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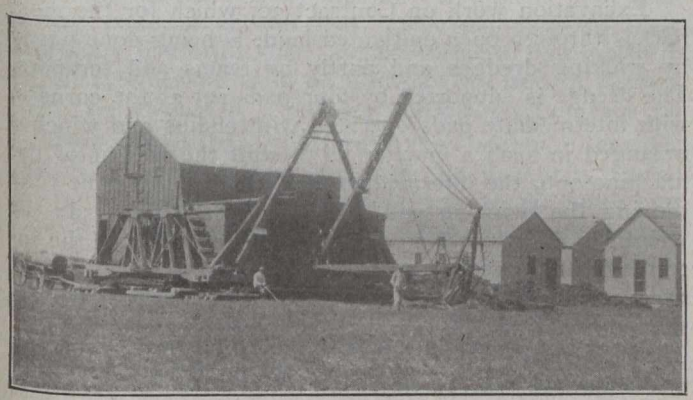
THE GREATER WINNIPEG AQUEDUCT

Methods of Construction of the Arches and Inverts—Railroad Will Be Permanent—This Year's Schedule Calls for Completion of 85% of the Concrete Work—Two Important Contracts Yet to Be Let

By CHAS. S. LANDON, A.M.Can.Soc.C.E.
Assistant Engineer, Greater Winnipeg Water District

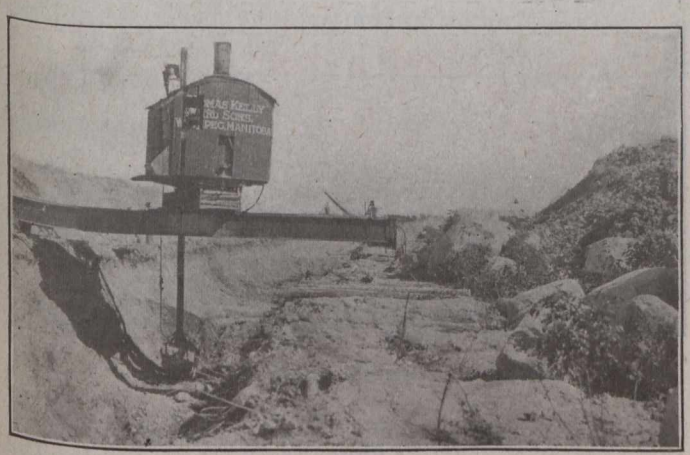
GREATER WINNIPEG, as an organization for the purpose of constructing the aqueduct, comprises the city of Winnipeg, the city of Saint Boniface, the town of Transcona, the municipality of Saint Vital, and part of the municipalities of Fort Garry, Assiniboia, and



"Walking" Dredge Excavating Trench on Contract 30

part of East and West Kildonan. This territory is known as the Greater Winnipeg Water District.

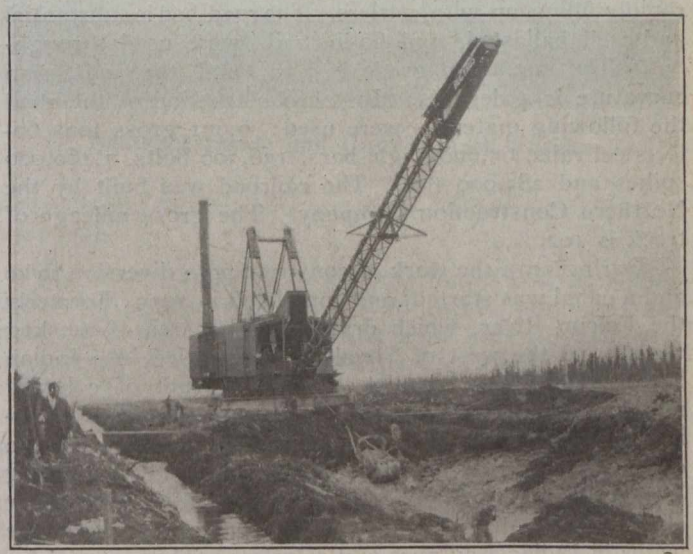
The scheme, which is nearing completion, is to bring water by gravity from Indian Bay, an arm of Shoal Lake,



Shovel, With Extra Long Arm, on Contract 31

itself a portion of the Lake of the Woods, to Winnipeg, and nearby municipalities. The distance is approximately 100 miles and the greater portion of the country through which the aqueduct passes was of an inaccessible nature.

The cost of the physical portions of the completed undertaking will be approximately $13,050,000. The main construction features of the scheme are a standard gauge constructional railroad having 111 miles of permanently established trackage, a dyke at Indian Bay 7,000 ft. long and containing 230,000 yds. of material, a telephone system which cost $32,000, an intake at Indian Bay, 96.5 miles of aqueduct including seven river crossings which are built as inverted syphons, a tunnel under the Red River lined with 5 ft. cast-iron pipe, and a 48-in. cast-iron pipe line from the Red River to the McPhillips Street reservoir in Winnipeg. The completed aqueduct will be capable of delivering 85,000,000 gallons



Dragline Excavator on Contract 34

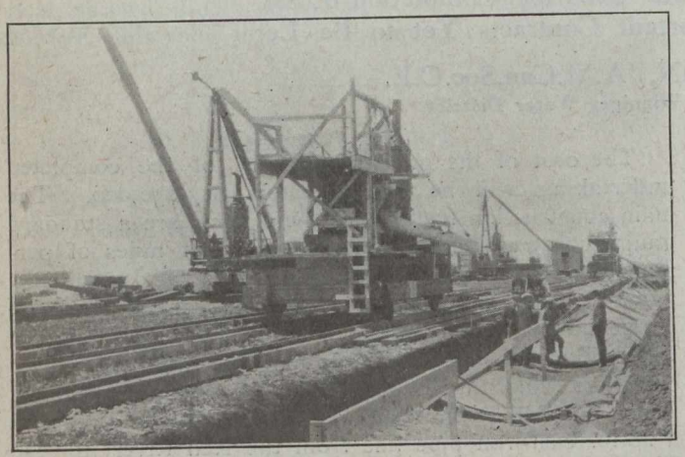
of water daily, or enough for the needs of the district until the population of 850,000 is reached.

The district supplies all cement and aggregate to the contractors and is thus able to control and vary the quantity of cement and aggregate in the mixture as desired. The cement is contracted for yearly and the aggregate is obtained from two pits and a rock-crushing plant, which are operated by the district.

The mixture which is used at present is 3 bags (262½ gross lbs.) of Portland cement to 18 cubic feet of loose aggregate containing its natural moisture. This mixture is approximately the same as the standard 1:2:4 mix which is usually specified for water-tight work.

Actual work on the scheme started in the fall of 1913 when parties were put in the field, and an administration and engineering staff established, with headquarters in Winnipeg. The final location was made early in the spring of 1914, and the contract for clearing a right-of-way varying in width from 300 to 500 ft., was let to E. J. Bawlf, of Winnipeg, who completed the work that year at a cost of $79,360. The acreage cleared was approximately 2,600, with a salvage of 7,900 cords of wood, 349,000 lin. ft. of poles and 14,500 fence posts.

The railroad was completed late in 1914 at a cost of $1,400,000 and will remain as a permanent feature of the



Movable Concrete Plant

work, as the country hitherto practically inaccessible is rapidly filling up with settlers. The road-bed is substantial and well ballasted, and 60-lb. rails were used throughout. The maximum grade is 0.5% and the maximum curvature is 4 degrees. In the construction of the road the following materials were used: 9,671 gross tons 60-lb. steel rails, 65,600 angle bars, 136,300 bolts, 1,160,000 spikes and 285,000 ties. The railroad was built by the Northern Construction Company. The gross mileage of track is 102.

During 1914 the work of constructing a diversion dyke and a canal was started, and completed in 1915. Formerly the Falcon River, which drains a large area of muskeg country to the west of Shoal Lake, emptied into Indian Bay. This water contains a large amount of coloring matter and it was imperative to prevent this from reaching the waters of the bay. In addition to the dyke, a canal was dug across a stretch of land separating Indian Bay from Snowshoe Bay, and the Falcon River now empties directly into Snowshoe Bay leaving the water in Indian Bay pure and colorless. The material for this work was obtained from a borrow pit nearby, and the rock was quarried from outcroppings on the shore of the bay at the end of the dyke site. The work was done with dinky locomotives and dump cars which were run out onto barges, the material being dumped into the water off the end of the barges. The dyke was built by Tomlinson and Fleming, the final payment amount being $87,327. The channel was dug by C. G. Anderson, at a cost of $16,007.

The telephone line was constructed by district forces, the cost being reasonable in view of the fact that the book charges include the cost of much necessary temporary work afterwards abandoned.

In the spring of 1915 work on the aqueduct itself was begun. Contracts for the construction were let as follows:—

J. H. Tremblay Co., Limited, Contract 30, 20.15 miles, $945,945.

Thos. Kelly & Sons, Contract 31, 17.75 miles, $1,301,485.

Northern Construction Co. and Carter, Halls & Aldinger Co., Contract 32, 18.20 miles, $1,268,680; Contract 33, 16.10 miles, $1,137,010; Contract 34, 13.00 miles, $1,489,520. Total, 85.20 miles, $6,142,640.

The size of the aqueduct being built under Contracts 30, 31, 32, 33 and 34 varies as follows, according to the slope on which it is being built,—

Section.	Slope of aqueduct.	Inside dimensions of section.
S	0.11	10′ 9″ x 9′ 0″
R	0.279	10′ 9″ x 9′ 0″
B	0.300	8′ 9″ x 7′ 4⅝″
D	0.382	8′ 3¾″ x 7′ 0″
N	0.480	7′ 11½″ x 6′ 8½″
G	0.600	7′ 7½″ x 6′ 5¼″
H	0.684	7′ 5½″ x 6′ 3½″
F	0.744	7′ 4″ x 6′ 2¼″
L	1.290	6′ 7″ x 5′ 6⅛″
C	1.537	6′ 4¾″ x 5′ 4¾″

Excavation work on Contract 30, which for the most part is through open cultivated land, is being done partly by walking dredges and partly by teams and scrapers. The dredge is supported by four pads set at the corners, with intermediate pads operated with chains and winches arranged in such a manner as to shift the weight of the machine onto the intermediate pads and at the same time moving the machine and the corner pads forward; the weight is then transferred to the corner pads and the intermediates moved forward. The machine straddles the excavation and removes the earth by means of a scoop-shaped bucket which is hinged at the end of a boom.

On Contract 31 the excavation was begun with small Thew shovels; two of these are equipped with extra long shovel arms. Where the excavation is deep, and consequently wide, the shovels are set up on steel frame work which is moved along the trench on track laid on both sides of the ditch. Part of the work on Contract 31 is through soft and boggy country and this year the contractors are using dragline excavators at four camps.

Pouring Inverts

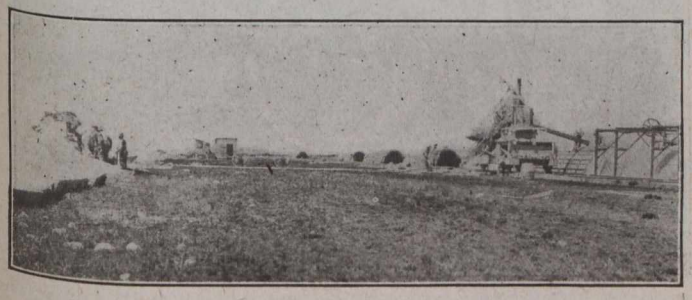
On Contracts 32, 33 and 34, draglines are being used for excavation and backfilling of trench material. The machine stands at the end of the ditch and pulls the bucket and excavated material towards the machine. The bucket is then elevated and the whole machine swings and the dump is formed as desired. The machine is carried on rollers on planks mounted on rectangular pads made of heavy timber. The area of the pad depends upon

the weight of the machine and the nature of the ground. When a move is necessary, the pad nearest the excavation is picked up and swung around to the rear. The bucket is then anchored and the machine pulled backwards over the rollers. The rollers are then blocked and the digging proceeds. This type of excavator will work on ground which will barely support the weight of a man. The pads are designed to reduce the bearing load on the swamp surface to 200 lbs. per square foot. There are several sizes of these excavators on the work, the smallest being equipped with a 1¾-yard bucket, and the largest weighing 150 tons and equipped with a 3½-yard bucket. The last-mentioned type will excavate 5,000 yards of soft material in 20 hours.

On none of the contracts is the machine excavation carried closer than 6 ins. to the final grade. The last 6 ins. is removed by hand, and just in advance of the invert profiles; this ensures firm and dry bottom upon which to place the concrete. The bottom is trimmed out to a neat grade and a concave cross-section.

On Contracts 30 and 31 the concreting plants are similar in arrangement. The mixer is set up on framework upon a car which moves along on a wide gauge track laid on the railway side of the trench. The concreting material is unloaded beside the railroad upon temporary platforms, and is delivered to the mixer in large size wheelbarrows, on Contract 30; and in buckets which are swung by a stiff-leg derrick, on Contract 31.

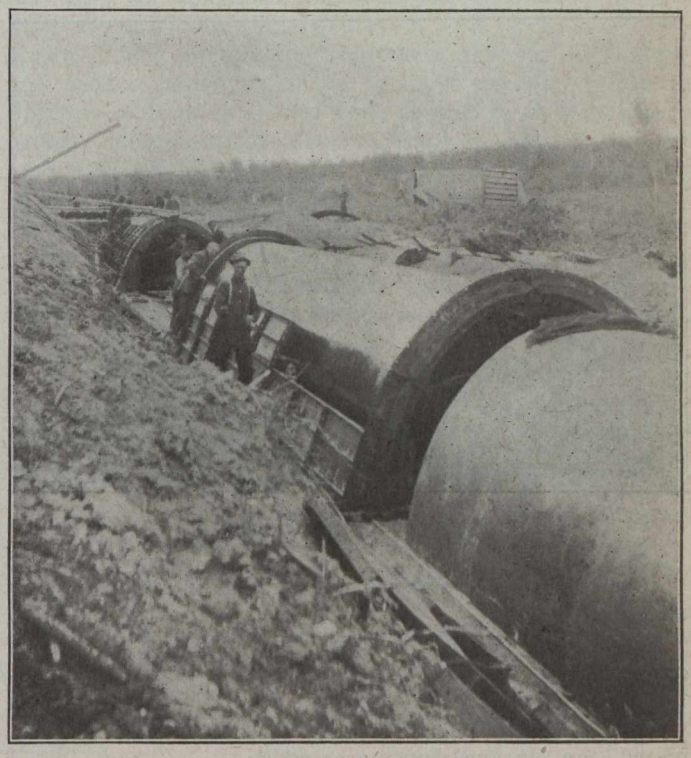
Owing to the boggy nature of the country, a movable concreting plant is less practicable on Contracts 32, 33 and 34. All camps on these contracts do the mixing at stationary plants, the mixer being elevated upon cribbing, with the material platforms arranged along the railroad track and extending about 150 feet on either side of the mixers. A dump is formed from the excavated spoil along the trench, upon which a narrow gauge track is laid, and near the mixer an elevated trestle curves away from the main track at points about equal distance from the mixer. The concrete is carried in small dump cars drawn by gasoline dinky engines and is poured into the work from the cars through spouts. The maximum distance for economical hauling is about ½ mile, and when the work has progressed to this point the mixer is moved a mile farther along the work. At certain camps this distance between mixer sites is halved, mixers working alternately on invert and on arch-making.



Pouring Arches

The inverts are laid in 15-foot lengths, with a copper expansion joint, having a V-shaped groove, extended across the pad at each joint. The pads are poured alternately and when the concrete has hardened sufficiently the profile forms are taken off and the intermediate inverts poured. The concrete in the inverts is screeded with tools made from 3½ x 3½ angle iron, 16 feet long, and equipped with handles at each end. This is pulled back and forth across the face from the centre to the sides and the process continued until the pad is true to form and no large stones are visible at the surface. It is then finished with wooden floats and steel trowels to the smoothest possible finish.

To guard against leakage at the joint between the invert and arch, a strip of soft pine ⅝ in. by 1¾ ins. is sunk to about half its depth along each side of the inverts



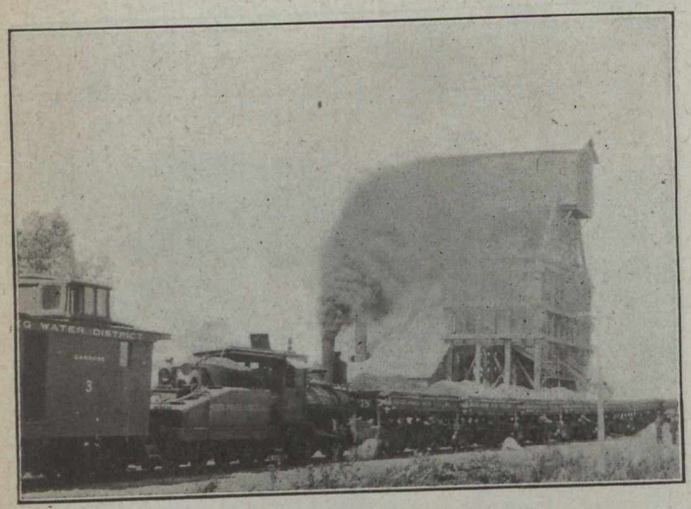
Showing Inside and Outside Arch Forms

and adjacent wood strips are made continuously tight at their ends.

The arches are built in 45-foot lengths with a copper expansion joint at each end. The forms used for the arch work are collapsible. The inner forms are moved on carriers running on a 2-foot gauge track, and are shaped up by means of turn buckles attached to the carrier. The outside forms are made in 5-foot lengths, which are usually bolted together. The methods adopted by the contractors for moving the outside forms differ in detail. On some contracts they are moved in sections, half of the form at a time, while on others carriers running on tracks laid along the bottom of the trench serve to move the whole outside form at once.

When the concrete is being poured into the form, lower panels are removed and the concrete is brought up evenly on both sides throughout the entire length of the arch. When the concrete has reached a certain level, the panels are set in place and other openings higher up are used until the entire arch has been poured. The pouring of each arch is a continuous process and careful spading of the concrete is insisted upon at all times. The arches are poured alternately, as are the inverts, and when sufficient time has elapsed, the forms are removed and sprinkling or other devices are adopted to prevent the concrete from drying out. The most reliable and satisfactory method has been to cover the entire structure with earth as soon as continuous arches appear, free from forms.

When the concreting has been completed for a distance and has hardened, backfilling is begun. This is done in two stages. Material is first tamped into place along the base of the arch to a depth of 4 feet and to an outer slope of 2:1. The remainder of the backfill is then done, usually by machinery. During the second stage instructions are given to bring the earth up evenly along both sides and thus furnish lateral support to the arch, care also is taken not to drop earth directly on the crown



Loading Crushed Stone

of the arch and thereby cause sudden and unnecessary stresses.

The depth of the finished backfill is 4 ft. over the crown of the arch, and the width usually about 8 ft. with a 1¾:1 slope to the ground line. When this has weathered for 12 months, and all settlement has been repleted, the top and slopes are seeded.

The district operates two gravel pits, a screening plant and a rock crushing plant. The screening plant is located at McCorkell Pit, mile 31, where the district owns 160 acres. In the pit a locomotive crane and a dragline excavator are employed for digging the gravel, which is then delivered to the plant in dump cars drawn by a dinky locomotive. The material is run through a series of revolving screens which separate it into four sizes and distribute the separated material into three bins, returning all oversize pieces to a crusher. It is drawn from these bins and mechanically mixed in the proper proportions necessary to make the densest and most watertight concrete. This graded aggregate is loaded into dump cars and hauled along the railroad to the various points on the construction work as it is required. During the screening and mixing operations, the material is continuously sampled and analyzed, and the plant equipment is adjusted to ensure a uniform output. The plant is laid out for an output of 6,000 cu. yds. per 10-hour day. A small electric lighting plant has been installed so that night operations may be carried on when necessary.

The "Government Pit," the rights to which were granted to the district by the Federal Government, is located about three miles north of the line of the aqueduct, at mile 80; 126,000 yards were taken from this pit to ballast the east end of the railroad. The material from the pit is used with that from the rock crushing plant to augment the supply from the McCorkell Pit. The mixture is made on the contractor's platforms and the proportions are always under the control of the district's chief engineer. The dust necessary for watertightness is supplied from a convenient excavation of loam.

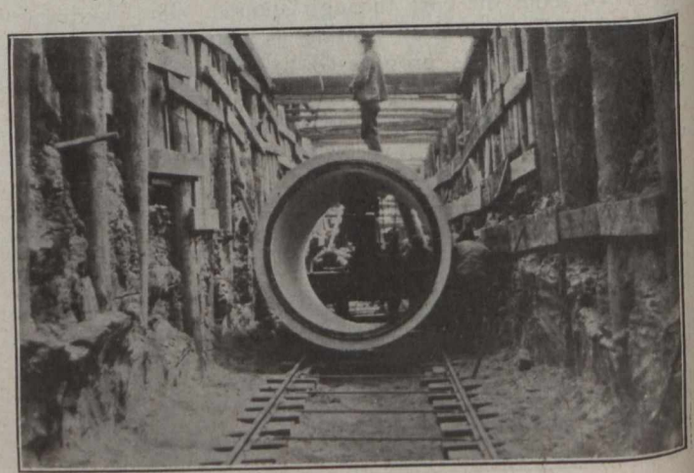
The "Rock Plant" at mile 95 is steam-driven and is equipped with two crushers and screens for grading the rock, which is a trap variety and very hard. It is quarried from an outcrop near the rear of the plant and drawn to the plant in horse-operated skip cars. From the crushed rock the fines are removed for purposes of uniformity; the stone is stored in bins and hauled away in dump cars.

Deacon, which is located on the line of the aqueduct, 12 miles from Winnipeg, is the railroad operating headquarters, and the office of the division engineer for Contract 30 is also located there. At this point the district constructed a 3-stall round house, a cement storage warehouse, a station building and houses for the engineering and railroad staff. There is a machine shop in connection with the round house, and all minor repairs to rolling stock and plant are done there.

The railroad equipment consists of one 65-ton locomotive; four 52-ton locomotives (Mogul type), one 40-ton locomotive, one 18-ton dinky locomotive, forty 20-yard air dump cars, twenty-five 16-yard air dump cars; twenty flat cars, ten box cars, four cabooses and four coaches. Fifty Hart convertible cars are leased from the city of Winnipeg.

In December, 1916, Contract 55 was let to the Winnipeg Aqueduct Construction Co., the amount of the tender being $1,308,753. This calls for the construction of 9.4 miles of reinforced concrete pressure pipe, 5 ft. 6 ins. diameter, the contract extending from Deacon to the Red River. The pipe is being made in 8-foot lengths, under the "Lock-Joint" patents, at yards established in the town of Transcona, and is cured by steam. The finished lengths are shipped to the line, where they are set, jointed and backfilled. Contract 55 includes the construction of the Seine River crossing. The aqueduct will be carried under the river in the form of an inverted syphon, carried on a reinforced concrete mattress, supported by piles driven to the rock.

Two important contracts remain to be let, *viz.*, the crossing under the Red River, and a pipe line from the



"Carrying" Concrete Pipe Into Place in Trench Photo, June 22nd, 1917

Red River to the McPhillips Street reservoir in Winnipeg. The Red River job will include the sinking of shafts on either bank and the driving of a tunnel through the rock under the river.

The pipe line through the city of Winnipeg is 2.3 miles in length and 4 ft. in diameter and will probably be cast iron throughout.

(Concluded on page 126.)

Nationalize C.N.R., Lend $7,500,000 to G.T.P.

That is the Program Announced by Sir Thos. White, Minister of Finance, as the Government's Temporary Solution of the Railway Problem—Government to Appoint C.N.R. Board of Directors—Arbitration to Determine Value of Capital Stock

SIR THOS. WHITE announced last week in the House of Commons that the government intends to nationalize the Canadian Northern Railway system and to make a demand loan of seven and a half million dollars, repayable at 6%, to the Grand Trunk Pacific. He introduced the following resolution, which was adopted:—

"Resolved, that it is expedient to provide:

"1. That His Majesty may acquire on such terms and conditions satisfactory to the Governor-in-Council as may be set out in the agreement to be made with the owners and pledgees of not less than five-sixths thereof, and for a price to be determined as hereinafter provided, the six hundred thousand shares of capital stock of the Canadian Northern Railway Company (par value sixty million dollars), not now held by the Minister of Finance in trust for His Majesty.

"2. That the Governor-in-Council shall appoint one arbitrator, the said owners and pledgees shall appoint another, and the two so appointed shall appoint a third, or failing agreement as to such appointment, the third arbitrator shall be appointed by the Senior Judge of the Exchequer Court.

"3. The said arbitrators shall determine the value of the said six hundred thousand shares as of the date of the said agreement and the said arbitrators shall proceed in a summary way and may apply their own judgment in determining such value and may receive with respect thereto, such reports and statements authenticated in such way as they may decide and such evidence as they may deem necessary or helpful, examine witnesses under oath and hear the parties by counsel or representatives and that the unanimous determination of the arbitrators shall be final, but should the determination not be unanimous an appeal from such determination shall lie to the Supreme Court of Canada on behalf of the Governor-in-Council, or of the owners or pledgees, upon any question of law or fact, such appeal to be made within thirty days from the rendering of the determination.

"4. That the amount of the value so determined shall be paid out of the Consolidated Revenue Fund, or otherwise secured in accordance with the terms of the said agreement.

"5. That upon the making of said agreement, at least five-sixths of the said six hundred thousand shares shall be transferred to the Minister of Finance in trust for His Majesty, and if there be any of said six hundred thousand shares not transferred as aforesaid, the Governor-in-Council may declare said shares to be the property of the Minister of Finance in trust for His Majesty, and the same shall thereupon become the property of His Majesty and shall be paid for pro rata with the shares so transferred.

"6. That so soon as said five-sixths of said shares has been transferred as aforesaid, the Governor-in-Council may assist the Canadian Northern Railway Company, or any company included in the Canadian Northern Railway system, in paying and settling any indebtedness of such company or postponing the payment thereof on such terms as may be agreed upon, and for such purposes may make advances out of the Consolidated Revenue Fund, may guarantee payment in whole or in part, and may give the obligations or securities of the Government in connection therewith.

"7. That the Canadian Northern Railway Company, and each company included in the Canadian Northern Railway system, shall from time to time do such acts and things, make and issue such agreements, obligations and securities in connection with the payment or settlement or postponement of payment of the said claims as the Minister of Finance may require.

"8. That the necessary qualification shares for directors may be transferred to or allowed to remain in their names by the Minister of Finance on such conditions as he may determine."

During the debate on the resolution, Sir Thomas announced that the owners or pledgees of five-sixths of the outstanding capital stock of the Canadian Northern Railway had already indicated their willingness to transfer the stock to the government upon the above arrangement. The owners of the other 10% of the stock are chiefly in Great Britain and their stock would be expropriated at the same arbitrated value to be paid to the holders of the five-sixths.

Sir Thomas called attention to the fact that all three railway enquiry commissioners agreed that it would be inadvisable to allow any of the Canadian railways to go in liquidation on account of damage to the credit of the company and disturbance to service, which should be most efficient at the present time. He intimated that the Grand Trunk Pacific might be nationalized in the future, but made no reference to any proposed nationalization of the Grand Trunk proper. On the other hand, he intimated that the finances of the old Grand Trunk were in satisfactory shape aside from its commitments in regard to Grand Trunk Pacific, and he defended the payment of dividends at the expense of betterments upon plea of the necessity of the road's maintaining its credit in Great Britain.

Any arrangement to nationalize the Grand Trunk Pacific at this time would involve long negotiations with the shareholders of the Grand Trunk and is not practical for the moment, said Sir Thomas, so that it was decided to continue the Grand Trunk situation as at present, making a loan to keep the road from going into liquidation. A mortgage on the Grand Trunk Pacific will be taken for this amount, this mortgage to rank after the existing securities. Sir Thomas admitted that existing securities probably equal the total value of the road, but he did not think that this should be looked at too closely, as it is worth a good deal of money to Canada, and to Western Canada particularly, to have the Grand Trunk Pacific continue in operation.

The Canadian Northern Railway will be operated by a board of directors just as at present, and not by a minister or department of the government. The government, however, will appoint the board from year to year. Sir Thomas White said that the present management of the Canadian Northern contains many men, such as Mr. Hanna, Mr. Mitchell and Mr. McLeod, who have great ability, and that the government would be advised to

retain such men to operate the road. He said that Sir Wm. Mackenzie and Sir Donald Mann would co-operate with the government in every way and they are ready to resign their seats on the board whenever the government might wish them to do so.

The method of arbitration to determine the value of the Canadian Northern Railway shares is such as was advocated by the majority report of the railway enquiry commissioners, but the method of operation differs from that advocated by those commissioners, who urged that an independent board of trustees be organized, to be known as the Dominion Railway Co., and to be self-perpetuating and entirely free from the influence of members of parliament.

The government already owns $40,000,000 capital stock of the Canadian Northern Railway, acquired in 1913 and 1914, when subsidies and guarantees were given to the Canadian Northern Railway, so that with the acquisition of the outstanding $60,000,000 capital stock of the company the government will become the sole owner of the road and all subsidiaries, including telegraph, express, steamship and elevator companies. Among other assets the Canadian Northern owns or controls the Lake Superior Terminals, with five elevators at Port Arthur; a steamship line, with six ships on the Great Lakes; the Canadian Northern Telegraph Co.; the Great Northwestern Telegraph Co.; and the Mount Royal Tunnel and Terminal Co.

Sir Thomas White said that the financial situation is more serious now than it was at the time of the report of the railway enquiry commissioners, and he did not believe that the financing then proposed by the commissioners could now be accomplished and that this was one reason why the government had not also nationalized the Grand Trunk and Grand Trunk Pacific.

During the debate upon the resolution, it was stated by Hon. Geo. P. Graham, and concurred in by Sir Thos. White, that part of the reason for the Grand Trunk Pacific's lack of success was the failure to secure sufficient branch feeder lines and the inability, on account of the war, to establish a steamship line to the Orient in order to divert through traffic from the Pacific to the G.T.P.

Sir Robert Borden said that the railway mileage in Canada is not excessive, considering all conditions, but that it is not well distributed. We have too many trans-continental systems and not enough feeders or branches for their profitable and efficient operation.

Through the debate there were hints from the opposition that the government intends to rent the C.N.R. to the C.P.R. The only statement of the government which lent any color to such a theory was a speech by Sir Robert Borden urging co-operative management between the various railroads, and saying that if, for instance, by such co-operative management, from ninety to one hundred million dollars of new construction by a great railway system in this country would become unnecessary, it would be to the advantage of the country. He admitted that he referred to double-tracking, saying that railway facilities already existing ought to be used to their fullest extent before any great corporation should be permitted to spend any considerable sum in construction which practically duplicates that already existing.

According to the financial statement of the G.T.P. which was tabled by the Minister of Finance, the cash requirements of the system from July 1st, 1917, to June 30th, 1918, total $7,494,761. The total fixed interest charges amount to $7,684,177, of which $1,189,416 are provided for out of the balance of the $8,000,000 loan of last year. The estimated amount required for improvements, including rolling stock, is $2,000,000. An operating loss of $100,000 is estimated for the steamship lines and a surplus of $1,100,000 for the railway lines.

In addition to the seven and a half million dollars which the country is advancing to the company, the treasury will also be called upon to pay $1,655,000 as interest on the mountain section 3% bonds, as under the original agreement with the company the Dominion has to meet this interest charge for seven years from January 1st, 1916.

In a special despatch from Ottawa to "The Montreal Gazette," it is stated that the Canadian Northern system to be taken over by the government "comprises 9,513 miles under operation, located as follows:—

"Nova Scotia, 370 miles; Quebec, 685; Ontario, 2,022; Minnesota, 215; Manitoba, 1,995; Saskatchewan, 2,220; Alberta, 1,266; and British Columbia, 540.

"In the latest financial statement of the affairs of the Canadian Northern Railway Company the surplus of assets over liabilities is given at $39,800,000. Outstanding securities guaranteed by the Dominion government amount to $104,000,000; by the provinces, $107,000,000; and not guaranteed, $147,000,000—a total of $358,000,000. On these the annual interest charges are $14,405,000. Of these interest charges for some years the Dominion government is directly responsible for $3,000,000 a year and the provinces for $1,500,000.

"The business of the company has shown a remarkable increase during the past three years. For its business year ended June, 1915, the gross earnings were $25,000,000; for 1916, $35,476,000; and for 1917, $42,319,000.

"For the same years the net earnings were $6,623,000, $9,373,000 and $11,525,000.

"The Canadian Northern has purchased equipment to the amount of $61,300,000, and paid $46,500,000, leaving a balance owing of $14,800,000. This equipment was estimated by the recent investigating commission to have been worth $56,000,000 and on this a depreciation was allowed of $11,000,000, making the value of equipment at pre-war prices $45,000,000, and estimated at present prices at $85,000,000."

NO FORTUNE FOR THE ENGINEERS

The cost of the Railway Enquiry Commission's report to date has been $70,088. Wm. Acworth received $15,330 and $1,128 expenses. A. H. Smith has not yet been paid for services. Sir H. L. Drayton returned a cheque for $15,000, stating that under the present circumstances he would make no charge for his services. Dr. Geo. F. Swain, consulting engineer, was paid $6,200 and expenses. W. H. Chadbourn, chief engineer, received $2,933, and none of the other twenty-one engineers employed on the work received that much, the amounts varying from $165 to $1,800.

The new coal yard, of 24,000 tons capacity, of the gas works at Karlsruhe is bordered on its southern side by a wall of ferro-concrete, 160 m. in length, 3 m. high, which supports the rail track and platforms of the coal-distribution plant. The structure is interesting in so far as the wall has been constructed as a continuous ferro-concrete girder, anchored at distances of 16 m. to piers of tamped concrete.

ROAD-BUILDING BEHIND THE TRENCHES*

ROAD-BUILDING and maintenance behind the trenches in western Europe is one of the most important features of the military operations. It is absolutely necessary, for supplies can only go forward from the railway terminal points by motor trucks. Horses and mules, although used in great numbers just behind many sections of the trenches, could not bring up food and ammunition from a distance fast enough, nor remove the wounded quickly and easily enough to meet the conditions. Moreover, even to do the work at all would require so many animals that to bring up food for them would be impracticable. Consequently, motor trucks and motor ambulances must be used, and these require roads which are fairly passable at least. Good roads are also of primary importance to the heavy artillery.

The road-building is carried on so as to utilize all the roads of the district as far as possible. The work is simplified by the fact that the traffic is controlled by soldiers detailed for that purpose, who have practically autocratic powers over the routing of cars and trucks. Without such universal traffic regulation not only would the roads be blocked most of the time, but their maintenance would be impossible. The most important traffic is allowed to use the best roads; the less important traffic is sent over the byways. If a car has trouble on the road it must draw off the roadway entirely. If it cannot do this under its own power and the road is crowded, as most of the main highways are, it is usually pushed into the ditch, to be salvaged later when repair gangs can be allowed on the road. Even on the less used byways a car is not allowed to block the roadway for repairs, however trifling, but must be moved to one side.

As the German and Austrian armies fell back they blew up what was left of the roads. Transportation of men and supplies over the roads is so important that neither side loses an opportunity to shell bridges and important highway intersection points. The roads under fire are constantly liable to be upheaved in this way, and in many places it is only by unceasing maintenance under fire that traffic can be kept moving. This maintenance is absolutely necessary in order to prevent a congestion of traffic many miles back from the danger zone. It is also necessary to construct screens of low trees and other materials, sometimes of painted canvas, along some of the roads in order to prevent the enemy from observing the traffic, and thus drawing his fire upon it.

In reconstructing roads for military purposes, where they have not been damaged by war operations, it is sometimes possible to afford considerable relief to traffic by widening them. In carrying on the work in mountainous sections subject to heavy rainfall, where it is necessary to have the surface dry out as quickly as possible, the roads are sometimes given considerable crown to shed the water into the ditches. This crown causes much complaint from drivers, for it results in considerable skidding, but the transportation authorities believe it is better to dry off the road promptly, even at the loss of a few trucks by accident, than to have it stay soft, damp and easily cut up for some time after each rainfall. Another interesting feature in the improvement of these roads is seen at some of the little hamlets where the road way is confined between houses, so that widening of it is impracticable. Here detours are built around the hamlets, sometimes narrow so as to take only the traffic passing one way, and sometimes wide enough for traffic in both directions.

There are some of these narrow roads which it is impracticable to widen rapidly, and in such cases traffic in one direction is routed over them and a new road built to accommodate the traffic in the other direction. It has also been necessary in places where narrow bridges would cause a congestion of traffic on a wide road to widen the bridge or build another beside it. Some of these bridges are by no means so strong as might be desired for concentrated military traffic, and the ways in which they are cribbed and braced include every expedient engineering ingenuity can suggest.

A great deal of the road building behind the trenches in France and Belgium must be done in soil very wet after rains. The old roads of this region were properly drained, but warfare ruined many of them. There was no time for the orderly methods of construction followed in peaceful days. Guns had to be pushed forward at once; the wounded had to be brought back. Where the roads were mere seas of mud in wet weather or new roads had to be built through marshes and swamps, the mud has been covered with a platform of tree trunks, refuse timber from destroyed buildings, abandoned railroad ties and similar material. Broken stone or gravel is very difficult to obtain in such places, so the platform is covered with the bricks and soft stone from the buildings demolished by gun-fire. This is wretched material for roads, for it is ground into fine dust that is turned into mud by water. The only remedy for a time is to dump more bricks and stone on the road, and if this is done daily, as it often is, the roadway gradually becomes firm. Such a road is very poor at first, and horses and mules do all the hauling over it. Finally, it can be negotiated by skilful drivers, and by the time the first rush forward is over and the confused conditions have been smoothed away, the final improvement can be undertaken. By this time supplies of broken stone are usually available, and the hardened surface is macadamized. If the traffic permits, the broken stone is rolled. This work is done with a rush; the rollers often work continuously when they are once allowed on the road, two crews of men being engaged so as to finish the job and leave the roadway clear just as early as possible.

The refinements of road-building receive scanty attention along the battle-line. In the early days attempts were made to use telford foundations in damp places where suitable stone could be obtained. The stones were set on edge and wedged with small stones. In ordinary times such a foundation is then consolidated by running a roller over it. But behind the trenches no roller could be used. It would rarely have been possible to get it there, and it would have been too much in the way of guns and ammunition wagons to be allowed there in the rush of a forward movement. So instead of a roller with broad wheels the much narrower wheels of heavy gun carriages and limbers were dragged over the stones and hammered them down into the mud. Had it been possible to cover the stones immediately with broken bricks or building refuse the foundation might have proved satisfactory, but under the existing conditions it was a hopeless failure. So instead of wedging the stones upright the army road-builders finally laid them flat. The traffic shook these flat stones down quickly, but more were placed on top of them, along with broken bricks and stone, and in this way many miles of roads have been built.

*From Bulletin of the American Highway Association.

In building a road through a district wrecked by gunfire the first thing to be done is to clear a right-of-way. Often the surface is so cut up that only wagons, caterpillar tractors, and possibly four-wheel-drive trucks can go over it. The holes are filled with refuse, if the road lies near or through what was formerly a village. In the open country, where haste was imperative, farm buildings have sometimes been torn down to furnish the necessary filling. Sometimes it was necessary to clear away the refuse from fallen buildings which formerly bordered the road, first opening up a lane for a single line of trucks and then widening this out.

Where a village has been the scene of many conflicts the ruins are not only a gruesome place, but a most unsanitary place. The remains of the dead in advanced stages of dissolution are liable to be centres of disease, and it is often necessary in working in such places to sprinkle the materials with chloride of lime and to take every possible precaution against the infection of cuts and bruises.

In mountainous districts in the Vosges region and on the Italian front the construction is much simplified by the ability to procure stone readily. When this is the case, heavy macadam roads are built in the usual manner, except that in the danger zone it is rarely possible to use power rollers.

SIR ADAM BECK IN DISPUTE WITH CITY ENGINEER BRAZIER

SIR ADAM BECK is complaining again to the Board of Control, of London, Ont., regarding the quality of the concrete foundations being laid by the contractors for the Richmond Street pavement. Sir Adam has submitted two reports by hydro engineers tending to show that the concrete is not of proper quality. City Engineer Brazier states that the concrete is satisfactory for the purpose for which it was designed, and refuses to take any action in the matter until he receives reports from the School of Practical Science Laboratory on samples taken from the Richmond Street and Wellington Street pavements, which he has sent to the school for thorough tests. "The school is a thoroughly independent tribunal," says Mr. Brazier, "and will give us reports based on experience. There will be no prejudice in the findings made by these experts."

Two hydro engineers state that they made two test cylinders. One, with the materials and mix being used by the contractors, withstood an average crushing load of 8,375 tons and showed ultimate strength of 303 lbs. per sq. in. (These were 6-in. cylinders, 12 in. high.)

For the second cylinder the aggregate was partially graded and less water was used, with the result, it is said, of an average crushing load of 23,550 lbs. and ultimate strength of 832 lbs. per sq. in.

"The results," say the hydro engineers, "show that by using the second method, the resulting concrete had over two and a half times the strength of that obtained by using the first method. An examination of the concrete test pieces after breaking showed that still further increase would probably result by using a sand containing more of the very fine material, and that even the better of the two concretes is very porous."

Sir Adam states that his interest in the paving work is as a taxpayer of the city of London, but it is not known what interest the Hydro-Electric Power Commission have in the matter.

METHODS AND COSTS OF LOCATION SURVEYS FOR THE LITTLE RIVER DRAINAGE DISTRICT, MISSOURI*

By B. F. Burns,
Office Engineer, Little River Drainage District

WHAT is the proper size of parties for field location on drainage work? What is necessary in the way of camp equipment? What can be reasonably expected in the way of miles of located line per week, and what are the costs of such work per mile? These are questions which naturally arise when work of that kind is projected and the installation of field parties contemplated. It is the purpose of this article to describe briefly the location work of the Little River Drainage District, the methods used in handling that work, and costs.

Prior to beginning the location on the 624 miles of drainage ditches and the 30-mile diversion works some preliminary work had necessarily been done in the field. The line of the diversion channel had been run out, several circuits of levels lines had been run to establish bench marks where they could be easily picked up in the work that was to follow; compass and level lines had been run across the district east and west at intervals of one mile, generally on section lines, for the purpose of developing the general surface of the land. The locations of the ditches were determined from the developments of these last-mentioned surveys. It was desirable to so locate the ditches that they would not cut up property, and, unless absolutely necessary to do otherwise, the ditches were located on the section, half or quarter section lines.

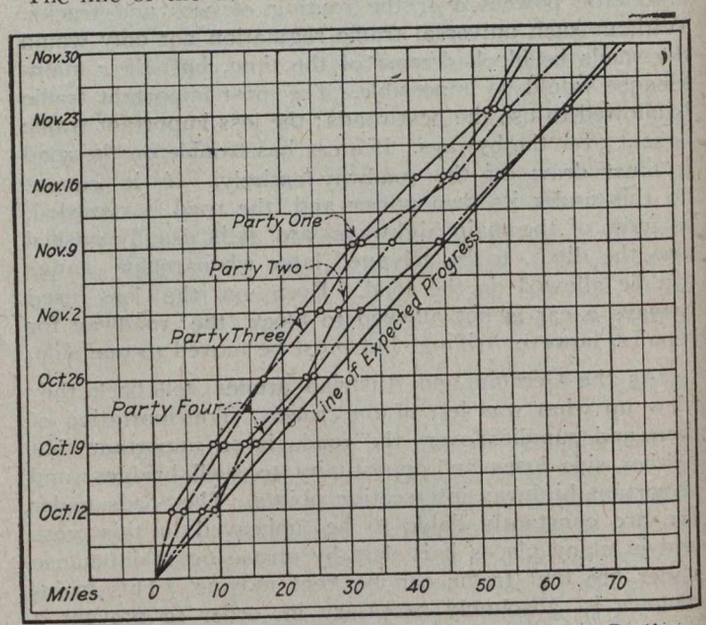


Fig. 1—Chart Showing Weekly Progress of Location Parties.

The preliminary work was done some time—possibly four or five years—before the location work was begun. In the interim the district had been fighting its legal battles, and, all cases bearing upon the legality of the organization and its right to proceed with the construction of the works described in its plan for drainage having been disposed of, the time for letting the work was set and parties assembled for the field location of the works.

*Engineering and Contracting.

The chiefs of party, levelmen and rodmen were, for the most part, gotten in touch with through a western agency, and while, with few exceptions, the men were capable and did the work acceptably and well, experience has taught that a greater number of men with a wider range of experience can be reached through the medium of an advertisement in the widely-read engineering journals.

Four field parties were organized. The regular party consisted of ten men: chief of party, levelman, rodman, two chainmen, stakeman, two axemen, teamster and cook. To one of the parties it was necessary to add a compassman, as the uncertainty of the land lines made it necessary for the chief of party, assigned to that portion of the work, to do considerable scouting.

The parties were all equipped and supplied before leaving headquarters. The following camp equipment was allotted to each party:—

1 cookstove.	1 dipper.
1 2-gal. oil can.	2 doz. tin plates.
4 frying-pans.	1½ doz. knives and forks.
2 skillets.	1½ doz. teaspoons.
3 breadpans.	1 doz. tablespoons.
2 dishpans.	6 yds. towelling.
4 kitchen spoons.	1 doz. tin cups.
3 pepper boxes.	3 tents and flies.
3 salt boxes.	1 doz. cots and mattresses.
2 kitchen forks.	4 camp chairs.
2 butcher knives.	2 doz. blankets.
1 cleaver.	1 doz. comforts.
1 flour sifter.	3 heating stoves.
4 lanterns.	3 lamps.

General instructions relative to carrying on the work were given in writing, and these were supplemented by specific directions relating to the particular work assigned to each party.

The chief work of the parties was to locate the lines, which were described in the Plan for Drainage. In each case the starting-point was definite, and from it the lines were run to follow the described course. As often as possible ties were made to section corners, and if the line run was within 100 feet of the true location at the tie the correct location was marked by offsetting at each quarter mile, driving hubs and blazing trees so that the hubs might be readily found later. Should the line fall more than 100 feet from the true location at the tie it was re-run.

Levels were run over the compass lines and bench marks established each quarter of a mile.

THE LITTLE RIVER DRAINAGE DISTRICT.
Monthly Report of Supplies for Sustenance.

Party No. 2.

Articles.	On Hand First of Month. Lbs.	Received During Month. Lbs.	Used During Month. Lbs.	On Hand Last Day of Month. Lbs.
Hams	25	115	120	20
Breakfast bacon	10	45	51	4
Navy beans	5	20	15	10
Rice	3	10	10	3
Coffee	5	5	7	3
Sugar	10	20	15	15
Corn meal	15	45	30	30
Flour	80	40	100	20
Lard	12	20	18	14
Molasses	1*	2*	3*	
Table salt	3		1	2
Black pepper	½		¼	¼
Vinegar	1*		½*	½*

*Gallons.

W. D. WATTLES, Assistant Engineer.
For the month ending December 14th.

Fig. 2—Monthly Report of Sustenance Supplies.

Full descriptions of the trees blazed were recorded in the compass notes and descriptions of all bench marks were given in the level notes.

Profiles were platted in camp on hard paper, tentative grade lines laid down and the alignment platted at the bottom of the profile. These field profiles and the level notes were sent to the chief engineer at the close of each week. There the level notes were checked, complete profiles platted, and the notes returned to the party with corrections of any errors noted on them. Field profiles were platted in pencil only, and with the exception of the alignment, which was traced on to the complete profiles, were used as a check against the work. Complete profiles were platted on transparent paper, and in addition to showing the surface and grade lines give elevations on the grade lines at each point where the elevation changes one-tenth, the depth of cutting at each station—worked out from deducting the surface elevation recorded in the level notes from the grade elevation at each station—together with descriptions of the bench marks established and the alignment.

THE LITTLE RIVER DRAINAGE DISTRICT.
ASSISTANT ENGINEER'S WEEKLY REPORT.

Mr. Wm. A. O'Brien, Chief Engineer,
Cape Girardeau, Mo.

Following is a report of work done by Party Three during the week ending Saturday, December 14th:

Sunday—No work.
Monday—Ran Ditch 1, Sta. 650-680, and Ditch 40, Sta. 590-618.
Tuesday—Ran Ditch 40, Sta. 618-670, and ½ mile of tie line.
Wednesday—Ran Ditch 37, Sta. 543-570, and corrected No. 1, Sta. 600-640.
Thursday—Moved camp. Ran Ditch 42, Sta. 618-638.
Friday—Ran Ditch 42, Sta. 638-670, and Ditch 43, Sta. 0-30.
Saturday—Ran Ditch 43, Sta. 30-75, and 1 mile tie line.

SUMMARY.

Miles Randon Line..	1½ miles	Total to date.....	15½ miles
Miles Located Line..	5½ miles	Total to date.....	81¾ miles
Total.....	7 miles	Total	96¾ miles

REMARKS.

Water rising rapidly in low spots, almost too deep to wade in hip boots.

Signed JNO. B. JONES,
Assistant Engineer.

Fig. 3—Weekly Report Form for Assistant Engineers.

At the end of each week each chief of party furnished a report of his progress on a prepared form. This outlined the work of each day and delays. From these reports a chart of the progress was platted to show what each party did in comparison with the expected progress. Blueprints of this chart were sent to each chief of party. Special efforts were commended and an explanation of unsatisfactory progress requested, if it had not already been made on the weekly report. These stimulated the parties somewhat and brought forth an effort to make the best possible showing consistent with thoroughness and accuracy.

Practically all supplies for the sustenance of the parties were requisitioned from the chief engineer. Where farm products were available they were purchased at the direction of the chief of party, but the general purchasing of supplies was discouraged because of a tendency to over-buy or to buy luxuries not in keeping with the plan of plain fare and good health. At the close of each month a full report of all supplies received during the month, used and on hand at the beginning and end of the month, was furnished by each party. From these reports the cost of sustenance per mile and the cost per day per man was figured and tabulated. The following shows the poorest showing, the best showing for one month and the final showing at the completion of the location work:—

MONTH ENDING OCTOBER 15.

Party No.	Miles located.	Total payroll.	Labor per mile.	Sustenance cost.	Sustenance per mile.	Days worked.	Sustenance cost per man per day.
1.....	5.2	$211.29	$40.77	$ 76.26	$14.77	116	$0.6575
2.....	12.09	200.66	16.59	57.97	4.80	103	.3601
3.....	6.83	180.89	26.49	51.53	7.54	99	.5200
4.....	10.59	254.30	23.16	76.37	7.21	121	.6310
	34.71	$847.83	$21.55	$263.13	$ 7.55	439	$0.6971

MONTH ENDING NOVEMBER 15.

Party No.	Miles located.	Total payroll.	Labor per mile.	Sustenance cost.	Sustenance per mile.	Days worked.	Sustenance cost per man per day.
1.....	32.90	$ 516.36	$15.69	$113.63	$3.45	289	$0.393
2.....	33.64	518.97	15.40	118.67	3.53	301	.394
3.....	34.17	451.27	13.21	75.29	2.20	272	.276
4.....	40.28	598.79	14.86	63.02	1.57	303	.208
	140.99	$2.085.39	$14.78	$360.51	$2.18	1,165	$0.309

FINAL ACCUMULATED FIGURES.

Miles Located.	Total Pay Roll Expense.	Labor per Mile.	Sustenance Cost.	Sustenance per Mile.	Days Worked.	Sustenance Cost per Man per Day.
608.1	$11.595.34	$19.06	$2,611.08	$4.30	6,145	$00425

The expense for the month ending October 15th was effected by the initial move from headquarters to the field, and further by the fact that the parties were not yet thoroughly familiar with the work at hand, having been in the field but ten days.

The organization as originally planned for the field work was maintained for a period of three months, when, because of the lowlands filling up with water to a depth that work was not possible, three of the parties were taken off. The remaining party completed the work, or as much of it as it was necessary to complete at that time, and the accumulated figures above represent the costs of the field work at the time that party was taken off. The remainder of the line which remained unlocated at that time was portions that it had not been possible to locate because of water conditions, and the location of which could be deferred until the construction work had begun and residences for the supervision of that work organized.

The successful and enonomical handling of location work depends upon having the work of each party completely mapped out in advance; securing men as chiefs of party who have had some experience in work of like nature, and who can effect an organization and maintain it in the field; providing instructions that are brief but explicit, and allow the chief of party some latitude wherein to use his best judgment should extraordinary conditions arise; by exercising a reasonable control over camp expenditures for sustenance or otherwise, and last, but not least, enforcing absolutely a "no booze" rule upon each and every member of the parties.

For the location work practically all the forms were made on a hektograph, using special typewriter ribbon. They were made in the office as required at practically no additional expense. Fig. 1 is a chart showing the weekly progress of the location parties. Fig. 2 is a monthly report of the supplies for sustenance. Fig. 3 shows the form of weekly progress report.

The world's platinum output in 1916 is reported in the United States Geological Survey as only 83,670 ozs. troy, against 143,145 ozs. in 1915 and 313,529 ozs. in 1912, the largest output in the last eight years. Russia has hitherto furnished about 95 per cent. of the total, and Colombia has stood second. Of the 1916 output, Russia is credited with 57,860 ozs., and Colombia with 25,000 ozs. The United States produced only 750 ozs. last year, which, however, is its largest output in eight years.

MONOLITHIC SHIP CONSTRUCTION

By G. Ernest Booker, Halifax, N.S.

MANY systems using concrete in the construction of ships have been evolved with varying success. During the present year vessels up to 3,000 tons have been constructed in Norway with success, the process in use there being the invention of M. Nicolai Fougnier. In San Francisco, capitalists have financed the building of a 5,000-ton vessel for ocean service, designed and under the supervision of Messrs. MacDonald and Kahn. These, however, are the only recent efforts which have come to the writer's notice, both processes no doubt have favorable points, and will meet with the success they deserve.

When the writer first decided to enter this field of effort, many objections presented themselves. The chief ones were dead weight, strength required for vessels of large tonnage, difficulty of repair, possibility of serious damage through collision with submerged or floating objects. In turn, these objections have been overcome and a series of rules have been drawn up governing the design of vessels of all sizes.

The necessity of overcoming the scarcity of tonnage has been the main object in view, and there is no question as to the attainment of this objective by the building of monolithic ships. The speed of production of duplicate vessels is, of course, one of the main features; and in view of the shortage of steel shipbuilding materials this feature becomes still more pronounced. Coupled with this advantage is the comparatively low cost, due to the great saving in skilled labor and, of course, lower cost of material, in addition to which must be considered the distribution of the initial outlay in formwork over the number of vessels of that particular type built.

Only the best obtainable materials of their respective kinds are used in construction, and the rules governing the design give high factors of safety.

As all who have given any attention to shipbuilding must be aware, all important members of the hull are subject to tensile, compressive and shearing stresses in varying degrees, but each and every member must be designed for the maximum possible load in each of these directions.

In order that sufficient strength might be obtained, cellular construction and the use of double, treble and quadruple skins was adopted. The full value of this particular feature can only be realized by going into much detail and therefore it will be sufficient to mention that amongst the properties it embodies are, minimum dead weight, great rigidity and strength, greater safety, safe storage space for liquid fuel and fresh water, facilities for the disposition of water ballast, and for the trimming of vessels with displaced cargoes. In addition to these features might be mentioned the high insulating properties of such a structure, enabling practically an even hold temperature being maintained, which is of great importance in vessels carrying grain or other perishable cargoes.

Recent claims made by various inventors include those of unsinkable ships. One such invention, from press reports, has been accepted by the Italian marine authorities, and is a vessel having two skins. If such a claim can be substantiated then there is no reason why ships built on the Booker and McKechnie process should not be equally unsinkable; but there is still some doubt on this point.

That the monolithic ship is to be a large factor in the merchant marine in the future, there can be little doubt.

THE DETERIORATION OF CARRYING CAPACITY OF CAST-IRON PIPE*

By Burt B. Hodgman,
Chief Engineer, National Water Main Cleaning Co.

IT is the belief of the writer, after considerable experience in examining cast-iron water mains that have been in service all the way up to one hundred years, and under almost every condition known in the United States, that the greatest item of depreciation is the corrosion, sedimentation or incrustation which occurs on the interior of water mains.

About two years ago a series of questions were sent out to waterworks superintendents and engineers all over the United States, asking for their experience with various kinds of water mains. Answers were received covering users of more than 15,000 miles of cast-iron pipe. These answers came from nearly every State in the Union, and almost without exception the answers stated that the outside surface of the iron was in excellent condition. There were some exceptions, but where those exceptions occurred there was some special condition covering them. This, of course, does not cover the question of electrolysis, but that should be considered a special condition, the same as pitting on the outside which occurs in cast-iron mains laid in peat bogs or laid in cinders, but with the interior surface it is a different thing.

Incrustation or scale results from several different causes. Probably the principal cause is iron corrosion, due to the soft waters which are impregnated with free carbonic acid, crenothrix, or some kindred source of trouble, such as the presence of manganese, sulphur, organic acids or mineral acids, all of which will greatly accelerate the incrustation of these mains. Also it should be noted that greater corrosion takes place in pipes which have free iron exposed, as in the case where the line is frequently tapped. This may be due to galvanic action. It is, nevertheless, a fact that the same water passing through a tar-coated line which has not been tapped will affect that pipe less rapidly than will the same kind of water where corporation cocks have been placed at frequent intervals.

There are, of course, other incrustants, such as pipe sponge, pipe moss, etc., but it is not my object to discuss this from a chemist's standpoint, as this was very thoroughly covered by N. S. Hill, Jr., C.E., in a paper read before this association in 1907.

Besides the iron corrosion, we have various deposits found in mains due either to sedimentation or the settling of lime in the water after treatment for softening or the deposit of limestone, such as is found in Salt Lake City, Utah, or the deposit of mud, also the deposit of red mud, due to the presence of free iron in some waters, particularly ground waters. These deposits take place in many different forms. The red mud deposits all around the pipe in a wavy surface, which retards the flow very much. Then there is a clay deposit, such as that found from the Big Muddy River in Southern Illinois, where the clay mud deposits all around the pipe concentrically, in one case to the extent of cutting an 8-inch pipe to an open area of 5 inches, and the surface of this also was wavy, further reducing the carrying capacity of that pipe. Then there are the waters which deposit mud in the bottom of the pipe, sometimes filling mains to more than one-half their diameter. This form of sedimentation is found in almost every part of the United States where turbid waters are pumped.

It has been the object of the writer to try and show some relation between the growth of iron corrosion and the hardness of the water, but due to lack of sufficient data, and also to the many special conditions affecting this corrosion, this has been practically impossible. A list of tests is submitted herewith showing the approximate number of years pipes in various localities have been down, the kinds of water passing through them, and the percentage of carrying capacity lost, due to this corrosion. These tests, while not numerous enough to form the basis for definite conclusions, still may, perhaps, be of use to the superintendent in determining what his conditions and his troubles may come from. Many of our tables on the flow of water in cast-iron pipes give a coefficient to use for pipe a certain number of years old. These coefficients are so variable that it seems better to find out what the local conditions are for each particular place before deciding what a pipe will carry after being a certain number of years in service. Some comparatively hard waters, such as that of the Great Lakes, for instance, may flow through cast-iron pipe for twenty years without seriously affecting the carrying capacity, while the waters of the Ohio River almost invariably destroy the carrying capacity to a very large extent in that length of time. In New England the surface waters in general will probably reduce the carrying capacity of small mains from 25 per cent. to 40 per cent. in twenty years. Some of the snow waters of the Pacific Coast have destroyed the carrying capacity of cast-iron pipe to the extent of 50 per cent. in twenty years. Some of the southern surface waters, which are very soft, and in cases contain organic acids, have been known to destroy 75 per cent. to 80 per cent. of the carrying capacity of small mains in a period of twenty years. The Upper Mississippi, which at times runs very high in hardness, seems to affect pipe but very slightly, excepting where the water has been softened, thereby causing a heavy, rough deposit of lime. This is more or less true also of the Missouri River or Central Plains waters. Then there is the Arkansas River water, which runs very high in salt as well as alkalinity, and in the small pipes supplied from this water we frequently find 50 per cent. to 60 per cent. of the carrying capacity destroyed in a period of twenty years.

To give the superintendent an idea of the effect of corrosion on small mains (6-in. to 12-in) so that he may judge of his local conditions by noting the interior of his mains when cuts are made the following estimates are given:—

Tubercules from 1/8-inch to 1/4-inch in depth occurring principally at the bottom of the interior surface of the pipe, will cut the carrying capacity from 15 per cent. to 20 per cent.

Tubercules from 1/8-inch to 3/8-inch in depth, covering practically the entire inner surface of the pipe, will cut the carrying capacity from 35 per cent. to 40 per cent.

Tubercules from 1/4-inch to 1/2-inch in depth, covering the entire inner surface of the pipe, will cut the carrying capacity from 45 per cent. to 50 per cent.

Tubercules from 1/2-inch to 1-inch in depth all around the inner surface of the pipe will cut the carrying capacity down from 70 per cent. to 75 per cent.

*Abstract of paper read before the Convention of the American Water Works Association.

Now what is the effect of this corrosion on the pipe? To determine this, some twenty-five samples altogether have been analyzed to determine the exact amount of the iron from the pipe which has been destroyed, and we find in the worst samples examined that the rate of destruction is only about one-tenth of one per cent. per year, or 10 per cent. of the iron in one hundred years. We find in some isolated cases that underneath these tubercules there is a slight pitting, but even though the pipes are scraped, some scale is left covering this pitting and forms more or less of a protective coating to the iron at that point, and, as a very large factor of safety is used in the designing of cast-iron pipe, this pitting could be many times as bad as it grows, or as it has been in any place so far observed, without seriously endangering the strength of the pipe. Many of us have seen samples of old Scotch pipe which was cast on its side, and which had less than 1/8-inch of metal, and this thin metal has stood the test of fifty and sixty years that we know. An example was found in Boston of this character where there was only about 1/16-inch of metal, and a very light tap with a chisel broke into the pipe. This pipe had been in service more than fifty years, and there had never been a break in the line. Also, we know that cast-iron pipe has been in use in France for nearly 250 years. We have samples of pipe laid in Philadelphia and in service ninety-eight years which show an excellent condition of the metal, even though an analysis shows that there were present in the iron elements and compound that the present-day foundry would not have in a piece of their pipe.

I believe it is safe to conclude that if cast-iron pipe is properly taken care of its useful life can be longer than any of us have ever figured it.

Locality	Kind of Water	Size	Age of Pipe	Capacity Lost	Special Conditions
So. Milwaukee, Wisc	Lake Michigan	10"	15 yrs.	18%	Hardness 180-200
Chicago, Ill.	" "	6"	30 "	32%	Hardness 180-200
Rochester, N.Y.	Lake fed by springs	4"	25 "	25%	Spring water
New Jersey	Ground	6"	30 "	34%	Iron deposit
Missouri	Miss. & Mo. Rivers	20"	21 "	50%	Lime & iron treatment
Rochester, N.Y.	Genesee River	12"	28 "	52%	Surface water
Lockport, N.Y.	Erie Canal	6"	20 "	54%	Polluted with sewerage
Salt Lake City, Utah	Mountain water	16"	20-25 "	50-65%	Hardness very high
Camden, N.J.	Ground water	8"	55 "	60%	
Philadelphia, Pa.	Surface water	6"	70 "	56%	Hardness 180 parts per million
Cumberland, Md.	Potomac River	6"	26 "	50%	Hardness 100-120
California	Mountain snows	16"	18 "	50%	Very soft
Meridian, Miss.	Surface and spring	16"		50%	Soft, sometimes acid
Madison, Ind.	Ohio River	6"	25 "	60%	Soft and sediment
New York	Surface		31 "	70%	Soft water
Kansas	Missouri River	10"	28 "	62%	Treated with lime hardness 300-450 parts
Kansas	" "	24"	21 "	44%	
Mt. Vernon, Ill.	Surface water	6"	18 "	75%	Manganese present
Arkansas	Arkansas River	6"	20 "	78%	High in salt and hardness
Missouri	Ground water	4"	20 "	80%	Sulphur and other minerals
Philadelphia, Pa.	Surface water	6"	70 "	56%	Hardness 180 parts per million
Huntington, W. Va.	Ohio River	6"	20 "	75%	Soft with mineral acids
Wheeling, W. Va.	" "	6"	20 "	80%	Soft with mineral acids
Illinois	Surface water	6"	31 "	70%	Soft water
Long Island	Ground water	12"	50 "	80%	Soft
Boston, Mass.	Surface water	16"	59 "	47%	Soft water
St. Louis, Mo.	River water	6"	25 "	63%	Treated water
Meriden, Conn.	Surface water	12"		49%	Soft
Connecticut	" "	36"	25 "	32%	Soft

The percentage of carrying capacity lost in large pipes is not as great as that in small pipes, due principally to the fact that the percentage of area filled by corrosion in the large pipes is not as great as that in the small pipes.

CANADIAN SOCIETY OF CIVIL ENGINEERS ELECTIONS AND TRANSFERS

At a meeting of the council of the Canadian Society of Civil Engineers held July 31st, the following elections and transfers were announced:—

CRONK, C. C., of Regina, Sask., elected as associate member. Mr. Cronk is bridge inspector of the Board of Highway Commissioners, Saskatchewan, and assistant on bridge and road construction and coal investigation.

CROWTHER, K. N., of Qu'Appelle, Sask., elected as associate member. Mr. Crowther is in private practice as Dominion and Saskatchewan land surveyor.

CUMMIFORD, S. A., of Toronto, transferred from junior to associate member. Mr. Cummiford is assistant to the chief engineer of the Toronto-Hamilton Highway Commission.

DE CORIOLIS, E. G., of Montreal, elected as member. Mr. de Coriolis is consulting chemical engineer with Arthur D. Little, Limited, of Montreal, and is a graduate of the University of Toronto, class of 1903.

FOWLER, R., of Victoria, B.C., transferred from associate member to member. Mr. Fowler is municipal engineer of Oak Bay, Minn.

GOODMAN, H. M., of Montreal, transferred from junior to associate member. Mr. Goodman is with the Sewer Department of the city of Montreal, as division engineer of the Melrose Avenue tunnel sewer. He is a graduate of the University of Toronto, class of 1913.

GRAND MONT, BRUNO, of Lauzon, P.Q., transferred from student to associate member. Mr. Grand Mont is senior assistant engineer on the construction of the new Lauzon dry dock. He is a graduate of the Polytechnic School, Montreal, class of 1914.

HERTZBERG, C. S. L., of Toronto, transferred from associate member to member. Lieut. Hertzberg is with the 7th Field Co., Canadian Engineers, at the Front. He is a member of the firm of James, Loudon & Hertzberg, consulting engineers, Toronto, and is a graduate of S.P.S., class of 1905. He has the Military Cross.

HORSEY, E. N., of Victoria, B.C., elected as associate member. Mr. Horsey is resident engineer in charge of maintenance-of-way for Victoria city and suburban lines, as well as construction and maintenance engineer of various properties, of the B.C. Electric Railway and subsidiary companies.

JOHNSTON, J. T., of Ottawa, transferred from associate member to member. Mr. Johnston is chief hydraulic engineer of the Dominion Water Power Branch, and is a graduate of the University of Toronto, class of 1910.

JOHNSTON, W. J., of Vancouver, B.C., elected as associate member. Mr. Johnston is in charge of surveys for the Dominion Government in British Columbia. He is a graduate of the School of Practical Science, class of 1909.

KENDALL, G. R., of Montreal, elected as member. Mr. Kendall is assistant inspector of steel with the Imperial Munitions Board of Montreal, and was previously lecturer in chemistry at McGill University College of British Columbia, Vancouver, and subsequently metallurgist for various munition plants in Montreal. He is a graduate of McGill University, class of 1903.

MAPLE, H. E., of Ottawa, elected as associate member. Mr. Maple has been in charge of the construction of the Dominion Arsenal at Lindsay, Ont.

MCMASTER, A. T. C., of Toronto, elected as member. Mr. McMaster is with Kerry & Chace, Limited, as de-

signing engineer, Calabogie power plant. He is a graduate of the University of Toronto, class of 1903.

MULLEN, C. A., of Montreal, elected as associate member. Mr. Mullen is director of the paving department of the Milton Hersey Co., Limited, Montreal.

PUTMAN, C. V., of Ottawa, elected as junior. Mr. Putman is construction engineer in charge of water mains and redistribution system, Ottawa Waterworks Dept.

RHODES, J. F., of Montreal, elected as associate member. Mr. Rhodes is in charge of publicity and promotion work, also of the technical information department of the Canada Cement Co., Limited. He is a graduate of the University of Pennsylvania and of Valparaiso University.

RUTHERFORD, F. S., of London, Ont., transferred from student to associate member. Mr. Rutherford is travelling examiner of component parts, Imperial Munitions Board. He was formerly assistant engineer with Morrow & Beatty on the construction of the Abitibi Pulp and Paper plant, and is a graduate of the University of Toronto, class of 1914.

SAVARY, R. J. L., of Quebec, transferred from junior to associate member. Mr. Savary is hydraulic engineer and surveyor with the Quebec Streams Commission.

VARCOE, CLIFFORD, of Kamloops, B.C., elected as associate member. Mr. Varcoe is district engineer of the Water Rights Branch.

PLANNING BOARD FOR CITY WORK

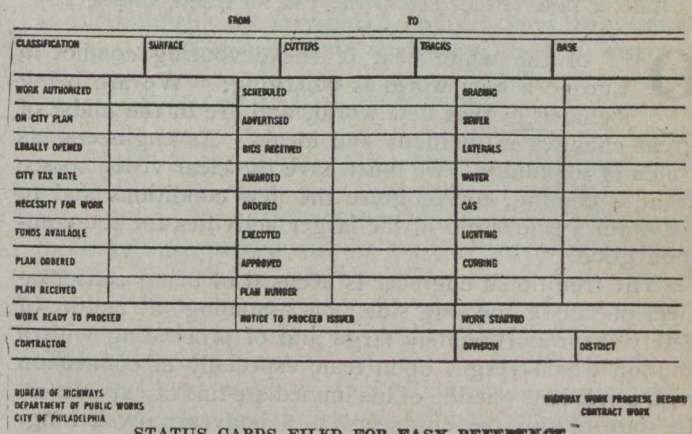
In order that the chief engineer and his assistants and subordinates may at all times be informed on every phase of construction work, either contemplated or in progress, the Philadelphia Bureau of Highways makes use of an unusually complete planning board. As applied to the Philadelphia highway problems, this board eliminates almost entirely the necessity for constant reference to office records, and presents all facts graphically in such a way that they are instantly and easily grasped.

As worked out by Mr. Wm. H. Connell, chief of the bureau, the system includes not only the boards, but current status records, indicators and daily progress reports. Of the current status record two forms are used, one for contract work and one for municipal work. This is for the chief engineer. Another form in three parts is used by the district assistant engineer. These forms give all necessary facts regarding the current status of work authorized, under contract and under way.

The planning board itself consists of a framed map showing the district involved. For the chief engineer this field is the entire city, while for each assistant only the portion over which he has direct charge is included. In each case the scale is sufficiently large to show all details plainly. For the chief engineer and the division engineers, a scale of 1,000 feet to the inch has been adopted, while for the assistant division engineers the more detailed proportion of 500 feet to the inch is selected. This gives the assistant division engineers a record of all work down to the most minute detail.

Colors applied to and shown on these maps indicate the kind of pavement. If more than one material is used on a street, the fact is indicated by the proper tints. Maintenance guarantees covering certain sections of paving are indicated by a pencilled cross-hatching, which readily can be erased on expiration of the guarantee period. Plain blank tints are used to indicate the existence of street railway lines.

For recording permanent information, a series of specially colored and labelled flat-headed tacks are used. These tacks by their appearance tell the observer at a glance some vital fact about conditions at the various

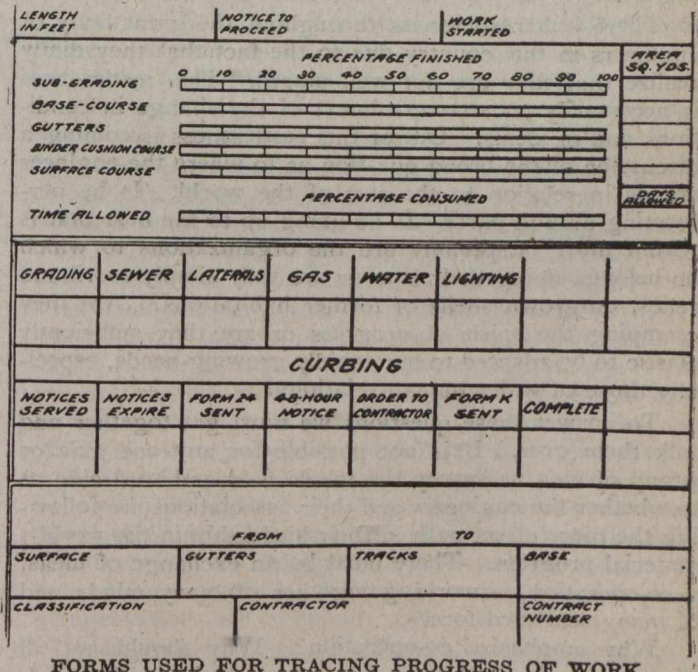


STATUS CARDS FILED FOR EASY REFERENCE.

points where they are inserted. Further reference is given by numbers imprinted on the tack heads, these numbers referring to numbered cards, on which is detailed all information about the point in question. Information of temporary value is given by colored glass-headed pins of varying sizes.

In order to fix responsibility for the proper "posting" of information, each board is supervised by a single employe, whose duty it is to see that all changes are made promptly and that the information recorded is at all times accurate. This posting is done at the beginning of each working day from reports turned in by inspectors and engineers.

Daily data on each job is sent into division engineers. This is in addition to the detailed construction report



FORMS USED FOR TRACING PROGRESS OF WORK.

that goes to the district assistant engineers. These "progress reports," as the daily postcard reports are called, indicate detailed facts as to the force employed, weather conditions, temperature and other necessary facts. These cards are then filed in alphabetical order in the division engineer's office.

A PRACTICAL PLAN OF ENGINEERING CO-OPERATION*

By F. H. Newell,
Head of Dept. of Civil Engineering, Univ. of Illinois, Urbana, Ill.

OUT of the white heat of the devouring conflict in Europe a new world is emerging. We are being included in that new world, and are in the midst of great changes in methods and ideals. As engineers, as "men of ingenuity," we must have the clear vision to see what is coming, to recognize the new conditions and to maintain a leadership in the larger activities for the common good.

The traditional engineer is accused of being conservative, of taking the safe side, of assuming a factor of safety disproportionately large and of proceeding with a caution which verges upon fear, especially in connection with conditions outside of his immediate line of experience. In spite of this the engineers as a body are awakening.

The conspicuous outcome of these charges is a larger recognition of human agencies in engineering work. In the past, the engineer has thought almost wholly in terms of materials; he is now appreciating more than before that the efficiency of his machines is dependent not only upon the quality of the steel and speed with which the tool operates, but even more than this upon the spirit of the man who is behind the tool.

We have been studying and conducting researches into the methods of securing the highest degree of efficiency out of the machine, overlooking the fact that with the very best equipment and the finest organization, we cannot attain the maximum result unless we have the men with us, unless they feel that they are not merely part of the machine but are being treated as men and are being afforded an opportunity to live their lives according to their highest ideals. The spirit of the men counts for more than the design of the machine.

There is a restlessness throughout the great body of engineers in this country due to the fact that they dimly realize that they are not well placed. This restlessness is necessarily an accompaniment of the change in conditions and in ideals. Out of this restlessness is coming a discussion of the broad question as to where the engineer stands in relation to the rest of the world. Is he performing his full part? Is he living up to the best that is within him? Especially are the organizations to which he belongs doing their best or are they simply moribund relics, outgrown shells of former habitations? Are they cramping the spirit of progress or are they sufficiently elastic to be adapted to our rapidly growing needs, especially those of wider human relations?

To answer these questions we must get together and talk them over. It is not possible for any one man or group of men to survey the whole field and to decide as to whether the engineers and their associations are following the more direct path in their leadership in the world's material progress. There must be an exchange of ideas, a co-operation, a working together of many minds and of many scattered forces.

Why emphasize co-operation? Why should not all engineers unite and form one great body with headquarters at some central point rather than attempt to maintain separate organizations at each point wherever a few engineers are located? The answer should be obvious. While a great centralized body is important in setting standards and in considering broad problems, yet from its very organization it cannot properly enter into the local affairs which make up nine-tenths or even 99 per cent. of the important details in engineering.

Every group of professional men have had the same experience, namely, that while there are many questions of national or even worldwide importance for which national organizations must be maintained, yet the immediate application of the broad principles of engineering and of ethics must be left to the many small independent units, each striving to develop according to its environment.

An engineering society is simply an individual grown large and with indefinite length of life. It is subject to very much the same laws, and if the individual finds that it strengthens and broadens him and makes him a better man in the community to get together with his neighbors and to exchange experiences, so in like manner the society is strengthened and improved in the efficiency of its work by meeting with other societies of like aims. Efforts are stimulated, new ideas brought forward and the progress is increased in geometrical ratio as the number of these organizations which get together is increased.

The stated object of an engineering association is usually the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members. Each new society at its birth has adopted largely the forms and methods of the older bodies, often unconsciously copying precedents which the more mature society would be glad to drop and overlooking the unrecorded improvements which have taken place. For example, when the first engineering organizations were formed, there was demand for the publication of technical papers; many of the associations thus practically became publishing houses for material much of which now might be printed to better advantage elsewhere. Their energies are often being expended in uneconomical ways.

The growth of the technical press, with its machinery for presenting quickly and concisely to the engineering profession and to the public at large the latest discoveries and the most recent achievements, has made unnecessary much of the work which was originally performed by engineering societies. Nevertheless, many of our newer associations persist in following along the old beaten track of publishing papers, not lifting their eyes from the ground and seeing the great neglected needs around them. Much of the money thus misused might better be expended in getting men together to discuss the present status and tendencies of affairs and to consider how best to help each other and the world in general, incidentally promoting the social features which are so vital in all human affairs.

What is an engineer? Before attempting to enter further into this matter of co-operation, and its importance to the profession, it is essential that we first stop to consider what do we really mean when we say that a man is an engineer. Is he a professional man? If so, then what is a profession?

A profession is defined as a calling in which one professes to have acquired some special knowledge used by way either of instruction, guiding or advising others or of serving them in some art. In former times, there were usually considered to be three learned professions, theology, law and medicine; but the engineers for many years have insisted that they form a fourth profession. Let us compare the typical engineer, as we would like to see him at least, with a member of one of the three older professions, for example, the doctor. The latter is unquestionably a professional man. In what respect does he differ from the mechanic or the engineer?

*Abstracted from paper read before the Cleveland Engineering Society, November 21, 1916.

The first and most distinctive feature is the fact that the doctor, and the lawyer as well, does not work under immediate direction of some other person nor does he perform certain set operations within certain hours. He is called in *not* to carry out instructions of an employer, but on the contrary to dictate to the man who ultimately pays the fee when, where and how certain things must be done. He ceases to be a professional man the moment he takes orders from an employer. More than this, the doctor, the lawyer and the minister as professional men glorify in the fact that they set the practice of the profession above remuneration. They have devoted their lives to a certain work for the love of the work and not for the money rewards. To the needy their services are free—no mechanic is called upon to work for nothing—the doctor frequently is. In theory at least they do not accept direct pay for so many hours' service, but finding it necessary to live and to maintain a suitable status in society, they accept a fee, a retainer, a stipend, or an honorarium, never wages.

In some respects this is a very narrow distinction, difficult to draw in many cases, but important. The lawyer, while his compensation is to a large extent fixed by custom, theoretically at least he sets it himself. He does not take directions from his client as to how he shall conduct his case, what hours or where he shall work. He, as a professional man, says, "These are matters of my profession, the methods, the reasons, the fees are not to be decided by the client but by the profession." In the same way the doctor is a professional man. He treats his patient in such way as he considers best, not the way the patient wishes to be treated; if you employ a physician, you must take his advice, you must follow his directions or he must leave you. He can not, for professional reason, tolerate any interference on your part or on the part of any other person.

To ascertain whether or not you are really a professional man, simply consider whether you are paid so much per day or month or year for spending certain time and following certain instructions. If you receive wages, you have not yet reached the full status of a professional man, although you may be in the path which leads to a profession. This matter of wages, salary, or fee is an index of the consensus of opinion as to what is or what is not a profession. It is not, of course, the way in which the money itself is paid or received, but the underlying theory as to whether on the one hand you are working under the direction of some one else who is dictating how you shall work or on the other, whether you are exercising the rights and duties of a professional man in determining how your patient or client shall or shall not conduct his affairs.

In the past we have assumed that engineering societies are made up mainly of professional men. Here is where confusion of ideas has arisen as to the duties of such organizations. In the case of some of the larger national societies, there has been a definite effort to restrict the membership to professional men, while admitting others as juniors or associates. In the case of local societies, such distinction is impracticable. The object of a local society is defeated if control is left wholly in the hands of a limited number of professional men. Most of these from their age and absorption in professional affairs have no longer the time or the desire to get together nor the enthusiasm and energy of youth to devote to the affairs of a local association. Moreover, the most important duties of such a body are those which pertain to the needs of the younger men who are on the road towards the higher professional status. These young men and all who are interested in engineering matters should be brought together and stimulated toward larger achievements, but not hampered in their growth by the limitations set by the older men.

We must clearly face this confusion and must endeavor to distinguish and straighten out the lines between the mechanics, often miscalled engineers, the real engineers who are technically educated and who are serving as employees, the business men who are educated as engineers and who are properly members of an engineering organization, but who are in engineering as a business, and the independent practitioner who originally built up the older engineering societies largely following the precedents set by the organization of the doctors and of the lawyers. The times have changed and this confusion of terms must bring about a great deal of discussion, a conflict of ideas. Thus we must, when considering the function of the engineer, clearly distinguish as to which of these kinds of men we have in mind and what are the classes of men to be benefited by our organization.

Under the assumption that the majority of the members of our local engineering associations are not professional men as yet, but should have before them the ideals of the professional men that they may grow into the profession; what are the things most important for this association and for all similar associations to do for the benefit of its members and of the public in general?

Our activities must be directed toward the needs, not merely of the small number of mature engineers, but more than this to the proper relations of the younger men. These needs may be enumerated under several headings. They must be considered under the headings (1) employment, (2) publicity, (3) better laws, (4) ethics.

The first thing, the thing that all must have, is a job. We must have employment. We cannot all start in life as professional men, picking out our work and stating what our compensation shall be. We have got to grow up to that status. In the meantime we must live, and if there is any one thing which an engineering society has as a duty to its members, it is to assist them in securing employment. If you stop to consider it, practically every one of us at some time or another is out of a job.

More than that, as we are out of a job perhaps only once or twice in a decade, we are of all people the most helpless when we are out of work. The highly trained and educated man is peculiarly unfortunate under these conditions. The mechanic is out of work more frequently. His comrades recognize this fact and do their part. The machinery of modern industry, while crude and inefficient in the matter of employment, does operate after a fashion for his benefit. He knows how to go about to get work, and it is no disgrace to him to be out of employment. Every one of us, when we are out, feel that it is a disgrace to let the fact be known. We are dazed. And if there is any one thing that the organization of our associates should feel incumbent upon them, it is to help the fellow member to do the thing which he cannot do himself, and to make it possible for him to get employment at proper compensation just as quickly as he can.

It is a most pitiable condition to see such men accepting mere living wages, men of high ability, high attainment, because of an inherent modesty, a condition cultivated by the engineering ideals. All should unite in intelligent, well-directed consideration as to how to help our fellow member to be better treated when the critical time comes. We can say things for him that he cannot say for himself and that he cannot ask us to say; it is one of our duties as men and members to look into employment systems

as we never have in the past, because, as has been said, the times have changed, and the conditions of employment now and in the future are getting more and more stringent. This is particularly the case for some of the older men. For them the line is often drawn rigidly at forty-five years of age. Any man over that line is not employed. It is a cruel and often unnecessary situation. This and other injustices can be cured, if at all, only by the united effort of an organization of this kind and by your co-operating with other organizations in similar work throughout the country.

Every day that one of the men who make up the rank and file of an engineering society is out of work is a loss not merely to him and his family, but also to the community. It is a duty as yet only vaguely recognized on the part of the society to see to it that the brother member secures congenial employment at the earliest practicable date. The traditions of the engineering profession, and the unwritten laws seem to penalize the unfortunate engineer who is not immediately employed on the conclusion of one enterprise or on the sudden termination of his former connections. Individual and professional pride prevent him from going outside of the circle of his people. To do this we must propagate throughout the country the kind of publicity which enables the public to know and appreciate what has been done, and to give to the engineer the standing which men of brains deserve, and which they do not get if they do not let the world know what their individual members are doing for the public service and for the up-building of all humanity.

Professional men shy at the word publicity and "go up into the air" at the idea of advertising. The older professions frown upon self-sought publicity. Nevertheless, they have seen to it that the public is at all times kept informed of their activities not as individuals, but as professional men ministering to the needs of humanity.

Many engineers have not been able to clearly distinguish between self-seeking advertising and the proper and necessary publicity or diffusion of information regarding engineering achievements. They have assumed that publicity meant the advertising of some one man or some scheme for personal advancement. They have overlooked the fact that the engineers as a whole cannot perform their full duty to the community until the community is well-informed concerning what has been done and, more than this, what can be done in the way of better water supply, better sewers, better roads, better bridges. The public uninformed little knows of the infinite variety of devices perfected by the engineer which have improved health, comfort and prosperity. While the individual engineer may not properly exploit his own performance, yet the association of which he is a member has a duty to itself, to the public and to the members to put out clearly and frequently statements acceptable to the daily press which systematically bring about the proper appreciation of engineering work.

The third line in which our engineering organizations should co-operate is that which will bring about improved civic conditions, through better laws. In this we have held back. We have thought that the law was something with which a respectable engineer should have nothing to do.

Our professional men, the men who devote their lives to the highest good of the community and whose greatest reward is not in their pay but in the performance of duties to the commonwealth, must be protected from the cheap man, the bungler, the charlatan, the quack, the man who is trying to commercialize the profession. To do this we must have and must enforce an ethical code.

Ethics is a word which has been too little heard at meetings of engineers. We know that there is such a thing and that in the profession of law and medicine the local organizations are frequently discussing and applying the principles of their ethical codes. They have found it absolutely essential to protect the man who puts the practice above the pay from the person who would drag him down and literally starve him out. By experience they have learned that the shyster, and the charlatan easily get the ear of the public and if not restrained will reduce the profession to a mere trade. The highly skilled man devoted to his profession in many lines would be practically unknown, were it not for the fact that the horde of cheap men were held in check by the enforcement of a firm code of ethics.

"It is not enough to set forth a code of ethics as a lamp to straying feet. It is necessary to make it worth while for wobbly practitioners to live up to the code."

"Mere moral suasion no more suffices to keep the professions straight than public opinion suffices to keep the peace. In either case, tribunals and punishment are necessary. The good in each of the professions ought to be organized in order to pursue and harry the bad." (See "The Making of the Professions," by Edward Alsworth Ross, in the International Journal of Ethics, October, 1916, pages 67-81.)

In conclusion my message to you is one of appreciation for the excellent work which your society has done and is doing in inspiring other organizations to greater activity. My mission is to call to the attention of all engineer the fact that we must adjust ourselves to the rapid changes which are taking place, and to do this we must get together, exchange ideas, devise standards of efficiency and discuss how each organization, as well as each individual, can reach this efficiency.

To accomplish large results each society should send its delegate to a general meeting and should pay his expenses, this for the present being the limit of its financial ability. Later, however, with the strengthening of each society such as comes from mutual co-operation, it will undoubtedly be possible for each to contribute its share to the expense of a travelling field agent or lecturer, inspector or organizer, as you may please to call him. In the meantime we hope that patriotic and far-seeing men will voluntarily contribute toward carrying on this work of co-operation. It necessarily costs something, even though merely for postage stamps.

The engineer, as in the case of every other individual in modern society, to keep up to the times, and to achieve his ideals, must unite with his fellows and in turn his associations must co-operate and secure the strength and inspiration which comes from good organization. In this way alone will we be able to perform our highest duties to ourselves and to the community.

AN OPPORTUNITY IN FRANCE

A firm in France is anxious to get into touch with someone in Canada who could take charge of the building of small steamships for a large concern. A man with boat building experience is desired. This is a splendid opportunity. Knowledge of the French language would be an advantage. Those interested are asked to communicate in the first instance with Jas. J. Salmond, president of *The Canadian Engineer*, 62 Church Street, Toronto.

FUNDING SANITARY IMPROVEMENTS AS A MEANS OF INCREASING WATER CONSUMPTION.*

By R. A. Butler, Publicity Counsel, and F. C. Jordan, Secretary, Indianapolis Water Co.

WHEN Moses, who appears to have been the first sanitarian of whom we have any authentic record, laid down a code for living and being clean, he fitted his laws to both the rich and the poor.

He set out, as you will recall, very specific methods by which those persons who had become unclean could cleanse themselves. He specified no other germicide than fire and water, and he wrapped up the sanitary measures in a parcel of rites which might be compared to the red tape of contract laws of to-day.

But Moses did one thing that the sanitary engineers of to day are not doing. He recognized a distinct division between the poor and the rich, and he provided a way by which the unfortunate, without worldly goods, could comply with the laws he established as well as the rich could meet their requirements.

Moses said that if the unclean person was too poor to sacrifice a sheep or a goat on the altar as a part of the purging process, he might sacrifice a fowl.

Just as in the present day, a sacrifice was necessary then to cleanliness. But unlike the present day, the sacrifice might be of two values, one for the rich and one for the poor.

In this day, however, there are not two prices for the water service necessary to sanitary disposal of sewage. Nor is there any considerable deviation in the price of bath tubs and plumbings. Each demands financial sacrifice, easy for the rich and prohibitively difficult for the poor.

What Moses did in the way of making clean the poorer class has largely been forgotten by sanitary engineers of to-day, who, in their zeal to give the general public what they know to be the best for it, have overlooked the inability of the poorer classes to comply with the sacrifices therein prescribed.

This inability of many to contribute to the sanitary progress of all should not be confused with ignorance or lack of interest in proper sanitation. We may not agree that all persons would rather be clean than unclean, but we must confess that every individual values his health, and the great majority value the health of the community as a whole.

Were it possible to have proper sanitation in every community without interfering with the pocketbooks of the people, sanitation would be a simple problem. But you, gentlemen, who have long been familiar with the difficulties that rich municipalities have in such necessary steps as sewage disposal or the procuring of potable water, know that there is always a strong fight waged against necessary measures because of the investments involved.

Too often we are inclined to lose all patience with this opposition. We accredit it to ignorance or indifference, regard it as miserly, and hope for the day of enlightenment when all property owners will be willing to expend the money necessary to produce proper sanitary conditions.

If possible, the engineer and the enlightened sanitary officer will ride roughshod over the financial opposition. He will regard the expenditure as a necessity, and will rightly point to the vast returns on money so invested. This course may be well enough when a municipality pays the freight, and the pro rata cost is so small that it involves no great sacrifice. But its repetition only meets with opposition of a more forceful character until the time comes, as it has in more than one city, when the money necessary for these improvements is not forthcoming and the improvements become impossible.

Opposition to public health measures is generally analyzed as due to ignorance. Perhaps it generally is. But there is a point where the public debt becomes a private hardship, and one has only to hunt up the owner of a lot with a big sewer assessment against it to find a man who has been called on in the interest of cleanliness to sacrifice a sheep when his financial condition justifies the sacrifice of a fowl only. This situation becomes all the more common when the question involved is one of individual sanitation rather than municipal or community sanitation.

In every community in Indiana there are hundreds of citizens who would thoroughly appreciate the advantages of sanitary closets, but who are still tolerating open vaults on their premises. Bath tubs are luxuries they forego, not through lack of desire, but through necessity. These people by no means constitute all those who are living in unclean surroundings, but they form a class so large, their conversion to sanitary living would be a step toward community health that would almost solve the problem of the sanitary engineer and reduce his opposition to a comparatively negligible quantity.

These are the people whom Moses declared could sacrifice a fowl instead of a sheep. They are willing to sacrifice a fowl on the altar of health, but they have no sheep, and the rigid law of the sanitary sacrifice is a sheep or no sacrifice.

Providing a sacrifice which is within their ability is the coming big problem of proper sanitation. It is a problem that has long been neglected, ignored, and little understood by the engineers and others who have, in spite of all opposition, forced their communities to healthy surroundings.

Progress has been made in other fields that should be applied in the sanitary field. Distributors of luxury have evolved methods of coordinating the financial problem with their merchandise. Sellers of service have found ways by which the poorer purchaser could be accommodated as well as the rich, comforts have been brought within the reach of the small pocketbook as well as the large.

To-day you may buy an automobile on a partial payment plan that brings its luxury in reach of the moderately well-to-do. You may enjoy the benefits of electric lights and power, and pay for your equipment while you enjoy it. Gas is brought into your kitchen, and a range sold to you on terms that you can meet out of a very small income. But you cannot have a sanitary toilet in your home until you have scraped together the cash with which to satisfy the plumber and the sewer digger.

Experience has taught the engineers and managers of water utilities that it is neither profitable nor practicable to develop large consumers of water at low rates faster than smaller consumers at higher rates. There is a certain point, varying with each utility, where it means a sacrifice of profits to deliver water in large quantities at a low rate. The proportion of manufacturing

*Paper read before the American Waterworks Association, May, 1917.

consumers using large amounts of water daily must be co-ordinated with the proportion of smaller consumers, who, by reason of the smaller amounts of water consumed, pay higher rates for their service. If their vital relationship is overlooked, the water utility will find itself with an enormous pumpage at a very slight profit, or no profit, wiping out the lucrative income from the smaller consumer by its efforts to meet the demands of the larger consumer.

With this distinction we are not now concerned further than to recognize its existence and suggest it as essential to waterworks sales promotion propaganda.

There are many methods of developing the larger water consumers. There is little or no problem of finance worrying the large consumer. Whenever the utility can convince the large consumer that its service is more economical than his private water system, the large consumer will enroll among its patrons. Whether or not this is desirable business is left to the management of each utility to ascertain in accordance with the peculiar conditions that exist in the utilities business.

Increasing the number of consumers of smaller amounts of water is the problem that confronts the water utilities of the United States to-day in their efforts to operate at a profit under rates that are generally fixed by regulatory bodies, often without the consent or approval of the utility. Analysis of the problem of obtaining this increased business generally reveals the lack of financial ability of the prospective consumer to make improvements as the greatest difficulty to be overcome. It is this lack of financial ability that must now be overcome.

Personal investigation of the territory reached by the water lines and the sanitary sewers, even when made perfunctorily, cannot fail to disclose financial inability as the main reason for the failure of these abutting property owners to connect their property with water service and sewers.

Investigation in Indianapolis revealed that the water utility was serving about 70 per cent. of the number of homes and small business properties. Of the 30 per cent. that lacked sanitary conveniences, fully two-thirds were within easy access of water lines and sewers, while the other third, or 10 per cent. of the total, lacked either sewers or water mains, or both. This percentage will, of course, vary in other cities, but as a broad and general rule it seems possible of application. Engineering Record, March 3rd, 1917, page 365, says: " . . . this 30 per cent. figure holds good as an average throughout the State (Indiana), according to investigations of both the State Board of Health and the United States Public Health Service."

Thus it will be seen that sanitary engineers and public health officers, bent on advancing sanitation, have in many instances completed surveys that may be used as fundamentals on which to base surveys for the new business plans of the water utility.

As a rule, however, these surveys of engineers and health officers are open to one vital criticism. They have generally, erroneously, accepted the theory that lack of sanitary improvements was due to indifference to private and public health. On this theory they have insisted that only stringent laws and building codes would bring about proper sanitation.

The theory has been challenged. Investigation has done much to upset the popular belief, and it is now set forth as a general rule that property with inadequate sanitary facilities is in nearly every instance owned by individuals who have nothing else, or are so encumbered by the burden of land ownership that they are unable to make these improvements.

Hundreds of instances have been found where property owners were not only willing, but anxious to provide either themselves or their tenants with sanitary conveniences. They have been prevented heretofore from making these improvements by heavy mortgages on their holdings, or the necessity of using the income from the property to defray the interest charges, expenses of living, or to meet the payments on other property which they were seeking to acquire. While they might realize that their income would be increased with the installation of sanitary conveniences they were unable to increase their incomes because of their inability to raise the cash necessary to install these conveniences.

Careful study of surveys made by health officers reveals in many instances a mistaken conception of the attitude of property owners toward sanitation. It is not indifference, nor prejudice that prevents the installation of bath tubs. It is sheer inability to get together at one time the money necessary to pay cash for plumbing, cash for fixtures, cash for sewering, and cash in advance for water service.

These prospective water-users are good credit risks. They have shown their thrift in the purchase of their properties, and they are able to qualify by the moral standard that financiers now say they consider most thoroughly in making loans. Yet no one has gone into the business of making it easy for them to care for their health. No one has offered to them the advantages now offered to the man of moderate means who would own a touring car. The opportunities of financing modern sanitary necessities have long been neglected.

The little home with its well water supply, its lack of sewers and its open vault must give way to water service, sanitary sewers and sanitary closets. Some way must be found to finance these improvements without throwing too great a burden on these owners. Have not the distributors of automobiles pointed the way for the distribution of sanitation?

To-day, if you wish, you may go to any auto dealer and purchase an auto by the payment in cash of half or less of the list price. A funding company will supply the rest of the purchase price and so arrange the deferred payments that you may make one a month for a reasonable period. The auto is delivered to you under a lease and the title remains with the funding company until the last payment is made. Insurance, interest, and brokerage make this an attractive investment from the standpoint of the funding company, and the everlasting longing of the American purchaser for more luxury is the incentive that makes the business possible. Why not apply the same principle to sanitation? Why not make it possible for the man who owns a small property to have sanitary plumbing installed in his home and the cost thereof extended over a reasonable period?

Electric light companies are wiring homes for electricity on this theory. Gas companies are installing ranges on payments. They have the sales and the collection systems already in operation, and the addition of appliance accounts is simple and involves little cost. The manager of the People's Gas Company, of Chicago, recently asserted that one of the greatest agencies in the development of the gas manufacturer's field to-day was the partial payment plan of selling appliances. His company has carried more than 600,000 of these partial payment accounts on its books. This same method of

financing can and will be applied to water service and modern sanitary improvements in the near future. It is a problem that confronts water companies all over the country, and it is a solution that means more service on their mains, the use of more water and the improvement of the health of whole communities.

Whether or not water companies or municipally-owned waterworks systems embark in the plumbing business, directly or indirectly, is a matter of small moment and local conditions. But even for the water utility that is restricted as to business by its charter or its ownership, there is no great difficulty in the partial payment plan. The automobile distributor has pointed out the way, and the way is easy to adapt.

For example, in Indianapolis there is an outlet from the mains of the water company for every 7.5 persons in the city. The average size of a family is five. It follows that the business of the water company is 33⅓% less than it might be. This one-third represents the field of prospects, and any merchandising expert will say that one-third of the whole of a city's population is a desirable field to cultivate.

With one-third the city as the field, there is necessary to the development of business capital sufficient to equip the possible user of water for its enjoyment. The installation desired in the class of homes in the city that now have no water service has been estimated at a physical cost of from $100 to $250, according to size and location. Taking the lowest figures as a basis, interest at 6 per cent. for two years and a brokerage charge of 6 per cent. could be added, and the installation made at a partial payment cost of $4.92 a month for twenty-four months. To this should be added the cost of water, not exceeding $1 a month, making, in all, a charge against the property of $5.92 a month, or approximately 19.7 cents per day. This should prove a fairly attractive proposition for the man with a small property whose concern is a safe water supply, such as is furnished by water utilities. Other advantages, such as baths and toilets, will follow quickly on the heels of the first installations, and their costs will be relatively small.

Brokerage charges should be no greater for the large installation than the small, if based on cost, but policy might dictate a sliding scale in order that first costs of installation be reduced. The organization of a funding company with capacity to handle this business should not be difficult. Capital would, of course, demand an ample margin of security, but it is the opinion of legal authorities that this security could easily be provided.

Two methods have been suggested for the protection of the capital necessary to make a home sanitary. Indiana laws provide for a lien against property so improved to protect the capitalist who makes the improvement. The process, however, is not without its troublesome delays and risks, and, unfortunately, it is possible for more than one lien to be filed against a property, thus making it necessary at times for the satisfaction of all liens in order to satisfy one.

A more applicable plan is the leasing of such fixtures as enter into the house to be improved. The cost of the fixtures in a modern home is not the major item of expense, but the fixtures are the necessary item to the enjoyment of sanitation. It is urged by plumbers and others that no property owner who has once had plumbing fixtures installed can afford to have them removed from a house. The removal is attended by such wreckage that the property would depreciate in value to a point far in excess of the cost of the fixtures and the labor necessary to sanitary plumbing. It is argued that an owner who has profited by better rentals or greater conveniences would exhaust every resource rather than suffer the removal of plumbing fixtures which have only recently been installed. Consequently, those who have investigated the credit problem maintain that a lease drawn to cover the fixtures installed in the house, and affording legal right to enter and remove these fixtures in event of non-compliance with the terms of the lease, would in practically all instances be sufficient protection for capital, no matter how timid it might be.

It is also argued that the funding company would deal only with that class of persons who have demonstrated their thriftiness and integrity in the acquisition of property, and the moral risk would be of the highest class. However, it is to be presumed that some lessees would fail in performance, and then, with a proper lease, the funding company would be in a position to take a lien on the labor done, or to remove the fixtures if it were deemed advisable.

Organization and operation of the funding company is possible at a very small overhead cost. The amount of capital actually necessary is dependent on the size of the field, but a consideration not to be overlooked is the fact that each month brings part of the capital back for reinvestment, and with each monthly payment the individual account becomes more secure.

Operating expenses of the funding company would consist of three branches: promotion of business, investigation of risks, and collection. The expenditure necessary for the promotion of business will depend on the method of operation finally adopted.

Investigation shows the great cost involved in installations such as are under construction is not the plumbing, but the sanitary sewer, the very thing that sanitation demands. This cost is not one of material, but of labor, and probably no one plumber has any advantage over another in doing it. Plumbing is largely a matter of labor, and in most communities is so restricted by ordinance that it must be made standard. Fixtures furnish the greatest opportunity for c st reduction by purchase in bulk, but there are other advantages to be considered in determining whether a funding company should work in conjunction with all local plumbers or take over plumbing as a part of its business.

In the automobile business it has been found more desirable to have the funding company separate from the sales agency, in name at least. Perhaps this would be more advisable in sanitary funding. Certain it is, that if the funding company were holding out to each plumber an opportunity to do work and collect his money immediately, even though the employer is not in a position to pay him cash, every plumber in the community would become an enthusiastic salesman and the cost of sales would be greatly reduced for the funding company.

A desirable situation seems to involve the organization of a company with sufficient capital or financial backing to be able to say to the property owner, "Hire any plumber you choose and select any fixtures you desire. We will pay the entire cost and give you two years in which to repay us."

Then, with the plumbers of a city the enthusiastic boosters of the funding company, the examination of the risks is the next important operating detail. It has been estimated that this work can be accomplished at a minimum fee of five dollars a risk. The burden of showing

title to the property is to be thrown on the applicant for a contract, and extensive investigation is not necessary. The up-to-date manager would be capable of judging the advisability of the contract, and a single inspection of the property would be sufficient to satisfy him. The time element is not important, and his work could be so distributed as to make it least expensive.

For convenience of collection the water rental and the partial payments should be payable at the same place, the lessee being billed for the total and the utility holding the funding company responsible for the water rental. A simple card system of bookkeeping and a stenographer supplied with suitable letter forms for prodding the delinquents should accomplish the collections without great expense.

Whenever it is possible for the small property owner to improve his property without shouldering a hardship in the form of a big initial expenditure it will be easier to insist on sanitary improvements. The greatest argument against the condemnation of open vaults and unsafe wells will disappear. Laws designed to wipe out these breeders of disease will not be assailable on the grounds that they are confiscatory.

More widespread sanitary conditions mean increased use of water service. Without water service of the kind furnished by public utilities modern sanitation in a city is dependent on expensive private water installations. The extent to which sanitary conditions are obtained measures the extent of water service. The increase of one is invariably the increase of the other. For that well-established reason the object of this plan for increasing the number of water consumers along the lines of the utility is reached by the promotion of better sanitation, through the method of inducing the application of water service to localities that are without water service, and hence without sanitary methods of handling sewage.

There is no greater appeal to man than a plea for the preservation of his own health and that of his family. Nothing is more likely to prompt quick action than the forceful presentation of the dangers to health and life of unsanitary conditions.

Fundamentally, we all like to be clean. We appreciate and enjoy sanitary surroundings. We envy the convenience of sanitary bathrooms and closets, and it is no exaggeration to say that if those of us who have these conveniences were suddenly confronted with the necessity of giving up electric lights, gas, or water service, we would in nearly every instance sacrifice the other two conveniences before we would sacrifice the safety and convenience of water service.

Building restrictions alone are not responsible for the fact that nearly every home erected in this age is fitted for sanitary sewers and water service. Back of the code is public sentiment, demanding these conveniences as measures of health and safety. Why, then, are they not universally used? The answer is purely one of finances. Nothing is harder to obtain in the average city than sanitary plumbing and water service. No public convenience is harder for the little home-builder to obtain than water service. It is for the purpose of making it easy to obtain sanitary conditions in the home that the data herewith presented has been compiled. When the purchase of the equipment necessary to enjoy water service is made easier water service will be purchased by many more people than can now afford it; water utilities will profit by increased business, and the general health of the whole community will be bettered.

CAN. SOC. C.E. SECRETARY TO VISIT WESTERN BRANCHES

Secretary Fraser S. Keith, of the Canadian Society of Civil Engineers, will leave Ottawa next Sunday evening, August 12th, for a visit to all of the western branches of the society. He will attend branch meetings as follows: Winnipeg, August 15th; Regina, August 17th; Moose Jaw, August 18th; Calgary, August 20th; Edmonton, August 22nd; Victoria, August 29th; Vancouver, August 31st. Mr. Keith will also visit Prince Rupert on August 24th.

The summer meeting of the Saskatchewan Branch, which had been planned for August 11th at Moose Jaw, has been postponed until August 18th, thus giving Mr. Keith an opportunity to be present.

The branch secretaries have made the necessary arrangements for the various meetings. The council requested Mr. Keith to take this trip for the purpose of meeting the secretaries and executives, and as many other members as possible, of the branches, with a view to closer co-operation between the branches and the headquarters of the society.

DEMURRAGE RATES INCREASED

THE Board of Railway Commissioners for Canada has revised its "Car Service Rules," replacing them by a new code called "Car Demurrage Rules." The chief change is in the demurrage rates. For the first day or fraction thereof that the car is held after expiration of the free time a charge of one dollar will be made. For the second day, the charge will be two dollars; third day, three dollars; fourth day, four dollars; fifth and each succeeding day, five dollars.

The new rules apply to cars held for or by consignor or consignee for loading, unloading, forwarding directions or for any other purpose. Cars held at railway terminal awaiting boat, private cars on private tracks, and empty private cars on carriers' tracks are exempt.

Forty-eight hours' free time, exclusive of Sundays and holidays, are allowed for loading or unloading. This is reduced to twenty-four hours for loading grain at Port Arthur and west, and increased to five days for unloading lumber and hay for export at Montreal and tide water ports. Manufacturers, lumbermen, miners, contractors and others who have their own motive power and handle cars for themselves or others will be granted an additional allowance of the time necessary for them to do the switching from and to the designated interchange tracks, but not to exceed twenty-four hours.

If wet or inclement weather, according to local conditions, renders unloading impracticable during business hours, or exposes the goods to damage, the free time allowance will be extended so as to give the full free time of suitable weather. If, however, the cars are not loaded or unloaded within the first forty-eight hours of suitable weather, no additional free time will be allowed.

Demurrage will not be collected for any delays for which government or railway officials may be responsible, such as customs or inspection delays.

These increases in demurrage rates are badly needed, and will be heartily approved by most shippers and receivers of all kinds of material, especially shippers who have found it difficult to get cars, and buyers whose shipments have been delayed by the car shortage.

Editorials

NATIONALIZATION OF THE C.N.R.

The government's proposal to nationalize the C.N.R. does not agree with the spirit of either the majority or minority report of the Railway Inquiry Commission. Both Mr. Smith and Messrs. Drayton and Acworth emphasized in their reports the manner in which the G.T.R. and C.N.R. complement each other, and this has also been pointed out by Mr. W. F. Tye and other railway authorities. By taking over only the C.N.R., the government does not avoid any duplication of railway effort and does not effect any economies in operation.

The acquisition of the C.N.R. at this time would be welcomed by the people of Canada, assuming that the road were to be acquired upon a fair basis, if there were prospects of adding the Grand Trunk Railway System to the government lines in the near future. But Sir Thos. White strongly intimated, when introducing his resolution in the House of Commons, that the government has no idea of taking over the old G.T.R. System. He said that the government would like to take over the G.T.P. later on if some way could be arranged for doing so and safeguarding the interests of the people, but he said that the finances of the Grand Trunk System, aside from its obligations to the G.T.P., are quite satisfactory, and he defended the payment of dividends at the expense of betterments. All this clearly indicates that the government proposes to leave the Grand Trunk Railway System as it is, and that it may even relieve it at a later date of its G.T.P. liabilities. The acquisition of the Canadian Northern, apparently, is therefore not intended to be the first step in the formation of a Dominion Railway Co. such as outlined in the majority report of the Railway Inquiry Commission.

If the government intends fully to protect its investment in the G.T.R., with a view to taking over the G.T.R. at a later date in case that road continues to seek periodical government loans, why does not the government require a mortgage upon the whole G.T.R. System in exchange for the $7,500,000 which it is now lending, instead of taking a mortgage only on the G.T.P.,—a mortgage which even Sir Thos. White admits may be practically worthless on account of existing securities totaling the value of the road?

Another point which arouses concern is in regard to the basis upon which the purchase price of the capital stock of the C.N.R. is to be arbitrated. The resolution before the House merely states that the arbitrators shall determine the value of the outstanding 600,000 shares of stock. It does not say whether the value is to be based upon physical value and assets of the road or whether the arbitrators are to be given a free hand in placing value upon good-will and future prospects. It does not say whether the actual value of the road is to be taken as replacement value or present value, nor does it say whether the road is to be valued at normal pre-war prices or at present abnormal prices. If the decision of the arbitrators be unanimous, it is finally binding upon the government as well as upon the railways. There can be no appeal.

How is the government to select its arbitrator? This man, whoever he may be, will have enormous authority; he will be able to commit the government of Canada, finally and without recourse from his action, to an enormous payment. The selection of this arbitrator is a very serious proposition. The opposition should be consulted and thoroughly satisfied; his appointment by parliament should be so nearly unanimous as possible. No one must have any influence on the appointment who is connected in any way with the owners or pledgees of the stock, or who has any interest in their affairs.

The question naturally arises, Who are the pledgees of the stock? Full information concerning their names and the amount of stock held by each should be given to parliament. The widest publicity should be given to the whole transaction. This is too big an affair for any corner of it to be left dark.

Sir Henry Drayton and Mr. Acworth, in their report, say that the capital stock is practically water and that it represents no value. With this view we are inclined to differ, and believe that the board of arbitration will most likely set a value of at least twenty to thirty million dollars upon the stock, but Sir Henry Drayton's published views make him the logical arbitrator for the government's side. The people will want an arbitrator who believes that the stock is valueless and who will work with that as an initial assumption. The company's arbitrator will no doubt endeavor to show that the stock is worth par, as Sir Wm. Mackenzie and others connected with the C.N.R. have claimed that it is, and it will be for the third arbitrator to mediate between the two.

The public may well demand some guarantee that the board of arbitration will at least be restrained from placing a wholly exorbitant and unreasonable valuation upon the stock. The railway owners know the worst they can expect,—that is, a valuation of zero. There is no such limit in the other direction. Any wild amount that might be agreed upon by the board of arbitration, if unanimously, would have to be paid by the government. This makes the selection of the government's arbitrator a matter of unusually vital importance.

Sir Wm. Mackenzie has been working for years to place the Canadian Northern Railway in a position where its capital stock will be worth par. The road has evidently now reached a stage where he cannot accomplish his aims in the normal way. The road apparently cannot stay out of the receiver's hands if the government withholds aid or purchase, and if the road goes into the receiver's hands the capital stock would likely be wiped out. Under the circumstances, the government's offer to take over the road, and to pay for the stock by arbitration, is a generous one, and Sir Wm. Mackenzie cannot expect to accomplish at one stroke, as a gift from the government, what it would take many more years to accomplish in the ordinary way, if it could be accomplished at all,—that is, making the stock worth par in cash or government bonds. On the other hand, the arbitrators must take into consideration the services which Sir Wm. Mackenzie and Sir Donald Mann have given free of charge in return for their capital stock, and for which they are no doubt entitled to consideration and remuneration.

PERSONALS

Lieut. J. B. L. Heney, of Ottawa, who, before enlistment, had completed three years' study in Applied Science at McGill University, has been awarded the Military Cross.

R. J. Cole, C.E., of Syracuse, N.Y., was recently in Hamilton, Ont., looking into conditions for the erection of a large coke plant in that city for the Semet-Solvay Coke Company.

Capt. Joseph A. LeRoyer, civil engineer, formerly of Montreal, has been awarded the Military Cross. He originally joined the 163rd Battalion, Montreal, and was then transferred to the Royal Flying Corps.

Lieut. Laurence B. Kingston, of the Canadian Field Artillery, and a McGill University graduate of the class of Science, '08, has been awarded the Military Cross. He was practising as a civil engineer in Toronto when he joined a battery as a subaltern and went overseas in 1915. Lieut. Kingston's home is in Ottawa.

Lieut.-Col. Chas. H. Mitchell, M.Can.Soc.C.E , of the firm of C. H. and P. H. Mitchell, consulting engineers, Toronto, has been made an officer of the Order of Leopold by the King of Belgium. The honor is a reward for Col. Mitchell's distinguished services in the fighting in Belgium, which culminated recently in the battle of Messines.

Lieut. D. M. Ewart, of the Canadian Engineers, son of David Ewart, consulting architect of the Department of Public Works, Ottawa, has been awarded the Military Cross. He was graduated in Applied Science at McGill University in 1910, and is twenty-seven years of age. Enlisting as a sapper in 1915, he was in England promoted to the rank of sergeant-major, and in November, 1916, won his commission. Lieut. Ewart was resident engineer at West Toronto for the C.P.R. when he enlisted.

OBITUARY

Geo. Bromley Kirkpatrick, who until a year ago held the position of Director of Surveys for the Ontario government, died at his home in Toronto on August 3rd at the age of eighty-two. He was born in 1835 near the city of Dublin, Ireland, and was educated at Trinity College. Upon graduating in 1857 he came to Canada, and was engaged for some time in the construction of the G.T.R. system in Ontario, finally becoming a land surveyor. In 1866 he entered the Crown Lands Department at Toronto, but a year later, the time of Confederation, when the government moved, he went to Ottawa. After serving twelve years in the Dominion office he was appointed in 1878 director of surveys for the government of Ontario, which position he held up to a few years ago, when he retired.

The Milton Hersey Company, Limited, Montreal, have been appointed as specialists in connection with the asphalt paving work on the Quebec-Montreal Highway. This work is expected to start in the near future, the asphalt paving plant for making the surface mixture being now in the process of erection. The Milton Hersey Company have also been retained by various cities, including Quebec, Montreal and Woodstock, upon a flat price per square yard, including consultation, reports on materials and mixtures, and inspection. C. A. Mullen, A.M.Can.Soc.C.E., is the director of the paving department, and Walter C. Adams, B.A.Sc., is chemical engineer.

PORTABLE CEMENT-GUN OUTFIT

The Burns Cement-Gun Construction Co., Limited, of Toronto, has designed and built a portable cement-gun outfit which appears to have several advantages over previous types. A light auto truck hauls the cement-gun and the workmen to the site of the job and at the same time pulls a trailer on which are mounted a compressor, engine and pump.

After placing the trailer in working position and unloading the gun, the truck is then used for hauling the sand and cement, and, where necessary, the reinforcing materials. The gasoline engine on the trailer is a 4-cylinder, 30-h.p. Gray marine type engine. The compressor is a Gardner, 8″ x 6″, duplex, with capacity of 180 cubic feet at 75 lbs. pressure, at 400 r.p.m. The compressor is belt-driven. The unloader of the compressor is regulated for 50 lbs. pressure.

Mounted on the trailer is also a 1½″ Albany centrifugal pump which cools the motor and supplies the water jacket of the compressor and also the nozzle of the cement-gun. The piping is so arranged that either the water or air can be taken from either side of the compressor, and when city water pressure is available, the pump can be cut out entirely. The pump is belt-driven from the compressor fly wheel. Underslung under the trailer is the air tank.

The company considered various types of portable outfits now in use by cement-gun construction companies in the United States, specially the type where the compressor is driven by the automobile motor, but rejected all of them on account of lack of flexibility. The arrangement decided upon has the advantage of allowing the truck to be used for hauling materials.

THE GREATER WINNIPEG AQUEDUCT

(Continued from page 108.)

At the end of the 1915 construction period, 14.6 miles of aqueduct had been completed. This mileage represented 17.1% of the work let. In 1916, 35.5 miles were built, making 50.1 miles of completed aqueduct, or 52% of the total mileage. If the contractors succeed in completing their schedule for 1917, by December of this year only 15% of the work east of Deacon will remain unfinished.

An administration board consisting of the mayor of Winnipeg, as chairman, and the Board of Control (four members), the mayor and one member of the St. Boniface Council, the mayor of Transcona, and the reeves of Assiniboia, St. Vital, Fort Garry, East and West Kildonan, conduct the affairs of the district. Subject to this board, two commissioners, R. D. Waugh (chairman) and J. H. Ashdown, manage the corporation. W. G. Chace is chief engineer in charge of construction, and J. H. Fuertes, of New York, is consulting engineer.

A new cement mill, with a capacity of from 50,000 to 100,000 barrels of cement per year, has just been opened about one mile from Guatemala City by American interests, acting under a special concession of the Guatemalan Government. The plant has been under construction for two years, and involves not only the mill itself, but two miles of railway connecting with the port. Practically all the machinery was manufactured in the United States. The new company is restricted under its franchise to a maximum charge of $4 per barrel for its product. The managers state that they will be able to manufacture cement at a cost of $1.25 per barrel.