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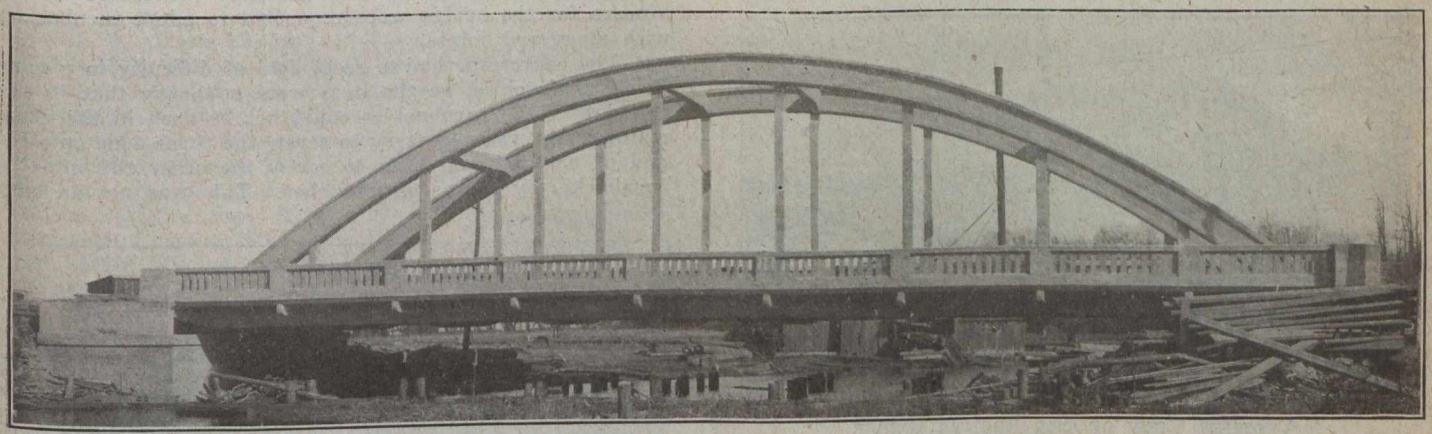
The Canadian Engineer

A weekly paper for civil engineers and contractors

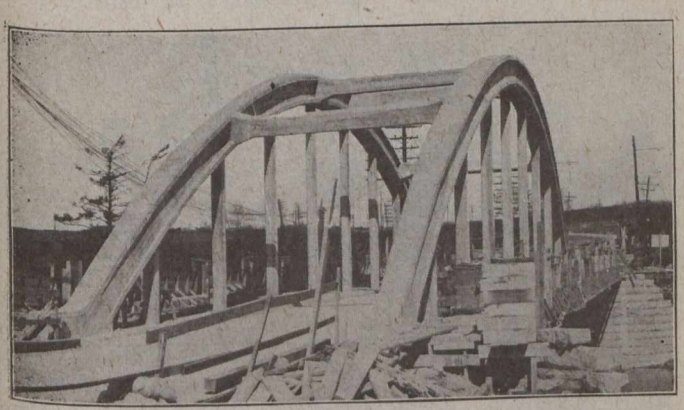


CONCRETE TRUSS BRIDGE OVER THE TWELVE-MILE CREEK AT BRONTE ON THE TORONTO-HAMILTON HIGHWAY

Canada's Longest Reinforced Concrete Trusses

Are the Two Bridges That Carry the Toronto-Hamilton Highway Across the Etobicoke River and Bronte Creek—Each 119 ft. 1½ in. Clear Span, With 20 ft. Roadway and 16 ft. Overhead Clearance—Arches Rise 26 ft. Above Floor Level

TWO reinforced concrete truss bridges have been completed on the Toronto-Hamilton Highway, each with a clear span of 119 ft. 1½ ins. between abutment faces. These are the longest concrete truss bridges in Canada. They carry the highway over the Etobicoke River and over the Twelve-Mile Creek at Bronte. The superstructures of these two bridges are identical. Work has also been started on a third bridge of identical superstructure to span the Credit River at Port Credit, and the abutments have been constructed for a bridge of practically the same design to span Mimico Creek, near Toronto, but the Mimico bridge will have a clear span of only 96 ft. 10 ins., although it will have a roadway with a clear width of 26 ft. as compared with 20 ft. for the three longer bridges.



THE ETOBICOKE BRIDGE

Concrete truss bridges were chosen for all these situations because in three of them there was insufficient headroom for under-deck arches, and also the considerable depth to hard foundations would have required more costly abutments had arches been chosen. In the case of the Etobicoke bridge, there was sufficient room for an arch but the old Longford limestone abutments of coursed rubble seemed to be in such good condition that it was thought that with some alterations they could be used again for a truss bridge similar in the main to the old steel bridge which they formerly supported.

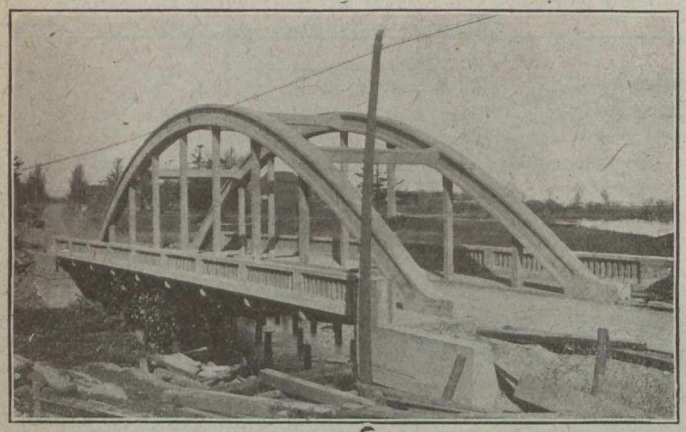
The following description of the Bronte bridge will serve equally well as a description of the Etobicoke and Credit bridges, as the dimensions and details of construction are the same throughout excepting in regard to abutments.

THE BRONTE BRIDGE

The Bronte bridge contains 91 cu. yds. of concrete in decking (1 : 1¾ : 3½), 36 cu. yds. in sidewalks (1 : 1¾ : 3½), 30 cu. yds. in parapets (1 : 1¾ : 3½), and 113 cu. yds. in arch ribs, ties, hangers and bracings (1 : 2 : 4), or a total of 270 cu. yds. of concrete exclusive of the abutments. (The abutments were 1 : 2½ : 5 concrete, 365 cu. yds. at Bronte, 215 cu. yds. at Etobicoke, 306 cu. yds. at Credit and 736 cu. yds. at Mimico).

According to the original design, there was to be 23.9 tons of steel reinforcing in the decking, sidewalks and ties; 19.3 tons in the arch ribs, hangers and bracings; and 1.8 tons in the parapets; or a total of 45 tons, exclusive of the approaches, abutments and piles.

These quantities of steel were those specified in the original specification and were guaranteed by the engineers as to quantity, although the amount of concrete was not guaranteed to the contractor. The original plans and specifications were altered as a result of objections by the engineers of the city of Toronto and of the three counties

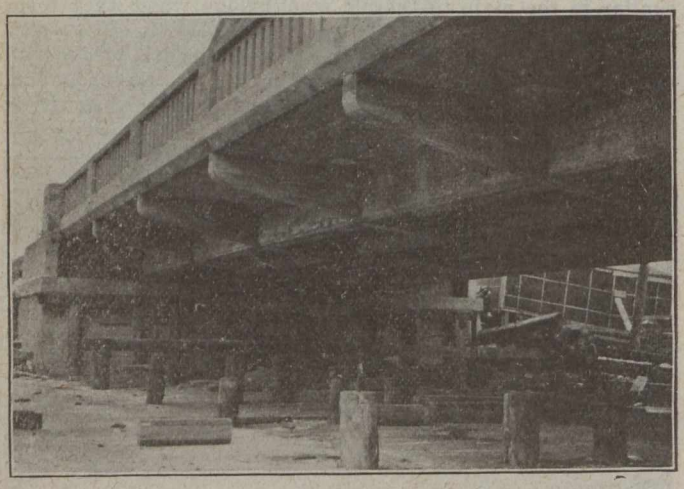


ANOTHER VIEW OF THE BRONTE BRIDGE

concerned in the payment of the bridges, and the quantities of steel were then somewhat enlarged.

The centre to centre distance between the arched chords and the lower chords at the centre of the bridge is 26 ft., and clearance above floor level (beneath bracings) is 16 ft.

The two parallel top chords are each 3 ft. 3 ins. deep, and 2 ft. 6 ins. wide at the centre of the bridge, tapering to 1 ft. 9 ins. wide at the skewbacks. Figs. 1 and 5 show the reinforcing in the top chord. Fig. 1, which is a section where the shortest hanger joins the top chord, shows 20 round bars, 8 of which are placed close together in the



VIEW FROM BENEATH BRONTE BRIDGE, SHOWING CANTILEVERED SIDEWALK

top of the chord and 8 close together in the bottom of the chord (10 of these 16 bars being 1⅝-in. diameter and 6 of them, 1⅜-in.). In the web of the chord there are 4 rods, each ½-in. diameter.

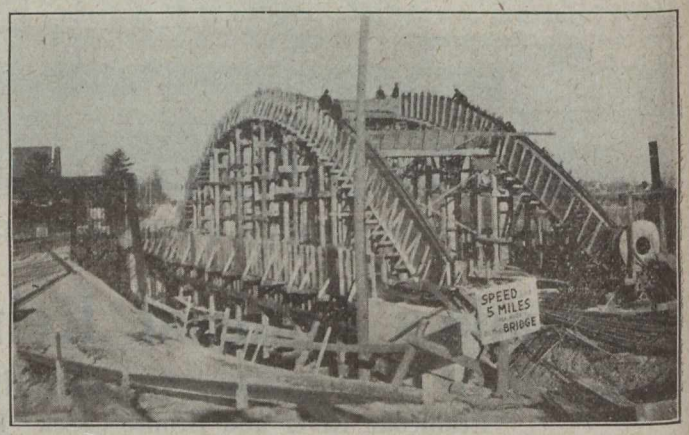
As will be seen from the upper part of Fig. 5, which is a section through the top chord at the centre of the bridge, the reinforcing there consists of twelve 1⅝-in. bars, placed six in the bottom of the chord and six in the top, in addition to the four ½-in. web reinforcing bars.

In the top chords there are ½-in. stirrups spaced 10 ins. apart between the first hanger and the second hanger, and ⅜-in. stirrups spaced 12 ins. apart between the second hanger and the crown of the arch and between the toe of the arch and the first hanger. The reinforcing in the top chord has lapped joints, with the ends of the bars turned up.

The reinforcing in each of the two bottom chords, or ties, consists of twelve 1¾-in. rods and two ¾-in. rods, spaced as shown in the lower part of Fig. 5, with ¼-in. stirrups spaced at 10-in. centres.

The original design of the bridge called for the reinforcing in the lower chords to be lapped 30 diameters and hooked, but the county engineers objected to the use of lapped joints in these tension members. Therefore the engineers for the bridge were requested to adopt turnbuckles with staggered joints.

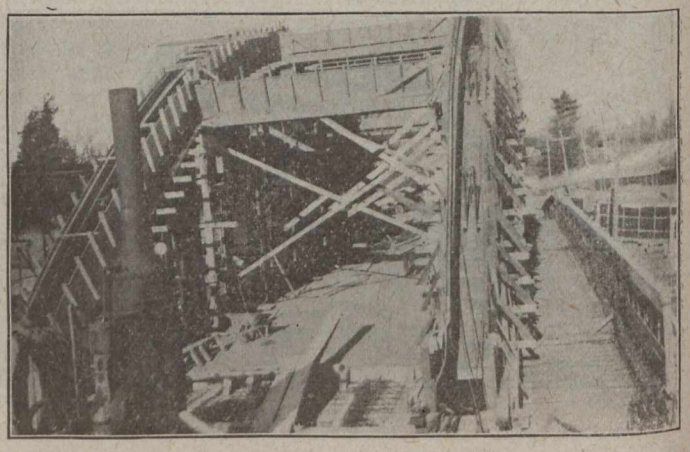
The contractor had a great deal of difficulty in placing these turnbuckles, as the bars were so heavy that it was found that the turnbuckles could not be used in the usual manner. It was necessary to screw the turnbuckle onto the end of one rod and then to screw the other rod into the turnbuckle by means of wrenches. This was not an easy



FORMS BUILT, READY FOR PLACING THE ARCH STEEL, BRONTE BRIDGE—OLD BRIDGE TEMPORARILY MOVED TO LEFT TO CARRY TRAFFIC

task owing to the weight of the rods and their tendency to sag and jam.

The original design called for the anchoring of the bars in the lower chord by bending them at the ends. This was not recommended by the Ontario government specifications, and it was thought by the counties' engineers that these rods would not develop their full strength by this anchorage, and those engineers suggested that the rods should be passed through vertical steel plates behind the junction of the upper and lower chords, and that the rods should be threaded and nutted behind the plates, which would be of sufficient size to resist the full thrust of the upper chords. It was



FLOOR SYSTEM CONCRETED TO FIRST HANGERS—WORK PROGRESSING ON THE ARCHED CHORDS—BRONTE BRIDGE

suggested that the two plates on the end of each lower chord would thus, in a sense, take the place of the skewbacks in an ordinary arch, and would be held together by the tension rods in the lower chord, which pass from plate

to plate. This idea was adopted in the modified design and is shown in Fig. 3.

At the skewback there is a large quantity of steel very closely spaced, as will be seen from Fig. 3, which shows sections through the junction of the top chord with the lower chord. The contractor had to use special care to get the concrete worked around the reinforcing.

There are 16 hangers, 8 on each side of the bridge, each hanger having a section 11 ins. by 13 ins. overall, as shown in Fig. 6. These hangers consist of six 1-in. rods, bound with 3/16-in. stirrups spaced at 8-in. centres, and encased in concrete. Some trouble was experienced in concreting the suspension members, or hangers, as the contractor did not concrete them before placing the steel in the arch rib. It was the intention of the designer that these members should be concreted from the top before placing the steel for the arch ribs.

The first concreting done on the bridge was the floor system. After all the other portions of the floor system had been poured, the parts immediately adjacent to the skewbacks were poured at the same time as the ends of the arch ribs and the junctions of arches and bottom chords, or skewbacks. Then the arch ribs were carried on up toward the crown, approximately equal progress being made at both ends of the bridge. The contractors for both Etobicoke and Bronte bridge used a concreting tower and chutes. The actual time required for concreting was about six days.

There are two 6 ft. sidewalks, cantilevered onto the lower chords. The sidewalk floor is concrete, 4½ inches thick. The clear width of each sidewalk is 6 ft. The roadway floor is concrete, 8 inches thick at each curb and 9¼ inches at the crown.

The distance centre to centre of lower chords is 21 ft.

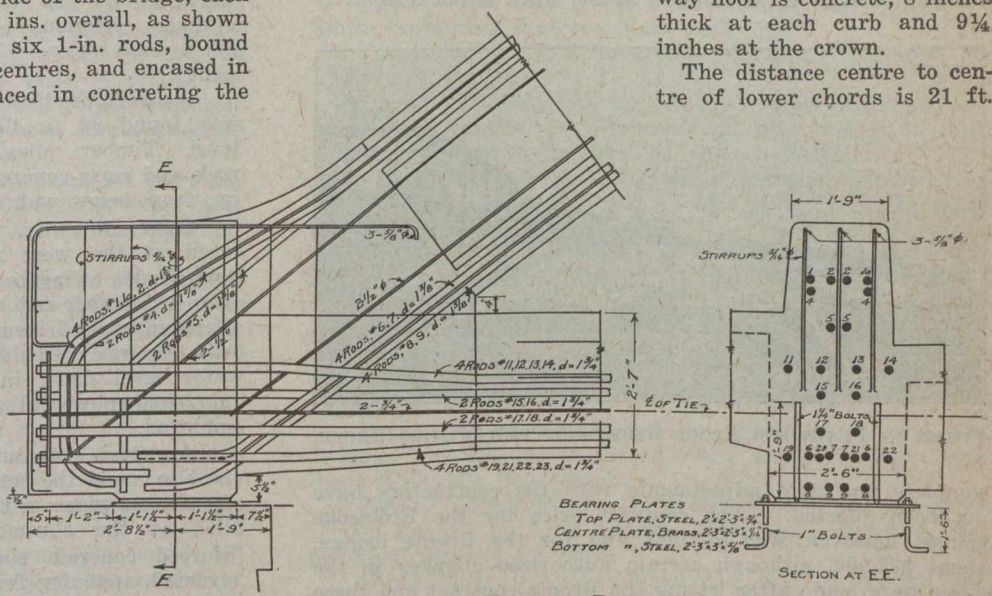


FIG. 3—SECTIONS THROUGH JUNCTION OF TOP AND BOTTOM CHORDS, BRONTE BRIDGE, SHOWING REINFORCING AND METHOD OF ANCHORAGE

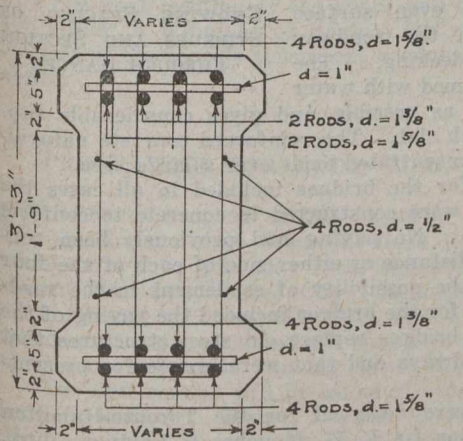


FIG. 1—CROSS-SECTION THROUGH TOP CHORD AT FIRST HANGER

10 ins., while the clear width of the roadway is 20 ft. In designing the bridge, a live load of 100 lbs. per sq. ft. of floor surface was assumed. The dead load per lineal foot is 8,700 lbs., or a total weight of superstructure amounting to

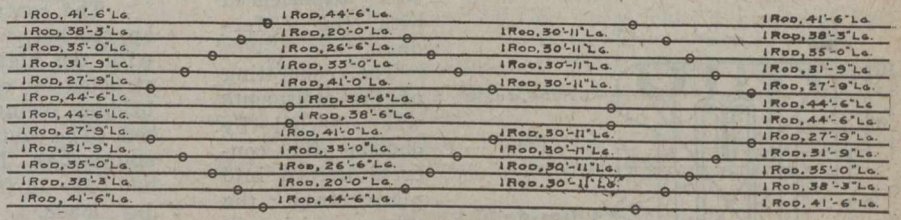


FIG. 4—DIAGRAM SHOWING THE STAGGERING OF JOINTS IN EACH BOTTOM CHORD—CIRCLES INDICATE TURNBUCKLES

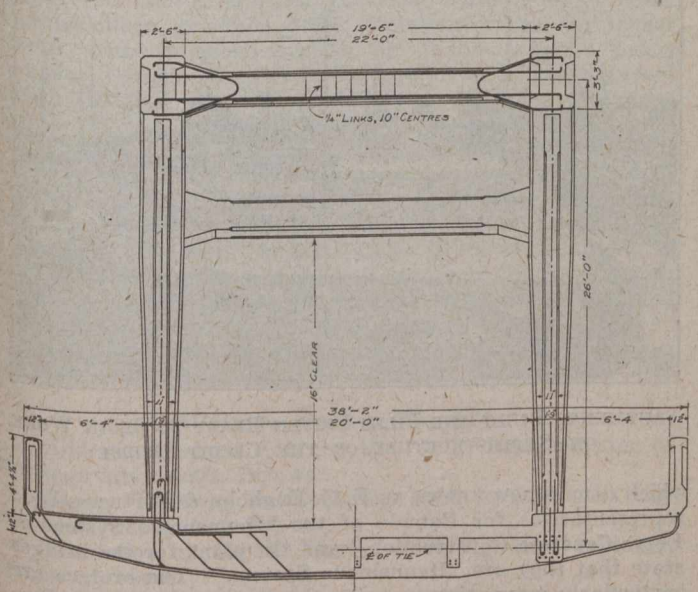


FIG. 2—CROSS-SECTION AT CENTRE OF BRONTE BRIDGE

over 556 tons. The concentrated load assumed was 20 tons on two axles at 10 ft. centres and 6 ft. gauge, with two-thirds of the weight on the rear axle.

The concrete used in the arch ribs, ties, hangers and bracings was 1:2:4 mix, excepting for the connection between the arch rib and the lower chord, which was 1:1¾:3½ mix.

In regard to the falsework, the specification required the concrete to be considered as a liquid weighing 180 lbs. per cu. ft. for vertical loading, or 120 lbs. per cu. ft. for horizontal loading. It was required that the working unit stresses for hemlock timber should not exceed 650 lbs. per sq. in. for bending, 250 lbs. per sq. in. for compression perpendicular to the grain, and 750 lbs. per sq. in. for compression parallel to the grain; the working unit stresses for other timber to be in proportion to these stresses as determined by the engineers.

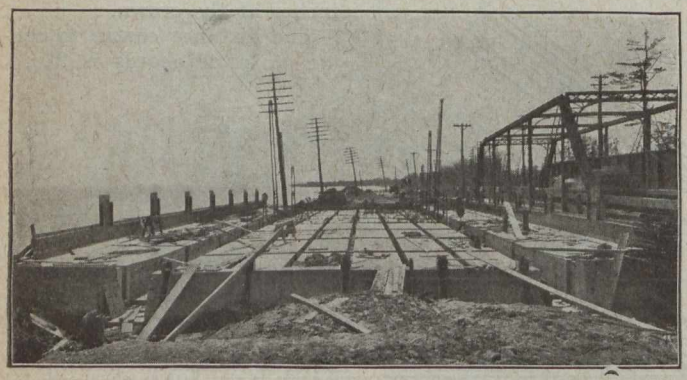
The contractor for the Bronte bridge was the Lewis Construction Co., Toronto; for the Credit and Etobicoke bridges, the Frid Construction Co., Hamilton; and for the Mimico bridge, the Toms Contracting Co., Toronto.

At the Credit River, the superstructure has not yet been started, although the abutments have been built. At Mimico, the abutments have been built and the form-work for the floor system is in place. The Bronte bridge is entirely finished excepting the rubbing down. The Etobicoke

bridge is complete excepting the hand-rail, a retaining wall, approach slabs, and the rubbing down.

The work started last summer and was continued through the open winter, the Etobicoke bridge being opened for traffic in January, 1919, and the Bronte bridge in February, 1919.

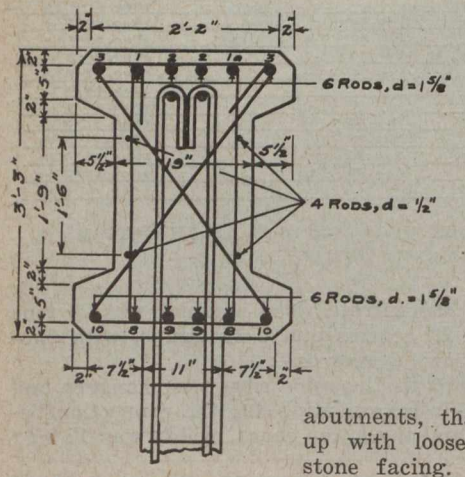
No report has been made by the commission regarding the final cost of these bridges, as the work is not absolutely



FORMS IN PLACE FOR FLOOR SYSTEM OF THE MIMICO BRIDGE

complete and final adjustments with the contractors have not been effected. The contract price for the Etobicoke bridge, however, was $18,900, and for the Bronte bridge, about $22,000, although certain authorized changes in the plans were made after letting the Bronte contract and these will somewhat increase the cost of that bridge.

The foundations for the abutments for the bridges varied considerably. The Mimico abutments were of mass concrete, carried to rock. The rock was near the surface on the west side, so the excavation and cofferdam were light and no difficulty was experienced. The site of the east abutment was excavated by clam-shell and some difficulty was experienced with the cofferdam.



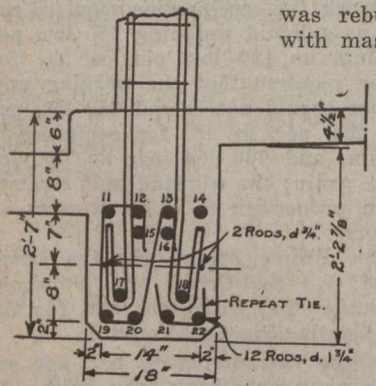


FIG. 5—SECTION THROUGH TOP AND BOTTOM CHORDS AT CENTRE OF BRONTE BRIDGE, SHOWING REINFORCING AND HANGERS

The concreting of the abutments was effected by chuting the concrete directly into place from the mixer, which was placed on the bank above.

At Etobicoke it was found on opening up the site to extend the existing stone abutments, that they were built up with loose filling behind the stone facing. The stone facing was rebuilt and was backed up with mass concrete.

On the abutments special provision was made for the reception of the main chords of the bridge by pouring solid blocks of concrete, the full thickness of the abutment. Expansion was provided for on one abutment of each bridge by anchoring a ¾-in. steel plate on the abutment, separated from a similar plate affixed to the springing, by a sheet of brass to prevent rust and adhesion, with heavy grease lubrication to minimize friction and to ease movement.

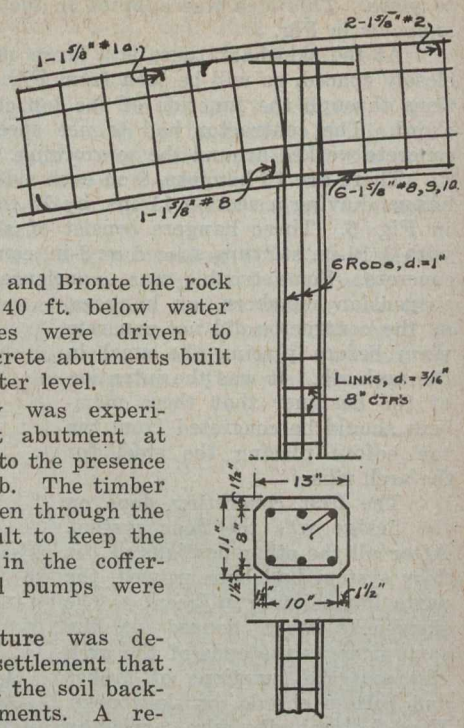


FIG. 6
PORTION OF TOP CHORD AND ONE HANGER, SHOWING SPACING OF STIRRUPS AND SECTION THROUGH HANGER

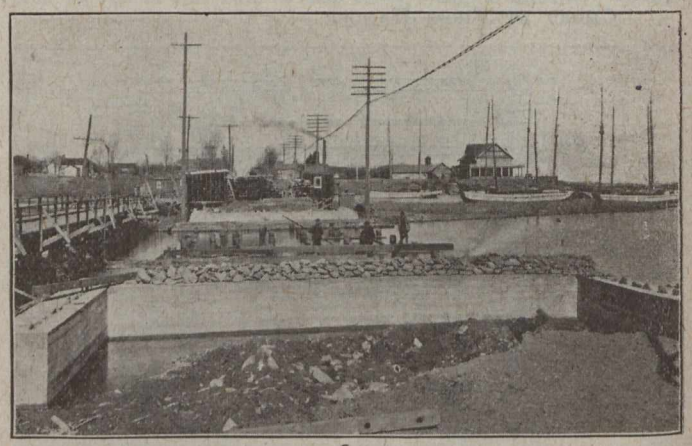
At Port Credit and Bronte the rock was found 30 to 40 ft. below water level. Timber piles were driven to rock and mass concrete abutments built up, from below water level.

Some difficulty was experienced at the west abutment at Port Credit, owing to the presence of an old timber crib. The timber piles had to be driven through the crib. It was difficult to keep the water level down in the cofferdam, and powerful pumps were employed.

A special feature was devised to avoid the settlement that often takes place in the soil backfilled at the abutments. A reinforced concrete slab was constructed, spanning from the abutments to the undisturbed roadway, thus ensuring an even surface connection between the roadway and the bridge decking. The backfilling was rammed with water and made as solid as possible, and gives considerable support to the approach slab. The reinforced concrete naturally distributes the concentrated loads over a large area.

The contract for the bridges included in all cases the approaches, which were constructed in concrete to conform with the highway. No paving had previously been constructed for some distance at either side of each of the four bridges, owing to the possibility of settlement in the roadbed. The contracts for the bridges included the paving of the approaches. These bridges replace old steel structures that had only 16 ft. roadways and that were unsafe for present-day loads.

The bridges were designed for the Toronto-Hamilton Highway Commission by L. G. Mouchel & Partners, Ltd.,



ABUTMENTS BUILT AND PILES DRIVEN READY TO BEGIN WORK ON SUPERSTRUCTURE OF THE CREDIT BRIDGE

which firm is now known as F. G. Engholm & Partners, Ltd., representatives for Canada of the "Hennebique System of Ferro-Concrete Construction," and the plans for the bridges state that they are "Hennebique System." The bridges are particularly interesting as being the first examples of bridge construction of this type in Canada according to this system.

PROGRESS IN LIGNITE BRIQUETTING SCHEME

J. M. Leamy Says that Plant Will be Ready for Operation by End of This Year—Particular System to be Used Not Yet Fully Decided

BEFORE the end of the year, the plant for the manufacture of briquettes out of lignite will be ready and the particular system of manufacture decided upon, announces J. M. Leamy, Manitoba's representative on the Lignite Utilization Board of Canada. Active work is proceeding, he states, and out of the thirty debatable points submitted to the board, twenty-five have already been determined and the other five are in process of solution.

The staff at Montreal is busy on the plans for the plant at or in the immediate vicinity of Estevan, the exact location of which will depend chiefly upon the railway facilities available.

There are a number of working mines of considerable capacity in the Estevan district, says Mr. Leamy, so that when the plant is ready for operation, no delay will be occasioned in demonstrating the suitability of the lignite for briquetting purposes.

Practically every plant on this continent has been inspected, says Mr. Leamy, but no data as yet procured has enabled the board to determine absolutely the most suitable process of briquetting. Good briquettes are being made of a high quality, but chiefly from a higher grade of lignite than is available in western Canada.

When the Estevan plant is in operation, the board will have more information at its disposal than has any other body on the continent, declares Mr. Leamy.

The next meeting of the board will be held before May 1st, either in Winnipeg or Regina, and at that meeting the location of the board's permanent headquarters will be determined.

PROGRAMME FOR GOOD ROADS CONGRESS

UNDER the auspices of the Canadian Good Roads Association, the sixth Canadian Good Roads Congress and exhibition will be held May 20th, 21st and 22nd, in the Parliament Building, Quebec City. Registration of delegates will commence at 9 a.m., May 20th, and a half-hour later the president of the association will announce the appointment of nomination, resolution and legislation committees.

The first session will be called to order at 10.30 a.m. by the president, S. L. Squire, and the following have been invited to deliver addresses: Sir Charles Fitzpatrick, lieutenant-governor, Quebec; Hon. Alfred E. Smith, governor, State of New York; Hon. Harris F. Graham, governor, State of Vermont; Hon. Carl E. Milliken, governor, State of Maine; Hon. Calvin College, governor, State of Massachusetts; Sir Lomer Gouin, prime minister, Quebec; Sir William Hearst, prime minister, Ontario; Hon. J. D. Reid, minister of railways and canals, Ottawa; Hon. W. G. Mitchell, provincial treasurer, Quebec; Hon. A. Veniot, minister of public works, New Brunswick; Hon. Findlay MacDiarmid, minister of highways, Ontario; Hon. J. A. Tessier, minister of roads, Quebec; Mayor Lavigueur, city of Quebec; O. W. Bedard, president, Quebec Board of Trade; Mayor Noel Belleau, city of Levis; J. A. Duchastel, president, Canadian Good Roads Association; L. B. Howland, president, Canadian Automobile Association; Hon. Frank Carrel, president, Quebec Automobile Club; and A. L. Caron, president, Quebec Provincial Motor League.

The programme tentatively arranged for the other five sessions of the congress is as follows:—

Afternoon Session, May 20th

Address, "Federal Aid," by Hon. J. D. Reid, minister of railways and canals, Ottawa.

Paper, "Highway Maintenance," by J. A. Duchastel, city manager, Outremont, P.Q.

Discussion by Gabriel Henry, chief highways engineer, Quebec Province.

Paper, "Gravel Roads," by Chas. Talbot, county road superintendent, London, Ont.

Paper, "Surface and Subsoil Drainage and Foundations," by Gabriel Henry.

Morning Session, May 21st

Address, "Roads as an Aid to Agriculture," by Hon. Geo. S. Henry, minister of agriculture, Ontario, and Hon. J. A. Caron, minister of agriculture, Quebec.

Paper, "Hot Mix Asphalt Pavements," by Francis P. Smith, consulting engineer, New York City.

Discussion by E. Drinkwater, consulting engineer, St. Lambert, P.Q.

Paper, "Practical Advice to Road Superintendents and Municipal Councils," by Alexandre Fraser, assistant chief engineer, Highways Department, Quebec Province.

Paper, "Bituminous Macadam, Penetration Method," by A. W. Dean, chief engineer, Massachusetts Highway Commission.

Discussion by E. A. James, chief engineer, York County Highway Commission, Toronto.

Afternoon Session, May 21st

Address, "Shall We Restrict the Load or Build the Road?" by W. A. McLean, deputy minister of highways, Ontario.

Paper, "Concrete in Road Construction, Culverts and Bridges," by Eltinge G. Breed, chief engineer, New York State Highways Department.

Paper, "Construction and Maintenance of Macadamized Gravel Roads," by Alex. Lariviere, engineer, Highways Department, Quebec Province.

Paper, "The Use of Refined Tar in Construction and Maintenance," by Paul D. Sargent, chief engineer, Maine Highways Commission.

Discussion by Alex. Stewart, superintendent, Ottawa Improvement Commission, Ottawa.

Morning Session, May 22nd

Address, "Schools for Highway Engineering," by Prof. A. T. Laing, University of Toronto.

Paper, "Drainage," by Geo. Diehl, chief engineer of Erie County, Buffalo, N.Y.

Paper, "Construction and Maintenance of Macadamized Municipal Roads," by A. Paradis, engineer, Highways Department, Quebec Province.

Paper, "Macadam Roads," by A. P. Sandles, secretary, National Crushed Stone Association, Columbus, Ohio.

Afternoon Session, May 22nd

Address, "Keeping the Highways Open in Winter," by Hon. Frank Carrel, Quebec.

Paper, "Road Machinery," by Prof. A. H. Blanchard, consulting engineer, New York City.

Discussion by E. Fafard, superintendent, plants branch, Highways Department, Quebec Province.

Paper, "A Comparative Study of the Different Methods of Transportation of Road Materials," by E. W. Gauvreau, engineer, Highways Department, Quebec Province.

Paper, "Contracts, the Contractor and Labor vs. Government Construction of Trunk or Main Roads," by Col. W. D. Sohier, chairman, Massachusetts Highway Commission.

The annual dinner will be held at 7.30 p.m., May 20th, at Chateau Frontenac. At noon, May 21st, the annual meeting and luncheon of the Canadian Automobile Association will be be held at Chateau Frontenac. At 8.30 p.m., May 21st, the annual general meeting of the Canadian Good Roads Association will be held for the election of officers for the ensuing year and for the reception of the annual report and the financial statement. At noon, May 22nd, the association will give a luncheon, to be followed by a drive around the city.

The Saskatchewan Branch of the Engineering Institute of Canada has decided to support the Edmonton Branch in the latter's request that the next western professional meeting of the institute be held July 10th, 11th and 12th, 1919, in Edmonton. Last year the meeting was held in Saskatoon.

DIFFERENTIA OF B. COLI*

By Everett Judson
Assistant Sanitary Engineer, U.S. Public Health Service

IN the 1917 edition of the American Public Health Association's "Standard Methods of Water Analysis" it is recommended that the B. Coli group be considered as including all non-spore forming bacteria which ferment lactose with gas formation and grow aerobically on standard solid media.

It is the purpose of this paper to consider briefly the two sub-groups of the B. Coli group which are of the most importance to the water bacteriologist, namely, B. Coli Communis and B. Lactis Aerogenes.

In 1893 Theobald Smith contributed his well-known paper, "The Fermentation Tube With Special Reference to Anaerobiosis and Gas Production Among Bacteria," in which he described the fermentation tube originated by him. In this paper he gave the results of his studies of gas production by certain bacteria, and suggested that the B. Coli group might be divided into two distinct sub-groups by reason of the action of the organisms upon saccharose.

Varied Conclusions

In the years intervening between the presentation of that paper and the present, we find a number of investigators reporting work done on gas formation and gas ratios. In the light of our present knowledge of the subject we must attribute their varied conclusions to the method and degree of accuracy used in their work.

In 1914-1915 Rogers, Clark, and Davis and Rogers, Clark and Evans found that the accurate determination of gas volumes and gas ratios produced in the anaerobic fermentation of glucose furnished most valuable data.

The work of Rogers, Clark, and Lubs, 1917, on "The Characteristics of Bacteria of the Colon Type Occurring in Human Feces" agrees with these former conclusions, and gives a new working basis for the study of the B. Coli group.

Later in the same year, Rogers, in his paper "The Occurrence of Different Types of the Colon-Aerogenes Group in Water," draws the conclusion that there are two types of the Colon-Aerogenes group which occur in fecal matter in large numbers.

By determining the ratio of the carbon dioxide gas to the hydrogen gas produced in anaerobic fermentation of glucose by the B. Coli group we can divide this group into two distinct sub-groups. The one, having a ratio of about unity, is designated B. Coli Communis, or low ratio sub-group; while the other, having a ratio of one and five-tenths, or higher, is designated B. Aerogenes, or high ratio sub-group.

It has been shown by these more recent investigations that the final hydrogen iron concentration of a given media correlates perfectly with the gas ratios and by the use of methyl red as an indicator we can readily make a colorimetric differentiation between the low and high ratio sub-groups, (low ratio—B. Coli methyl red, positive; high ratio—B. Aerogenes methyl red, negative.)

Determining Nature and Source of Pollution

In routine work we deal with colonies fished from Endos media which has been streaked from lactose broth tubes after 24 or 48 hours incubation at 37 degrees C. The growth on Agar slants made from these colonies is inoculated into the methyl red media and back into lactose broth. The gelatin liquefaction test may also be made to eliminate cloacae. (The standard methods of water analysis with the corrections as suggested by Hasseltine are followed by the writer.)

It is then generally assumed that the organisms of the methyl red positive sub-group are of fecal origin, while those of the methyl red negative may be from either fecal or other origin.

*Paper read before the Illinois section of the American Water Works Association.

If the low ratio or B. Coli Communis. alone. is shown to be present it fixes definitely the source of the pollution.

If the high ratio or B. Lactis Aerogenes alone is shown to be present the pollution may come from either fecal or non-fecal origin.

Rogers, Clark, and Lubs. suggested means of differentiating Lactis Aerogenes of fecal and non-fecal origin. Whether or not this differentiation will prove satisfactory in routine work can only be decided after repeated trials.

In some recent work the writer collected water samples from sources exposed to varying degrees of pollution and isolated typical and atypical colon colonies on Endos media. Inoculating tubes of methyl red media with one hundred and thirty-three colonies it was found that eight atypical colonies gave the methyl red positive result, while seven typical colonies gave a negative result. This one example shows the failure of Endos media to differentiate the colon-aerogenes group. The opinion is held that many bacteriologists attribute to Endos media a differential action for which it was not intended and does not perform.

It is believed that wherever possible the water analyst should differentiate between B. Coli Communis and B. Lactis Aerogenes by use of the methyl red test. A sufficient number of colonies should be isolated from each sample tested to determine the relative quantity of the organisms present.

This procedure will bring us one step nearer to our ultimate aim: the determination in the laboratory of the exact nature and source of the polluting organisms with which we have to deal in order that laboratory work may supplement and substantiate the field survey and enable the executive authorities whose duty it is to eliminate the source of pollution to act with intelligence and confidence.

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A bill has been introduced in the House of Commons authorizing the reclamation of Dominion lands by drainage, and also providing for a Director of Reclamation Services. It is proposed to reclaim at first about 1,200 acres. Representations have been made to the government regarding the advisability of draining Lake Manitoba.

An amendment to the Ontario Highways Act has been introduced in the legislature by the Hon. Finlay G. Macdiarmid, Minister of Public Works, which will enable the Ontario government to give greater financial assistance in the construction of suburban roads. Previously forty per cent. of the cost of construction has been paid on county roads, but the act has limited the assistance for highways within suburban areas around cities and large towns to $4,000 a mile. This limit is now being removed, and the full forty per cent. will be paid on all suburban roads. Another amendment permits the provincial government to designate as a provincial county road, any part of a highway in a suburban area. In the past, provincial county roads ended at the suburban boundaries, but hereafter roads within such areas may be so designated.

MAINTENANCE AND PAINTING OF HIGHWAY BRIDGES*

By Charles D. Snead
Bridge Engineer, State Department of Public Roads of Kentucky

No maintenance of bridges will be as effective as maintenance applied regularly each year and the necessary repairs determined by periodical inspection of the structures. Every structure, concrete, steel, wood or pipe, should be inspected at least once every year and a detailed report made upon its condition. More frequent inspections should be made of structures in a bad state of repair, while small culverts should be inspected after every hard rain. By such a system repairs can be made where and when needed. The cost of repairs will not be allowed to accumulate nor will the structure be allowed to suffer from the lack of repairs.

Classification of Structures According to Conditions

I will explain what I should do with the funds you may have available were I county road engineer in your county, and will try to suggest something helpful which may be done by everyone and which must be done if existing structures are to be preserved in suitable condition for traffic.

First—A complete inspection would be made as heretofore suggested and a complete report made of every existing structure within the county.

Second—The structures would then be subdivided into three classes: (A) Structures needing no repair or maintenance; (B) structures which must be rebuilt immediately; (C) structures which may be repaired or strengthened.

Third—The classes noted under (B) and (C) would again be subdivided, the class noted under (B) under three subheads as follows:—

1. Structures which must be permanently renewed, both the substructures and superstructures.
2. Structures in which the substructure only shall be renewed permanently and a temporary superstructure built thereon.
3. Structures in which the substructures are serviceable and require a permanent superstructure.

The bridges noted under (C) would be subdivided as follows:—

1. Bridges requiring strengthening to trusses and floor systems.
2. Bridges requiring no strengthening but new floors.
3. Bridges requiring only painting.
4. Bridges requiring partial painting and repairs to floor.
5. Bridges requiring complete repainting and new floors.
6. Bridges requiring repairs to the substructure.

Would Show Many Things

What would be the value of such a complex system of dividing and subdividing? There are many things it would show quickly. First, it would give a complete list of structures in your county with a classification which would allow the only correct distribution of the bridge fund. Second, it would show your court what was necessary on every bridge in the county during the coming year. Third, it would quickly afford a basis for estimating the money necessary for this maintenance and construction during the year and would be in such a form that it would appeal to every business man in the county because he would know you had investigated conditions. Fourth, it would emphasize the want of funds for this work. Fifth, it would outline this work for your men in advance for the year in every district and eliminate bringing the forces back and forth as these conditions were discovered or reported.

Having completed the report and an estimate of the cost of the work, it should be published in every newspaper within the county with a statement of the funds available and your policy for expending such funds in each district. Everyone would then see that the money had been allotted where needed. This is the only reason for a common pool of the county's funds in the county treasury, and the only equitable way of spending money raised by taxation.

Strengthening and Repairing Old Bridges

Only class (C) structures will be discussed under maintenance. These are bridges which are to be strengthened, painted, refloored, or upon which work is required on the substructure. This work through necessity must be handled both by force account and by contract, and it is well that we consider the most important features of such work—namely, strengthening old bridges, reflooring and repainting.

The old wooden trusses if too light for modern traffic do not offer much opportunity for strengthening at an economical cost. These trusses should be temporarily repaired and their floor systems brought up to the maximum capacities of the trusses. These bridges should be posted with signs warning the travelling public against overloading. The maximum allowable load should be clearly stated on the sign. It is possible that the floor systems can be increased by increasing the number of the floor beams and stringers, or else by increasing the size of floor beams and stringers. This can be economically done at a time when the floor has been removed for stringer repair or reflooring.

Many of the light steel truss bridges can be strengthened by changing the sizes of floor beams and increasing the number of stringers so that they may be made to carry safely double or perhaps three times the present wagon or truck loading. It may be necessary to make changes in connections and in certain web members to increase the capacity, but it can be done far cheaper than rebuilding in many cases. It is far cheaper to spend a few dollars in strengthening than to allow structures to be daily overloaded and their cost of maintenance to soar. There is a certain bridge I have in mind in which it is impossible to keep the floor nailed down in place, due to the fact that the stringers and floor beams deflect so great under the heavy loads that they pull the nails.

There is a suggestion, too, with regard to strengthening bridges which may be accomplished with little additional expenditure. It is more important to be able to get your loads over a structure than it is to save time getting them over. It is possible in some cases to reduce both the dead load on a structure and to confine the moving load to the centre of the bridge and thus carry over with safety greater loads. This can be accomplished by reducing the width of travel way of the bridge. The proper fences and guard rails must be installed to prevent accident or traffic from using the remainder of the structure.

Bridge Floors

The day when bridge floors 2½ ins. to 3 ins. thickness can be economically used for modern traffic has passed. For heavy traffic the maximum span for 4-in. flooring should be about 27 ins. This span can be somewhat increased for loads of 10 tons or less, or 3-in. floor used when the spacing of stringers does not exceed 24 ins. Investigation of your bridge floors will show that few of them remain long enough for decay to destroy, but instead traffic wears them out. In replacing wooden floors, if the span is not strong enough and cannot be economically strengthened to carry a better type of floor, it is to be recommended that a 2-in. x 4-in. wooden floor be used, the lumber being laid on edge and all contact surfaces thoroughly swabbed with hot tar and cambered to shed water. This type of floor has been extensively employed on new structures and is giving complete satisfaction. I have just recently had occasion to inspect such a floor which had been down for a period of nearly 6 years and it showed no signs of decay or wear, yet it was subjected daily to a large volume of heavy traffic, both horse and motor drawn. The cost of this type of floor is about 50 cents per square foot of floor surface. In laying this type of floor on old truss bridges whose stringers in the end panels merely rest on the concrete or masonry, it will be necessary to anchor at least the outside stringers to the masonry or else the floor will lift these stringers. About one barrel of tar is required for every 30 ft. of length if the bridge has a 16-ft. roadway.

*Abstracted from an address before the Road School, University of Kentucky.

THE RELATIONS BETWEEN ENGINEERS AND CONTRACTORS*

By John F. O'Rourke
President, O'Rourke Engineering and Construction Co., New York

THE growth of things, the necessity for having better engineers, for having larger contractors, for having a different sort of construction, for having a building lot that comprised something beyond the building that was 25 ft. front and 100 ft .deep and five stories high (which everybody who knows anything about New York building laws knows was the building law of New York up until about 1892 or 1893), all this great concentration in cities, this great growth of wealth, this great independence of depending upon somebody abroad to furnish you wth plans, evolved the modern engineer and the modern contractor.

The Modern Contractor

The modern contractor is the man who, even in front of the modern engineer, would be entitled to membership in the American Society of Civil Engineers, because that says in order to be an associate of the American Society you must be able to make plans and build work and that you have had at least one year's experience in independent charge of work; to be a full member, which at the present time is restricted to people over 30 years of age, you must have had at least five years' experience in independent charge of work. Now where is there a contractor who belongs to what we call the educated class who can't fill that bill? So when I talk about the relations between engineers and contractors, I don't want it to be understood that the engineer I mean is the man that makes the plans, and the contractor I mean is the man the engineer tells how to carry out the work, because that is what they did in the very beginning when it was easy. I am going to talk about the engineer and the contractor in the sense of the two parties to the contract.

There is first the owner and his representative, the engineer; and the engineer is to tell the contractor everything that the specifications say and everything that the plans mean, and if there is anything missing he can tell him a great deal more than anybody else can tell him that they mean. That is where we get down to what I am talking about now as the relation between the engineer and the contractor. The thing that appeals to many engineers that started a good many years ago, was the fact that in making their plans they had a great deal more trouble in having them carried out than if they did the work themselves.

The Contractor's Engineer

There were others who were not engineers, but were fine men—men with a large business who were put up against the higher development of construction that they had never any experience of, because there was no experience in it. They associated engineers with themselves to enable them to carry out their work. Those engineers I am going to call the contractor's engineers. That is, the engineer whom the contractor employs and without whom he could not do his work, ordinarily, is the contractor's engineer. The engineer who became a contractor, I am going to call a contracting engineer. The owner's engineer is the one who makes the original plans.

What is the situation to-day in the relations of those people? In a certain society any man who is not working for some city or corporation, or who does not act as the engineer of the party of the first part, has no more voice in one of those national societies than if he were very obscure in the profession.

There are other branches of engineers who have gotten to the point that they have an office. They have hired an office and call themselves consulting engineers, and many of them, of course, are among the most eminent men in the world. But take them as a body. In their body, if one of them resigns his job as a consulting engineer, and looking for a consulting fee here and there, has a chance to do something real big and takes a part in the execution of a contract, his first duty to that organization is to resign—no longer is he eligible.

In all these cases there has grown up a feeling that if a man is an engineer and is not making the original plans (however shadowy they may be as to the final execution of them), unless he belongs to that party of the first part, he is not, strictly speaking, an engineer.

Engineers,—and Other Engineers

Now, as to the part of the first part—engineers, and the party of the second part— engineers. It is safe also to say that in one case they are so underpaid that I don't know any class of professional men who are so much the victims of the employers as the straight engineers in America. The other one is the fellow who comes in where there are four dimensions. A lot of people are greatly troubled to know where the fourth dimension is. Unless they are very poor indeed, they've got it in their pocket.

Take length, breadth and thickess—from that you get quantity. Multiply that by this thing that you may have in your pocket as the fourth dimension, then you get cost. You get everything that applies really to the practical side of anything because you can't talk about building billion dollar railroads or ten billion dollar courthouses or anything that way. You've got to get down to something that is practical; you've got to get down to something within the bounds of reason, compared by the standards of the fourth dimension. Also you've got to get that fourth dimension in before you get any dimension at all on a contract as a contractor. You don't count if it is too large, and that's what I'm after.

Products of a Theoretical Service?

The thing that I've got in my mind outside of the organization of this body, the making of an association in which all the contractors of the United States will get their rights made known and their power felt and their possibilities of doing good—get that all in national dimensions both for buildings and builders of any other kind of a structure—I am getting after the engineers where they will get something and where among other things they will get out of their shell and come out and shake hands with the fellow that is showing them how the work is being done because most of them know nothing about it.

They are simply the products of the civil service which takes into view the capability of answering a lot of theoretical questions, most of which don't apply to engineering at all and which is one of the curses to-day of doing work for any body that is covered by civil service.

We haye got to broaden ourselves; we have got to have contracts in which there will be something more than the statement that the engineer is the sole judge without providing any standard by which he can be judged as to his judging. We've got to make the contractors free in the sense that when they undertake to do anything and feel honestly that they are going to do it and that they are going to do it in the best and most efficient way, that they will be able to do that without having somebody that does not know anything at all about the work starting in to tell them how they shall do it wrong.

Says Contractors Need Association

The only way this can be done is to make ourselves felt as a body of contractors, a body of contractors who (as my first definition states) are really a body of engineers. They are called contractors because they draw the thing together, not because they draw them. Note the difference. And we've got to have it so that whether a man is on one side or the other, it has got to be fully understood that there is a particular side that he is on and that they are all on, and that is the efficient, economical, rapid performance of the work. This is more to the owner than it is to the engineers of either side and it is more to the people in general than it is to the owner.

*From an address delivered before the Associated General Contractors of America.

ENGINEERS, LABORERS AND EDUCATION*

By J. G. Sullivan
Consulting Engineer, Winnipeg

EDUCATION is the most important question before the world to-day. I refer to the education of the people of the world to a better appreciation of their fellow-man, and especially to the education of the laboring man to make him appreciate the class who represent capital at their true value and on the other hand, the education of the class who represent capital to appreciate the laborer at his true value.

The object to be gained is to get the laborer and the officer pulling together instead of pulling asunder as they are doing to-day in the majority of cases.

That you may judge for yourselves my right to express opinions on this grave subject, I may tell you that being brought up on an eastern farm, getting my ideas from agricultural and similar papers antagonistic to representatives of capital, you will not wonder when I tell you that as a student, in my freshman year, I was one who hissed a noted professor of political economy when he made statements exactly along the lines my argument will take here to-day, although, I must say in justice, that I do not as yet share in the opinion he expressed of the laboring classes.

Capital not a Monster

There are several reasons why I consider this an appropriate occasion to discuss this subject. I may mention a few. No doubt a number of you are taking up engineering for the principal reason that lack of capital makes it necessary that you make the most of your education and take that course which will make it possible for you to be self-sustaining when you leave the university. You have ideas and theories of your own, and you know from the history of the past five years that there are several well-established theories that are not correct or good for the world. It is necessary that your ideas be sound and true, because you are going to be leaders of men.

I am a firm believer in the theory of the force of mind over matter to the extent that if we think right, we will live right and be right. It appears to me that this statement will be borne out by the fact that we can see for ourselves that socialism and anarchy make most progress in those countries where those forces are able to recruit the greatest number of university students.

How are you going to get the "boss" and the "servant" to pull together? Simply by having more confidence in each other and getting together to discuss each other's plans. I have never changed my ideas of the working man or of his rights. I radically changed my boyhood idea of the hideous monster, "capital," as soon as I realized that this inert body in itself could not destroy me nor do me any harm, and that it was not capital that we had to deal with but rather human beings like ourselves who represent or control capital.

I wish you would get this idea clear, namely, that you are not dealing with any mysterious and hideous monster, but with human beings like yourselves. To my mind, one of the greatest misfortunes of the day is the fact that in the minds of a large number of the laboring class, capital has taken the form of a creature the like of which never did exist, and as a consequence these people believe that they are perfectly justified in any action that they may take in harming or tending to destroy this terrible mythical creature. On the other hand, a large number of those who represent capital think that the laboring class is a lawless band.

We Are All Servants

They are both wrong. The idea that we should live by the "sweat of our brow" has been stated on pretty good authority and that idea seems to prevail very generally, so that as a matter of fact we are all servants, and justly so. It is, therefore, not correct to refer to any class as "the laboring class" when we are all laborers, but that honorable distinction having been conferred on those who work with their hands for wages, I may state that I had the honor to belong to that class until I was 35 years of age.

At the age of 32, after the A.R.U. strike in the United States, I was working as a section foreman on a railroad. Since that time I have had thousands of working men under my direction, and my experience has been that the average working man, as an individual, is just about as intelligent, reasonable and sensible as the individual of any other class, and that he is just as capable of thinking on correct lines as the average citizen; and further, he is just as ready to reason and to think on such lines, if he is properly approached, as he is to listen to the socialism and anarchy which are being pumped into him on all occasions.

How Should Capital be Distributed?

My idea of labor is that every man should to the fullest extent enjoy the fruits of his labor, and that every man who is able and willing to work, and who does work, should receive enough to enable him to live comfortably, to support and educate his family, and in addition to be able to buy some of the so-called "luxuries" of life.

No country or nation can be considered economically sound or as resting on a sure basis if the majority of its population are in a condition verging on starvation. The need of bread has caused the ruin of more governments than any other cause you can mention.

Before you can prescribe a remedy for a difficulty, you should know and study the cause of the trouble. What is the trouble between the so-called "laboring class" and those laborers who represent capital? It is the division of their surplus earnings,—the old story of the division of the spoils. How should surplus earnings, or "capital," as we call it, be distributed? To find the correct answer is our problem, and it is no easy task. I can, however, say without fear of contradiction, that the proper solution will not be found in extremes in either direction.

While I am a firm believer in individualism and the principle of fully rewarding individual exertion, I can see how this principle could be carried to extremes. As an example: Supposing there were no laws restricting the entailing of property or limiting contracts in perpetuity, the humblest man on earth might be able to place one dollar out at 2 per cent. or 3 per cent. compound interest, to create a fund. He could then entail his right to this fund to his oldest next of kin relative, with a provision that the fund should not be touched for twelve or fifteen hundred years. What would be the result? The surplus earning of the world would not pay the annual interest on the fund. This would be an awkward position and one not likely to arise under any system, but it shows what might happen in extreme cases.

Wealth is Chiefly Invested

What are the conditions of to-day? The wealth of the world consists chiefly of plant and developed natural resources, with a small percentage of the medium of exchange, in form of gold and silver, called money. I wish you to get that idea clear, for it does not agree with the idea of the extreme socialist who thinks of the wealthy man as one grabbing all the cash in the world and rolling in money as he is cartooned, while as a matter of fact the slackers arrested in Winnipeg have been found with $500 to $1,000 on their person,—more actual cash than the average millionaire ever has at his immediate command.

What does the plant consist of? It consists of our homes, sewers, water-works, roads, railroads, factories, street cars, shops, farms, mills, office buildings, telephones, telegraphs and thousands of other things that contribute and add to the comfort, luxury and happiness of life in this world.

How was this plant created? Almost entirely by individual effort,—by men of master minds who either by themselves or by association with other men, had power and will to create industries that are producing comforts and luxuries for the world and especially for the poorer classes. To-day

*Address delivered recently to the engineering students of the University of Manitoba.

the laborer in Winnipeg has on his table, bananas, oranges and other tropical fruits, thanks to the large companies who grow and collect those fruits for shipment, to the large steamship companies who run regular refrigerator ships, to the railroad companies who bring them to Winnipeg in cars of proper temperature at all times of the year, and to the wholesale and retail stores who handle them when they get here. The same is true of his tea, coffee, cocoa and sugar, and of the fuel he uses in heating his home. He sleeps on a sanitary, steel-spring bed instead of straw, as he would if the extreme socialist had his way.

Socialistic Doctrines

You will rightfully say that the comfort of the working man is not the reason that Carnegie and Schwab built large plants and Jim Hill built a large railroad system. I care not what the incentive was,—the result is the same. The surplus earnings (capital) controlled by Carnegie, Schwab and Hill are doing just what I have outlined, and will continue to do good for the people of the world when those founders are dead. They will not take any of this capital with them across the Styx. They are only the stewards in whose care this capital is intrusted during the short time they are on this earth, and to my mind that capital has done a thousand times more good to the world than if it had been divided into ten million portions and hid in the belt of a socialist who does not believe or trust anybody on earth.

Never in the history of the world was the strife between individualism and socialism more serious than it is to-day, and to properly understand this grave subject would require years of investigation and study. I can only give you a brief synopsis of the more important facts. I think, however, that we can sum up in a few words the definition and doctrines of a socialist.

A socialist is one who wants to receive more than he is now getting, but who does not want anybody else to get more than he does, and there are all kinds of socialists, from the two-dollar-a-day man to the millionaire, but unfortunately the former are in the great majority, and it is the majority that rules.

We can assume that in a properly organized social country, the presidents, general managers, superintendents, foremen, skilled laborers and common laborers would receive the same pay. I do not know where you would get the men for the higher positions. I know from experience that if the prestige and remuneration of a section foreman were the same as that of a chief engineer, that I would much prefer the former position; and I know that the position of president and general manager is more arduous than that of chief engineer.

But why waste time discussing such a chaotic condition? There would be no incentive for individual exertion, and that is saying enough. Anyone can understand that instead of progress, the world's civilization would at once degenerate and in a short time revert to barbarism or worse.

The great error of the socialist is in the belief that the laboring man is the creator of everything, and that he is the only man who actually works, while the actual fact is that so far as exertion goes, the laboring man has the easiest time of any class in the world.

Education Needed "To Carry On"

Another mistaken idea of the more ignorant is that the wealth of the world is sufficient to keep him without work if it were only divided up. He entirely loses sight of the fact that we must all work or we will starve, and therefore any division he may make will in no way reduce the amount of work that he will have to perform.

Some will say: "The world as it is to-day is good enough for us. We will take things as they are and run them as they are, but with cheaper men in official positions." That is the gravest mistake of all their impracticable ideas. The plant of the world to-day, operated by private individuals and corporations with the keenest of competition, has developed a system with the smartest men in the world directing and controlling same. Ask yourselves what would take place if these men are replaced by those who have not had enough energy or brains to provide even an education for themselves?

Now to sum up, I would like you to think of all classes of laborers as reasonable, sensible beings, and if we can get the "boss" and the "servant" to study each other, their differences will soon disappear. I would like you to think that there is no reward too great for individual exertion, and that the wealthy man is simply a steward over what he controls, and that so long as he is a just steward, he is one of God's noblemen and is carrying out in a satisfactory manner the work for which he was created.

TO PROMOTE ELECTRIC FURNACE PRODUCTS

IN order to promote the use of electric furnace products, a meeting of about thirty men interested in that industry and representing over a dozen firms, was held March 21st and 22nd in Niagara Falls, N.Y. Following is a part of the official report of the meeting which was mailed to *The Canadian Engineer* by the publicity committee:—

"Acheson Smith, vice-president of the Acheson Graphite Co., called the meeting to order and made a general statement of the importance of getting before the consumers of electric furnace products, and the public generally, the many great advantages of the use of electric furnaces, and the uniformly high-grade products which are made by them. He asserted that it was his belief that all interested in the matter could join together on a common basis to extend the use of electric furnaces and their quality products.

"A special emphasis was laid on electric steel, the tonnage of which during the past four years has shown a remarkable increase not only in the United States, but throughout the world. This has been brought about for two important reasons: (1) The higher quality which can be made by use of the electric furnace; (2) the lower cost of operation shown in most cases as compared with the previous method of manufacture.

"The meeting passed resolutions inviting all manufacturers of electric furnaces, electrical apparatus, electric furnace supplies and accessories, public utility corporations, designers and inventors of electric furnace equipment and the users of electric furnaces to become members and to join in making an aggressive and thorough campaign to disseminate to engineers and to the public accurate data as to the quality of electric furnace products of all kinds.

"The organization formed is to be called the 'Electric Furnace Association.' A permanent organization was created as follows:—

"President, Acheson Smith, Niagara Falls, N.Y.; first vice-president, C. H. Booth, Booth-Hall Co., Chicago; second vice-president, W. E. Moore, Pittsburg Electric Furnace Co., Pittsburg; secretary, C. G. Schluederberg, Westinghouse Electric Manufacturing Co., Pittsburg; treasurer, F. J. Ryan, American Metallurgical Corporation, Philadelphia; directors, the officers and C. A. Winder, of the General Electric Co., Schenectady, and F. J. Tone, of the Carborundum Co., Niagara Falls, N.Y.

"The president was authorized to get in touch with all companies and persons who should be interested in joining the organization. It is quite likely that the next meeting will be held in New York City at the same time as the spring meeting of the American Electro-Chemical Society."

On page 310 of the March 20th issue of *The Canadian Engineer*, in an article on "Standard Gauge Railway Work at the Front," it was stated that the usual track-laying train was made up of "track-layer, three tank wagons with steel, locomotive and *sleeping* cars as required." There were no Pullmans at the Front, as might be inferred from this typographical error. The reference was to "sleeper cars," or cars loaded with railway ties.

TO DISCUSS CLOSED PROFESSION

Committee of Engineering Institute Will Meet Saturday—Montreal Branch Submits Questionaire to Members

At the last annual meeting of the Engineering Institute of Canada, a resolution was passed calling for the formation of a special committee "to draw up such sample legislation as it may deem necessary and advisable in order that the members of the institute throughout the different provinces may ask for legislation on the same uniform basis." This committee, composed of one delegate appointed by each branch, has now been formed, and will hold its first meeting Saturday, April 5th, in Montreal. It has been asked to report to council before May 1st, 1919, so it has only one month in which to finish its work.

In order to provide information for the representative of the Montreal Branch, the secretary of that branch has mailed the following questionaire to the Montreal Branch members:—

Montreal Branch's Questionaire

"Are you in favor of a closed corporation for engineers having responsible charge of engineering works?

"If so, do you favor legislation embracing all engineering works, or only public works?

"In the event of the majority of the members of the institute residing in Quebec declaring in favor of a closed corporation, what are your opinions on the following questions:—

"Do you consider that the only method of entrance into the engineering profession should be through the engineering colleges?

"If not, do you think that candidates who do not follow college engineering courses should be obliged to pass an examination for admission to study somewhat along the lines of the matriculation examinations required for university entrance?

"Do you think that candidates should be required to pass an examination for admission to practise similar to the examinations required by the bar and medical associations?

"Should candidates be obliged to serve a period of apprenticeship or employment under an engineer before being allowed to take the final examinations for admission to practise? (The word practise is understood to mean taking responsible charge of engineering works.)

"If in favor of examination, do you consider that these should be held by the corporation only or by a joint board of the members of the corporation and representatives of the McGill and Laval faculties of applied science?

"Do you consider that graduates of engineering schools should be exempted from any or all the examinations?

"If so, from what examinations should they be exempted?

"Do you think that graduates of engineering schools should be required to prove that they have had experience under some engineer before being admitted to take charge of engineering work?"

The text of the resolution by which the general committee on legislation was created, and which was passed last February in Ottawa at the adjourned session of the annual meeting, is as follows:—

Resolution Creating Legislation Committee

"Whereas, it seems that the wishes of the majority of the members and of the branches of the Engineering Institute of Canada are that provincial legislation should be obtained to define the status of the engineers throughout Canada; and

"Whereas the members of this annual meeting are of the opinion that this legislation should be as uniform as possible throughout the provinces;

"Be it resolved that a special committee be formed, composed of one delegate appointed by each branch, to meet at headquarters before the 15th of April, 1919, to draw up such sample legislation as it may deem necessary and advisable in order that the members of the institute throughout the different provinces may ask for legislation on the same uniform basis.

"That the secretary be instructed to call the first meeting of this committee.

"That this committee be authorized to obtain the necessary legal advice on the matter.

"That this committee shall submit the proposed legislation to the council before the 1st of May, 1919.

"That the council shall then ask by letter ballot, before the 1st of June, 1919, the opinion of all the members of the institute regarding the adoption of the proposed legislation prepared by the said special committee of the institute.

"That the council be authorized to pay all the expenses of this committee and of each delegate.

"That the council of the institute shall report the result of the ballot to the branches, and if the vote is favorable to legislation, the council of the institute shall immediately take the necessary measures, in co-operation with the branches, to have such legislation enacted."

Following are the members of the general, or special, committee on legislation, one member having been elected to represent each branch:—

R. F. Uniacke, Ottawa; N. L. Somers, Sault Ste. Marie; Arthur Surveyer, Montreal; F. H. Peters, Calgary; A. R. Decary, Quebec; R. J. Gibb, Edmonton; C. C. Kirby, St. John, N.B.; A. G. Dalzell, Vancouver; C. E. W. Dodwell, Halifax; A. E. Foreman, Victoria; Willis Chipman, Toronto; E. R. Gray, Hamilton; E. Brydone-Jack, Winnipeg; G. D. Mackie, Moose Jaw.

COMPOUND METERS*

By Fred B. Nelson
Department of Water Supply, Gas and Electricity, New York City

What I have to say on the subject of compound meters is not based on experience with such meters in service nor on elaborate study of the principles and performance involved, and department tests and investigations have not to date been sufficient to warrant too positive conclusions or too elaborate treatment. If, therefore, I may mention some phases of the subject which will bring out discussion or information from those who have had experience in their design or use, I will consider that the purpose of the paper has been met.

The compound meter designed to obviate the loss of registration on flows too small for accurate measurement by the full line size meter, consists essentially of three units—a large meter, a small by-pass meter and a regulating valve so arranged that as the flow through the by-pass reaches a reasonable capacity of the small meter, the pressure loss actuates the regulating valve which opens and deflects all or part of the flow to the larger meter.

Not on the Approved List

At the present time, compound meters as such are not on the approved list for use in New York City, but the advisability of their use in saving revenue on numerous large and often over size installations has been considered, particularly in the past one or two years. Nearly a year ago, tests were made on fifteen current meters in service from three to six inch, inclusive, in size to determine the amount of under-registration in actual service. These tests were arranged by inserting a small meter in a by-pass around the outlet valve of the large meter. Thus with the outlet valve closed the meters would be working in series, each under the variation of rates produced by the actual service demand. The duration of the tests was from one week to five months of continuous operation. The results showed a total registration on test meters of 828,229 cubic

*Excerpts from a paper read before the February 19th, 1919, meeting of the New York Section, American Water Works Association.

feet against 651,642 by the service meters, an under-registration of 176,587 or 21.3%, representing on the 15 meters a revenue loss of $176.58 per month, or 2,119 per annum. Out of the 15 service meters, three over-registered, two, four and eleven per cent., respectively. The under-registrations of the other 12 ran from 6 to 95 per cent. While the results secured on these meters may not be accurately representative, they are at least suggestive of the possible loss of revenue being sustained by lack of proper compounding of the 3,500 odd meters three-inch and larger now in service in the city. (You may note that if the tests were representative of the actual conditions, the annual loss to the city would be upwards of one-half million dollars).

Accuracy and Pressure Loss

Other and more striking examples might be mentioned as illustrations of the possible saving to be secured by compounding. In one instance, the replacing of an old 8-inch Standard meter by a compound combination of an 8-inch current meter, 8-inch regulating valve and 2-inch by-pass meter, resulted in raising the monthly registration from 1,645 to 56,480 cubic feet, a saving of $650 per year.

Tests for accuracy and pressure loss at varying rates of flow have to date been made by the department on five makes of 4-inch compound meters. By a study of resulting curves some features of possible improvement are suggested. On all meters tested, the by-pass meter usually about ¾-inch, is sufficiently small to register with accuracy, very minute flows as low as 0.01 c.f.m., but on the other hand does not seem to be of sufficient capacity to carry the load to a rate which can be accurately registered on the large meter before reaching the pressure loss at which the regulating valve opens, resulting in an under-registration immediately following the opening of the valve and between the total rates of about 1½ and 3 or 4 cubic feet a minute. It would seem from the average curves obtained, that accuracy at these rates which could easily represent a large portion of actual use or continuous fixture leakage was being sacrificed in order to secure registration of the extremely small flows of say less than 0.1 cubic foot per minute which on all services of this size are relatively unimportant.

Under-registration of such service flows may also be due in a large measure to the very gradual opening of the regulating valve, while the by-pass meter subjected as in some makes to the pressure difference, continues to operate on high flow, leaving the increase of flow only to be deflected through the large meter with but slight, if any registration. Instead of this gradual opening regulating valve it would seem that one designed to more abruptly deflect practically the full flow from the by-pass to the main line would be preferable.

On some compound meters the stem of the regulating valve carries within a cylinder a small close fitting piston, one side of which receives the water pressure of the main tending to hold the valve closed while the other side of the piston is open to atmosphere. If this piston were so designed that a slight opening movement of the valve would allow water pressure to replace the atmospheric an opening impulse would be given the valve tending to suddenly reduce the pressure loss, thereby transferring a large portion of the by-pass flow to the large meter and favoring its more accurate registration.

Improvements Suggested

From these more or less superficial observations, the following improvements are suggested:

1. An increase in the capacity of the by-pass meter to cover all service rates too small for accurate registration on the main line meter and at a pressure loss that is sufficiently low to avoid opening of the regulating valve until the flow is well within the range for accuracy on the large meter.

2. A regulating valve so designed as to open more abruptly with either simultaneous closing of the by-pass or with a sufficient reduction of pressure loss to materially relieve the by-pass meter and deflect the bulk of its flow through the main line, thereby setting up a flow through the main line sufficient for accurate registration on the large meter.

RAINFALL RECORDS*

By L. M. Hastings
City Engineer, Cambridge, Mass.

At the December meeting of the New England Water Works Association, a letter was read from Robert E. Horten suggesting that an effort be made to get officials in charge of water works to establish rain gauges at the water sheds upon which their water supply depends. While there are a fairly good number of rain gauges established in various parts of New England now, the number might be greatly increased with good results, especially if they were established in locations not already closely covered by existing observers.

The southeasterly corner of New England is well supplied with rain gauges, but there are in the remaining sections of New England large areas where the gauges are very widely separated. Many of these sections are well elevated with many streams, and opportunities for reservoirs, dams, etc., for the development of power or water supplies.

Wide Distribution of Rain Gauges

If, as is recommended so strongly at the present time, a careful study of the streams and water courses of the country is to be made with a view to their more complete development as a source of power in order to conserve the consumption of coal as a power producer, the establishment of numerous rain gauges in various parts of the country will be found exceedingly useful in the study of that important question, as well as the one in which the members of this association are more directly interested, viz.: the development and conservation of our streams as sources of domestic water supplies.

It is proposed in this paper to give a few simple illustrations of ways in which rainfall records may be put to practical use in the study of questions relating to water supply, and so encourage the establishment of additional gauges.

Stations Should Check Results

One advantage to be gained by having gauging stations located at relatively short distances apart would be to check the results obtained at other stations and correct any variation which may appear in the gauging due to special or unusual topographical conditions in the water shed, such as elevation, nearness to large hills, mountains, or water surfaces, directions of prevailing winds, etc. As the amount of rain which may be expected to fall on a given district is often the only basis upon which its values as a power or water producer can be formed, it follows that it is desirable to have the very best data that it is possible to obtain on that vital point.

Location	Average Yearly Rainfall 1874-1913 (40 years)	Rainfall for Year 1880	Rainfall for Year 1883
Manchester, N. H.	38.27	27.30	31.47
Concord, N. H.	38.63	35.28	39.84
Lowell	42.01	35.28	39.84
Waltham	43.36	31.73	29.32
Cambridge, Harvard College	43.49	35.22	32.65
Framingham, Sudbury River	44.26	37.87	31.95
New Bedford	46.65	40.06	43.51
Providence, R. I.	47.20	41.29	39.54

It may be thought that with so many rain gauges already set up, especially in eastern New England, it would be easy to obtain accurate and reliable data for almost any location in that section; but any one not familiar with the subject will be surprised and puzzled at the wide variation in the results obtained at locations not far apart, which often renders any close estimates impossible. As illustrating this fact, the above table has been prepared showing

*Excerpts from a paper read before the February meeting of the New England Water Works Association.

the average rainfall at various stations for a forty-year period ending 1913, and also the rainfall for the exceptionally dry years of 1880 and 1883, which for some purposes it might be desired to use. Manchester, N. H., and Providence, R.I., are only about eighty miles apart in a straight line.

From the above, it will be seen that even for a long term period the average amount of rainfall at the points named varies greatly, the extreme variation being 8.93 inches or about twenty-three per cent., while for the dry year of 1880, the extreme variation is 13.99 inches, or over fifty per cent. From this it will be seen that anyone attempting to design a water power or a water supply system for a water shed at all remote from a long established rain gauge must unavoidably make his estimates upon data which have a large element of uncertainty in the makeup.

Marked Change in Years

It has been stated by some writers that a rainfall record of from thirty-five to forty years makes that record fairly reliable as a basis of estimates for the expected average yield of a watershed. While this may be true in an ordinary period, an examination of the rainfall records of the last forty years of the Sudbury river watershed, and others which have commonly been used in this vicinity, shows that a marked change in the amount of rainfall has occurred during the last fifteen years of that period and that while the average for the forty-four years since the Sudbury river records were begun is 44.66 inches, the average for the period 1904 to 1918 (fifteen years) is only 40.97 inches.

The Stony Brook rainfall record of the Cambridge Water Works in Waltham, Mass., shows a similar change. While the average rainfall for the entire period of twenty-nine years the gauge has been established—1890 to 1918—is 41.53 inches, the average for the period 1904 to 1918 (fifteen years) is 38.75 inches. These last are remarkably low average rates for so long a period and there seems to be but one period of that length of time with so low a rainfall record in this vicinity. This is in the Cambridge record of Prof. A. Winthrop from 1760 to 1775 where the average rainfall is shown as 37.38 inches.

Still further the record of the yield or run-off for both these areas shows a corresponding persistent decrease. While the average run-off from the Sudbury river area for the forty-four years is 20.54 inches, the average run-off for the last fifteen years is 15.85 inches. On the Stony Brook area, the average run-off for the twenty-nine years is 17.81 inches, and the average run-off for the last fifteen years is only 15.70 inches.

Proportion of Run-Off Also Decreased

If these records are analyzed by percentages, the interesting fact is shown that in the dry periods, the proportion or percentage of run-off to rainfall is less than that in the wet periods. Thus for the wet period in the Sudbury river area 1875 to 1903, the run-off was 49.3 per cent. of the rainfall, while for the dry period, 1904 to 1918, it was only 38.7 per cent., while for the exceptionally dry year, 1883, it was 34.1 per cent., and for the year 1911, it was 28.1 per cent. Similarly on the Stony Brook area, for the wet period, 1890 to 1903, the run-off was 42.9 per cent. of the rainfall, and for the dry period, 1904 to 1918, it was 40.5 per cent., and for the year 1910, it was only 27.1 per cent. of the rainfall. In other words, a diminished rainfall gives not only a diminished run-off, but a diminished proportion of run-off. From these facts, it is evident that it may not be safe to draw conclusions even from a forty-year record, without a careful study of the records of other places and other periods, that proper allowance may be made for abnormal results which may have been obtained.

There is another rather curious fact shown in the records for the year 1909 which may be noted. While the rainfall for this year is about six inches more than for either the years 1908 or 1910, the run-off for 1909 is about 1.50 inches less than for the year 1908. The Stony Brook record shows the same peculiar result,—a lessened run-off in a year of increased rainfall. The explanation of this anomaly may be that the underground storage had become so depleted by the continued drought of a number of years that the increased rainfall for the one year failed to restore the deficiency in this storage and so caused a lessened run-off for that year.

A very important and interesting question may be raised just here. Will the diminished rainfall as noted during the last fifteen years be permanent or will the rate "come back" to its old level? While no definite or authoritative answer can be given to this query, two things should be remembered in this connection. No permanent marked changes ever take place in the processes of nature without adequate cause. No such adequate cause is apparent by which the rainfall of this section could be permanently diminished, and again, in the past marked changes have occurred in meteorological conditions, cold winters, hot summers, wet and dry seasons—some continuing for considerable lengths of time, but inevitably the balance has been restored and the general mean of conditions re-established. Even if the period of low rainfall given in Prof. Winthrop's somewhat fragmentary records be taken as reliable as showing the entire rainfall for that period, the records of other observers for following years show the amount of rainfall to be well up to or above the average.

How Much Water in the Reservoir?

A very practical and convenient way of using the daily rainfall records is by plotting them in the form of a mass diagram. Probably one of the most common inquiries a superintendent of water works has to answer is one relating to the condition of the reservoir as regards the supply in storage. Much misconception frequently exists in the "average citizen's" mind as to the amount of rain which has fallen to a given date and consequently as to the amount of water which has been received into the storage basins.

It is rather a curious fact that taking a long term of years, the average rainfall for each month differs but little, the rainfall of the so-called "dry months" being on the average but little less than that of the wet months. The greatly increased evaporation during the hot months, together with the demands of growing vegetation, etc., makes the rainfall seem much less than it really is and results in a greatly decreased run-off during those months. As the evaporation from ponds, brooks, reservoirs, etc., amounts to over thirty-nine inches during an average year, it will be seen that the presence of large water surfaces in a water shed may have an important bearing on the amount of run-off to be expected from it.

The distribution of the rainfall during the year has an important bearing on the amount of the yield or run-off. If the rainfall is largely during the season when the ground is frozen, a much larger run-off may be expected than if it occurred during the hot months, when the ground is dry and the evaporation rapid.

From the above, it will be seen that rainfall records can be made to serve a variety of practicable purposes, and that long time records obtained on or near the ground are most reliable and satisfactory.

The cost of an ordinary rain gauge (not automatic or self recording) is small and its care and maintenance requires only the attention which can be given to it by some intelligent employee on the ground, or by some resident for a nominal sum.

Gauges are Useful

If it is desired to obtain automatic records of the rainfall, a more complicated and expensive type of gauge can be installed, and data obtained very useful in the study of many questions not covered by the mere quantity of rainfall, especially such as relate to the time at which the rainfall occurred and its intensity or rate per hour at any given time. These data are very interesting and sometimes are exceedingly valuable as factors relating to the required strength and height of dams, length of spillways, size of culverts, damages caused by floods, overflows, washouts, raising or lowering of the water in storge reservoirs, and a great variety of other questions of a similar nature.

If a water shed is large and the works established upon it are important and involve a large investment of capital, the establishment of an automatic gauge is strongly recommended.

ALBERTA IRRIGATION PROJECT

"THE reports of the irrigation conference have already gone far abroad and yesterday there were enquiries from construction contractors, who claim to be in a position to build irrigation works and take the Irrigation District bonds in payment. No doubt other tentative offers of this kind will be coming along," says the Lethbridge Daily Herald.

"There can be little doubt, however, that much better tenders on the engineering works could be got if the money were available separately, and if the financing were kept clear of the engineering. A man with ready money can always make the best deals.

"The construction work in connection with the Lethbridge Northern project, for instance, presents no engineering difficulties; and the head gates at Peigan are very small compared with the Bassano dam or the Nile barrage.

"It is impossible yet, of course, to foresee what may transpire in the matter of the provision of finance, but the Hon. Arthur Mieghen, Minister of the Interior, in his telegram the other day, repeated distinctly what he told Mr. Marnoch in Ottawa, namely, that if the Province of Alberta purchased district bonds and desired a Dominion loan against those, that proposal would be considered. The present time is opportune and we may not have that chance again.

"The delegation from the executive of the Irrigation Development Association, consisting of Chairman G. R. Marnoch; Vice-Chairman, John Powelson, and P. W. Crofts, along with S. Dunham, and P. Baker have arranged to meet with Premier Stewart and his Executive Council on Monday evening, and they are now leaving for Edmonton."

STORING TIMBER TO PREVENT DECAY

AS sometimes serious losses from decay of wood are doubtless due to the fact that timbers used were infected with wood-destroying fungi while in storage, the following hints as to how these losses might be avoided have been issued by the U.S. Forest Products Laboratory:—

Strong efforts should be made to store the products on well-drained ground, removed from the possible dangers of floods, high tides and standing water.

All rotting debris scattered about yards should be collected and burned, no matter whether it be decayed foundation and tramway timbers or stored lumber which has become infected. In the case of yards already filled in to considerable depths with sawdust and other woody debris the situation can be improved by a heavy surfacing with soil, slag or similar material. Weeds should be cut away from the piles to allow good ventilation.

More attention should be given to the foundations of lumber piles in order to ensure freedom from decay and better ventilation beneath the stacks. Solid foundations should never be used. In humid regions the stock should not be piled less than 18 to 24 ins. from the ground. Wood blocking used in direct contact with wet ground should be protected by the application of creosote or other antiseptic oils or else replaced by concrete, brick or other durable materials. Treated skid timbers would also be highly advantageous.

Foundations should be built so that the piles will slope approximately 1 in. to every foot of length.

In most regions lumber should not be close piled in the open, but should be "stuck" with crossers at least 1 in. thick. Lateral spacing is also very desirable. Roofing or cover boards on the piles should not be neglected, and should extend over for several inches in front and back.

Instead of throwing the "stickers" about on the ground to become infected with decay, they should be handled carefully, and when not in use piled on sound foundations and kept as dry as possible. If pine saturated with resin, or the heartwood of such durable species as white oak or red gum be employed, the danger of possible infection will be greatly decreased.

In storage sheds the necessity for piling higher from the ground is very apparent in many cases. The same remedies apply here as for pile foundations in the open. The sheds should be tightly roofed and the siding should not be run down below the bottom of the foundation sills. Free air circulation should be allowed from all sides beneath the inclosure. Only thoroughly dry stock should be stored in close piles under cover.

Should fungus outbreaks occur in storage sheds not constructed to meet sanitary needs, the infected foundation timbers should all be torn out and replaced with wood soaked in an antiseptic solution or by concrete or brick. In all cases the new foundations should be so constructed as to keep the lumber well off the ground, and the soil and timber immediately adjoining the infected area should be sprayed or painted with an antiseptic solution of a water-soluble salt, like sodium fluorid, mercuric chlorid, zinc chlorid, or copper sulphate.

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of The Engineering Institute of Canada held March 25th in Montreal, the following elections and transfers were announced:—

Members,—L. G. Denis, Otawa; E. C. Gaines, Montreal; Robert Hobson, Hamilton; S. J. Hungerford, Toronto; C. H. Larson, Cabri, Sask.; R. K. Palmer, Hamilton; J. A. Reid, Cobalt; W. M. Tobey, Ottawa; W. H. Wardwell, Westmount; M. B. Weekes, Regina.

Associate members,—W. S. Bellows, Fort William; G. J. Brown, Winnipeg; C. A. Buchanan, Levis; Arthur Duperron, Montreal; A. H. Eager, Winnipeg; Charles Howarth, Calgary; F. W. Hubbard, Hamilton; A. D. Huether, Niagara Falls, Ont.; A. R. MacPherson, Hamilton; W. G. Milne, Hamilton; G. A. Mills, Winnipeg; J. H. Morley, Wabana, Newfoundland; St. John Munroe, Vancouver; E. A. Neville, Windsor; R. C. Robinson, Saskatoon; R. J. Sandover Sly, Campbellton, N.B.; Arthur Sedgwick, Toronto; F. H. Smail, Regina; C. H. Timm, Westmount; F. P. Vaughan, St. John, N.B.; Ephrem Viens, Ottawa.

Juniors,—W. I. MacTavish, Toronto; L. C. Nesham, Ottawa; J. E. Owens, St. John, N.B.

Transferred from associate members to members,—John Armstrong, Winnipeg; Maj. F. L. C. Bond, Montreal; J. M. Leamy, Winnipeg.

M. E. Crouch, Ontario Land Surveyor, of Nipigon, has received a contract from the Department of Lands, Forests and Mines of Ontario for the survey of the Pic River pulpwood limit, comprising an area of approximately 1,400 square miles. The easterly limit is near Heron Bay, the westerly near Jackfish. Mr. Crouch will commence the work about May 15th and hopes to complete it within three months. This is the largest survey contract made by the Ontario government for several years. E. R. Bingham, of Fort William, and Phillips & Benner, of Port Arthur, will survey certain townships this summer for the provincial government.

Walter J. Francis, Arthur Surveyer and F. B. Brown, of Montreal, were entertained at dinner last Friday by the Toronto Branch of the Engineering Institute of Canada. Later in the evening they addressed the branch on the affairs of the Institute. Mr. Francis urged the members to take a livelier interest in public affairs, and to advance the welfare of the institute in every way. Engineers, he said, forget that energetic service to the community is essential in creating a healthy public appreciation of the engineer's value. Mr. Surveyer discussed the question of legislation to secure a closed corporation. Mr. Brown advocated one great national institution of engineers for all Canada, in preference to Canadian branches of American societies.

ESSEX COMMISSION IS GROWING

HAVING as its purpose the extension of the duties of the Essex Border Utilities Commission, a bill which was introduced in the Ontario legislature by S. Ducharme has been favorably reported by the Private Bills Committee. Several years ago this commission was formed to construct certain works within the municipalities of Windsor, Walkerville, Sandwich, Ford City, Ojibway, and the townships of Sandwich East and Sandwich West. Its main duties at the time of organization were to build a joint sewerage system. Under the proposed bill it is the intention to give the commission authority to proceed with other works, including a joint hospital, and also to do away with the separate Boards of Health, and substituting therefore the commission as a joint Health Board.

Dr. J. W. S. McCullough, Provincial Officer of Health, approved of the centralization of health administration, but he objected to the commissions assuming the duties of a Health Board. To overcome this criticism, an amendment is to be drafted by the Law Clerk to provide for the appointment of a separate Board of Health by the commission.

FUEL CONTROL NO LONGER NECESSARY

THE office of the fuel controller for Canada was formally closed about the end of last month. The last official statement was issued a couple of weeks ago by C. A. Magrath, announcing that supplies are now ample for requirements. The coal regulations will probably be allowed to remain in force until the actual declaration of peace, although importers and dealers will not be required to take out new licenses for the coming coal year. In the United States the fuel administration, as constituted under the Lever Act, officially continues until peace is declared, although the organization at Washington has been reduced to the vanishing point.

During the war the United States Bureau of Mines made strenuous efforts to find a special fuel for airplanes that would be superior to others already in use. Of the numerous products and mixtures obtained some were originated by the bureau engineers and chemists and others were suggested by outside interests. Through its own experiments, or by co-operation with other organizations, notably the Research Division of the Dayton Metal Products Co. and the Bureau of Standards, it was possible to establish the fact that certain types of fuels had elements of superiority that had not before been noted or appreciated. Of the fuels proving most satisfactory, gasoline refined from the crude petroleum of certain producing fields was distinctly superior to the type most extensively used. The blending of moderate proportions of benzol with gasoline was found to be distinctly advantageous, and motor fuel of this type would undoubtedly have been employed for military purposes if the war had continued much longer. It is believed that through the proper use of benzol and other distillates derived from coal, it may be possible to embody features in the design of internal combustion motors that will notably increase their efficiency. Benzol and other coal-derived fuels are already being sold for use in automobiles and are believed to be giving satisfactory results even with present types of motors. The bureau was particularly interested in a special fuel tested in co-operation with the Dayton organization and named "hecter." This fuel, which was a mixture of cyclo-hexane and benzol, gave indications of marked superiority over any other product tested and should, unless unforeseen deficiencies appear, prove ideal for the military aviation service. In some experimental flights, this fuel has given ten miles an hour more speed. It is not certain that the cost of production will ever be low enough to permit its use in peace times, but it is planned to complete the work of obtaining comprehensive information regarding all of its possibilities and to publish reports on the subject.

PUBLICATIONS RECEIVED

GEOLOGICAL SURVEY.—Summary Report, 1917, Part A, issued by the Department of Mines, Ottawa. 20 pages and cover, 6 by 9¾ ins.

BOILER WATER TREATMENT.—Reprint of engineering bulletin No. 3 prepared by the United States Fuel Administration in collaboration with the Bureau of Mines. Issued by the Government Printing Office, Washington, D.C. Copies, 5c. each; 8 pages, 5¾ by 9 ins.

THE LARGER UNDEVELOPED WATER POWERS OF TENNESSEE.—Reprint by the Tennessee State Geological Survey of paper read by J. A. Switzer, professor of Hydraulic Engineering, University of Tennessee, and hydraulic engineer of the Survey, before the American Electrochemical Society.

ABSOLUTE PERMISSIVE BLOCK SYSTEM CIRCUITS.—Bulletin 135, issued March, 1919, by the General Railway Signal Co., Rochester, N.Y., reprinting article by Sedgwick N. Wight descriptive of this system, of which 54 miles have been installed by the T.H. & B. R'y, 31 miles by the G.T.R., 25 miles by the C.P.R., and 3,185 miles by railways in the United States.

STORAGE OF WESTERN CANADIAN COAL.—Issued February, 1919, by the Western Canada Fire Underwriters' Association, Winnipeg. Twelve pages and cover, 8 by 10½ ins. Discusses spontaneous heating, sulphur, moisture, size of coal, mixing, temperature, size of piles and prevention of heating. Deals particularly with the shipment and storage of lump lignite and lignite slack.

DESIGN OF CONCRETE MIXTURES.—Bulletin No. 1 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, April, 1919. Reprinted from the minutes of the annual meeting of the Portland Cement Association held last December in New York. Twenty pages and cover, 6 by 9 ins., 7 figures. Discusses effect of quantity of mixing water, effect of fineness modulus of aggregates, effect of grading of aggregates, quantity of mixing water required, etc. Engineers and contractors who are interested should address Prof. D. A. Abrams, c/o Lewis Institute, Chicago, for copies of this bulletin.

ANNUAL REPORT DOMINION WATER POWER BRANCH.—For the fiscal year ending March 3st, 1917. Published by the Department of the Interior, Ottawa; 106 pages and cover; 6½ by 9½ ins.; with a number of colored maps and frequent half-tone illustrations. It contains the reports of the superintendent of water power, the chief draftsman, the accountant and the chief hydraulic engineer, and reports regarding the British Columbia and Manitoba Hydrometric Service, and the Alberta and Saskatchewan power and storage investigations; also report on the work carried out in co-operation with the Nova Scotia Water Power Commission, and a report on reclamation.

Australian railway engineers recently made 2,000 tests of 126 devices submitted by inventors for overcoming variations in railway gauges. There are in Australia 12,252 miles of 3 ft. 6 in. gauge track, 7,171 miles of 4 ft. 8½ ins., and 6,356 miles of 5 ft. 3 in. In order that an effective and complete interchange between all the states may be possible, any device should be applicable to all classes of rolling stock, including locomotives, and should be interchangeable between all states. In considering the devices submitted, the engineers rejected everything that unduly increased the cost or the danger of train-running, or that caused a delay of more than half an hour in the case of passenger and two hours in the case of freight trains. A third rail was seriously considered, but as the gauges of all the states are different, something more than a third rail will be necessary. Victoria, for instance, would have to add a third rail for N.S.W. cars, and a fourth for Queensland cars; moreover it was thought that a train of cars of different gauges would not be very satisfactory. The 4 ft. 8½ in. gauge has been accepted as the standard, and the Australian papers seem to think that the problem will be solved only by changing all the other gauges.

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DIFFERENTIA OF B. COLI

UPON another page of this issue appears a valuable article by Everett Judson, assistant sanitary engineer in the United States Public Health Service, on the "Differentia of B. Coli." It is believed that the method discussed by Mr. Judson is the most promising in differentiating the Colon group and should be thoroughly tried out in practice. However, for those who care to go further into the subject it would be well to consider synthetic media.

Koser proposes a uric acid synthetic medium in which B. Coli fails to develop, while B. Aerogenes produces a dense clouding. The theory is that B. Aerogenes is capable of utilizing the nitrogen of the purin ring, while B. Coli lacks this power and fails to develop, there being no other source of available nitrogen.

Ayers and Rupp have devised a synthetic medium for the direct enumeration of the organisms of the Colon-Aerogenes group. They do not, however, claim that this medium will differentiate between sub-groups of the Colon-Aerogenes group.

METERS AGAIN SHOW BIG SAVING

IN Vancouver the daily consumption of water during the hottest weather last summer was 200 gallons per capita, while Point Grey citizens averaged 35 gallons. Point Grey is metered; Vancouver is not. The cost of Point Grey's meters and of their installation was soon saved if these figures, quoted by a Vancouver newspaper, are correct.

We are a water-wasting nation. No Canadian would hesitate, for example, to flush a toilet three or four times where one or two flushings would suffice for all purposes, Moreover, our plumbing fixtures are extravagant with water. The average Canadian or American flush tank releases several times as much water at each flushing as does the average European tank.

Cooling the milk by means of running water, neglecting leaky taps and even leaky mains, flooding the lawns unnecessarily, leaving the taps open to prevent freezing,—these are but a few of the many ways in which we daily waste huge quantities of water that has been pumped, filtered and chlorinated at a definite cost per thousand of gallons used. Meters are a good investment. Experience has shown that they do not retard cleanliness, but they do encourage the careful and thrifty use of water. They save capital expenditures in water works plant extensions and lower maintenance and operating charges. Meters will be included—sooner or later—in the conservation programme of every thoughtful municipal engineer.

SOUGHT LEGISLATION 20 YEARS AGO

AT a recent meeting of the Toronto Branch of the Engineering Institute of Canada, Willis Chipman related interesting details of the unsuccessful attempt made 20 years ago by the civil engineers to secure a closed profession. Action was taken in Nova Scotia, Quebec, Ontario and Manitoba. The prairie provinces, as now constituted, were not then organized. In Ontario, the movement was strongly supported by the Toronto Branch of the Canadian Society of Civil Engineers, including such leading engineers as Messrs. Butler, Rust, Keating, Jennings, etc. They personally solicited the interest of members in various centres. A bill was drafted and printed but got no further than the committee. In Nova Scotia, the bill passed the House, but failed to pass the legislative council. In Quebec and in Manitoba the bills passed and became law, and are still on the statutes, but not enforced. In Ontario, the bill was opposed by the mining men, led by Mr. Bell, editor of the Mining Gazette, and Prof. R. Harris, of Kingston. Negotiations were carried on with the Mining Institute, but with no favorable result. The engineers were not united then and are no more united now, declared Mr. Chipman. Many of the engineers present did not agree with this statement, however, and the prevailing sentiment seemed to be that most of the engineers are now united in their ideas regarding the desirability of legislation of some kind.

THE COMMUNITY AND INDUSTRY

INDUSTRIAL difficulties of the past few decades have demonstrated essential differences in the relations between various industries and the public. The tying up of railroad or street railway service or of that of a telephone company results in an obstruction to all classes of business and is most serious.

In the early days of the capitalist system, public sympathy was, generally speaking, with the capitalist; he was supposed to be the only responsible party interested in the dispute, and the law was entirely on his side. It soon became apparent, however, that a combination of workers was not necessarily any more in restraint of trade than a combination of employers, and the right to form unions and to strike was gradually obtained by the labor forces; in other words, it was recognized that there were two parties who had an interest in industrial disputes. With the growth of large scale industry, a third group grew up, the managing class; this group is allied to the wage earners inasmuch as its members themselves work for a fixed remuneration; on the other hand they are allied to the employer because their remuneration depends in large degree upon the success of the undertaking. For the latter reason this group has generally been regarded as being on the side of capital. Meanwhile no consideration was given to the interest of the citizen upon whom in his capacity of consumer the success of any industry is built.

In many industries an industrial war may be carried on until either party is forced to succumb, without causing

the public grave inconvenience. With the increasing solidarity of economic life, however, the number of such industries has been gradually reduced. The Hon. W. L. Mackenzie King is right in emphasizing the fact that there are these four parties to industry and that the recognition of the interests of the first three must be supplemented by a recognition of the fact that the community is also a constructive factor in the control of industry, not merely a body of consumers ready to be served when an industry so chooses and when its members can agree.

PERSONALS

WILLIAM FORBES has been appointed county road superintendent by the Oxford (Ont.) County Council.

A. K. GRIMMER, of Fredericton, N.B., has been appointed by the Kipawa Co., as town engineer of the newly-established industrial community known as Kipawa.

LT. LIONEL W. HARRON, M.C., who graduated with the class of 1916 at the University of Toronto, Faculty of Applied Science, has returned from France. He went overseas in 1917 with the 204th Battalion.

CAPT. G. M. HAMILTON, M.C., of New Hamburg, Ont., has returned from France. He was wounded three times while with the 7th Battalion, Canadian Engineers. Capt. Hamilton graduated from S.P.S., University of Toronto, in 1912.

CAPT. A. M. GERMAN, of Port Colborne, Ont., has returned from France. He was mentioned in despatches in June, 1918, while serving with the machine gun corps. Capt. German graduated from S.P.S., University of Toronto, in 1913.

CAPT. F. M. PRATT, M.C., of Ottawa, recently returned from France. He was wounded twice while with the Canadian Engineers, and was mentioned in despatches. Capt. Pratt graduated in 1912 at McGill University in an engineering course.

CAPT. R. D. HAGUE, of Toronto, has returned from France. He was a member of class '08, Applied Science, University of Toronto. He enlisted as a sapper in No. 3 Company, Divisional Engineers. In 1918 he was mentioned in despatches.

LT.-COL. G. W. MACLEOD, D.S.O., of Edmonton, Alta., has returned from France in command of the 3rd Battalion, Canadian Machine Gun Corps. He enlisted as a lieutenant in the 49th Battalion. Col. MacLeod graduated in 1907 at S.P.S., University of Toronto.

G. G. HARE, city engineer of St. John, N.B., who succeeded the late William Murdoch in that position, was born at Kaarsloof, South Africa, but spent his boyhood in St. John. He graduated in 1896 from McGill University in civil engineering and since then has been engaged in engineering work, principally in British Columbia, Ontario, New Brunswick and Nova Scotia, but also for a time in Mexico and the United States.

A deputation from the counties of Bonaventure and Gaspe, P.Q., have waited on the Hon. F. Carvell, Minister of Public Works, Ottawa, with a request for financial assistance in improving the roads along the shores of the Gaspe Peninsula.

Geo. A. MacKenzie, managing-director of the Canadian Western Steel Co., Ltd., of Calgary, announces that his firm is now able to supply open-hearth steel bars in sizes from ⅜-in. to 3 ins. squares or rounds, and flats up to 6 ins., and angles and channels up to 4 ins., and reinforcing steel in all these sizes. The company's new 25-ton furnace at Redcliff is now in operation. There is a complete laboratory at the plant and the whole equipment is said to be modern in every respect. Natural gas is being used as fuel. In the future the company will manufacture bolts and nuts from open-hearth steel bars.

LASALLE BRIDGE LEGISLATION

THE Quebec Legislature has passed the bill concerning the LaSalle bridge, the contracts for the construction of which were terminated by the city of Montreal, the deposits made by the contractors being retained. The bill was promoted by the contractors with a view to securing a settlement, it being contended that the failure to carry out the work was due to causes over which the contractors had no control.

The city opposed the bill, on the ground that the legislature must not intervene in civic questions of pure administration, and especially on the question of the contract regarding the LaSalle bridge. The commission also insisted that any legislation on the question of the LaSalle bridge would serve as a precedent in several similar cases, in which the contractors have already made claims.

The Private Bills Committee amended the bill in several particulars, but the legislative assembly struck out practically the whole of these, and restored a clause, struck out by the legislative council, for arbitration in case the Administrative commission of Montreal do not agree to a settlement with the contractors. The legislative council thereupon gave way, and accepted the bill as it came from the assembly.

The Montreal Portland Cement Co., Ltd., has been incorporated with a capital of $2,000,000. The promoters of the company state that a site of 52 acres has been secured at Pointe-aux-Trembles, near Montreal, and that it is proposed to erect a plant of 5,000 barrels a day capacity, the plans having been prepared.

An important amalgamation of English firms has been announced, there having been a consolidation of the interests and activities of Willans & Robinson, Dick Kerr & Co., Phoenix Dynamo Mfg. Co., and the United Electric Car Co. These firms will now operate as the English Electric Co., Ltd. The new company takes over a large number of important contracts for street railway equipment, turbines, turbo-alternators, condensing plants, etc.

G. T. Milne, Montreal, and F. W. Field, Toronto, British Trade Commissioners in Canada, have been officially informed that iron and steel manufactures generally except high speed steel and certain special articles, machinery of all kinds except textile machinery and machinery wholly made of brass or copper, barrels and casks, boilers, fuel economisers for boilers, dry white lead, resins, lead coated sheets, cast iron pipe, iron or steel wire, wire rope, cast iron radiators, railway springs, railway wheels, railway constructional material except rails, tinplate, and many other articles and materials can now be exported from Great Britain without an export license.

The Canadian Incinerator and Furnace Co., Ltd., Toronto, recently completed an installation of a 60 ft. by 4 ft. angle furnace, a 24 ft. by 8 ft. plate furnace, and also a shim and rivet making furnace for the Port Arthur Shipbuilding Co. These furnaces have been in operation for about six weeks. Coal-fired furnaces were previously used, and a marked difference, both in economy and output, is said to be evident. Formerly it took from 45 to 90 minutes to heat a frame or a plate, whereas it now takes 15 minutes. The cost per 10-hour day formerly was $48 for fuel, plus one man full time firing and one man part time wheeling out ashes and wheeling in coal, plus a team part time removing ashes and hauling coal. The present cost per 10-hour day is calculated to be $16 for oil fuel, plus part of one man's time for burner operation, which is stated to be a saving of 89 per cent. The Canadian Incinerator and Furnace Co. have completed similar equipments for the Davie Shipbuilding Co., Point Levis, P.Q.; the British-American Shipbuilding Co., Welland, Ont.; and the Dominion Shipbuilding Co., Toronto; and have a contract for an equipment for the Halifax Shipyards. The company also manufactures smaller furnaces for various uses, including annealing, oil tempering, rivet making, rivet heating, brass and lead melting, copper heating, etc.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer* to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Beebe Plain, Que., highway	May 1.	Mar. 20.	43
Esquimalt, B.C., military hospital	Apr. 14.	Mar. 27.	48
London, Ont., drainage work	Apr. 7.	Mar. 27.	46
London, Ont., school	May 1.	Feb. 27.	44
McGillivray Tp., Ont., drainage work	Apr. 7.	Mar. 20.	44
Nipigon, Ont., abutments, piers and culverts	Apr. 9.	Mar. 20.	43
North Bay, Ont., culvert and abutments	Apr. 11.	Mar. 27.	46
Ottawa, Ont., bridge	Apr. 6.	Feb. 6.	41
Ottawa, Ont., refrigerating equipment	Apr. 12.	Mar. 27.	52
Sherbrooke, Que., highway	May 1.	Jan. 23.	44
St. Thomas, Ont., railway stations	Apr. 4.	Mar. 27.	50
Sutherland, Sask., sewers	Apr. 9.	Feb. 20.	44
Winnipeg, Man., hospital	Apr. 16.	Mar. 27.	50

BRIDGES, ROADS AND STREETS

Amherstburg, Ont.—Tenders will be received by the undersigned up till noon, April 12th, for the construction of three cement bridges on the Coulter Side Road Drain. Plans and specifications may be seen at the Clerk's office, Gesto. A. C. Atkinson, township clerk, R.R. No. 2, Essex.

Amherstburg, Ont.—The Town Council intends to construct concrete sidewalks on Laird Ave. A. J. Burns, clerk.

Arnprior, Ont.—Carleton County will erect a new bridge over the Mississippi River, on the fourth concession line, Township of Fitzroy. The Ontario Bridge Co., of Toronto, have been awarded the contract at the price of $55,500.

Bridgewater, N.S.—The Town Council has decided to pave streets, of which there are about 30 miles. Estimated cost, $60,000. Mayor, W. T. Ritcey.

Calgary, Alta.—It has been suggested that a bridge be built across the river, about ten miles from Morley.

Calgary, Alta.—Work on the new six-span concrete bridge over the Bow River will be started this year. Estimated cost, $210,000.

Cayuga, Ont.—The Haldimand County Council at a recent meeting decided to build 25 miles of good roads this year. Cayuga will be connected with Hagersville and Caledonia with the Hamilton road, and extension will be made to Jarvis St.

Chateauguay, Que.—A by-law has been proposed to authorize rebuilding cement roads on each side of the Chateauguay River, from the New York Central bridge to the limits of the parish. Estimated cost, $11,500. Secretary-treasurer, Fortunat Laberge.

Drummondville, Que.—Paving and repairing of streets is contemplated by the Town Council. J. A. Montplaisir, mayor.

Ethelbert, Man.—Tenders addressed to the undersigned will be received until noon, April 19th, for the construction of three reinforced concrete bridges at the following sites in the Municipality of Ethelbert: Bridge—Section 21, Township 28, Range 21 West. Bridge—Section 2, Township 31, Range 22 West. Bridge—Section 31, Township 29, Range 21 West. Plans, specifications and tender forms may be obtained at the office of the Highway Commissioner, Parliament Buildings, Winnipeg, or at the Municipal Office, Ethelbert, Man. P. Melnyk, secretary-treasurer, Ethelbert Municipality, Ethelbert, Man.

Galetta, Ont.—Sawyer and Smith have the general contract for erection of bridge over the Mississippi River for the County Council.

Hamilton, Ont.—Some county roads in this vicinity will be repaired this spring.

Hamilton, Ont.—The Board of Control has resolved to support the citizens and townships who urge that the Provincial government prepare a new survey and include Barton St. as the most feasible route for the proposed highway from Hamilton to the Niagara frontier.

Kentville, N.S.—Construction of pavements is contemplated by the Town Council. Estimated cost, $50,000. J. Carrol, clerk.

Kingston, Ont.—The Board of Works contemplates the construction of asphalt pavements on Brock St., between Bagot and Barrie Sts. City engineer, R. J. McLelland.

Lindsay, Ont.—Several streets will be paved this summer. Mayor, B. L. McLean.

Longueuil, Que.—Tenders will be received by the undersigned until 5 p.m., April 7th, for construction of concrete pavements on St. Antoine St. and St. Charles St., and Bond De L'Eau Rd. J. R. Bournet, secretary-treasurer.

Moose Jaw, Sask.—Tenders will be received by the undersigned up to noon, April 15th, for the following work: One 15-foot and one 10-foot concrete arch culvert on the Lanigan subdivision; two miles new wood pipe line at Macoun; 3,000 feet new pipe line at Estevan; new baggage and express building at Saskatoon. Plans, specifications and form of proposal may be seen in this office; Assistant Chief Engineer's office, Winnipeg; Superintendent's office, Regina, Moose Jaw and Saskatoon. W A. Mather, general superintendent, Moose Jaw.

Paisley, Ont.—J. A. McKinnon, Walkerton, has the cement contract for $3,124 and the Hunter Bridge Co., Kincardine, has been given the steel contract for $4,600 in connection with rebuilding bridge for the County Council.

Skead, Ont.—Residents are asking for a road to connect with main highways.

Ste. Anne de Bellevue, Que.—Tenders, addressed to the undersigned will be received until noon, April 7th, for grading and road work, Military Hospital, Ste. Anne de Bellevue, Que. Plans and specifications can be seen and forms of tender obtained at the office of the Chief Architect, Department of Public Works, Ottawa; the Superintendent, Military Hospitals, Ste. Anne de Bellevue, and the Overseer of Dominion Buildings, Central Post-Office, Montreal, Que. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Strathroy, Ont.—Tenders will be received by F. W. Atkinson, Clerk, for concrete, asphaltic concrete and bitulithic pavements. Minimum contract, 12,000 sq. yds. Plans and specifications may be seen at Clerk's office or at office of Engineers, James, Loudon and Hertzberg, Ltd., 36 Toronto St., Toronto.