama and Alabama Polytechnic after two years' experience for surveyor. After four years' experience for civil engineer or mining engineer. (4) Non-graduates. After four years' experience for surveyor. After eight years' experience for civil engineer or mining engineer. (5) To engineers holding licenses from other states. (6) To members of American Society of Civil Engineers. (7) To members of Institute of Mining Engineers. (8) Any junior or military engineer in United States Civil Service.

Taking up those acts which license only a limited number of the profession.

The State of Wyoming passed a law in 1906 which has been in operation ever since. This law licenses only those who prepare plans or designs in connection with the use of water in the state or who apply for a permit to divert water.

Licenses are issued to the following: (1) Land surveyors on examination—plane surveying. (2) Topographical engineers on examination—plane and topographical surveying. (3) Hydraulic and hydrographic engineers on examination—plane surveying and hydraulics. (4) Construction and designing engineers on examination

—plane surveying; design of irrigation works and structure computation of earth work. (5) Administrative engineer on examination—plane surveying; hydraulics; construction work; irrigation; law and practice.

Within four years after the passage of this law 200 men had qualified under it and all had taken examinations except members of the American Society of Civil Engineers. As this is a very sparsely settled state I doubt very much if this law had any effect upon competition.

It is a serious question whether a license law really excludes the incompetent man from the profession. There are quacks still practising in the medical profession and incompetents in the legal profession in spite of the acts governing the practice.

It is suggested that strict governmental supervision of plans, specification and construction of all structures where the safety of the public is involved, combined with laws requiring a high qualification for engineers at the head of the departments, will result in a more effective public protection than any legislative attempt to control the engineering practice.

The qualifications for the heads of departments requiring engineering knowledge should provide for (1) a minimum residence in the country, province or state in order to ensure familiarity with local conditions. (2) Membership in one or more of the three national engineering societies—Canadian Society of Civil Engineers, American Society of Civil Engineers, or British Institution of Civil Engineers. The requirements for admission to the grade of member in all of these societies is high and the tendency is to stiffen the requirements. (3) A minimum amount of experience in the particular line of engineering, a knowledge of which is required in order to fill the position. The above suggestion has greater possibilities in it for public protection than any system of licensing engineers.

The proper method of handling the fake engineer is through the local branches of these national societies. His record can be investigated by them and shown up.

In addition to the above, these local branches can do a considerable amount of advertising which would be considered unprofessional on the part of the individual to the end that the public may be kept in touch with engineering matters and be made to realize that membership in these societies represents high qualifications as an engineer.

NEW EXPLOSIVE.

A new permitted explosive, known as Bellite No. 1, has been sanctioned by the Home Secretary of Great Britain. Its composition is as follows:—

Ingredients.	Parts by weight. Not more than	Not less than
Nitrate of ammonium	65	62
Tri-nitro-toluol	16	14
Chloride of sodium	17·5	15·5
Starch	5·5	3·5
Moisture	2	—

It is stipulated that the explosive shall be used only when contained in a case of Manilla paper, fire-proofed and thoroughly waterproofed with a mixture of carnauba and paraffin waxes, and that the greatest weight which may be used in any one shot hole shall not exceed 20 oz. Four oz. gave a swing of 2.74 ins. to the ballastic pendulum compared with a swing of 3.27 ins. given by 4 oz of gelignite containing 60 per cent. of nitro-glycerine.

LETTER TO THE EDITOR.

Revision of the Patent Act.

Sir,—I believe that your columns are always open to a discussion of matters of general interest and importance to the engineering, manufacturing and industrial public.

Few matters are of greater or more vital importance, yet so little known, as the patent laws of a country, and their administration. Their one broad purpose is to encourage and stimulate improvement, advance or invention in every branch of human activity.

For many years it has been widely admitted that many considerable changes are very badly needed in the Canadian patent act and its administration.

The great growth of the Department of Agriculture, proper, has made ample work to occupy fully the time and attention of both the minister and his deputy. Yet the patent office has developed equally or to an even greater extent. It is the unanimous opinion of all who are experienced in the matter, that the patent office should have a separate and distinct head practically independent of any department though, possibly, nominally subordinate to the head of a department—similar to the arrangement in the United States, after which the Canadian patent law and practice is molded to a considerable extent.

Many very prominent corporations and individual business and professional men, and practically all important industrial associations and societies, have petitioned the government to appoint a commission to look into and revise the patent act and its administration.

Certainly there could be no time better than the present. There is in existence a commission with very wide powers of investigation with the purpose of finding ways and means to prepare Canada for her great future. Revision and administration of the patent laws is certainly one of the matters that will have a great influence upon future prosperity.

Why, then, is nothing done?

Since the enactment of the present patent act, the value and advantages of many of its provisions have frequently been tested. Some of them have been found defective and productive of far more evil than good.

The following suggestions arise from the experience of the leading manufacturing patentees and prominent patent counsellors and solicitors of the Dominion. It is their common desire to overcome these defects, greatly strengthen the validity of patents, remove some of the useless burdens now attached to patents, eliminate a great part of the clerical work of the department, increase the net receipts of the department, remove the more fruitful grounds for misunderstandings on the part of patentees, decrease the cost of patents to the applicants, provide for complete authentic official records in interferences and all other patent matters, eliminate all private bills for re-establishment of forfeited patents, and to avoid the doubt and discrimination of section 44. In general, to facilitate and improve the administration of the department, and encourage and stimulate invention, while at the same time maintaining the rights of the public. To those ends, the following amendments, with attached reasons, are suggested as indicative of the main points only:—

1. *Substitution of a single continuous term of eighteen years, with payment of the entire fee at time of filing, in lieu of the divisable term with instalment payment.*

The present total government fee for eighteen years is $60. However, as shown by the records, less than 17% of the patents have more than the first $20 paid. In the

year ended March 31, 1910, the total received for second and third term fees, was $21,960. During the same period, 7,216 original patents were granted. If the total government fee for eighteen years had been made $30 there would be a net increase of $50,200. Had the total government fee for eighteen years been $25 the net profit would still have been $14,120. In addition, many patentees would be holding valuable patent rights which, under the existing act, have become lost by accident, neglect, or impossibility of payment on the part of the patentee or parties by him entrusted with such payment. Furthermore, all private bills for the re-establishment of patents forfeited for non-payment would be avoided, and the embarrassing question of intervening rights of innocent third parties would be entirely eliminated. A considerable saving would result in the clerical work in the patent office. All endorsements, entries, and accounting in connection with the second and third term fees would be abolished. Nor can it be argued that a total of $30 for an eighteen-year patent would deter applicants. Many Canadian inventors take United States patents which run for seventeen years with payment of $35 total government fee before the patent is granted.

2. *Substitution of interference proceedings within the patent office in lieu of the present arbitration proceedings under section 20 of the act, or the corresponding Exchequer Court practice.*

All interferences originate in and are declared by the patent office. Therefore, they must become somewhat skilled in the subject. On the other hand, arbitrators appointed to hear and determine the issue of interferences are usually the attorneys of the respective applicants, either patent solicitors or lawyers. The average patent solicitor or lawyer handles only a very small fraction of the total applications filed. Obviously his experience in interferences is very limited as compared with that of the patent office. This has long been clearly recognized in the United States where the interference practice on most points is very similar. There an interference examiner gives his time exclusively to interferences, and the attorneys, instead of acting as arbitrators, argue their cases before him. One great and very valuable advantage thus gained is the right of appeal. The action of the interference examiner is the action of the commissioner and is, therefore, appealable. It is not appealable in the case of arbitration under the Canadian practice. It can not be denied that the question of priority in conflicting applications is very vital, and that the corrective effect of an appeal exists on many far less important questions. Why, then, should it not be granted in the case of conflicting applications? Furthermore, all possibility of fraud, collusion, etc., between the arbitrators in deciding the issue would be eliminated. It can not be denied that there is a very fruitful field for such practice under the present procedure. Two of the three arbitrators would be eliminated, with that much saving to the contestants, and the fees now payable to the third arbitrator would go to the department for the services of the interference examiner. The practice in interferences would become uniform and greatly simplified.

3. *Substitute for compulsory manufacture section 38a and compulsory license section 44, an optional choice between manufacture and compulsory license, the same to be applicable to all patents and to extend throughout the life of the patent except the first two years.*

No court has yet decided whether section 38a applies to process patents. There are many strong opinions both ways and the matter is very much in doubt. Hence all process patents not under section 44 are of very doubtful validity, simply because the law is very vague. Proof of non-manufacture is proof of a negative, which is exceedingly difficult. It is, therefore, nearly a worthless weapon, in the hands of the public, against the patent owner. It can not be said that such provision compels the patentee to manufacture in Canada. Where there is no demand, the most that is done is to make one of the patented devices, starting it within the two-year period, and dragging it along as slowly as possible. If there is an appreciable demand, the inventor is always very glad to made the invention as rapidly as he can sell it. He needs no law to compel him. Furthermore, it should be remembered that the inventor is the originator. No one else knew of the invention before he did. The public have no rights in it prior to his. Therefore, it can not be argued that he is in any manner injuring the public by not manufacturing or selling to the public; nor can it be said that section 38a has caused the building of factories here in Canada. If any section of the patent act has had any effect in that direction, it is clearly the section about importation.

Compulsory license applies to certain classes of invention only. To many it does not apply. Also, it does not apply to any unless specifically so requested within a limited time from the date of the patent. About one-sixth, only, of the annual issues of patents is placed under the compulsory license clause. That means from 1,300 to 1,500 petitions to be considered by the commissioner, an equal number of decisions to be made out and mailed, and about an equal number of endorsements and other record entries to be made. In many instances an extension of time to manufacture is sought. In each such case a rather lengthy petition with affidavits must be considered, a decision made and mailed, and an endorsement and entries made.

With the suggested change, all of these petitions, decisions, endorsements and entries would be completely abolished, the doubt about process patents would be cleared up, the public would be in just as strong a position to get or use the invention, all patents would be on the same footing and subject to the same conditions, and the validity of all patents would be greatly strengthened, because, to prove invalidity it would be necessary to prove both that the patentee would not grant a license and that he did not manufacture. This is very similar to the present British Patent and Designs Act.

4. *Consolidation of the trade mark and copyright branch with the patent office, and appointment of a commissioner who would give his time exclusively to the consolidated branch.*

The practice and procedure, the rights protected, the rules and regulations and the legal requirements in the two branches are in many respects similar, and most of the business of the two branches is carried on by the same profession—patent attorneys and lawyers.

W. S. BABCOCK,
Registered Patent Attorney.

Montreal, May 1st, 1916.

SUMMER COURSE IN SCIENTIFIC MANAGEMENT.

The fourth summer course in scientific management will be held in Providence, R.I., under the directorship of Frank B. Gilbreth, consulting engineer. The course, to which only a selected group of teachers and thinkers will be admitted, consists of lectures, laboratory work and visits to various plants where scientific management may be studied. The course commences on July 31st and terminates on August 12th.

COAST TO COAST

Quebec, Que.—The entrance piers of the new graving dock at St. Joseph de Levis have been completed and excavation work for the dock proper is well under way.

Winnipeg, Man.—An analysis of all public water supplies in the province has been ordered by the Provincial Board of Health. The recent epidemics are blamed on impure water.

Ottawa, Ont.—The Laprairie link of the new highway from New York to Montreal is to be finished this year. The cost of completing the work will be about $79,850, which will make the total cost about $150,000.

Ottawa, Ont.—Provision has been made for the appointment of a commission to study the railway situation in Canada. It is possible that the government has in mind the nationalization of both the Grand Trunk Pacific and the Canadian Northern Railways.

Simcoe, Ont.—The Lake Erie & Northern Railway management has extended that part of the local depot in which the electric installation for current will be placed, having changed its plans. The road will receive considerable Hydro current through Simcoe.

Vancouver, B.C.—The B.C. Electric Railway is completing the construction and equipment of the sub-power station near Horne Payne station on the Burnaby Lake Line, which was delayed two years ago, and a large gang of men is now at work on the building.

Toronto, Ont.—Work is now in full swing on the long-awaited Lansdowne Avenue civic car line. All the material necessary—rails, switches, poles and other supplies—are to hand, and are being rapidly placed in position. It is expected the line will be in operation before the fall.

Brantford, Ont.—Work on the L. E. & N. Railway between Brantford and Port Dover is progressing favorably despite the scarcity of labor. Overhead work as far as Waterford will be completed by the end of the week, and the company expects to have the line into Simcoe opened in a month.

Ottawa, Ont.—Frank Darling, architect of the Federal Plan Commission, in reply to a request of the Board of Control, in which an application for a building which was to be over the 110-foot height limit, was referred to him for report, objected strongly to the recommendation of the Commission being set aside, and held that the 110-foot limit should be preserved.

Montreal, Que.—Hollinger Gold Mines, Limited; Acme Gold Mines, Limited; Millerton Gold Mines, Limited, and Claim 13147 of Canadian Mining and Finance, Limited, all situated at Porcupine, Ont., two of them producers of yellow metal, are to be amalgamated with nominal capital of $25,000,000. Title of the new corporation is to be The Hollinger Consolidated Mines, Limited.

Montreal, P.Q.—The Canada China Clay Company is applying for a Dominion charter, the capital of the company is to be $1,500,000. The company owns a large kaolin deposit in Amherst Township, Que., and this will be connected up to the C.N.R. by a branch line. Tests carried out on the clay indicate that it is of high ceramic value and also may be used in the manufacture of high-grade paper and certain paint pigments.

South Vancouver, B.C.—The trunk sewer on George Street is almost completed; the progress on the Prince Albert Street sewer has during the past week been somewhat slower on account of the nature of the ground. A strata of hardpan mixed with heavy gravel and boulders has been met. Satisfactory progress is being made with the Commercial Street work, the trunk there being laid to within 135 feet of the intersection of Twentieth Avenue and Commercial Street.

Ottawa, Ont.—Discussion arose during a debate on the Canadian Northern Railway situation in regard to the passage of the two C.N.R. Niagara charter bills. It was commenced by W. A. Buchanan, who stated that as the C.N.R. held many charters in the Lethbridge district and had built no roads, it did not seem fair that they should be given permission to build in settled parts of Ontario when the West was in need of transportation facilities.

Winnipeg, Man.—Foundation work on the new Eaton building is well advanced. The retaining wall trenches on the east and south sides are ready for the concrete. The excavation for the basement is half finished. It is expected that the first steel girders for the skeleton will arrive about the middle of June. After that the progress will be fairly steady and rapid. Some of the grillage has already been delivered, but the sections that will have to be laid first will not get here until about June 15.

Calgary, Alta.—The large cement plant at Exshaw Alberta, which when working regularly employs about 300 men, will be reopened about the 1st of June, according to a statement of the manager of the Canada Cement Company at Calgary, A. H. McGuire. "The Calgary plant may be opened later," said Mr. McGuire, "but the Exshaw plant is the largest one in this district and the one best equipped to supply large quantities of cement at bottom cost of production because of its proximity to the cement rocks."

Sudbury, Ont.—Serious damage amounting to hundreds of thousands of dollars has been done by floods in this district. Dams and bridges on the Spanish and Vermilion Rivers have been carried away or badly damaged. The Spanish Pulp and Paper Company's dam at Onaping was carried away and the whole season's cut went with it. The C.P.R. bridge at Whitefish was damaged, the approaches being swept away. The Sudbury flour mills' dam at McPherson Falls, has been carried away. Several miles of Algoma Eastern Railway tracks are under water.

Westmount, Que.—In keeping with the progressive policy of this city an architectural commission is to be appointed who will pass on all plans. The city council is determined that the city will not lose any of its beauty and that no buildings, walls or monuments which are not in keeping with the general tone of the community will be erected. The commission will be composed of the mayor, the general manager, and the engineer of the city, all ex-officio; four architects, and any other persons that the council may appoint from time to time. Each member of the commission will act without any remuneration.

Collingwood, Ont.—The Collingwood Shipbuilding Company, Limited, successfully launched the steamer "Iocolite," the second of the oil tank steamers which they are building for the Imperial Oil Company, Limited. The Imperial Oil Company has awarded the builders three contracts for vessels of this class, and also an order for two larger ocean-going steamers, making five vessels in all. The ships are equipped with all the latest appliances for the rapid handling of oil cargoes, and have special arrangements for carrying either crude oil, gasoline and lubricating oils. The propelling machinery, boilers and other equipment have all been manufactured by the Collingwood Shipbuilding Company, Limited.

Editorial

UNITED STATES PROTESTS ONTARIO'S NEW POWER SCHEME.

Protesting against the diversion of water from the Niagara rapids, as planned by the Ontario Hydro-Electric Power Commission, Secretary-of-State Lansing of the United States has written an official "note" to the British Government. He says that not more than 40,000 second-feet can be diverted from the rapids without damaging their scenic beauty, and that it is therefore important to come to an understanding regarding a diversion of even 6,500 second-feet.

The Boundary Waters Treaty, which was ratified May 13th, 1910, by the United States and Canada, specifies that the United States can divert 20,000 cubic feet of water per second, and Canada 36,000 second-feet, from above Niagara Falls, for power purposes. Up to the present time, all the water that has been so diverted by the plants located at Niagara Falls, has been returned to the Niagara River above the rapids. But there is nothing in the treaty to specify just where the water is to be returned—whether above or below the rapids.

The Ontario Commission plan to divert about 6,500 second-feet from above the Falls, and to return the water (via a new channel) at a point near Queenston, below the rapids. Now Secretary Lansing reads the words "and return the water below the Falls and above the rapids" into the treaty.

If the treaty can possibly be construed in the meaning taken by Secretary Lansing, then the United States itself is by far the more serious offender, and has clearly established a precedent for diversions such as Ontario proposes. Between fourteen and fifteen thousand second-feet are being diverted down the Mississippi by the Chicago Drainage Commission. This is water which is diverted "above the Falls" and which is certainly not returned to the Niagara River above the rapids. It is used "for power purposes" too—under 16-foot head.

Then there is the Erie Canal. The treaty permitted 500 second-feet to be diverted into the Hudson River, and that 500 second-feet is not returned above the rapids. Power is also developed with that water, and it is stated that more than 500 second-feet are now being illegally diverted for that canal. And, as a matter of fact, only 4,000 second-feet are permitted for the Chicago Drainage Canal according to the treaty, the other 10,000 second-feet now being illegally used.

Even in Canada there has been precedent for such diversion without "return above the rapids." About 1,000 second-feet are used by the Cataract Power Company for the Welland Canal power development at De Cew Falls.

Diplomatic correspondence will result for some months, probably, as a result of the United States note, but there is no doubt of the outcome. The Hydro Commission plant—which will develop 300,000 h.p.—will be built.

A larger plant than 300,000 h.p. cannot be built now because the existing Canadian companies own rights aggregating 29,390 second-feet, and the present treaty allotment specifies a total diversion of 36,000 second-feet. The Commission might at some time, perhaps, buy out one of the companies and so increase its plant to 600,000 h.p., which is the amount that will really be soon required.

As exclusively reported in the December 9th, 1915, issue of *The Canadian Engineer*, an order-in-council apportions the volume that may be used by the companies as follows: Canada Niagara Power Co., 8,225 second-feet; Electrical Development Co., 9,985 second-feet.; Ontario Power Co., 11,180 second-feet.

The United States has no grounds upon which to protest the Ontario Hydro's scheme, and after proper representations are made through the usual diplomatic channels, will undoubtedly gracefully acknowledge the error. Canada would have no objection to a diversion from the rapids of a similar amount by the United States, provided that in so doing the United States does not exceed the 20,000 second-feet allotted by the treaty. There is no reason, however, why the United States should ask Canada for an additional 6,500 second-feet allotment as the price of consent.

CORRECTION.

In a small "filler" paragraph at the bottom of a page in our issue of April 6th, 1916, it was carelessly stated that "The asphalt deposits found at Trinidad and the Red Sea are practically pure bitumen." The word "are" should have been "contain," as it is, of course, generally known that about 40 per cent. of Trinidad and Red Sea asphalt is not bitumen.

A reader of *The Canadian Engineer* has called to our attention the importance of making this distinction between "are" and "contain," because bitumen is the content upon which asphalt depends for its binding power, and therefore upon the percentage of bitumen in any asphalt depends the amount of sheet asphalt, asphaltic concrete or asphaltic macadam that can be laid with a ton of the asphalt.

LOAD OF VEHICLES ACT.

The province of Ontario has recently amended "The Load of Vehicles Act" for the purpose of regulating and limiting the load which vehicles will be permitted to carry upon the public highways.

The bill, which was originally introduced in 1915, was discussed and allowed to stand over for a year. When it was brought up again this year it was referred to a sub-committee for discussion, given its final reading, and is now law.

While a number of the States of the Union as well as certain European countries have a similar act, Ontario is the first of the Canadian provinces to make it a provincial measure.

In the early days of the good roads movement, an attempt was made to increase the width of tire and in this way limit the load per inch, but because of the large investment in narrow-tired vehicles regulations of that character seemed impossible of application.

Within the last few years the heavy motor truck has come to be more generally used. With its load of from four to eight tons, it has created new conditions with each succeeding increase in size and load, and each year the question of methods of regulating the wear and tear on our highways has led to more and more confusion.

The main provisions of the new bill are briefly:—

1st. No vehicle shall carry upon the highway a load, including the vehicle, greater than twelve tons or more than four tons on any one wheel.

2nd. No vehicle shall carry a load, including vehicle, which will impose a greater weight than six hundred pounds per inch of tire on the highway. The use of flanges, ribs, clamps, or other attachments to the wheels or other parts of the vehicle is prohibited where such attachments are likely to injure the highway.

3rd. Permits will be granted by the authorities for moving object or vehicles over highways when the maximum allowable loading has been exceeded.

4th. Speed of traction engines and motor trucks carrying a weight in excess of four tons, including the vehicle, is limited to ten miles per hour. The maximum speed for a load of six tons on iron or steel tires is six miles per hour, while a speed of eight miles per hour is allowable if the vehicle is equipped with hard rubber or other similar tires.

The effect of this Act will be to make highway loads more uniform so that those who have to do with the construction and maintenance of our highways, and particularly those engaged in bridge design, will possess reliable information so far as the probable loading on highway bridges and culverts is concerned. Up to the present it has been necessary to design such structures between very wide limits, necessitating what has often been anything but an economical use of material.

PERSONAL.

M. T. CANTELL has been appointed municipal engineer of St. Vital, Man.

ALLAN PURVIS has been appointed general superintendent of the Eastern Division succeeding A. E. Stevens, transferred.

A. C. VOLKMAR, forester of the Riordon Paper Company, St. Jovite, Que., has been elected an associate member of the Canadian Society of Forest Engineers.

Lieut. ERIC G. KINGWELL, formerly city engineer of Kamloops, B.C., and now attached to the First Canadian Pioneers, is actively engaged in recruiting work for his battalion.

R. R. BRADLEY, forest engineer of the New Brunswick Railway Company, is preparing his final maps of the territory owned by that company and expects in the spring to undertake planting operations on a large scale.

Lieut. FRANK J. LAWSON, B.A.Sc., recently with the engineering department of the city of Calgary, has died of wounds received in France. He was the only son of the well-known architect, F. J. Lawson, of Calgary.

VALDIMAX J. MELSTED, B.Sc., A.M.Can.Soc. C.E., until recently engineer of water services and tests for the C.P.R. at Winnipeg, has been engaged to conduct analyses of all the public water supplies in Manitoba. Mr. Melsted was appointed by the Provincial Board of Health.

J. W. HARRIS, M.L.S., M.Can.Soc.C.E., after 37 years' service to the city of Winnipeg as assessment commissioner and city surveyor, has handed over his departments to his successors, Leo. W. Donley and R. H. Avent, and his name will be inscribed on the civic pension roll.

Major HOWARD L. BODWELL, A.M.Can.Soc. C.E., according to recent casualty lists, has been wounded. He is a graduate of the Royal Military College, Kingston. For some time he was adjutant of the 47th Battalion and later joined the Second Pioneers, in which battalion he received his wounds.

Lieut.-Col. GEORGE G. NASMITH, Ph.D., C.M.G., who has rendered such signal service at the front as analyst and advisory offices on sanitary work for the Canadian forces, is to be honored by the University of Toronto with the honorary degree of LL.D., at the convocation to be held May 19th.

STANLEY H. FRAME, A.M.Can.Sco.C.E., has recently received the appointment from the Dominion Government as District Hydrometric Engineer with the Irrigation Branch, Department of the Interior, Calgary. For the past three years he held the position as assistant to the city engineer of Calgary.

A. E. STEVENS, now general superintendent of the C.P.R. at Montreal, has been appointed general superintendent of the Saskatchewan division with headquarters at Moose Jaw. The appointment was made necessary by the extended leave of absence, on account of ill-health, having been granted to J. G. Taylor.

AUGUSTIN FRIGON, C.E., has resigned from the firm of Surveyer & Frigon, consulting engineers, Montreal, to become engineering manager of the Canadian Siegwart Beam Co. Mr. Frigon is a graduate of Laval University, and for several years past has been a member of the Faculty of that university. The firm name of Surveyer & Frigon has been changed to Arthur Surveyer & Co. Mr. Surveyer's research work in regard to water-powers is well known to our readers. He is a member of the Canadian Society of Civil Engineers, the Société des Ingénieurs Civils de France, and the International Association of Navigation Congresses.

CANADIAN SOCIETY OF CIVIL ENGINEERS—COMMITTEE ON PRESTIGE, ETC.

Referring to the elections recently held in the various districts of the Canadian Society of Civil Engineers for the selection of members for the committee on prestige, influence, etc., the Council of the Society announces the following results:—

Representing District No. 1—W. J. Francis, Phelps Johnson, R. S. Lea, H. H. Vaughan, W. F. Tye and A. Boyer.

District No. 2—D. H. McDougall, W. A. Duff and L. H. Wheaton.

District No. 3—A. E. Doucet, A. Amos and A. R. Decary.

District No. 4—John Murphy, R. deB. Corriveau and G. B. Dodge.

District No. 5—H. E. T. Haultain, R. W. Leonard and E. W. Oliver.

District No. 6—H. B. Mucklestone, W. L. Mackenzie and A. J. McPherson.

District No. 7—H. F. Hayward, D. O. Lewis and E. A. Cleveland.

AMERICAN SOCIETY FOR TESTING MATERIALS.

The nineteenth annual meeting of the American Society for Testing Materials will be held at Atlantic City, June 27th to 30th inclusive. The new Hotel Traymore has been selected as the headquarters for the meeting.