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CONSULTING ENGINEERS

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

BASCULE BRIDGE ACROSS CATARAQUI RIVER

Details of Construction and Method of Operation of 160 Foot Span Bascule Bridge at Kingston, Ont.—Precautionary Means Taken to Ensure Counterweight Would Exactly Balance the Moving Leaf—How Weight Adjustment Was Determined

By R. K. PALMER
Chief Engineer, The Hamilton Bridge Works Company

AMONG the important public works which have been carried out during the past year is the system of docks, causeway and bridges across the Cataraqui River at Kingston.

There are three bridges at this site, a 164-ft. fixed span at the Kingston end, a 208-ft. fixed span at the far end and a Strauss bascule bridge at a point between the first two.

All of these bridges have a 24-ft. clear roadway, with provision for a future street car track, and they each have a 4-ft. clear sidewalk on the outside of one truss.

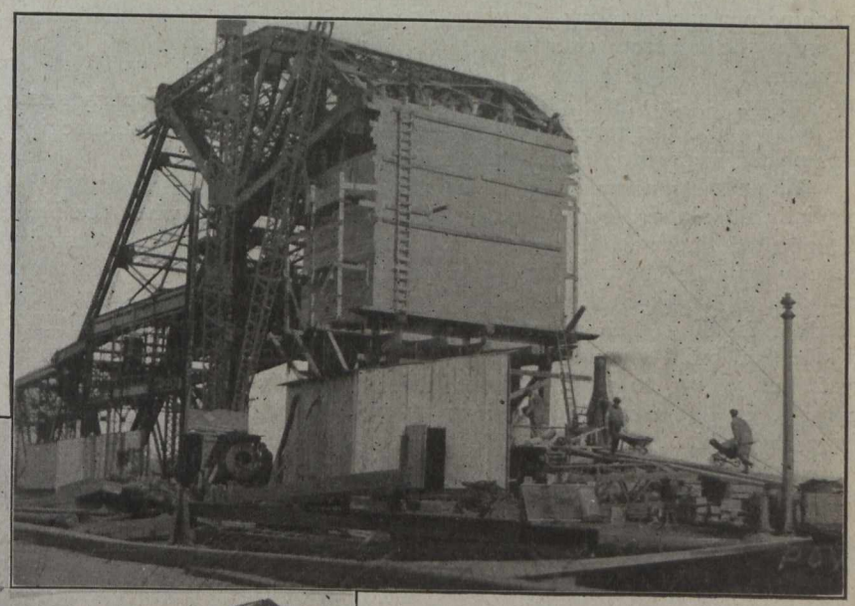
They are all of the through riveted type, and the fixed spans have inclined top chords. The bascule span is, of course, the most interesting of the three, and will be the only one considered in this article.

This span is 160 ft. from the centre of the outer support to the centre of the main trunnion, and provides a 140-ft. clear waterway between waling timbers. The distance c. to c. of chords at the outer end is 20 ft. and at the trunnion end 26 ft., and the distance c. to c. of trusses is 27 ft.

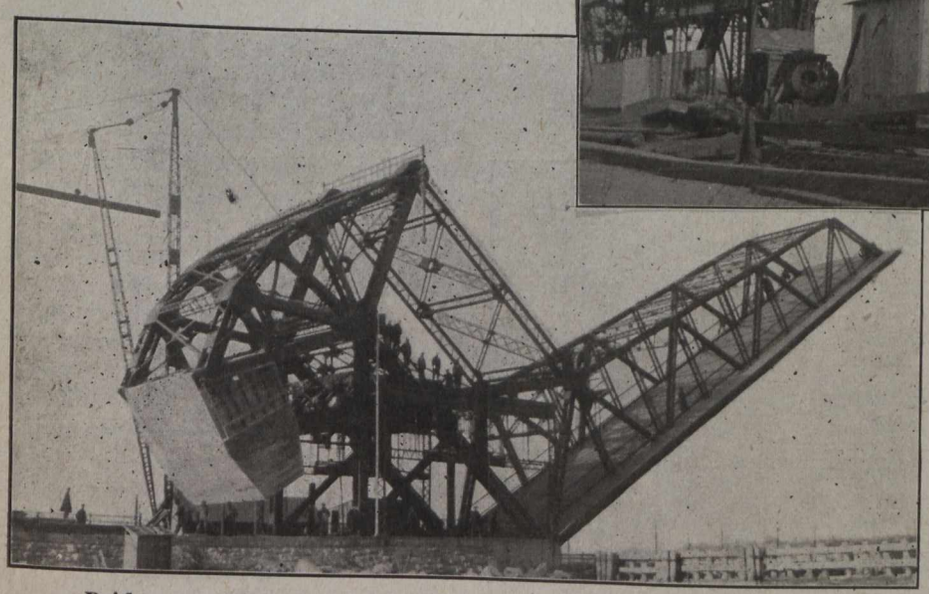
The bridge was designed according to Dominion Government Specifications for Bridges and Building for 1908, with such modifications as would adapt them to bascule bridge requirements.

The floor is of wood, with an under layer of 4-in. x 6-in. British Columbia fir, laid diagonally, with 6-in. openings between the timbers, and on top is a wearing floor of 3-in. maple, also laid diagonally, but in the opposite direction. While the maple planks were laid as closely together as possible, there is enough space between them to allow water to run through, and if the openings get stopped with dirt the 3-in. crown in the floor will carry the water to the sides of the roadway and off the bridge. The sidewalk is of 2-in. maple, laid at right angles to the walk, and carried through the truss and across the top of the felloe guard. Both felloe guards are bound with 3-in. x 3-in. x 3/8-in. angles fastened with countersunk screws.

There is a lattice railing 4 ft. high on each side of the roadway, and on the outside of the sidewalk a pipe



Close View of the Filling in of 600-ton Concrete Counterweight.



Bridge was First Opened for Passage of Boats, April 17th, 1917.

railing is used, with ornamental cast posts and three lines of 1¼-in. pipes.

As this is one of the latest Strauss bascule bridges, it embodies the newest features peculiar to this type. For instance, the machinery house is attached to the counterweight tower, whereas in former spans the machinery house has been beside the portal of the moving leaf. This new location provides greater accessibility to the machinery and ease of operation by hand-power if the electric power should fail. Another feature that is different from that in the earlier bridges is the location of the main trunnion. This trunnion is now raised to come above the level of the roadway, and it is, therefore, more accessible for greasing, and, what is more important, it is now in a position where all the dirt of the roadway will not run down and cover it when the bridge is raised.

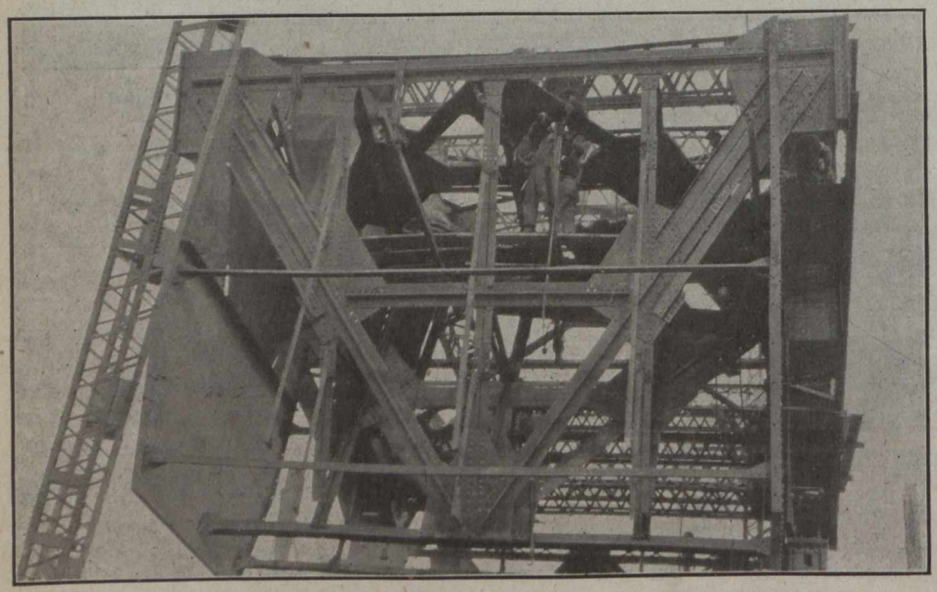
While this structure is called a bridge, it is in reality a machine, and the structural portion is the frame of the machine.

The processes of manufacture of this bridge are not different from those used for other high-grade structural and heavy machine work, except that in this case the two are more or less combined and require special care to secure proper working fits.

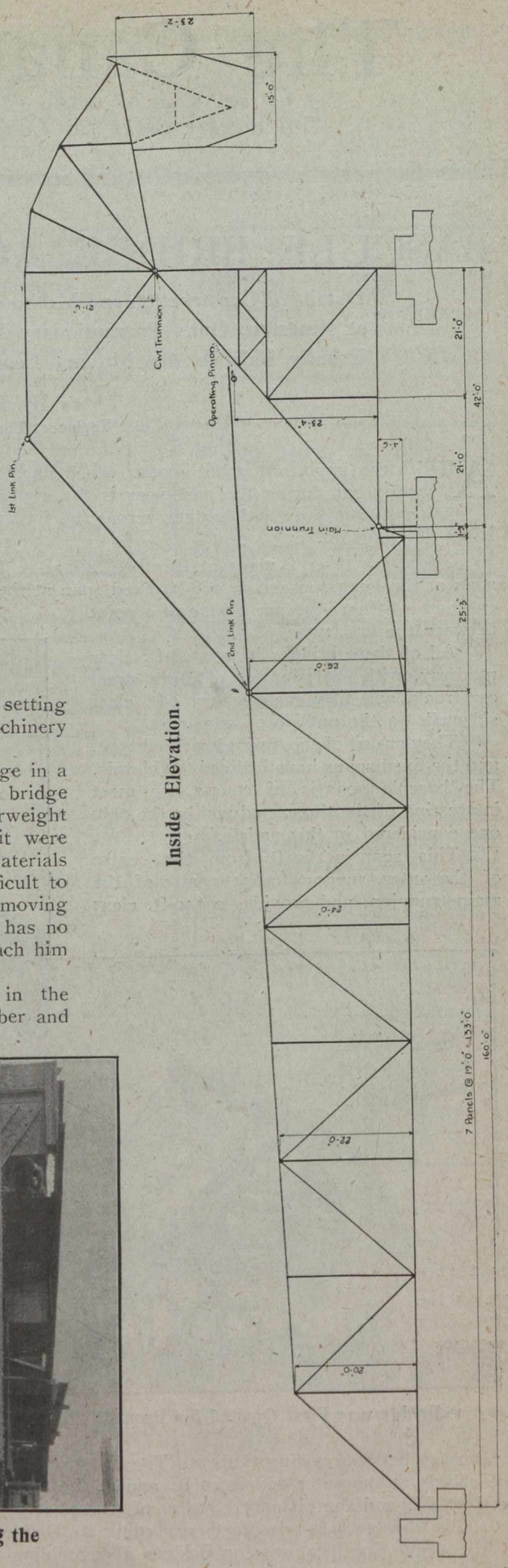
The erection of this bridge required expert attention to secure proper levelling and lining up of the various machine parts, as well as the securing of a static balance between the concrete counterweight and the rest of the structure for all positions within the range of the required movement. Careful work with transit and level served in properly setting the main and counterweight trunnions and the remainder of the machinery was placed in position by machinists in the usual way.

While the machinery is sufficiently heavy to operate the bridge in a partially unbalanced condition, as it, of course, must do when the bridge is operated under wind load, it is desirable to have the counterweight exactly balance the moving leaf under normal conditions. If it were possible to know in advance the exact weight of each of the materials used in building such a bridge, it would not be particularly difficult to design and build a counterweight that would exactly balance the moving leaf, but, owing to practical conditions over which the designer has no control, he had to wait for data on the weight of materials to reach him from the field.

The designer knows very accurately the weight of steel in the structure, and he assumes approximate unit weights for the timber and



Showing the Structural Steel Enclosed in and Supporting the Concrete Counterweight.



Inside Elevation.

concrete used, and with these assumed weights he determines approximately the position of the centre of gravity, both vertically and horizontally, of the moving leaf, and then proceeds to determine the position of the centre of gravity of the counterweight, together with its general outline and volume.

Precautions were taken to avoid trouble in securing a balance by keeping the counterweight on the light side, because it is easy to add weight and exceedingly difficult to remove concrete once it is placed. To this end, pockets were left in the concrete counterweight in such size as not to interfere with its strength and in such positions as not to interfere with the position of its centre of gravity when more concrete was added.

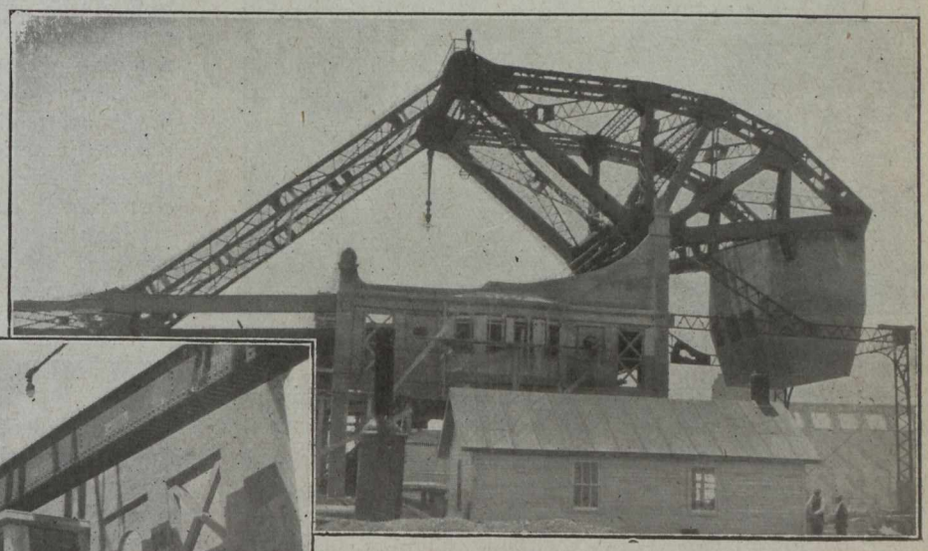
Blocks of concrete were made as early as possible of the local materials to be used for the counterweight in order to determine the unit weight of this material, and some of the timber was also weighed as soon as it arrived. This data was used in completing the design of the counterweight, but before the counterweight was built the entire wood deck had been completed and all the timber weighed. This final weight was used to check the calculations, with the result that only a few yards of concrete had to be added to the counterweight to finally make a balance. The weight adjustment was made by adding concrete until the motors required the same amount of current in operating the bridge either up or down.

Showing Machinery House and Operating Cabin from Bridge. Note Rack on Underside of Operating Strut.

The bridge is lifted by means of two operating struts, which are pin-connected to the moving leaf at the hips, and which are actuated by two heavy pinions which engage steel racks bolted to the under side of the operating struts. The operating struts pass through roller cages or guides, which are pivoted to the shafts carrying the operating pinions. These cages hold the operating struts in contact with the pinions so that the racks and pinions can by no chance get out of mesh.

The machinery house encloses the emergency foot-brake drum, the gasoline engine, the hand-operating mechanism, the electric motors, and the train of heavy gears which carry the power from the motors to the operating pinions. A large compensating gear is provided between the two operating pinions, and is placed on the shaft carrying the second reduction. This gear is similar to an automobile axle gear, and compensates for any variation existing between the rack-teeth on the two operating struts, and thus avoids indeterminate strains in the mechanism. All the machinery is of cast-steel and all large bearings have special bronze bushings, while certain of the smaller bearings are lined with babbit.

The main trunnions are 12½ in. diameter and 1 ft. 5 in. long on the bearing surface, and the counterweight trunnions are 21 in. diameter and 2 ft. 6 in. long on the bearing surface. These are forged steel pins working in phosphor bronze bushings, and a special effort has been made to provide reliable lubrication and numerous grease-cups and greaseways were provided for forcing grease into all such bearings.



View Taken June 14th, 1917.

The bridge is opened and closed by means of two a.c. three-phase, 60-cycle, 550-volt motors running at 560 r.p.m., with a normal running torque of 480 lbs. and maximum starting torque of 1,150 lbs. Each of these motors is provided with a solenoid brake. In addition to the solenoid brakes, there is an emergency foot-brake for use when there is no current. To prevent accidents automatic cut-offs are provided for these motors when the bridge is nearing either the open or the closed position. These cut off the current from the motors and set the solenoid brakes after the operator has been warned by electric light indicators. The operator usually stands by and prevents the current being cut off in this manner, thus completely closing or opening the bridge without interruption.

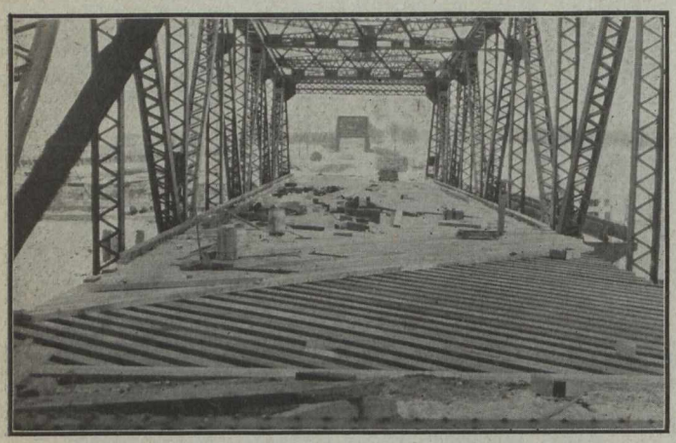
In order to make doubly sure of never blocking the channel through failure of the electric power, a 6 h.p. hopper-cooled gasoline engine, with a speed of 320 r.p.m., is provided in addition to ordinary hand operation by means of an endless chain from the bridge deck.

An air buffer is located at the outer end of the moving leaf for the purpose of relieving the bridge from jar when coming to rest, and the bridge is locked in the down position by means of a bolt under each truss. These bolts are operated by means of a 5 h.p. a.c. motor, 550 volts, three-phase, running at 750 r.p.m., and furnished with

a solenoid brake. This motor is electrically interlocked with the operating motors so that it will be impossible for the operator to open or close the bridge with the locking bolts in the wrong position.

At each end of the bridge there is provided an electrically operated roadway gate under the control of the operator in the cabin.

The driveway, as well as the machinery house and cabins, is well provided with electric lights, and various

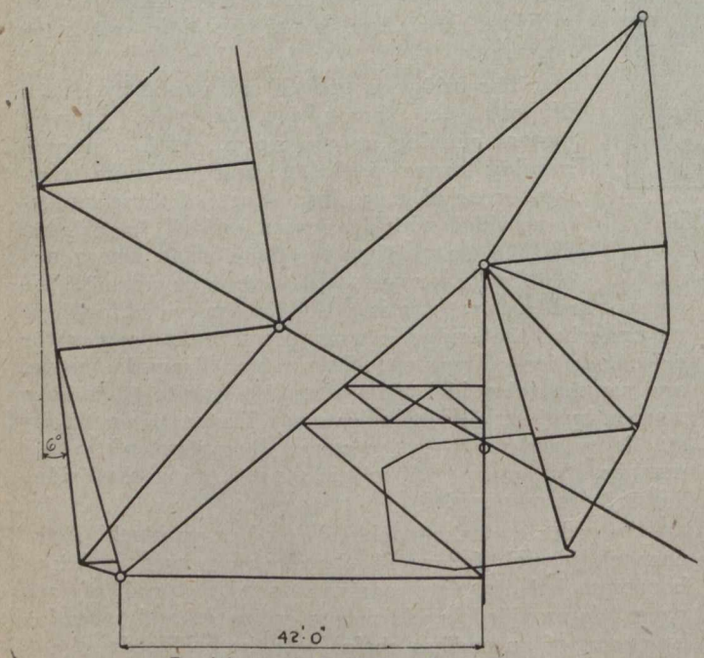


Showing the Method of Laying Bridge Floor.

signal lights to comply with regulations of the Dominion Government are provided and operated from the cabin.

It is expected that the bridge will be completed and open for traffic by July 1st, 1917.

The general contractor for the superstructure was the Hamilton Bridge Works Company, Limited, of Hamilton, Ont., and the electrical machinery was furnished and installed for them by the Canadian Westinghouse Company, of Hamilton, Ont. The bridge was designed by the Strauss Bascule Bridge Company, of Chicago, Ill.



Position of Bridge when Open.

All this work was carried through for the Dominion Government under the direction of Eugene D. Lafleur, Chief Engineer of the Department of Public Works; Mr. S. J. Chapleau, District Engineer, and Mr. S. Fortin, Bridge Engineer for the Department of Public Works.

TO ARBITRATE AQUEDUCT CLAIMS.

The Cook Construction Co. and the Board of Control of the city of Montreal have decided to arbitrate the claims for damages, amounting to $1,500,000, submitted by the company owing to alleged delays by the city in regard to the Montreal Aqueduct contract.

The arbitrators will be J. M. Fairbairn, assistant chief engineer of the C.P.R., for the city of Montreal; W. F. Tye, former chief engineer of the C.P.R., for the Cook Construction Co., the third arbitrator being Aime Geoffrion, K.C.

Mr. Ker, chief engineer of the Cook Co., has made a proposition to the controllers to postpone the completion of the aqueduct until after the war. Some of the controllers are in favor of the delay, providing that it will not give rise to new claims from the Cook Co.

The city of Montreal intends to ask the various power companies for quotations for the supply of electric power for periods of ten, twenty and forty years, and if the companies can furnish the city with power at less cost than it can be supplied hydraulically by means of the aqueduct, the controllers say that they will make a contract accordingly for pumping purposes for a long period of years.

NEW MERGER INCLUDES BOVING COMPANY.

Announcement was made at Ottawa last week of the incorporation of the Electric Steel and Engineering Company, Limited, with an authorized capitalization of two million dollars, and head office at Welland, Ont. This new firm is a merger of the Electric Steel and Metals Company, of Welland; the Boving Hydraulic and Engineering Company, of Lindsay; and the Wabi Iron Works, of New Liskeard. No announcement as to plans will be made until after a meeting of the directors, to be held this month.

CANADIAN SOCIETY OF CIVIL ENGINEERS, ELECTIONS AND TRANSFERS.

At the council meeting held June 19th, the following elections and transfers were announced by the Canadian Society of Civil Engineers:—

Members—Boris Bakhmeteff, of Petrograd, Russia; Harrison Estell Howe, of Montreal; Harry Linwood Johnston, of Vancouver.

Associate Members—James Welland Calder, of Swift Current, Sask.; Clifford S. Dewis, of Calgary; Nels A. Pearson, of Calgary; Will Malcomson Stewart, of Saskatoon; Alton D. Taylor, of St. John, N.B.; and John Henry Thompson, of Ottawa.

Junior—C. L. Archibald, of Bathurst, N.B.

From Junior to Associate Member—A. C. Crepeau, of Sherbrooke, P.Q.; Francis J. Cronk, of Montreal; Percy E. Jarman, of Westmount, P.Q.

From Student to Associate Member—Norman C. Stewart, of Vancouver.

From Student to Junior—Wm. Harold Hunt, of Moose Jaw; Wm. Wallace Perrie, of Hamilton.

The aggregate capacity of electric motors in China is said to be only 70,000 kilowatts. The number of electrical undertakings is 87, of which 62 are in China proper and 25 in Manchuria.

Winnipeg and Port Arthur Are Natural Junction Points

If Minority Report of Railway Enquiry Commission Be Adopted, North Bay Is Not the Natural Junction for G.T.R. and C.N.R.— Review of the Railway Situation and of the Various "Solutions"

By JAS. H. KENNEDY, M.Can.Soc.C.E.
Vancouver, B.C.

As one who has taken a deep interest in railway matters for some years, and has given some thought to the various suggestions and reports upon the present railway problems in Canada, the writer is under the impression that there is still some room for further discussion at this time.

The facts brought out as to the financial affairs of the various railway companies agree fairly well, or as well as might be expected, but the suggested remedies are so varied that instead of being much help they appear to make the problem more confusing to the general public; and possibly to the powers that be. There is no doubt but that the facts brought out by the Royal Commission in great detail in their valuable report, and the facts as given by Mr. W. F. Tye, M.Can.Soc.C.E., in his valuable paper to the Canadian Society of Civil Engineers, agree fairly well, and are most excellent information. It is in the remedies suggested that the radical differences creep in. Up to the present we have the following suggested remedies:—

1st. The proposal of Sir Thomas Tait that all the Canadian railways be combined into one government owned and operated system, including the Intercolonial and the Canadian Pacific systems. This makes a system of 31,967 miles.

2nd. Mr. W. F. Tye recommends a combination of the Grand Trunk, Grand Trunk Pacific, National Transcontinental and Canadian Northern into a single system, to be privately owned and run upon a commercial basis in competition with the C.P.R. This makes a system of 19,021 miles.

3rd. The Royal Commission's majority report recommends the incorporation of the Dominion Railway Co., to include the Intercolonial, the National Transcontinental, the Grand Trunk, the G.T. Pacific and the Canadian Northern. This makes a system of 20,512 miles, to be operated for the government by a commission of five members.

4th. The Royal Commission's minority report recommends nursing the different railway corporations along in the future as has been done in the past, with government aid, until they get sufficient strength to stand upon their own feet.

It would serve no useful purpose to discuss the reasons or causes that have led up to the present financial difficulties of the various railway companies. No doubt there are many circumstances contributing to the result. The main question confronting the country is that they are in the hole, and how can they get out? That is the point. The proposal of Sir Thomas Tait would be a colossal undertaking; such as has never been undertaken anywhere. The taking over of, say, 32,000 miles of railway as a single government owned and operated system at a single gulp, would be "taking the bull by the horns" in earnest, indeed. Sir Thomas has given Australia the best government-operated system of railways known, and no doubt looks at the system from the inside; and from the inside of a well-managed system. There are some others of us who have seen it from the outside, who look upon it as a calamity to be averted, especially on such a huge scale as that proposed.

The proposal of Mr. W. F. Tye would be a good, sound business proposition if it could be materialized. It would free the properties from political troubles, and the new system would have a free hand to forge ahead with somewhat better grades and distances than the C.P.R. It should be well able to compete successfully in a very short time. As to the difficulties in launching the project, it may be noted that the Royal Commission reports it to be impossible to form a commercial company in their opinion, and cite New York and Mexican cases as precedents; but we have done many things in the past without any precedents.

Without offering any opinion regarding the feasibility of forming this commercial railway company, the one objection the writer has to Mr. Tye's proposal is that it seems to be too radical. It takes cognisance of the financial and physical conditions of the properties and proceeds to apply a drastic remedy on cold business principles, without looking for the lines of least resistance and regardless of any rights or feelings the present owners may have.

The Dominion Railway Company recommended by the majority report of the Royal Commission would include the same railway systems as Mr. Tye's proposition, with the Intercolonial additional; that is, a new system of over twenty-one thousand miles, to be managed by a board of five trustees, in trust for the owners. This Board of Trustees is to be self-perpetuating, electing their successors subject to the approval of the Governor-in-Council, and after appointment responsible to nobody,—autocrats of the old school.

The writer may say here that he has no wish to criticize unduly the constitution of the proposed Board of Trustees, but thinks the Royal Commission has made the best of an impossible proposition. To see this fact it is only necessary to look at the proposition from the standpoint of the G.T. R'y or C.N. R'y, and ask how is it possible for any government, irrespective of party, to ask them to surrender the control of their properties to an irresponsible Board of Trustees without developing a sufficient opposition to endanger the life of that parliament? The constituencies along the line of the Intercolonial would also be likely to fear interference with their long-enjoyed low rates, and make themselves heard. On the whole, this is a more radical adjustment than that proposed by Mr. Tye, and the writer thinks unfair to the owners of the properties proposed to be taken over.

The minority report of the Royal Commission appeals to the writer as the opinion of a man who has the faculty of taking a view of the situation from all angles and interests. He sees it in connection with the difficulties to be encountered and compares it with other solutions that will accomplish the end sought without raising new troubles infinitely worse than those sought

to be remedied. Mr. Smith sums up his conclusions in these words:—

"Let the Canadian Pacific alone; let the Grand Trunk operate the eastern lines now held by the Canadian Northern; let the Canadian Northern operate the western lines now held by that company and the Grand Trunk Pacific system; let the government operate the connections or procure their operation by private companies; all of which should be done under arrangements that are equitable and yet look to the not distant day when the country will have survived the war and resumed its prosperous growth."

It should be noted that Mr. Smith recommends that the Grand Trunk operate east of North Bay and the Canadian Northern operate west of Winnipeg, the government to operate the lines between Winnipeg and North Bay. The writer begs to differ with the latter part of this arrangement. North Bay is not a natural junction point; and there is no necessity for any government-operated lines.

The two natural junction points are Winnipeg and Port Arthur. The Grand Trunk should have its own line to both those points and the Canadian Northern should have its own line to Port Arthur. It would be a benefit to both systems. The C.P.R. found it necessary to double-track its line between these points first, which goes to show that there two lines are necessary for a single-track business at other parts of their system. Will it not be the same with the new lines?

Why should all Canadian railways wish to become transcontinentals? There is not one in the United States, though there are systems with greater mileage than the C.P.R., which became a transcontinental on account of its being the first line in a new territory.

It cannot be shown that the C.P.R. is any more economical or serves the public any better than two separate systems with interchange of traffic at Fort William and Winnipeg. Nor was there any adequate reason for the Canadian Northern, the Grand Trunk and the government getting the transcontinental "bee in their bonnets" at the time, and starting on a race for "transcontinental or bust," than there is at the present time for saddling the country with a government-operated system that will continue the "bust" for all time.

For the government to continue to furnish the means for two independent transcontinentals at this time would be equally indefensible.

The Grand Trunk system has been limping along for over fifty years, hobbled by a foreign directorate, as everybody knows. Had it been in the hands of live men on the spot, with power to act and direct the policy of the company, it would be in a different financial condition to-day.

It is nothing new for the Grand Trunk to be hard up. Nor has it been shown that it is any worse off now than it was when Mr. Hays took hold of it, and placed it on its feet. If the government would insist upon a Canadian directorate, with all authority, at Toronto or Montreal, and arrange for a fair and equitable exchange of lines with the Canadian Northern, and abandon the policy of granting subsidies, there is very little reason to think the Grand Trunk would not survive its present difficulties.

With the elimination of Canadian Northern competition in its territory, and with the G.T.P. fixed charges taken care of by the C.N.R., and all C.N.R. business turned over to it at Winnipeg and Port Arthur, it should be able to survive and become great and prosperous.

In any event, it is the Grand Trunk's prerogative to do the worrying over the debt, and save their property if possible; not for the government to transfer it to the people. This would seem to be the fairest settlement. It is difficult to understand how the G.T.R. can see any unfairness, still they seem to charge the government with being unfair in the Grand Trunk Pacific deal.

The Royal Commission have done a great service in showing that the firm of Mackenzie and Mann have not profited any at the expense of the Canadian Northern Railway Company. All will be glad to know this fact, as it has been generally thought that the Canadian people were stall-feeding the Canadian Northern cow, while Mackenzie and Mann were doing the milking.

The report should give renewed confidence in the Canadian Northern management and in the whole situation. Almost all great railway systems have grown up from small beginnings as the life work of one master mind that has grown with that system from the beginning. One of the most successful of these is the Canadian Northern under the financing of Sir William Mackenzie and the constructive direction of Sir Donald Mann. They have not wasted their means on bad construction or financing, and until the present war they never defaulted in interest payments. Their one mistake seems to be that they felt divinely inspired to emulate the Canadian Pacific in constructing a transcontinental railway, with great hotels and ships; and had it not been for circumsances over which they had no control, they would have succeeded.

Now it appears to be proposed that this Napoleon of finance, whose education in the particular line has been his life work, and whose education has been contributed to by the Canadian people to the tune of 298 millions of dollars, shall be deposed and his physical properties placed in the hands of five trustees.

If it were possible to find suitable men for trustees to replace Sir William, which it is not, the fact that two of them are not supposed to be railway men, or give their whole time to the project, would still leave the proposition a huge joke. Any man entrusted with the responsibility of an undertaking such as this, and not required to give his whole attention to it, cannot be otherwise than a figurehead.

The Canadian Northern is not insolvent. It may be a fact that if the men at the head of its affairs be eliminated, and the property placed on the market at forced sale, it would not realize anything; but with the efficient management that may be expected from the directorate who look to the common stock for their compensation, it is far from insolvency. The fact that their financial affairs have been brought prominently to public notice lately is in itself unfortunate, tending to create distrust.

Now, anybody can point out supposed flaws in any scheme that may be proposed for a settlement of the great Canadian railway problem, but that is not the writer's present object. The object is rather to call attention to what seem to be a few pertinent points not fully brought out in former discussions. The writer's opinions may not be of much value, but after some study of the various proposed solutions they appear to cover the case, and at any rate cost nothing. On the other hand, if they prove of any value to anyone, the writer will feel repaid. The writer's proposition follows:—

The government should insist upon the Grand Trunk head office being moved to Montreal or Toronto, with all authority to direct. The G.T.R. should not be released from responsibility for the Grand Trunk Pacific. It should take over the C.N.R. lines in the East, or as many of them as can be made to pay operating expenses, also the N.T.R. to Winnipeg and the branch to Port Arthur. This should be done by a mutual arrangement between the

G.T.R., C.N.R. and the government, on some equitable basis.

With the C.N.R. out of the east as a competitor, the C.N.R. lines as feeders, and the N.T.R. in its hands, the Grand Trunk should enter upon an era of prosperity, notwithstanding their efforts to show their insolvency and dilapidated condition in order to avert the G.T.P. responsibility.

The Canadian Northern should be confined to the west of Port Arthur and Winnipeg, and given the Grand Trunk Pacific lines on some equitable arrangement. They should be required to shake loose from all Eastern lines as best they can. Nobody knows how to make the most of these Eastern properties better than Sir William Mackenzie. A scrap railway is worth more to-day than ever before. Scrap may be the best disposition of some of them.

This arrangement, if consummated, would eliminate competition for both the G.T.R. and C.N.R., and put them on a paying basis, cause little disturbance, preserve those companies in the hands of present owners, and save the government from endless trouble. If it came to the worst, then a government loan to save either from the hammer would be a safe investment. The future of both companies would be assured.

Both companies should be called upon to furnish the government with detailed plans and estimates of economies which they could effect, as well as of the enhanced profits in operation of each in its own territory. This should be furnished before anything is done to effect any change in the direction of government ownership.

The writer has no systematic figures to show that the enhanced value in both of the systems would be considerable; but until it can be shown, he does not believe either system is likely to go into the hands of receiver for some time to come. In conclusion, it may be said without fear of contradiction that no government can compete with a private company in railway construction or operation.

Who has ever heard of a government getting the best of any deal with a private railway company?

U.S. ENGINEERS FORM JOINT COUNCIL.

On June 27th was held the first meeting of the Engineering Council of the United Engineering Society. The Council was recently organized as a medium of co-operation between the four national United States engineering societies. The function of the Council may perhaps best be described by the following extract from the by-laws of the United Engineering Society: "The Council may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers."

The Council is composed of twenty-four members, five being appointed by each of the four founder societies and four by the United Engineering Society. The founder societies are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

At the organization meeting the following officers were elected:—

President, I. N. Hollis; vice-presidents, H. W. Buck and George F. Swain; secretary, Calvert Townley; executive committee, the four officers and J. Parke Channing and D. S. Jacobus.

The Council discussed at length ways and means by which the founder societies through the Council may be of use to the nation. The unanimous desire to help the government in the prosecution of this war resulted in a resolution instructing the executive committee to co-operate with the government in procuring the services of engineers, also the appointment of a committee of three consisting of Messrs. H. W. Buck, A. M. Greene, Jr., and Edmund B. Kirby, to consider the best means of utilizing the inventive ability of the societies' members.

ANOTHER ENGINEER RECEIVES APPOINTMENT TO HIGH DIPLOMATIC POST.

Boris Bakhmeteff, who was last month elected to membership in the Canadian Society of Civil Engineers, has been appointed Russian Ambassador to the United States, to serve in co-operation with the diplomatic mission which the new Russian government has sent to America. Members of the Society will naturally be pleased that one of their number has been selected for a position of such international responsibility.

Ambassador Bakhmeteff was born in Russia in 1880. He is a member of the Institute of Engineers of Ways of Communication, of Petrograd, and holds a Russian degree similar to the Canadian and American "Doctor of Engineering."

During the years 1898 to 1907, he was engaged in railway work with the Transcaucasian Railway, and in connection with the construction of the Simplon tunnel. He went to the United States and spent some time in New York as engineer in the Barge Canal office, and in the office of John Bogart, consulting engineer. In 1907 he returned to Russia to become assistant professor of hydraulics at the Peter the Great Polytechnical Institute in Petrograd. Later he became full professor. In 1910 he was appointed as a member of the advisory board of the ministry of agriculture, and in 1913 became chairman of engineering investigation of the department of land improvement, ministry of agriculture.

He has been in the United States for the past year or more as a member of the Russian purchasing committee.

Among the undertakings of which Ambassador Bakhmeteff has had responsible charge, are the power developments at Schuja, Topoxal, Tauchxo, Copperwoms Chols, etc., small plants not exceeding 2,000 h.p.; Rion, 24,000 h.p.; Bug, 20,000 h.p.; Petrograd, 120,000 k.w. (as vice-president and chief hydraulic engineer); Kaikys, 10,000 h.p.; Dnieper, 800,000 h.p.; canalization of river and general schemes of power development at Duma for the Ministry of Ways of Communication; and various consulting and advisory work for government and municipal boards.

Ambassador Bakhmeteff addressed the United States Senate last week, assuring the senators that Russia will "carry on." The previous week he spoke before the House of Representatives, and was given a hearty reception by both branches of Congress. He was later given a reception by Secretary of State Lansing, and President Wilson attended.

"Russia rejects with indignation any idea of separate peace," said the ambassador. He thought that many of the rumours of internal dissension in Russia have grown out of misunderstandings regarding the great changes taking place in the whole fabric of the government in the transformation to democratic standards, and he pleaded for patience with and confidence in Russia, saying that all of her many serious problems would be solved successfully in the end and satisfactorily to England, France and the United States.

REINFORCED CONCRETE SHIPS.

"The problem that confronts our country of increasing the merchant marine requires the consideration of every possible method or material of construction; several prominent engineers have suggested reinforced concrete," says a recent bulletin of the Portland Cement Association, Chicago.

"A San Francisco paper mentioned in a recent issue the interesting fact that a local firm of engineers was designing a ship with a length of 330 feet, a beam of 44 feet and a depth of 31 feet, with a capacity of 4,500 tons—to be built of reinforced concrete. This is not something new. A concrete schooner was employed for some years in the north Atlantic coasting trade, having been constructed in about 1898. The London Times mentions a small boat of reinforced concrete built by a Frenchman in 1849 and still in service after a test of 68 years.

The concrete ship is only a further development of the concrete barge and such craft have been in successful use for years. Concrete lighters have been used for the past six years on Chesapeake Bay, supplying coal and water to dredges, carrying loads of sand and gravel, etc.

"With such a craft there is no necessity for caulking or painting, the upkeep is small and there is no danger of decay. Barnacles will not collect on a concrete hull.

"A concrete barge has been in service on the Welland Canal since 1910 and has seen very hard usage. It has a length of 80 feet, a beam of 24 feet and is 7 feet deep. It is interesting that the walls which were constructed between forms are 2½ inches thick, reinforced with steel rods, yet the barge is used for carrying loads of stone, etc., with conspicuous success.

"Since 1910, reinforced concrete barges have been built for use on the various sections of the Panama Canal and their experience has enabled the engineers to develop a very efficient type of vessel. Recently concrete pontoons were constructed for service as landing stages for boats up to 65 feet in length. These pontoons have a length of 120 feet, a beam of 28 feet and are 8 feet deep. They are very thoroughly reinforced.

"Vessels which are more like ships than barges have been built of reinforced concrete in Norway. A report from the American Consul General at Christiania describes a plant at Moss, Norway, where vessels of 3,000 tons displacement are being constructed. The following quotations from the report indicate the extent of the work under way at that time:—

" 'The inventor of this new style of vessel is said to be M. Nicolai Fougner, an engineer, who claims to be able to construct a ship of any size demanded. He is now building a lighter for a mining company at Sydvaranger for the oversea export of iron ore and the import of coal. The vessel, having a displacement of 3,000 tons, is to be ready before the end of the current year. It is stated that these concrete ships can be sailed or engined like other vessels, and experts consider that a new epoch in shipbuilding has arrived.'

" 'The ship, which arrived in Christiania last month, resembles a large barge, and is constructed entirely of concrete with the exception of the ribs, which are of steel. This new method of constructing ships has attracted much attention. The Swedish Minister of Marine, M. Brostrom, one of Sweden's largest shipowners, immediately ordered a lighter of some thousand tons displacement, and he was present when the craft was launched at Moss. He was accompanied by four experts, all of whom expressed much satisfaction at the result.'

" 'Two other lighters are now on the stocks, and a large slip for a 4,000-ton craft is nearly completed. More than 200 men are now working in the new yards, and five lighters have been contracted for in addition to the one completed and the two on the slips.'

"In view of such examples proving the usefulness of concrete vessels of this character, it would seem wise to consider concrete in the construction of ships which are to increase our merchant marine to the proportions demanded by the present requirements. If sea-going barges were to be constructed, or smaller craft suitable for lake traffic, this would release for other purposes many ships now in use in this capacity. The presence of the necessary materials for a concrete vessel at so many convenient locations would make it possible to provide a large tonnage, and progress in construction would be faster than with ships of steel or even wood."

KITCHENER ALDERMAN FURNISHES BAIL.

Alderman H. M. Bowman, charged with attempted bribery in connection with the recent appointment of City Engineer Michel to succeed the former engineer, Herbert Johnston, was last week committed for trial at the fall assizes by Magistrate Weir. The case is of interest to engineers owing to the circumstances under which Mr. Johnston was virtually dismissed without stated cause other than the desire to employ a "cheaper engineer."

The magistrate held that sufficient evidence had been presented to commit Bowman for trial, and that with the consent of the crown he would accept bail for $1,500, Bowman to give personal surety for $500 and two other sureties for like amounts. Bowman declared that he would not furnish personal bail, and was given two days to furnish it or be committed to jail. He declared that there was no evidence warranting committal, and that the men behind the charge would some day realize its seriousness.

"One of the best ways to make them realize it would be for me to sit in jail until October," said Bowman. "I don't think there is any chance of getting a conviction. So it's up to you as crown attorney to say whether there is any case. Remember, there is the probability that you will have to face the contingency of an acquittal after my being in jail for several months."

Continuing his argument Bowman said: "Surely you wouldn't put an innocent man to jail and keep him there for three months."

"You don't have to go to jail," commented the magistrate, "if you furnish bail. You are just trying to pose as a martyr."

"It is a serious case for me," said Bowman.

"It is if you wish to make it so," the court observed.

The magistrate finally said: "I will adjourn the case for two days, when you must either furnish the bail asked for or I will commit you to jail to await your trial."

When the case was resumed, Ald. Bowman was not present. Upon being found and brought to court by a policeman, he claimed that his attorney had told him that the case had been further postponed, so the magistrate did adjourn it for two days more so that Bowman's attorney could attend.

The case was called for the third time last Friday, and again Ald. Bowman was absent. His attorney said that the alderman had a nervous attack and was confined to his room. The magistrate at once adjourned the court to the alderman's house, and there the bail bond was signed, Bowman deciding not to go to jail for the summer. Two other aldermen also signed the bond.

CANADA'S RAILROAD PROBLEM

Suggests Consolidation of All Roads Excepting the Canadian Pacific, By Means of a Holding Company

By W. T. JACKMAN, M.A.,
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NOTE.—The following article is the last of a series of three. In his first article, published in our issue of May 3rd, 1917, Mr. Jackman considered the advantages of government ownership. In the second article, published in our issue of June 21st, 1917, he discussed the objections to government ownership. In the following article he proposes remedies for our existing difficulties. All of these articles were written before the publication of the report of the Railway Inquiry Commission. Mr. Jackman is not an engineer, and his opinions are expressed from the economic viewpoint only, but they will no doubt interest readers who have followed the papers by Messrs. Tye and Tait, the report of the Railway Inquiry Commission, the letter written by Mr. Wicksteed, and the many other discussions upon this subject that have appeared in print.—EDITOR.

Thus far, we have shown the anticipated advantages of and the chief objections to government ownership of railways in Canada. In considering the disadvantages of government ownership we have shown certain things which would seem to destroy some of the arguments of those who favor such a course: we have shown that public ownership would not necessarily give equality of treatment to all, that the government might not be able to raise needed capital at a lower rate of interest than private corporations, and that there would be a tendency toward higher rates rather than the opposite. Before leaving our view of the advantages, it will be well to note that the unified system of rail and water carriage, upon which some have expatiated as a means of securing great economies in transportation, would by no means be sure to bring such a desired result. Under conditions such as we face in normal times, the greatest element in the cost of service is that of labor.

Rail and Water.

Now, if by this proposed unification of rail and water systems it is expected, for instance, that wheat from the great plains of the West will be taken by rail to Fort William or Port Arthur and thence shipped by water to Montreal, the cost of transportation may be greater than if the wheat were sent through by rail, for the labor required to transfer the grain from the rail to the vessels at the head of the lakes, the payment of the labor and lock dues at Sault Ste. Marie, St. Clair Flats, Welland Canal, and the St. Lawrence canal system, together with the expenses of transhipment in order to permit the grain to go down the St. Lawrence canals, might be so great that it would exceed the cost of all-rail shipment. It is possible, therefore, in fact it seems probable, that when all the expenses are considered, including interest on capital, the cost of carriage by such a unified system as that here mentioned would exceed the estimates of its sanguine advocates. It behoves us to look at all these phases of the matter before endeavoring to decide upon the relative merits of private and governmental control.

Two Important Advantages.

From what we have said it appears as if there were left but two clearly defined advantages of government ownership; namely, that by this means there would be the elimination of the wastes of competition, through avoidance of duplication and triplication of lines. and that for purposes of national defence the government would own its indispensable and strategic transportation facilities. So far as the latter is concerned, should war in the future require, the government could commandeer the railways for the time being without any disorganization of the service; and, as for the former, if the government were now earnestly desirous of eliminating competitive wastes and had the ability to withstand the pressure of influence it could refuse to sanction enterprises which would be merely the multiplication of unwarranted lines. It seems, therefore, that the vaunted advantages of government ownership shrink to very restricted proportions.

It may be that some person will, at this point, suggest the good results that have been obtained by the Temiskaming and Northern Ontario, operated by a provincial commission. It must be acknowledged that this is the best of all our government roads, for while it, like the others, has failed to earn interest on its capital cost, it has at least earned enough to meet its operating costs. The elements in its success are chiefly three in number: First, the important mineral output and the developing agricultural resources of the territory it serves; second, the character of the men who have been in charge of its affairs; and third, the comparative shortness of the road and its use as a junction of two longer through routes. The comparative success of this road contrasts strangely with the checkered career of the Intercolonial, which is about five times as long, and which has seldom made even its operating charges. But when a road is taken out of politics and left in the hands of capable men whose sole object is to serve the public we would expect different results from those secured by a road which has been in politics from its earliest days. Since, then, the Temiskaming and Northern Ontario Railway furnishes us with an instance of a government road which has had some degree of success, we are asked: Why should the Dominion not embark on a wider project, by nationalizing all the railways and placing them under the management of a non-partisan commission, composed of men of conspicuous ability, so as to obtain for the nation results which are comparable to those secured by these same men in private enterprise?

No Delegating Government Authority.

Why should not a commission composed of such men as Baron Shaughnessy, Sir William Van Horne, Mr. Chamberlin, Mr. Hanna and Sir William Mackenzie be given full control of the management of all the railways of the Dominion united under government ownership? Doubtless, excellent results could be obtained in this way if such a commission were made entirely independent of political changes and could rely upon unimpeded authority with ample and dependable appropriations. But, from what we have said above, it is manifest that our government does not delegate authority in this way and no such funds could be assured. Hampering restrictions of all kinds would embarrass the activities and nullify the plans of any such board. The same thing would be true if only the Grand Trunk system and the Mackenzie and Mann lines were joined under such a government commission.

One of the most persistent arguments in favor of government ownership is to direct attention to what has been accomplished by state-owned roads in other countries. It is a forceful and facile means of bringing conviction to some minds; but he who would form a judicious opinion upon this great problem must consider the many differences between countries, in regard to political tendencies, economic influences and prevailing individual and social ideals, before reaching a final decision. To say

that because the Prussian railways have been operated with success by the state, the Canadian railways could be equally successful under state administration, is to leave out of account a great many differences between the two peoples which vitally affect the result. Some are pointing to Australia as a country closely akin to ourselves, and are saying that since the government in that country is successful in operating the railways it is giving an entirely erroneous opinion to say that government railways in this country would not be equally efficient.

Perhaps it will not be amiss here to quote the words of Mr. Acworth, the most eminent English authority, who has had a place upon our Canadian Board of Inquiry, who recently said, concerning the English railways: "Now, I am no foe of government railways. On the contrary, I believe that in countries with a population less self-reliant than our own, such a policy is necessary. In a country with a bureaucracy as well-trained and as well-organized as that of Prussia, it may even be desirable. Nay, more, I am not concerned to deny that even here state purchase might do something to bring up the worst railway services more nearly to the level of the best. But a careful study of the evidence has convinced me that in the long run state control ends in keeping down the best to the level of the worst, and that, taking them all for all, the private railway companies of England and the United States have served the public better than the gavernment railways of the Continent, or of our Australian colonies, and, which is still more to the point, are likely to serve it better in the future."

There seem to be good reasons, one may almost say overwhelmingly good reasons, for adherence to the principle, which has proved so effective hitherto, of private ownership of the facilities.

Enough has been said regarding the general features of these two methods of administration. What are the remedies for our existing difficulties?

It will be conceded that the chief trouble in connection with the railway problem is financial, and that when considering this problem exception must be made of the Canadian Pacific Railway Company, which is one of the strongest railway corporations of the world. The immediate issue comes in regard to the Grand Trunk Pacific in its relations with the National Transcontinental and to the Canadian Northern Railway. Both of these concerns have recently been before parliament seeking assistance to enable them to pay their fixed charges; it is, therefore, clear that their revenues are insufficient to meet all necessary expenditures of roads that are endeavoring to keep pace with the demands of a growing country. Two possible courses are suggested as alternatives in the present temporary emergency: either increase the amount of revenues by an increased volume of traffic or by increased rates, or else reduce the expenses of operation so as to make expenditures correspond with revenues. The former plan seems impracticable for until these railways can get additional funds they cannot construct branch lines and feeders that will provide increased traffic and revenues, nor would increased rates tend to develop traffic and cause enlarged revenues. The only other course, therefore, which is open to them is to devise some plan by which these lines can reduce their working expenses.

As has recently been pointed out by Engineer W. F. Tye, of Montreal, in a paper read before the Canadian Society of Civil Engineers, the Grand Trunk system has a great network of paying lines in the east but only one long through line with almost no important branch lines as feeders in the far west. On the other hand, the Canadian Northern system has a network of branches in the west but is deficient in the east. His plan, therefore, was to consolidate the Grand Trunk system (including the Grand Trunk Pacific), the Canadian Northern system and the National Transcontinental under a new company to be formed. In this way there would be the formation of one consolidated company, to which each of these systems would contribute its elements of strength; each would supplement the other where it was weak; and in the combination of the assets of these various companies there would be the elimination of destructive competition and the working together of all for the national welfare. His plan is admirably delineated and is an important contribution to a vexing question.

I am convinced that the holding company is by far the better solution of the perplexity. I am heartily in accord with Mr. Tye in urging the desirability of the government's owning a certain proportion of the stock of the controlling company, say, 35 or 40 per cent., but it seems to me that instead of a complete fusion of all these companies for permanent operation, equally good results can be accomplished in a more economical manner by the holding company.

The holding company would pay for the stock acquired by the issuance of its own securities. The result would be a single company, the assets of which would be the securities of the other three companies, and the liabilities would be the amount of its own securities issued in payment for its assets. In this way, the existing corporations would be left in full possession of their corporate facilities and exercising all of their lawful corporate activities; but the affairs of all three would be placed under the permanent direction of the company owning the controlling interest in each, and thus there would be harmonious action on the part of all. That is, a new company would be chartered by the Dominion government with authority to hold the securities of other companies; this company would proceed to acquire a controlling interest in the stock of the Grand Trunk system, the Canadian Northern system and the National Transcontinental, and in this way competition among these companies would be prevented.

Offer to Exchange Securities.

What advantages would be secured by this form of organization, and why should we advocate this method of bringing these three concerns together? If an effort were made to bring these companies into a consolidation, it might be nullified by the refusal of certain stockholders to give up the separate existence of their companies; but by this method the separate companies would be maintained as operating units in the same capacity as they are to-day. The holding company need only secure in the open market or by private bargaining a controlling amount of the stock of each constituent. This negotiation may take the form of an offer to exchange the securities of the holding company for those of the operating company. It seems fairly certain that if the stockholders of the three companies that are now separate were shown the advantages to be obtained through such an alliance there would be no trouble in inducing their acceptance of the plan.

In financing the transaction there would be no necessity of getting together a vast amount of new capital. All that is required in the purchase of such stocks is to exchange the securities of the holding company for them, and as a bare majority, say, 51 per cent., of the stock is usually enough to control the corporations, the amount of capital required would be reduced to a minimum. If the

details of the plan of operation are carried through in such a way as to show that the stock or bonds of the holding company will have a greater value than the corresponding securities of the existing companies, there would be no difficulty in securing the consent of the present security holders to exchange their holdings for the capital obligations of the holding company. In this respect the holding company has the pre-eminence over any consolidation, for in order to effect a complete consolidation of these three railway aggregations an enormous amount of capital would have to be obtained to buy up all the assets of each company; and no good purpose is to be served through consolidation that cannot be secured with much greater facility and with a small amount of capital by the method I have outlined. The economy in the use of capital and in concentration of its control is the greatest advantage which we can mention in connection with this proposal; and it is with regret that we cannot go into it more fully.

Funds Easier to Get.

The holding company would also be of decided value to the existing three companies over which it would exercise control. At the present time two of these companies are finding great difficulty in getting funds with which to carry on and enlarge their undertakings. But with a holding company at the top of the organization this would be rendered much easier. The two companies may not now have sufficient assets to mortgage as the basis of additional borowings; but the holding company could take the securities of these companies and use them as the basis of large issues of collateral trust bonds which would command a ready sale in the market. In this way the holding company could turn back funds into the treasury of each of the subsidiaries when the latter would be unable independently to borrow in the money market. The necessity of the Grand Trunk Pacific and the Great Northern Railway Companies to come to parliament for assistance would be greatly reduced and in a short time entirely avoided by having them joined under such control.

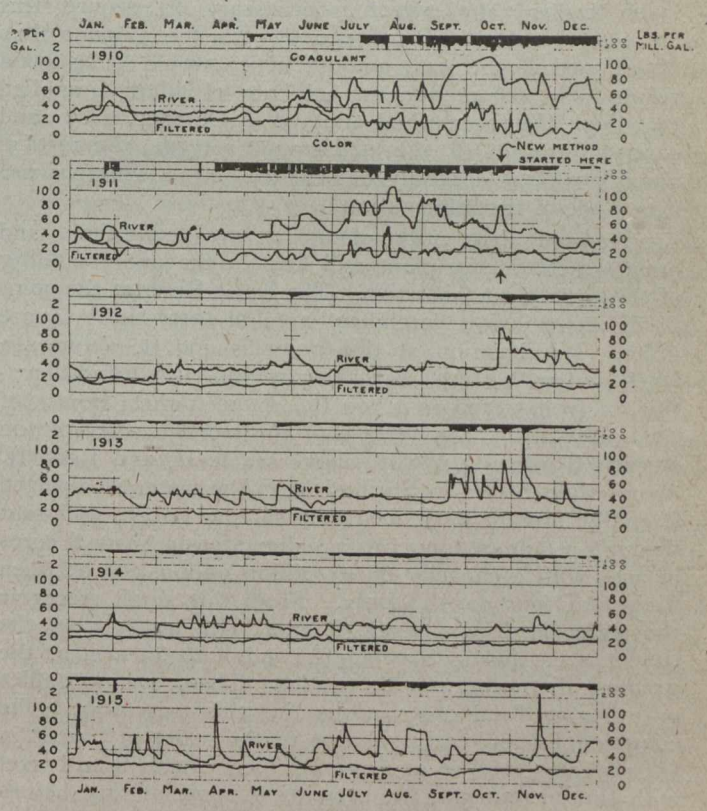
By having this unified central management, while preserving to the constituent organizations most of their individuality and initiative, and by having the finances of the aggregation managed with the utmost economy and the largest results, the country would be given the most efficient service at the least cost.

It may be said that this opens the way for a gigantic railway monopoly; and it seems to be assumed by many that anything which tends to overthrow competition and deprive us of its regulative influence must be only baneful in its results. The fact is that competition has already ceased so far as the making of rates is concerned; and well is it for the country that this has been accomplished. The railway enterprise is essentially monopolistic and the sooner we can recognize this and get our regulative machinery adjusted to it the better it will be for all interests. My own opinion, formed after prolonged and careful study of the problems of transportation, is that all the railways of the country should be grouped under centralized control. But until that can be effected, and as a step preliminary to it, I make the foregoing proposal as the best way out of the existing dilemma. It will avoid the concomitant evils of government ownership and will give the greatest measure of benefits to all interests. I trust that what I have given in brief outline will induce others to see many accessory advantages from the scheme proposed and may form a nucleus around which to crystallize some effective thinking concerning this great issue.

THE APPLICATION OF COAGULANT INTERMITTENTLY IN EXCESS AMOUNTS.*

By Elbert E. Lochridge,
Chief Engineer, Springfield Waterworks.

COAGULATION by sulphate of alumina prior to slow sand filtration has been the practice at the West Parish filter plant of Springfield, Mass., since its construction. Records are now available covering six full years. During the last four years of this time the method of application has been so altered that materially reduced amounts of coagulant are necessary, although at all times it has been possible to produce satisfactory water. This method has been the application of over-doses of sulphate of alumina to the water intermittently. The filters, six in number, are of the slow sand type and of one-half acre



Coagulant—Grains per Gallon—Pounds per Million Gallons—Color—River and Filtered Water.

area each. The water of Little River as it comes to the filters is that of a mountain stream usually clear, of low alkalinity, but with a varying color, which with the rise of the stream may increase several-fold within a few hours. The color in the river water may be low enough for use without any reduction for a long period of time, when suddenly a rise in the stream will cause a large increase of color which makes the water objectionable for use.

A chart is presented with this paper on which are two lines, the upper of which represents the color of the river water day by day, and the lower the color of the filtered water at the same time. These are plottings of daily results. The amount of sulphate of alumina in terms of both grains per gallon and pounds per million gallons, is plotted above the color lines in such manner that the

*Paper read before the New England Waterworks Association.

amount applied each day may be readily seen. This chart gives the comparison of the two-year period of 1910 and 1911, during which time coagulant was applied in the usual manner, with the years 1912, 1913, 1914 and 1915, in which the method to be described was used. The records for the six years are plotted in such manner that seasonal comparisons are also possible.

It is a well-known principle that it is necessary to apply enough sulphate of alumina to secure a complete reaction if the coagulant is to be of value in quickly clarifying the water. If, for example, on a certain day one grain of sulphate of alumina per gallon is necessary to secure a complete precipitation or reaction and decisive reduction of color, nine-tenths of a grain will not secure nine-tenths or even five-tenths of the same result. It is necessary to apply the coagulant at least in the amount or rate necessary for this reaction point. It is, therefore, necessary to determine each day the amount of sulphate of alumina which is necessary to secure this clean-cut reaction. In 1910 and 1911 the amount thus determined as the least amount which would bring good results was the amount of sulphate of alumina applied that day. In the method adopted in October, 1911, and carried through all the subsequent records, this critical amount was as carefully determined, but a different use was made of the information.

A brief description of the general conditions and arrangement of the plant will help in the understanding of this process at this point. The Little River at the point of diversion has a catchment area of forty-eight square miles. Its elevation at this point is 496 ft. above sea level, and with steep slopes the ground rises to an elevation of from 1,500 to 1,700 ft. at the highest points of the watershed. The surface of the storage reservoir on Borden Brook is 1,070 ft. above sea level, and 1,000 ft. above Main Street in Springfield. The water is diverted from the stream in a deep and narrow gorge, and sent through a mile of tunnel to a sedimentation basin 8 acres in area with a capacity of 40 million gallons, or between three and four days' supply. From this small reservoir the water is drawn to the filters. The water from the tunnel is carried by a concrete conduit to an arm at the greatest distance from the outlet. There are no baffles or other artificial obstructions in this reservoir. The coagulant is applied in solution to the water in transit in the concrete conduit at a point which causes it to travel with the current 540 ft., permitting some mixing before its submerged delivery into the basin. Water is constantly flowing from the river to this basin through the conduit and is drawn uniformly from this basin to the filters.

The determination of the amount of aluminum sulphate necessary for complete reaction is made in a series of two-gallon bottles from fifteen to twenty in number, which are filled each day with the river water. To these are added, in uniformly varying increments, definite amounts of sulphate of alumina. For example, to the first bottle enough is added to give the effect of the rate of 50 pounds per million gallons; to the next, 60 pounds; to the next, 70 pounds, and so on by ten pounds per million-gallon increments to 270 pounds. Within a few hours all of the bottles with amounts of coagulant in excess of the "reaction point" will indicate complete color removal, and the precipitation of foreign matter will be complete, while all bottles containing less coagulant than this amount will be in a cloudy or murky condition, indicating incomplete reaction. The determination is made in this manner each day, permitting a study of the effects of the rise and fall of the stream, the effect of storms, melting snows, etc. This information is also of great value at times of sudden changes, when there is insufficient time to make the determination. The amount necessary is dependent on a number of different conditions. With waters of the same alkalinity there may be quite a marked difference in the amount necessary for reaction, varying with river conditions. It is not entirely dependent on the amount of color, as with the same color to be reduced it varies on different days. The amount of coagulant actually applied to the water is always a little in excess of the reaction point determined, and during the period of application this is kept as nearly constant as possible.

With the amount or rate of coagulant application per hour thus known, it is still necessary to determine the number of hours per day during which it shall be added. Throughout most of the year, from four to six hours per day is sufficient, but at a time of flood, resulting in a very material increase in color, this period may be lengthened to twelve hours, or 50 per cent. of the time.

Generally speaking, the standard set for filtered water is that of no coagulation if the color does not exceed 25. Before the filtered water reaches this figure, coagulant is resorted to, and during such application the color is to be kept at 20 or below. By referring to the accompanying diagram it will be seen that, since the adoption of this method, it has been possible to make the line of color in the filtered water substantially straight or uniform throughout the year; the consumer thus becomes accustomed to a water of low and definite color and never sees water of high color at any time. Under the old method of constant coagulant use, it was found impossible, especially at times of low alkalinity or sudden changes, to add sufficient sulphate of alumina to reduce the water to a satisfactory color at all times. The addition of soda ash or lime was necessary for restoring alkalinity at such times. This is entirely unnecessary with the intermittent application, as but a small portion of the alkalinity is used in the formation of the floc. The first coagulation in the conduit and basin results in a water of substantially zero color, with at least a theoretically slightly acidic reaction. This treated portion of the water, which has entered the basin chemically active, with the precipitate or floc forming rapidly, is then followed by untreated water in a quantity, because of the longer period of time, in excess of the treated water. The thorough mixing of this raw water with the treated water is brought about at the outlet of the submerged conduit as it displaces the basin water at this point. The second reaction begins at once and is carried to completion with a restoration of alkalinity to the entire supply, this action probably being consummated during the period which elapses before the next application of coagulated water. The floc of the treated water has not had an opportunity to settle when the raw water is admitted, and readily furnishes a base about which the additional precipitation resulting from this secondary reaction forms, and serves to carry down color, sediment, and bacteria mechanically, as well as through the chemical reaction which is taking place in every part of the untreated water as it mixes with the overdosed water. The resultant reduction of color is, therefore, due to the effect of dilution of the higher colored water with water of no color; to the second reaction, which is, in reality, the completion of a reaction started under favorable conditions of overdosing, and which reaction chemically is always complete, as the excess of the applied coagulant is taken up by the alkalinity of the untreated water, resulting in the completion of the mass reaction; and also to the mixing of the floc of the fully treated portion with the mass of the entire day's

water supply, before it has the opportunity to settle. The precipitate thus formed in a large part settles before it is carried to the filters.

The sedimentation basin was drawn off and cleaned after five years' operation of the filtration plant, and it was found that large masses of precipitated organic matter and aluminum hydrate had settled in the upper portions of the basin. This deposit covered the entire basin, varying from three to four feet in depth near the inlet to a few inches in proportion to the distance from the point of entry to the basin of the raw water.

The average length of filter runs during the four years described in this paper of the use of this process were as follows:—

	Filter Runs after Scraping			Filter Runs after Raking		
Year	Number	Average in Millions of Gallons per ½-acre Bed	Maximum Runs in Millions of Gallons	Number	Average in Millions of Gallons per ½-acre Bed	Maximum Runs in Millions of Gallons
1912	22	76	90	26	76	84
1913	22	95	115	23	79	91
1914	26	85	152	24	77	157
1915	29	89	229	21	42	104

In conclusion, it may be said that the use of intermittent coagulation results in a saving in expense, uniform results of satisfactory quality, coagulation without exhausting alkalinities in soft waters, and coagulation without excessive overloading of the precipitated hydrate on the filter beds.

LABOR DEAR IN MONTREAL.

Montreal's Board of Control is discussing a proposition made informally by the Cook Construction Co. to discontinue all work on the Montreal Aqueduct owing to the scarcity of labor and the price of material. A proposition is also being discussed of returning to the city treasury all available money needed for public works, pooling the proceeds and dividing them among the aldermen to be applied to the various improvements that each alderman desires in his ward, so far as the money will reach.

SAYS NEW CAPITAL UNNECESSARY.

W. M. Acworth, one of the three members of the Royal Commission to Enquire into Railways and Transportation in Canada, wrote to the London (Eng.) Times on June 20th, stating that a cable message received recently from Ottawa by that paper "will, I fear, give rise to misunderstandings here among persons interested in Canadian railways."

The correspondent wrote:—

"Complete nationalization of the railways of the Dominion along the lines of the Acworth-Drayton report is impossible owing to the fact that Canada is shut out for the time being from the financial markets of London and New York."

Mr. Acworth writes:—

"Personally I do not accept that the plan as put forward by Sir Henry Drayton and myself is impossible. It is not impossible for reasons given. The course we recommend was expressly based on current war conditions, and was carefully planned to minimize the necessity for provision of new capital by the Canadian government."

MODERN ROADMAKING MACHINERY; ITS SELECTION, USE AND CARE.*

By W. Huber, A.M.Can.Soc.C.E.,
Assistant Engineer, Ontario Dept. of Public Highways.

ROAD construction is carried on under widely varying conditions, and the selection of machinery for any operation involves a careful study of these conditions. The capacity of the machines to be purchased, the power required, the most desirable weights for rollers, etc., should be carefully determined in advance. Equipment once used and found unsuitable cannot be sold or exchanged except at a heavy discount, and it therefore behoves the purchaser to make no initial mistakes.

The progress of the work and the interests of the machinery itself demand the very best class of operators. No machine is endowed with human intelligence, nor is any roadmaking machine automatic in action; success depends on human guidance and control, the efficiency of which is reflected in the results. While the various operations included in the construction of county roads may be classed as rough work, they require much skill and intelligence of a certain kind, and the lack of these two great essentials is sufficient to prevent results otherwise obtainable with even the best equipment.

The ordinary operations in the construction of country roads are grading, quarrying, crushing, hauling, rolling and watering. Each of these operations is now performed by up-to-date machinery as against more or less primitive methods formerly in use. For ordinary grading operations, work far superior to that done under the old method of shovel and scraper is now obtained from the use of grading machines, and in a fraction of the former time. The steam or compressed air drill has superseded hand drilling.

Efficiency demands that the stone be rolled and finished immediately after being placed on the road. If left only half-rolled, it is certain to be disturbed by traffic, and much of the roller's work is undone. The spreading and partial rolling of long stretches of stone is the cause of much unnecessary expense. Economical practice also requires that both crusher and roller be working to capacity, but that the roller is not rushed to such an extent as to encourage inferior or half-finished work. Exactly as much stone must be furnished the roller as it can properly consolidate, and no more.

A common source of loss in crushing road material is the attempt to operate a crusher with too limited capacity. In an attempt to compete in price there is a tendency on the part of some manufacturers to overstate the capacities of their machines. Selection of a suitable size should be based on more than the maker's or salesman's statements. The daily output of crushers with jaw openings less than 9 ins. x 16 ins. or 10 ins. x 18 ins. has been found too limited to satisfactorily supply the average roadmaking outfit, and the smaller machines should not be considered. Similarly the motive power should be sufficient to drive the machine at full speed under a full load. The time lost in a day's run due to slowing down when the load becomes heavy amounts to a considerable total. Frequently the boiler supplying steam to run the crusher also furnishes steam for a rock drill, under which conditions ample capacity is necessary. Experience has shown that where a portable or traction engine is used it should not be less than 20 horse-power.

*Abstract of paper read before the Fourth Canadian and International Good Roads Congress.

In the interests of the crusher itself, special attention should be given to lubrication. The conditions under which such a machine works are severe enough without its having to suffer from lack of oil. Owing to the dust, automatic oiling devices have not in general been found reliable, and good lubrication is better assured by the frequent application of small quantities from an ordinary oil can. The oil should be chosen with due regard to the weather. On hot days a heavier grade should be used than when the temperature is low. In cold weather a grade should be selected which retains its fluidity.

Even with the best of care, the wear on crusher bearings is very rapid. In the selection of an outfit a point worth considering is the ease with which bearings and other wearing parts may be replaced. Certain makes of crushers are now supplied with replaceable babbit bearings fitting into machined seats, and the work of renewal is accomplished in a few minutes.

Almost equal to intelligent operation and feeding as a factor governing crusher output is the condition of the jaws. As usually supplied, the jaw plates or dies are of chilled cast iron and wear is rapid. In spite of a much higher cost, jaws of manganese steel are cheaper in the end, and by reason of the much slower wear, give a more uniform product.

The selection of screens for separating the various sizes of crushed stone is important. For road work, two screens, furnishing three sizes are advisable, the sizes of the perforations depending on the character of the stone. When limestone is being crushed the perforations giving best results are 3-inch and 1¼-inch or 1½-inch. For use with granite or trap rock, the perforations should be rather smaller, 2½-inch and 1-inch holes having been found most satisfactory. An excess of dust may be removed by means of a dust jacket placed around the fine screen. A bad practice occasionally observed is that of using three screens having approximately 3-inch, 1½-inch and ¾-inch perforations. This arrangement gives four sizes of stone, including a size ¾-inch to 1½-inch, which when used by itself is more detrimental than useful.

The stone having been placed on the road, the next, and in many respects the most important operation, is that of rolling. The intelligent selection of a roller requires the careful consideration of a number of points. First, the weight must be decided on, and will be governed principally by the subgrade on which it is going to work. On old gravel or stone roads, which furnish a firm foundation, a 12-ton roller may be used to advantage. This size should, however, never be exceeded on country roads. Where the roads have not been previously metalled or where the subgrade is not firm, better results will be obtained with a 10-ton roller, which does not tend to disturb the subgrade to the same extent as the heavier machine.

Motor-driven rollers having in recent years come into prominence, the choice between steam and gasoline or kerosene may well be considered. Owing to its longer and wider use, steam is more generally understood, and it has heretofore been easier to find operators who understand steam engines than those conversant with gasoline motors. This condition is rapidly changing, and with the greater simplicity and increasing reliability of gasoline engines, together with the greater number of men who really understand them, the motor roller is rapidly gaining in favor. It has a number of advantages over the steam roller. No time is required for raising steam, and no delays are incurred through the necessity of firing and taking on water. The time saved by reason of these advantages is estimated at from one and one-half to two hours per day. Smoke and soot are eliminated, making it preferable for work on urban streets. Provided with a competent operator, the motor roller can undoubtedly perform more work in a given time than its steam-driven competitor.

If a steam roller is selected, it should be one with a double-cylinder engine. The twin or compound engine has so many points of superiority over the single cylinder that the slight extra cost is fully justified. Combined with smoother running, it has the advantage of being able to start from any position. This latter advantage is most marked when the roller has dropped into a hole or has slid into a ditch. With a single cylinder engine it is frequently necessary to reverse in order to get a start, and this has usually the effect of putting the machine further into difficulty. Cross-compound engines are now found on numerous rollers, which possess, in addition to the foregoing, the advantage that live steam may be turned into the low-pressure cylinder to provide extra power when required.

The greatest wear on a roller is seen on the rear rolls, which soon become rounded. When this occurs consolidation is slower and not so well done. With rear wheels having detachable rims, such as are supplied on certain rollers, the cost of renewing the rims is much smaller than where the entire wheel must be purchased.

The roller is, or should be, the limiting factor of the organization, and as it is the most expensive part of the outfit, it should be worked to capacity. It is a comparatively easy matter to suit the other operations,—quarrying, crushing, hauling, grading, etc., to the capacity of the roller. For this reason it will pay to secure the most capable operator obtainable. His duties are twofold,—to obtain the greatest amount of effective work from the roller, and to keep it in a condition of maximum efficiency. Having secured such a man, it is advisable to hold him at almost any cost, for the savings he can effect will amount to many times his wages.

The principle on which all rolling should be done is that of securing the utmost consolidation with the least work. It must be so performed that each passage of the roller accomplishes something in the final consolidation of the stone. With careless or inefficient handling the roller may on one passage partly undo the work of the former trip, and not only will the work required for final consolidation be increased, but the result will be less satisfactory. Excessive rolling wears the sharp edges off the individual stones, thereby destroying an important factor in the prevention of internal movement.

To prevent this waste it is necessary that the road be kept finished right up to the wagons delivering the stone. This is especially true where a temporary road is not available and traffic is forced onto the partly consolidated metal.

Satisfactory consolidation can be secured only when the stone is confined at the sides. Unless a shoulder of some kind is furnished to keep the stone within the required width the weight of the roller on top will cause it to spread and form a thin edge which is easily broken off, at the same time destroying the crown of the finished road. A shoulder permits an appreciable depth of metal on the outer edge, the stone is consolidated with the width originally intended, and the time of rolling is considerably shortened. This shoulder may be formed with the grader, or if the subgrade is very hard, or consists of old metal which it is desired to leave undisturbed, a small trench may be picked at the outer edge of the width desired, which will effectually hold the metal within that width.

The efficiency and economy of rolling depends on continuous operation, and anything which tends to retard the roller destroys its efficiency and raises the cost. Frequently a serious retarding influence is lack of water for finishing. Delays due to this cause may be prevented by the employment of two tanks in order that there may always be a full tank on the job. Considering the delays which may be caused by lack of water, the cost of operating an extra tank is negligible. Hand pumping which was always laborious, particularly in hot weather, is now replaced in up-to-date outfits by a pump driven by a small gasoline engine mounted on the tank.

As a means of moving large quantities of material, team haulage is fast losing its importance. The increasing wages of teams and men has made this method, always woefully inefficient, almost prohibitive, and it is being replaced by mechanical traction. The cost of team haulage is usually between 20 cents and 40 cents per yard-mile with an average on country roads of from 25 to 30 cents. Under very favorable conditions traction haulage has been accomplished for less than 5 cents per yard-mile, while a fair average would probably be 8 cents to 12 cents. With such a difference in unit costs for the transportation of material it is a source of wonder that teams are still used to such a great extent.

A common mistake in the purchase of hauling machinery is that of selecting equipment which is too large and heavy. For country roads, experience has shown that the size of the traction wagon should not exceed three or four yards. The larger sizes are too heavy for certain roads, are more difficult to handle, and are generally unsatisfactory. Better results can usually be obtained from reducing the size of the car and increasing the number. One advantage attending the use of smaller cars is that where a steep hill on a route compels a slight reduction of the load it may be accomplished by the dropping of a single car. If two or three large cars are used the dropping of one car means the reduction of the load by a much larger percentage than when only one of a larger number of small cars is removed. Nothing but reversible cars should be used, otherwise the train may be compelled to travel a considerable distance along the road to reach a suitable turning place.

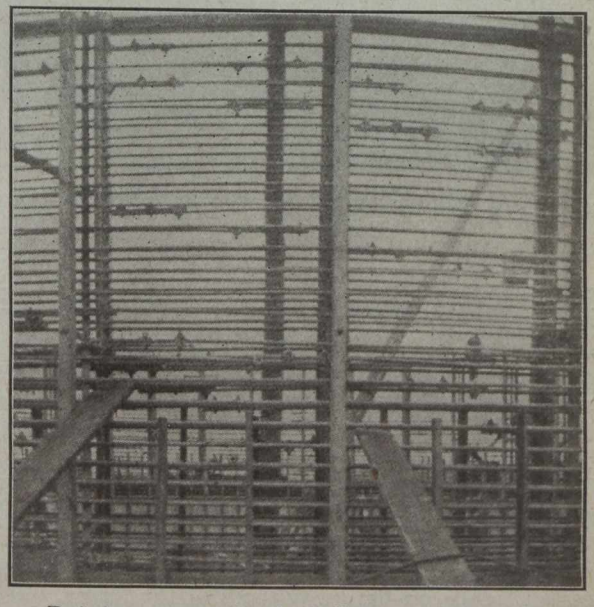
The entrusting of general care and repairs to the operator of each machine is inefficient, extravagant and dangerous. Operators are changed frequently, and many of them go to one or other of the two extremes of wanton neglect of their machines or a desire to be continually "tinkering" with it,—either of which is bad for the machine and bad for the work. "Everybody's machine is nobody's machine," and continuous and efficient operation of equipment can be assured only where responsibility for the condition of the entire outfit is centered in a capable master-mechanic. His duties should include frequent personal inspections of each machine, both in operation and at rest, the acquiring and storing of a reasonable stock of repair parts likely to be needed, and the supervision of all repair work.

Care of machinery during periods of idleness is almost, if not quite, as important as its care during operation. A few months' exposure to the elements, or to conditions promoting rust, will cause greater depreciation than a whole season's legitimate use.

Summing up, modern roadmaking requires modern machinery. In order that it may give best returns for its cost it must be exactly suited to the work it is doing, it must be operated by competent men who know how to get results from it, it must be operated without loss of time, and it must be kept under experienced supervision and carefully maintained. Failure of any equipment to accomplish all that is expected of it may usually be traced to the violation of one or more of these rules.

BUILDING A 2,000,000-GALLON REINFORCED CONCRETE TANK.*

THE new 2,000,000-gallon reservoir for the water system of Tuscaloosa, Ala., is a reinforced concrete cylindrical tank 75 ft. in diameter and 62 ft. high with a concrete floor on red clay 5 ft. below the surface of the ground. The wall, 10 ins. thick at the top and 42 ins. thick at the base, is battered on the outer face and is heavily reinforced by horizontal circular bars, single rings in the top, double rings in the intermediate lengths, and triple rings at the bottom. The wall rests on a continuous circular concrete footing about 6½ ft. wide and about 3½ ft. deep on which it takes bearing with a circular tongue-and-groove joint. The inner edge of the footing is rebated to receive the double floor having a 6-in. bottom part reinforced by two crossed layers of half-inch twisted bars 12 ins. apart and a 4-in. upper floor without reinforcement.



Reinforcement Steel, Splices, and Vertical Spacing Angles.

Building Foundations.

The ground was excavated about 6 ft. and carefully levelled for subgrade of floor and the circular trench was excavated to a depth of 8 or 10 ft. for the wall footings. Concrete blocks about 8 ins. wide, 8 ins. thick, and 4 ft. long were set in the bottom of the trench about 6 ft. apart to receive the framework for the wall reinforcement. This consisted of three circular rows of 3 x 2½-in. angles with their lower ends seated in 3½ x 3½-in. pockets 2 ins. deep moulded in the tops of the blocks. The angles in the inner row were vertical and extended to a height of about 50 ft. The second row was also vertical and extended to a height of about 30 ft., and the third or outer row was battered parallel with the face of the wall and extended to the top. The angles were made in convenient lengths with bolted splices and ½-in. holes were punched

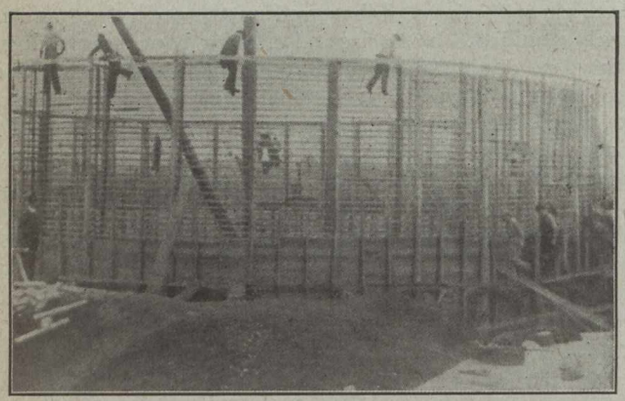
*From "Contracting" of Chicago.

in their circumferential flanges to receive the connections for the horizontal reinforcement bars.

The location of this reservoir was on ground higher than the surrounding country, where strong winds were quite common. For that reason the forms were fastened rigidly to the steel framework and the entire wind stress was transmitted through them to the anchorage of the angles in the foundation blocks.

Wall Forms.

A ring of 2 x 10-in. plank cut to a radius of 37 ft. 5 ins. was laid flat and doweled to the floor on the inner side of the wall footing. On this were seated 4 x 4-in.



Assembling Reinforcement Steel in Advance of Form Construction.

vertical studs 3 ft. apart on centres with 1-in. matched flooring boards nailed to their outer faces and to the outer face of the circular ring, to make the inner concrete form. The outer form was similar except that the boards overlapped the vertical shoulder of the wall footing and the circular plank was laid on radial 2 x 4-in. pieces doweled to the footing.

The outer and inner forms were braced and connected at intervals of 5 to 10 ft. by horizontal 2 x ¼-in. steel bars set on edge with their ends bent at right angles to make flanges secured by horizontal bolts passing through the vertical studs on the outer faces of the forms. These bars were punched with holes to receive bolts through the flanges of the vertical angles and held them in position at the proper spacing.

Assembling the Reinforcement.

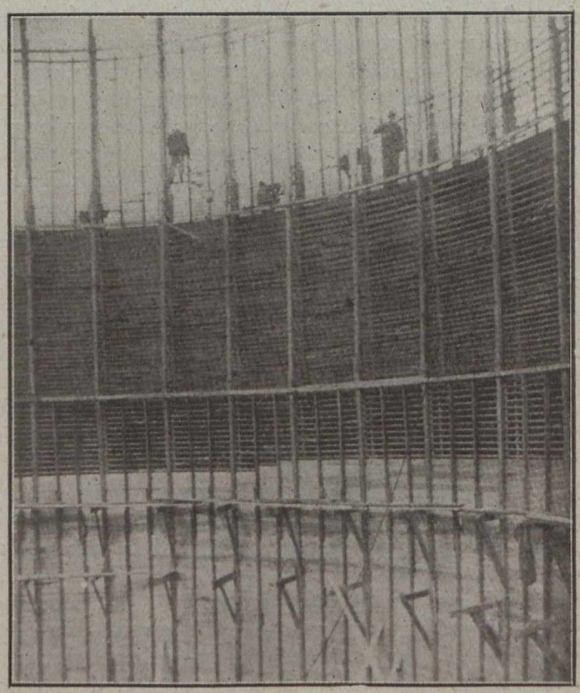
The lower sections of the vertical angles were set in place in the sockets of the concrete blocks and the concrete footing was cast around them, giving them abundant stability and rigidity. The upper ends were bolted to the radial facing bars and were spaced circumferentially by temporary wooden strips which held them securely until the footing concrete was placed.

The reinforcement bars in 50-ft. lengths were sprung to position in contact with the vertical angles and were spliced to make continuous circles with overlaps secured by three Crosby wire clips, making an expensive connection which the contractors believe might have been easily replaced by longer laps, without the clips. Soft steel ⅜-in. rods with one end upset so as to form a head and making pieces similar to long button head rivets were put through the open holes in the vertical angles and formed supports on which the circular reinforcement bars rested. The ⅜-in. rods were then bent to U-shape enclosing the circular bars and holding them tight against the angle bars.

After the circular reinforcement bars were assembled, the inside and outside forms were built from the bottom up and bolted to the horizontal bent radial bars.

Both reinforcement steel and form timber were handled by a derrick installed in the centre of the reservoir with a round timber mast 85 ft. high and a somewhat shorter boom both made of local timber. The mast was guyed with very long ropes, making angles flat enough to clear the top of the reservoir and allow the boom to swing over it in a complete circle.

After the forms were boarded up to the top of the vertical studs, the latter were extended by additional sections spliced to them, a second row of inside and outside brackets was nailed to the studs to carry tackles for working platforms, and the assembling of the reinforcement was continued. Additional lengths of angles were spliced to the lower sections and braced circumferentially and radially as before and the circular reinforcement bars were assembled and cast as already described. The inner and outer forms were then built up again to the top of the studs, and so on, both operations being repeated to the top of the wall. None of the forms were shifted or used twice, this method providing for continuous complete forms from top to bottom on both the inner and outer faces of the wall. It is obvious that the form gained little strength from the uprights, but the rigid steel framework to which the sheeting was bolted made the form monolithic and prevented any perceptible movement in high wind. The uprights were merely bearing strips assisting the bolts in holding the sheeting. The decision to build a complete form instead of lifting sectional forms was based on the wishes of the engineers that it be done in that manner, and the price of the lumber used, which was a high-grade for such work, being but $10 to $12 per M. There was approximately 100,000 ft. of lumber used, the salvage value of which, for other work



Interior View of Reinforcement and Scaffolds.

outside of the lumber region, was considerably more than the cost of transportation. It is the opinion of the contractor that there was little difference in the cost of form work, whether sectional form method was used or the method which was adopted. The steel frame work in-

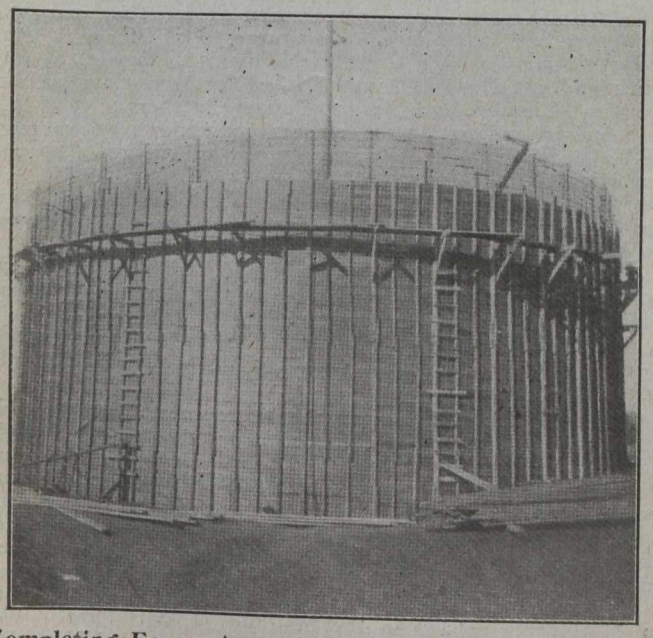
tended to support the reinforcement made this method of construction possible with practically no expense for bracing forms of such height, which would otherwise be a costly requirement.

Concreting the Circular Wall.

Concrete made with 1:2:3 washed sand and gravel and standard Portland cement was machine-mixed outside the reservoir, and was discharged from mixer into a chute which extended through a 20-in. cast iron wall sleeve and delivered the concrete into a tower bucket.

The tower bucket was hoisted by a line carried through a pipe in the wall to the same hoisting engine that operated the derrick. The concrete bucket was automatically dumped at the successive required heights into a receiving hopper moved up in 10-ft. lifts as the work advanced.

The receiving hopper discharged into wheelbarrows on the inside circular scaffolds, which in turn dumped into



Completing Forms Around Finished Reinforcement Steel.

small movable wooden hoppers that delivered the concrete through 6 x 12-in. holes cut in the inner form and closed as the work advanced.

Two men were stationed in the form to spade the concrete but their work was very difficult on account of the small clearance between the reinforcement bars and it was therefore necessary to make an unusually sloppy mixture of concrete with a larger amount of water than was usual.

Care was taken to maintain continuous operation in pouring the wall which contained about 1,200 yds. of concrete and was poured in about 180 hours, the men working two 11½-hour shifts daily with half-hour intervals for lunch at noon and at night. This secured an absolutely monolithic wall through which there was at first a slight percolation partly by seepage which dried up eventually, and partly through a few small leaks which were easily repaired from the inside.

After the wall was cast and the forms stripped, the exterior was finished by rubbing with corundum bricks from light scaffolds suspended from the top of the wall and lowered to the ground, permitting the men to cover all portions of the surface.

Laying the Floor.

Both upper and lower floors were laid in separate sections consisting of a centre octagonal slab about 15 ft. wide and eight corresponding sectors, each of them divided by a transverse line midway between the centre slab and the circumference and reducing the longest dimension to about 15 ft. The dimensions of the slabs in the upper floor varied somewhat from those in the lower floor, so as to stagger the joints between the sectors and at the centre piece, making them overlap. The outer portion of each sector was also divided into two pieces in the upper floor.

The upper floor was of plain concrete but the lower floor was reinforced by two tiers of ½-in. twisted rods about 12 ins. apart on centres. These were blocked up from the level surface of the ground and were aligned and spaced by boards laid edgewise and provided with notches to receive the bars.

The floor and footing contained 400 yds. of concrete, making a total of 1,600 yds. for the entire reservoir. The reservoir was commenced in November and completed the next February, thus being built in about 75 working days with an average force of 45 men. The total labor cost, including washing of sand and gravel for the concrete, was $7,500.

It was designed in the office of Morris Knowles, Pittsburgh, and was built for a contract price, including extras, of about $31,000. The contractor was The Pitt Construction Co., Pittsburgh, E. D. Harshbarger, president.

Letter to the Editor

Municipal Consulting Engineers.

Sir,—Upon my return to the office, after having been away for a considerable period, my attention has been called to Mr. Godfrey's "Letter to the Editor" in your issue of May 17th, in which he says that we may know of a certain town in the southern part of the province where the cost of a waterworks system was estimated at a certain figure, and that when the bids for the work were found to be in excess of the estimate, and that the money to proceed with the work would not be forthcoming, the estimates were pared and bids received within the amount available, after assuring all concerned that the first figure was an overestimate for the work proposed.

From private advices we have received, we have no doubt but that Mr. Godfrey refers to our own firm's work at Assiniboia. We can hardly understand Mr. Godfrey's accusations. We made an estimate for this work, and when the council took the matter before the local government board, the board gave them a sum of money which was lower than our estimate. Under these conditions we of necessity had to eliminate certain portions before the work could be proceeded with. We feel that our estimate easily covered the contract prices as received at the time of the letting of the contracts.

MURPHY & UNDERWOOD,
Consulting Engineers,
per J. E. Underwood.

Saskatoon, Sask., June 23rd, 1917.

MOBILIZING OUR HIGHWAYS.

"At the present time the railways in some parts of the country are so congested that it is impracticable to handle local freight," says a recent bulletin of the American Highway Association. "This condition will continue for some time, if the announcements by railway officials are reliable forecasts. In the vicinity of important railway centres this congestion is particularly marked, because the facilities are taxed so heavily for through shipments that the local demands are very far from being met. It is not surprising, therefore, that the roads are being considered very seriously in many places as the best relief from the serious interference with commercial and industrial activities. Before the year is over it is probable that motor trucking on suburban and main roads will develop far beyond anything expected six months ago.

"The maintenance of these roads under such traffic will call for the highest skill and good judgment, and already it has been suggested in some places that it will be desirable to restrict the trucking to certain roads and keep it off those which are not surfaced to carry it properly. Other suggestions are to maintain to a much lower standard those roads which are used by large numbers of trucks, providing merely a durable, rough surfacing, free from ruts and holes, like that employed on the new military roads of France. Still other suggestions are to concentrate all the new construction and reconstruction on roads of high grade suitable for both trucking and lighter service.

"The fact is, there is no generally applicable rule to govern such work, and the improvement best for one locality may not be desirable for another. Some kind of improvement must be made in very many places, however, if the motor truck is to come to the relief of the overcrowded railways, and the way to determine what shall be done is to ascertain where trucks must be run to meet best the demands for better transportation and then improve the roads so they will serve this purpose.

"It is by no means certain, without considerable study, that heavy trucks will be used extensively; five-ton trucks are not increasing in general favor while lighter sizes are growing in popularity. A truck weighing, loaded, not over 3 tons and moving at a speed of 18 miles an hour, is no more destructive to a road, so far as is known now, than a heavy touring car driven at a speed of 30 miles. This is indicated by Prof. Kennelly's experiments on roads near Boston, which showed that the speed had a very great influence on the resistance of a road to travel, and consequently on the destructive effect of a vehicle on the road, provided the road was strong enough to carry the loads without breaking through.

RAILWAY ROLLING STOCK SITUATION.

In replying to questions at the Canadian Manufacturers' convention at Winnipeg last month in regard to the car shortage, Colonel Cantley said that when the war broke out foreign governments, especially Russia and France, came to Canada and the United States and sought to place contracts for the manufacture of cars and other railway rolling stock. The Canadian car manufacturers went to the government and stated that if the Canadian government wanted cars manufactured they would not accept the foreign contracts, but that if the government did not, they would. The government said there was no work to be done, and, consequently, the car manufacturers accepted the foreign orders. Those presented many difficulties in the matter of price and delivery, especially as the Panama Canal was closed. Some months after the government asked for cars for the Transcontinental, but the car manufacturers could not handle them as the companies had contracted to deliver for foreign governments altogether between 16,000 and 18,000 cars.

To-day, if the government had money and were prepared to place orders for cars, there could be no relief for the present car shortage for at least six months, and no material relief could be got for probably a year.

The reason also for car shortage was the fact that the wooden cars were running out of existence at the rate of fifty a week on some lines.

The urgent need for rolling mills in Canada was emphasized by many of the members, so that the steel plates for the manufacture of locomotives could be got in the country without having to go to the States for them.

BUILDING SHIPS IN BRITISH COLUMBIA

The result of the investigation conducted by Mr. R. P. Butchart and Capt. Troup, of the Imperial Munitions Board, in regard to the construction of a number of wooden vessels in British Columbia, was given in the following report recently handed out by Mr. Butchart:—

"There being only a limited number of vessels to be laid down within a given time, there have been a great many difficulties and considerations to be dealt with. The board is able to report, however, that final negotiations are now in progress for completing the following programme:—

"Five ships to be laid down at the old Turpel's shipyard, Victoria Harbor, by the Foundation Company, Limited.

"Four hulls to be laid down by the Cameron-Genoa Bay Shipbuilding Company's yard, Victoria Harbor, in addition to which, the Cameron-Genoa Bay Shipbuilders will complete the remaining vessels they have under contract for private owners.

"In New Westminster four hulls will be laid down by the British Columbia Construction and Engineering Company, associated with the New Westminster Marine Railway Company.

"In Vancouver six hulls will be laid down by the Western Canada Shipyards, Limited, a company formed by associating under one organization the interests of Messrs. Armstrong, Morrison and Company, Limited, Messrs. Grant, Smith and MacDonald, Limited, the Northern Construction Company, Limited, and Messrs. Palmer Brothers.

"And in addition, arrangements are under way whereby the Wallace Shipyards at North Vancouver will get a proper proportion of the hulls to be built.

"The Coquitlam Shipbuilding Yard has been taken over by the Pacific Construction Company, who will lay down two hulls.

"This programme, when concluded, will complete the plans laid down by the ministry of shipping to the Imperial Munitions Board for wooden steamers."

Mr. Nicol Thompson, ex-president of the Vancouver board of trade, is quoted by a Montreal paper, as giving the following interview:—

"Because, notwithstanding the fact that we have the raw materials, we have to get our steel from the United States, and, because we believe that, with a little assistance, we can build up a permanent steel shipbuilding industry on the Pacific coast of Canada, a deputation from the Vancouver board of trade will wait upon the government at Ottawa and ask for aid in the building of a $5,000,000 to $10,000,000 steel industry for British Columbia. We want an iron and steel plant, especially fitted up for the turning out of all the iron and steel parts needed in the building of steel ships. We are building steel ships now both at Vancouver and Victoria, but we are dependent on our neighbors to the south for our steel.

"All we need is the steel plant. We have iron ore and coal in abundance, all along the coast for hundreds of miles, and at tide water. We think that British Columbia has every advantage for the building of wooden as well as of iron ships. There is no finer timber in Canada for the building of ships than Douglas fir. But we recognize that the demand for wooden ships is but temporary and we are now trying to make provision for steel shipbuilding—which will be permanent."

The first keel of the six vessels to be built in Vancouver will probably be laid down within three months by the Western Canada Shipyards, Limited, and from 400 to 700 men ultimately will be given employment. The vessels to be built are to be wooden, of a gross tonnage of 2,800, and 280 feet in length by 44 feet beam, but the plans allow of the construction of steel ships in the future, although this policy has not yet been definitely decided upon. Four ways are to be laid down upon the property, and arrangements have been made for the necessary buildings and railway siding to insure an efficient plant.

According to a United States Commerce report, among the construction work planned in Manchuria are the Dairen engine sheds, a system of sidings for the use of the Anshanchan Steel Works, the completion of the double-track bridge over the Hun, the extension of the Ssupingkai station and the replacement of 60-pound rails with 80-pound on forty-eight miles of line.

Editorial

AFTER THE WAR.

Senator Frederic Nicholls introduced a resolution in the Senate recently, calling for the appointment of a committee to inquire into and report upon the best methods of conserving and increasing our domestic and overseas trade, so that at the end of our present prosperity, we may not unduly suffer when the stimulus resulting from munitions orders and other war supplies is removed. After the war, trade and commerce will again be disorganized. New conditions will be met. In addition to conserving our present trade in natural and manufactured products, efforts must be made to increase our trade in foreign markets. The countries now at war, particularly those that have been devastated in Europe, will have to expend large sums in reconstruction, and will become customers of those countries which are most ready to supply the requirements promptly and at a reasonable price.

The Senator is one of the first of our prominent manufacturers to admit that in this country we have had little experience in either looking for or catering to an export trade, and if we desire to share in the volume of business that will be offering overseas, we can make our preparations none too soon.

Admitting that Germany in the past has built up her foreign trade largely through the help of the State, and admitting, as intimated by Sir Robert Borden, that State aid will be extended at even greater lengths after the conclusion of the war, it behooves us, said Senator Nicholls, to consider whether we in Canada will leave to the individual the development of the foreign trade that might naturally accrue to Canada, or whether the government of this country will, in some form, undertake to assist in the development. The Canadian government probably will have to take a more intimate interest in the active promotion of foreign trade. The British government for two years has been making its preparations for the encouragement of British trade and commerce after the war and the preparations are well advanced.

We have a number of commissions working on various problems. The government should be encouraged to seek the services of business men and experts, as is being done particularly in Germany, France, Great Britain and the United States. The war, and the period to follow, involve matters too large to be handled adequately by governments as they were before August, 1914. The problems we are facing, and will face, are sufficiently complex and serious to demand the attention of the most capable business men of the country, working in conjunction with the cabinet ministers and their deputies.

HANDLING CONSTRUCTION MATERIALS.

At this time, when every car on the continent is urgently needed, special attention must be given to methods of handling construction materials. Cars which are standing on sidings or in teaming yards, waiting to be unloaded, are doing nobody any good. Their idleness not only deprives shippers of their use when they are sorely needed, but their presence in yards which are crowded is a nuisance. Incidentally delays in unloading them are expensive to the persons to whom their contents are consigned, on account of demurrage charges. As a matter of fact, however, these charges by no means represent the loss at present caused to the public by delays in unloading cars, and they should be much higher. Several years ago roadbuilders, for instance, discussed at length the difficulties caused by the practice of holding on sidings, for long periods, the tank cars in which road oil is shipped; and now, where any considerable amount of work is done with bituminous materials, large storage tanks are often provided so the cars can be discharged as rapidly as possible and returned to the shipper. Now that cars used in delivering brick, gravel, broken stone, cement and all other materials are so difficult to obtain, it is desirable to employ the same promptness in removing their contents as that which the roadbuilders generally show in the case of tank cars.

RECONSTRUCTION AND THE ENGINEER.

The new atmosphere created by the events of the past three years will make the general public intolerant of past methods of government. It will require facts rather than finely spun theories.

It has been the engineer who has saved Europe and all civilization by destruction. The same adaptable individual can save the future by reconstruction; the task is well within his powers. Statecraft is merely national engineering; large extension of solutions already made in various directions by the engineer form a solid basis upon which to build.

It is a mystery why the engineer is inarticulate; he knows and is seemingly content with knowing. Men of action are rarely glib of speech. It would seem as though we now choose our masters by the sole test of ready tongue and whirlwind delivery. Any man, however hesitant, who has a real grip of solid fact, can, with some practice, interest an audience. Hesitant delivery, if the sense is right, will be tolerated. Glib tongue and easy promises which always fail to mature are the ordinary experience of the existing system.

This much at least is certain, that as the creator of modern wealth, the engineer fills the pockets of the community. It is high time an exchange of commercial values be made. Every engineer should see to it that the opportunity now open should not be allowed to pass. A similar chance to exchange the men who do for the men who talk will possibly never recur.

The profession of an engineer is popular in the sense that, although it is not understood by the layman, the latter is quite able to judge cause from effect. Where the achievement is wonderful it is safe to infer that brains and capacity of a high order accompanied the material to produce the visible end. The man who designs bridges, builds docks and railways, and employs thousands on a single job, can surely apply this mentality and fertility of resource to aid in governing a country.

There are, doubtless, numerous reasons why the engineer does not figure in the national administration,

but none of them can be allowed to stand in the way of the vital and pressing need of his services in a public capacity. The engineer is as public-spirited and patriotic as any other section of the community and once the need for his aid is realized, it will be easy to accomplish his elevation to office. This much is certain about history, that it never repeats itself; the fact that no engineer has held the highest possible offices merely emphasizes the probability that his turn is imminent. No one can ask a higher destiny than to serve one's country in a responsible capacity, especially when fitted in a peculiar manner to guide and control. The curve of tendency is to select men of proved capacity rather than men of words, and this points to the engineer as the future legislator.

PERSONALS.

FRANK HEARNE CROCKARD, of Birmingham, Ala., has been elected president and general manager of the Nova Scotia Steel and Coal Company, Limited, as noted in this column last week. Mr. Crockard is vice-president of the Tennessee Coal, Iron and Railroad Company. As the Boston News Bureau says, "he is a steel man by birth and experience. He is very largely the recreator of the old, decrepit Tennessee Coal and Iron Company. Under his direction that company has expended some $33,000,000 in reconstruction and development work. It has been brought up from a state of inadequacy and inefficiency to a position where it is one of the bright stars in the United States Steel Corporation's galaxy of subsidiary corporations." Mr. Crockard was born at Wheeling, West Virginia, and educated at Lehigh University, South Bethlehem, Pa., and at the Michigan College of Mines. Upon completion of his university work, he at once engaged in the iron and steel business, first as blast furnace superintendent of the Riverside Department of the National Tube Company, continuing with that firm until his election in 1906 as vice-president and general manager of the Tennessee Company. John A. Topping, chairman of the Schley Syndicate, placed him in general charge of new construction. Upon the acquisition of the Tennessee Company by the United States Steel Corporation, Mr. Crockard continued his work in charge of all operations, including extensions and betterments exceeding $30,000,000. As chairman of the executive committee of the Alabama Coal Operators' Association, he labored consistently to establish and maintain harmonious relations between employers and employees. Mr. Crockard is a member of the Alabama State Board of Directors of the Naval Consulting Board, the American Iron and Steel Institute, the Iron and Steel Institute of Great Britain, the American Society of Civil Engineers and the American Society of Mechanical Engineers.

COL. THOS. CANTLEY, who for many years has occupied one of the foremost positions in the Canadian steel trade, recently made a request to be relieved of his exacting duties as president and general manager of the Nova Scotia Steel and Coal Company. He was general manager of the company for sixteen years and served as president for the past two years, since the retirement of Judge R. E. Harris. "Scotia" has been the pioneer in the steel trade of the Dominion, and Colonel Cantley has been responsible for its growth from a small company, with a capital of $150,000 and employing about 200 men, till to-day it has a capital of over $20,000,000 and is carrying on its pay-roll about 7,000 employees. The directors only agreed to accept his resignation upon the condition that he accept the chairmanship of the board of directors, so that the company can retain the benefit of his experience, foresightedness and executive ability.

Major E. G. M. CAPE, president of E. G. M. Cape, Limited, general contractors, Montreal, has returned to Canada from the front on sick leave. Major Cape was recently wounded.

F. J. CRONK, Jr.M.Can.Soc.C.E., has been appointed lecturer in Railway Engineering and JAMES WEIR lecturer in Surveying at McGill University.

A. LONGSTAFF, for seven years superintendent of the municipal electric plant at Cardston, Alta., has resigned to take over the management of the electric light department at Pincher Creek, succeeding F. RHODES, who has enlisted in the Flying Corps.

J. B. TYRRELL, consulting mining engineer, of Toronto, has been appointed Canadian representative of the Consolidated Mines Selection Co., of London. The company's president, Walter McDermott, began his professional career at Silver Islet on Lake Superior. Mr. Tyrrell will also continue to represent the Anglo-French Exploration Co., of London.

A. G. NORRIS, transmission expert with the S K F Ball Bearing Co., Hartford, Conn., will spend about three months in Canada on behalf of this company and in co-operation with the Canadian Fairbanks-Morse Co., who are agents in Canada for the S K F transmissions. Mr. Norris will work on transmissions only and divide his time between the Montreal and Toronto territories.

C. U. PEELING has accepted the position of manager of the Stormont Electric Light and Power Co., Limited, and the Cornwall Street Railway, Light and Power Co., Limited, in succession to WILLIAM HODGE, resigned. Mr. Peeling was manager of the gas and electric properties at Oshawa, Ont., for some years, and latterly for the Hydro-Electric Power Commission.

Lieut.-Col. J. W. BOYLE, of the Canadian Militia, and Lieut.-Col. J. A. MacDONNELL, of the Canadian Pioneer and Railway Battalions, have been sent to Russia by the American Committee of Engineers in London, a body of prominent engineers organized to render advisory and practical assistance to the United