PAGES

MISSING

# The Canadian Engineer

*A weekly paper for Canadian civil engineers and contractors*


## DON RIVER BASCULE BRIDGE, TORONTO

### Toronto Harbor Commission Erects Single Leaf Strauss Trunnion Bascule Over Don River at Cherry Street To Accommodate the New ' Eastern Harbor Terminal District"—Some Details of Design and Construction


By GEORGE T. CLARK

**Designing Engineer, Toronto Harbor Commission**


AS the reclamation work in the Eastern Harbor Terminal District, formerly called Ashbridge's Bay, in the city of Toronto, progressed to the point where industries were able to locate and traffic to this district consequently increased many fold, it became necessary to provide for the handling of this traffic by the construction of a modern movable bridge across the Don River Channel at the foot of Cherry Street, in the location shown in Fig. No. 3.

The temporary timber swing bridge formerly in use not only was inadequate to handle the increased traffic, but also, on account of its centre pier, greatly limited the size of vessel which was able to pass up the channel.

Before deciding on the type of new bridge best suited for the purpose, studies were made of several types of bridges, after which skeleton plans of the several studies were submitted to the builders of various types of movable bridges, with the request that they furnish rough plans and estimates of their particular type, together with methods and cost of operation.

After carefully going into the situation and considering all the circumstances in connection with the location, it was decided that the Strauss type of bascule bridge would be best suited for the Cherry Street bridge; consequently a contract was entered into between the Toronto Harbor Commission and the Strauss Bascule Bridge Co., Chicago, for detail plans and specifications, and tenders were called for on the basis of those plans and specifications.

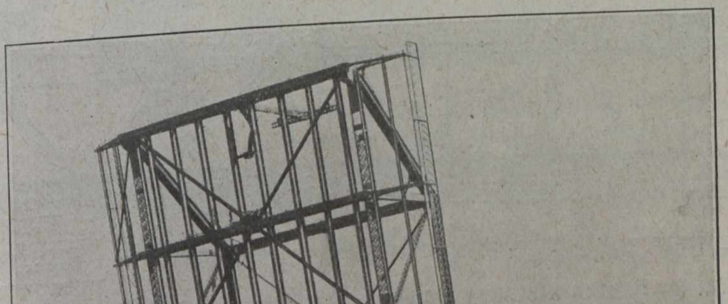


**Fig. No. 1—Moving Leaf Erected in Its Open Position**

The main foundations for the bridge consist of two main trunnion piers and two counterweight trunnion piers. The main trunnion piers consist of concrete cylinders, 6 ft. in diameter, resting on rock. The counterweight trunnion piers are of the same construction and are 8 ft. in diameter, also resting on rock. The method of construction consisted in driving 14-inch, arch-web Lackawanna steel sheet piling in a circle the inside diameter of which equalled the required diameter of foundation. This sheet piling was given two feet penetration in the rock. The excavation was then removed in the water with an orange-peel bucket. When the excavation was completed, the unwatering was commenced. As the water lowered in the cofferdam, pairs of angles, bent to the exact circle of the interior of the piling, were placed at intervals to prevent the collapsing of the forms. The concrete was placed in the dry. The angle bracing above referred to was removed as the concrete was brought up.

In the case of one of the cylinders, some difficulty was encountered in excavating. There was evidently a fissure in the rock not stopped by the sheet piling and the sand entered from the bottom as quickly as it was removed from the top by the bucket. The difficulty was overcome by plugging the fissure with clay.

Particular care was taken to see that all superstructure metal resting on concrete work was set to exact position and elevation. In order that the elevations of the bases of the four trunnion posts would be exactly the same, the tops of the concrete piers were first brought up to an elevation approximately correct. Screed strips were then placed and any differences in elevation were corrected by floating with a 1 to 2 portland cement mortar.

In each trunnion pier there are four anchor bolts 1¾ inches by 6 ft. The value allowed for concrete in compression in these piers was 400 lbs. per square inch.

The total reaction per truss on the main trunnion piers is 680,000 lbs., and on the counterweight trunnion piers is 1,068,000 lbs.

The ballast walls or shore abutments of the bridge are as shown in Fig. No. 5. The elevation of the top of the Don Channel wall is 251.0, Toronto Harbor Commission's gauge; that is, taking mean sea level of New York Harbor as zero. The elevation of the crown of the roadway of the bascule bridge is 256.87. Hence it was necessary to raise the channel wall, for a distance equal to the width of the bridge, to a height of about 6 ft. above its former elevation in order to form the abutment.

The approaches to the bridge rise about four feet. The grade is an easy one on both approaches, but special attention had to be paid to the north approach on account of its intersection with Keating Street. The retaining walls to hold the fill in the approaches are of standard types and vary in height from that of an ordinary sidewalk curb to 6 ft.

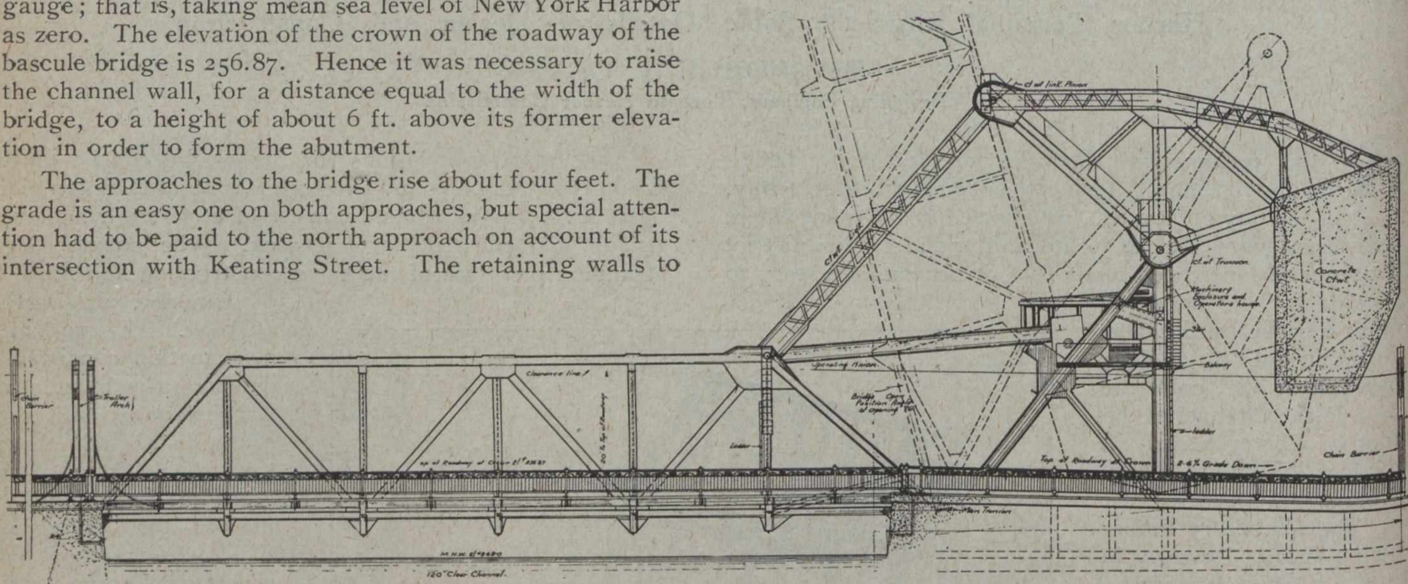


Fig. No. 2—Sketch Showing General Appearance of the Don River Bascule Bridge

### Superstructure

The loadings governing the structural design of the bridge were as follows:—

*Dead Load*, the weight of the entire structure, including the floor system, rails, ties, guard timbers, pavements, handrails, etc.

*Live Loads* for trusses and floor systems:—

Electric railway, two 40-ton cars, class 20, Ontario Railway and Municipal Board specification.

Roadway, city bridges, class A, and road roller on floor.

Sidewalks, city bridges, class C.

*Impact*—All live load stresses, except those from road rollers or traction engines, were increased by an impact stress obtained by multiplying the live load stress by a factor derived from the following formulæ:

$$\text{Electric railway,} \quad I = \frac{130}{L + 150}.$$

$$\text{Roadway,} \quad I = \frac{100}{L + 150}.$$

$L$ being the loaded length of the span producing the stress under consideration.

No impact was added to stresses produced by road rollers, traction or centrifugal forces, or wind loads, nor to any dead load stresses except as specifically mentioned for movable bridges.

All dead load stresses in members of movable bridges, towers, and counterweight arms and connections were figured for such positions of the structure as give maximum tensile and compressive stresses, and such stresses were increased by 20% for impact. These impacts were not taken in conjunction with the live load stresses and impacts.

*Wind Loads*—The entire structure was proportioned to resist a wind pressure of 15 lbs. per square foot on the exposed surface as projected on any vertical plane for any open position of the span; and for a wind pressure of 30 lbs. per square foot when the span is in its closed position. The machinery was proportioned for the maximum wind load on the basis of 15 lbs. per square foot, and the power was proportioned for the maximum wind load on the basis of 5 lbs. per square foot. Lateral systems of main trusses were proportioned for wind loads given for fixed spans where such loads exceeded the above.

The general appearance of the bridge is shown in Fig. No. 2. The moving leaf is a through Warren truss of six panels. The overhead clearance for traffic, from crown of roadway to top-chord bracing, is 20 ft. The length of the bridge, from centre line of main trunnion to centre line of bearing on the north abutment, is 130 ft., and the clear span is the full width of the Don Channel, namely 120 ft. The distance from centre to centre of truss is 45 ft., and the clear width of roadway, face to face of curb, is 42 ft. The roadway will have a double track street railway, 11 ft. from centre to centre of tracks. Sidewalks are 8 ft. wide, in the clear.

The wearing surface of the roadway consists of 3-inch Norway pine paving blocks, treated with 14 lbs. of creosote oil per cubic foot. These blocks are laid on a course of 3½-inch Douglas fir sub-planking, treated with 12 lbs. of creosote oil per cubic foot, and the sub-planking is laid on 6" x 9" Douglas fir cross-ties, treated with 8 lbs. of creosote oil per cubic foot, and laid flatwise, spaced 24" centres.

The requirements for structural and rivet steel and the allowable unit stresses are in accordance with standard bridge practice. All trunnions and pins are of forged steel having an ultimate tensile strength of from 70,000 to 85,000 lbs. per square inch. Bearings and pillow blocks are of cast steel having an ultimate tensile strength of

70,000 lbs. per square inch. All main bearings are grooved for lubrication and fitted with screw compression grease cups directly connected to the bearings. The diameter of the main trunnion is 11", and of the counterweight trunnion, 12". Particular care was taken that trunnions and pins were turned perfectly true throughout; that they were provided with a sufficient number of adequate keys; and that they were accurately aligned and set.

The total weight of structural steel is 876,500 lbs.; and of trunnions, pins and bearings, 38,100 lbs.

Chain barriers will be installed at each end of the bridge, protecting both roadway and sidewalk. Each barrier is balanced by counterweights, and they are operated by a 5-h.p. motor. The mechanism of each barrier is so arranged that the brake shoes are free from the brake wheel except when the barrier is down, protecting the bridge opening. This eliminates the danger of the barrier failing to work on account of rust. The barrier itself is elastic and is so constructed as to gradually absorb the shock of any vehicle striking it. Fig. No. 6 shows the general elevation.

The painting specifications required that all riveted work in contact, and surfaces not accessible for painting after erection, should be given two coats of paint before the parts were assembled. The paint specified was 12 lbs. of red lead and 10 oz. of lamp black mixed with one Imperial gallon of pure raw linseed oil. It was subsequently decided that in regard to the riveted work in contact, the number of coats be reduced from two to one, to lessen the possibility of loose rivets resulting from the burning of the paint. All field rivet heads and all areas on which the shop coat was damaged, were given a coat of shop paint before the finishing coats were applied.

The bridge will be operated by electric power, delivered at the switchboard in the operator's house in the form of 3-phase, 25-cycle alternating current at 550 volts. Provision is made for taking current from either of two independent sources of supply.

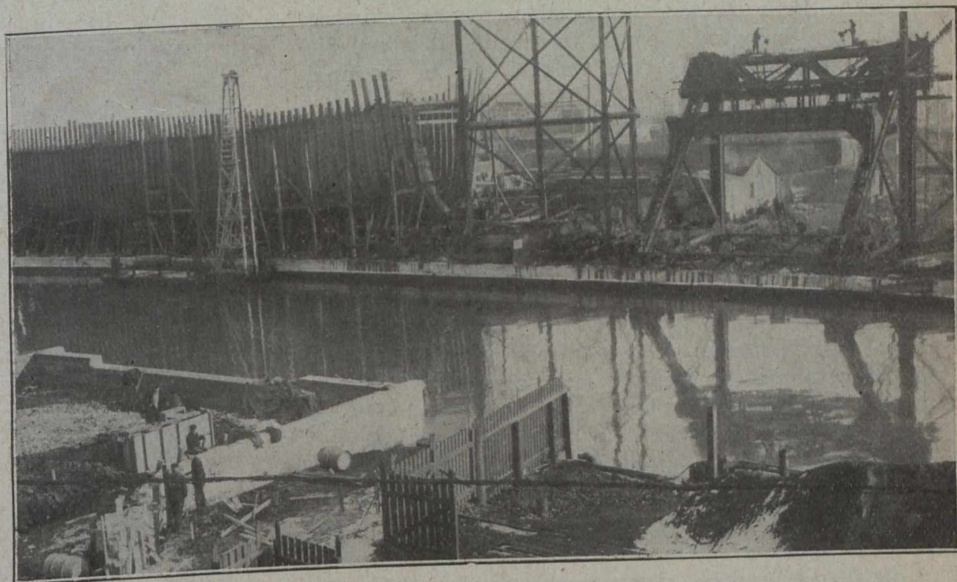


**Fig. No. 4—North Shore Abutment in Foreground; Tower Posts of Counterweight Truss Erected Across the Channel**

The bridge leaf will be operated by two heavy-duty, enclosed type, variable speed, reversible electric motors, each operating at 710 r.p.m. with a normal running torque of 740 ft.-lbs. and a maximum starting torque of 1,600 ft.-lbs. The motors are capable of maintaining the above normal rating for thirty minutes without exceeding a rise of 75 deg. C. above the temperature of the surrounding air. They are capable of starting under, and of carrying for two minutes without injurious heating or sparking, the maximum starting torque specified. The entire insulation and rotating electrical parts are equivalent to the mill motor type. Each motor is furnished with a steel pinion of proper proportion to drive the operating machinery.

The end lock is operated by one 5-h.p. enclosed type, reversible motor, running at 825 r.p.m., with 30-minute rating. This motor is designed to permit of swinging the span through an angle of ninety degrees without spilling oil or becoming otherwise affected. Hinged manhole covers are provided for the protection of the end lock machinery.

Each motor is provided with a "Block" brake which is normally held in the set position by a spring with such force as to overcome from 80% to 100% of the normal motor

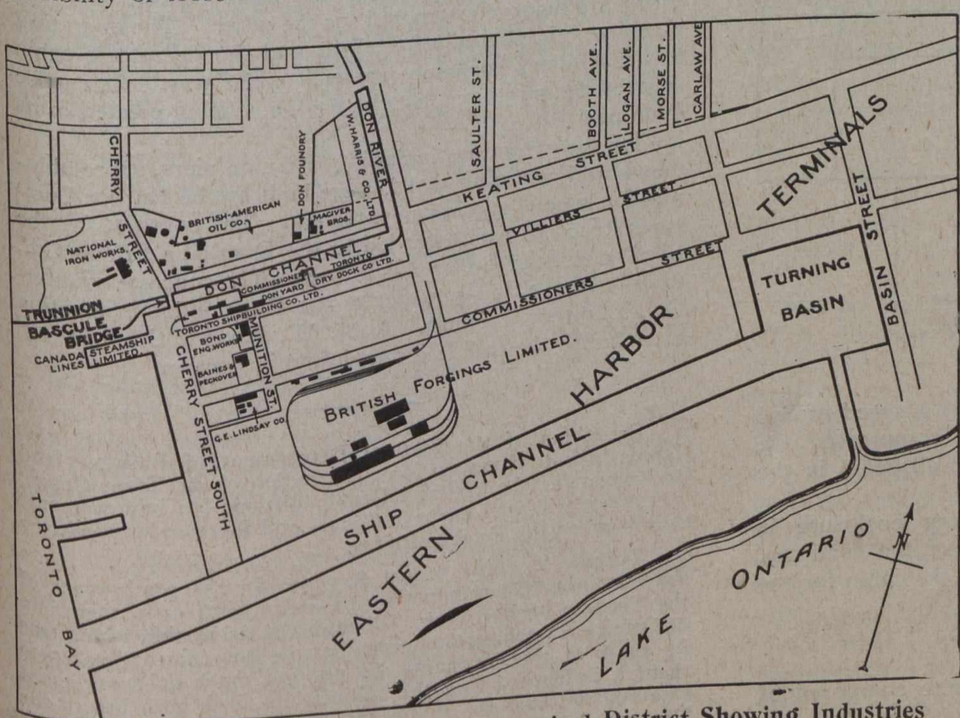



**Fig. No. 3—Plan of Eastern Harbor Terminal District Showing Industries Already Operating There and Location of the Don River Bascule Bridge**

torque. All brakes are released by a solenoid and held in release when the motor is taking current. Means are provided for releasing the brake mechanically when the bridge is to be operated by hand.

The controller for operating the motors is of the standard drum reversing type, and is of sufficient capacity and resistance to control the motors properly without injury and without shock to the machinery when starting the motors and bringing them up to speed. It is capable of reducing the starting torque to 35% of the nominal rated torque.

A foot switch with spring release is located near the controller so as to enable the operator to keep the motor brake released after shutting off the current, if it be desired to allow the bridge to coast.

The switchboard is large enough to locate meters, switches, circuit breakers and fuses without crowding, so that each device can be safely and quickly reached and operated.

Signal lights, meeting the requirements of the Dominion Government for bridges over navigable streams, are provided on the moving leaf and also on the abutments on each side of the channel.

On the north end of the bridge two contacts are provided, one to operate the chain barrier and the other for the two pier lights on this abutment. These contacts link up the operator's house with two solenoid relays which in turn engage a separate power service for the north abutment chain barrier and lights.

For emergency operation there will be installed a two-cylinder, vertical, self-contained gasoline engine capable

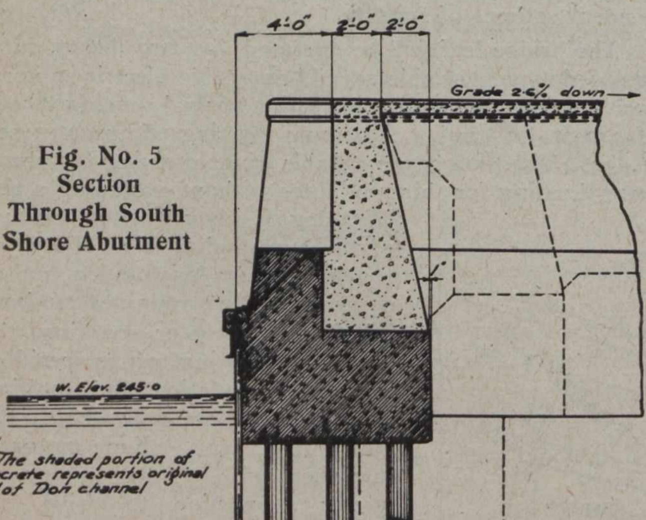



**Fig. No. 5 Section Through South Shore Abutment**

of developing 18 h.p. when operating at a speed of 800 r.p.m. The engine will be started by compressed air. Dust-covers and guards are placed over all gears in the machinery enclosure.

The operator's cabin and machinery enclosure is erected on the steel superstructure above the roadway. Hatchways were provided in the floor of the cabin for the removal of parts requiring repairs.

### Counterweights

The counterweights consist of concrete composed of one part of portland cement, three parts of sand and five parts of broken stone, gravel and iron ore. The stone and iron ore were so proportioned that the concrete, when dry, weighed 173 lbs. per cubic foot. The proper proportions, in order that this unit weight might be obtained, were determined only after considerable experimenting. Consideration had to be taken of the fact that a part of the water used in mixing the concrete united chemically with the cement, and part was given off in evaporation while the concrete was setting. Experiments showed that one cubic foot of concrete lost about four and one-half pounds in weight during the first ninety days, and that

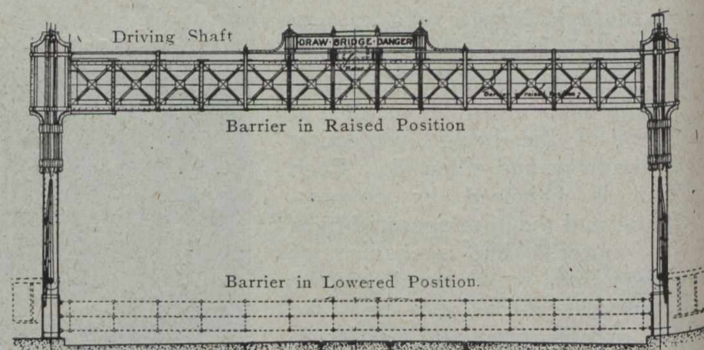



**Fig. No. 6—End Elevation Showing Chain Barrier**

the proper proportions of stone to iron ore, in order to obtain a weight of 173 lbs. per cubic foot of dry concrete, were 1 to 3 by weight.

Adjusting compartments, capable of holding 65 cu. ft. blocks of concrete when half-filled, were left in each counterweight. According to the centre of gravity calculations, the weight of the counterweight proper plus the weight of these additional blocks was just sufficient to balance the moving leaf. In case the unit weight of concrete varies, there is a working margin of approximately six tons in the adjusting compartment of each counterweight. The total weight of each counterweight is approximately 700,000 lbs.

The assembly of the steel has been completed, and riveting gangs are rapidly covering their end of the work. One concrete counterweight has been poured and the forms are being constructed for the other. The operating machinery is partially installed, and the operator's cabin and machinery enclosure are well under way. As can be seen by the photographs, the bridge is being erected in its open position.

The substructure, including trunnion piers, shore abutments and retaining walls, were built by the Harbor Commission's construction department. The contract for the superstructure was awarded to the Dominion Bridge Co., Limited, whose tender was lowest. The concrete counterweights are a sub-contract to the Raymond Construction Co., Limited, Toronto. Robt. W. Hunt & Co. Limited, attended to the mill, shop and field inspection.

---

Estimates of the Federal Department of Railways and Canals include $500,000 for construction of the Trent Canal; $1,860,000 for the Welland Canal; $43,000 for improvements to the Ontario-St. Lawrence Canal; and $700,000 for construction work on the Quebec Bridge.

Toronto is going to get $150,000 for the continuance of the Dominion Government's part of its contract in regard to the Toronto harbor work. Though the delegation which was in Ottawa a week ago, urging that the government live up to its share of the covenant, did not get much encouragement then, it is learned that the subject has since been before the Cabinet and that the justice of the city's claim is conceded. The supplementary estimates, it is understood, will provide $150,000 to be applied mainly to the protection of the work already done by the city and the government, so as to prevent it being damaged by ice or storms.

## MANITOBA ENGINEERS' WAR COMMITTEE

At a special meeting, held April 22nd, in Winnipeg, the Manitoba Branch of the Canadian Society of Civil Engineers appointed a "War Committee" to promote in every possible way the co-operation of engineers with the military authorities, in order that the engineering and construction man-power of Canada may be used in the war with the utmost effectiveness.

The members of the committee are Harold Edwards, consulting engineer, who is the convenor; J. G. Legrand, bridge engineer, G.T.P.; D. T. Main, works manager, C.P.R.; Guy C. Dunn, division engineer, G.T.P.; and G. L. Guy, electrical engineer, Manitoba Public Utilities Commission. The committee has addressed the following letter to each of the members of the branch:—

"There is a great and increasing war demand for trained engineers and technical men. For any position in the service, the man whose civilian experience will be particularly useful must be found and given effective preliminary training for the peculiar and special conditions of active service. The right men for commissions must be discovered and helped along by special preliminary training.

### Must Know What Material We Have

"Before the best system of training can be organized, we must know what material we have. The War Committee enjoins the earnest assistance of the members in order to make this inventory of the engineering man-power as complete as possible. Therefore, fill in the enclosed blank immediately.

"In addition to filling out the enclosed blank, the members should canvass their acquaintances who have had engineering or construction experience, and who are likely to be called in the near future. Knowing what the experience of the available men has been, preliminary training can be adapted to the needs of the greatest number.

"We have reason to expect instruction (from special instructors, who have seen active service in France) along the lines indicated on the inventory blank.

"Remember that the man of 55 can be trained to do work that in many cases will set free the man of 30.

"In view of our special training as engineers, it is our duty to strive to bring home to the minds of the people what this war really means. We must not forget that the German government has requisitioned every engineer, every chemist, every man, in fact, with technical experience of any kind, in order to utilize their special knowledge for the successful prosecution of the war, and for the winning of the great industrial struggle which must inevitably follow in its wake. Canada expects every man to do his best in the great cause, and this branch of the Canadian Society of Civil Engineers proposes to help to work out the methods of preliminary training that will prepare engineers to do their utmost whenever they are called. Therefore, give your country your leisure and enthusiasm. Fill out this blank and get others to fill one out also."

### Questionnaire for Manitoba Engineers

Attached to the above letter was a questionnaire seeking the following information:—

"Name; birth date; married or single; if married, number of children; are you physically fit; what military experience and training have you had; in what lines have you had your best experience? Check off below:—

"Railway—construction, operation, maintenance or shops and rolling stock; general building construction; mining and quarrying; surveying and mapping; highways—construction or maintenance; electrical engineering—power and lighting, wireless, telegraphy or telephony; automobiles and motor transports—driving or repair; municipal engineering—sewer or water supply; machinery—manufacture or repairs; chemical engineering or analytical chemistry.

"What experience have you had as an executive in charge of men? Will you give two evenings per week for instruction and training that will fit you for more effective service?"

---

## ENGINEER OFFICERS' PRELIMINARY TRAINING*

**By J. G. Legrand**
Bridge Engineer, G.T.P. R'y., Winnipeg

What help to the military authorities can the Manitoba Branch of the Canadian Society of Civil Engineers give by way of suggestion or actual service? That is the question which the present special meeting has been called to consider.

In January, 1916, I addressed to the general meeting of the Canadian Society of Civil Engineers a communication suggesting that they memorialize the government and offer their services along the following lines:—

"That the society should appoint an engineer of national standing, who should be their representative with the government. Whenever any question requiring special technical knowledge should arise, this representative should be called into consultation, and he immediately should put himself into communication with engineers having special knowledge along the lines in question."

If this suggestion had been accepted, all the members of the engineering profession would have been able to render useful service during the war, and not only millions of dollars would have been saved, but thousands of precious lives would have been spared.

It is just such an organization of technical skill that has proved Germany's strength during the present war. Every engineer, every chemist, every scientific man has been requisitioned by the German government and forced to devote his entire energies and special knowledge to the prosecution of the war.

### All Trained To Do Almost Anything

In a free country like Canada, force would not have been necessary, but every individual would gladly have placed his services at the disposal of the government.

This offer was actually made. There appeared in *The Canadian Engineer* of January 4th, 1917, an article entitled "Engineers Will Offer Services." It appears from this article that Mr. O'Hara, Deputy Minister of Trade and Commerce, intimated that the government did not understand clearly just how engineers might like to help, and suggested to Mr. MacLachlan, secretary of the Canadian Electrical Association, that the engineers should get together and present some definite plan of action to the government. Mr. MacLachlan might have answered Mr. O'Hara that it is not for an officer to ask a soldier what he is willing to do, but that it is his place to command, and that he would find, in the case of engineers at least, that all have been trained to do almost anything, and that some of them could give useful lessons on organization and prompt execution.

---

*Abstract of address delivered at special meeting of Manitoba Branch, Can.Soc.C.E., April 22nd, 1918.

It is the duty of all Canadians, and especially those who have received special training, to concentrate all their energies so that Canada may do its full share in the crushing of the fiendish power which is threatening to overthrow civilization. How may this be done?

Experience has shown that the physical training of such large bodies of men as needed in the present war can only be obtained by long years of intense work. That means that the training must be begun in boyhood. This is so well known that in France it has been the practice for the last thirty years, to begin this training in the schools.

This training is so thorough that when a young man is drafted into the army he feels quite at home, and his body is so trained and inured to fatigue, that he can endure without hardship the intensive training which he receives in the army. It is not only the army that profits by this physical fitness, but when the young man reverts to civil life the entire nation benefits by it.

### Thoroughly Equipped Along Technical Lines

A striking example of the benefit of this early training is to be found in the class which has been just drafted into the French army. According to competent military authorities, no body of recruits has ever been found so thoroughly fitted for military service. This has proved to be equally true for technical training, for the officers have not only shown that they were physically fit, but they have proved that they were thoroughly equipped along the technical lines required for the multitudinous services of a modern army. This result has been obtained by long and arduous special training in military schools, supplemented by actual experience on active service.

In France, as all know, military service is compulsory. Every young man of twenty who is physically fit is drafted into the army, and remains on active service for three years. He is then put on the reserve of active service for ten years; that is, until his thirty-third year. During this period he is called twice to take part in the general manoeuvres for twenty-eight days. He is then transferred to the territorial army for six years, and remains till his thirty-ninth year. During this period he is called once for thirteen days. He then passes to the reserve of the territorial army for six more years; that is, till his forty-fifth year.

Having been brought up myself under these conditions, I noticed how little attention was being paid to physical training in this country.

### Advocating Compulsory Training

To remedy this defect, in Montreal, where I was stationed for eighteen years, I succeeded after several fruitless attempts, in having gymnastics introduced into the schools. The result was so satisfactory that after three years we were able to send a team, chosen after a competitive elimination from among several hundreds of young men, to Europe. This team won the first prize, and there were several individual prizes. Two or three years later, another team was sent to Europe and had almost an equal success.

A few years before the war broke out, at least 6,000 boys were taking physical training in the Montreal schools, and I have no doubt but that some of them have given a good account of themselves during the present war.

My great desire would have been to see this movement spread throughout Canada, and to have organized interprovincial competitions. Unfortunately, my removal from Montreal and more absorbing occupations prevented the realization of this dream. More than ever, at the present juncture do I believe in the opportuneness of this aim.

For the purpose of preparing men who are likely to be called in the near future, I would suggest, therefore, the immediate introduction of compulsory physical training for the men of Class 1 who are still to be called, the men who will be entering Class 1 within a year, and the men of classes 2 and 3; this physical training to be undergone at least three times a week, say, two hours at a time, outside of the ordinary working hours, especially by men who now lead comparatively inactive lives in banks, offices, stores, factories, etc.

In order to accomplish this, instructors could be chosen especially among the returned officers, non-commissioned officers and men who have distinguished themselves at the front, and who know by hard-won experience the value of physical training.

I would also suggest the immediate introduction of compulsory physical training in all the universities, colleges and schools of Canada.

Regarding the students who are at present taking engineering courses, I would suggest that the classes be continued all the year round in order to allow them to complete their courses before being called to the colors; thus enabling them to render the greatest possible service in engineering corps. I understand this has been done in the United States universities.

Now, as regards engineers proper, who at the present moment are in great demand at the front as officers of engineers, I would suggest that all engineers likely to be called should be immediately put through such a course of special physical and technical training as should enable them to discharge efficiently their very arduous and tremendously important duties at the front. It must not be forgotten that this war is eminently an engineer's war.

---

## WOULD TRAIN WOMEN FOR DRAFTING, TESTING AND INSPECTION WORK

IN joint session on May 3rd, the Detroit Section of the American Society of Mechanical Engineers and the Detroit Engineering Society passed the following resolution:—

"Whereas the demands of the country for men and means to fight the war has resulted in a deficiency of skilled workers in the trades and professions; and

"Whereas the women of this country could with a short period of training fit themselves to fill these positions, as women have done in other countries at war; and

"Whereas among the things which women could do advantageously are drafting and tracing, inspection and testing of materials, both physically and chemically; therefore

"Resolved that the universities, colleges and technical schools throughout the land be asked to consider the question of meeting this demand by providing special courses of instruction open to women students qualified to pursue such courses; and further

"Resolved that employers who could use such skilled help exert their influence with their universities, colleges and technical schools, and co-operate with them in developing and making available a great body of intelligent and adaptable women who are as eager and willing to serve their country as their brothers;

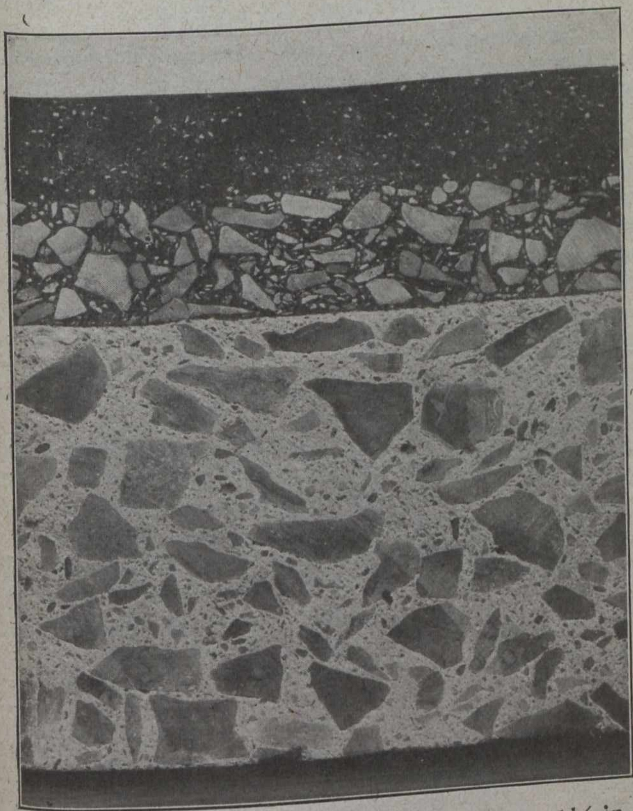
"Thereby bringing about not only increased effectiveness in fighting the war, but also a greater mutual respect and saner relationship of our men and women."

## ASPHALT PAVEMENTS

By Charles A. Mullen

*(Concluded from last week's issue)*

STANDARD sand sieves are used in making screen analyses of asphalt paving aggregates, and not the commercial sieves that may be had on the open market at a low cost; though these may serve other purposes quite satisfactorily. Results on such commercial sieves are frequently as much as 20 per cent. off, and these results are of no value to the engineer making asphalt paving mixtures. The 200, 100 and 80-mesh sieves are particularly troublesome, and should be frequently checked for accuracy.



**Sectional View of Sheet Asphalt Pavement, 1½-in. Wearing Surface on 1½-in. Close Binder on 6-in. Concrete Base**

The mixing of three sands at the asphalt paving plant is not a difficult matter. At Saint Foy, in Quebec, last season, where the province was laying a "stone-filled" sheet asphalt pavement, we combined five grades of material in the mineral aggregate, exclusive of the filler, without difficulty. The various piles are arranged around the boot of the bucket elevator that feeds the heating drum, and then an intelligent laborer can be directed to feed so many shovels of this material and so many of that. A satisfactory result is secured in this way without additional expense other than possibly half a dollar a day extra to hold the interest of the man doing the feeding.

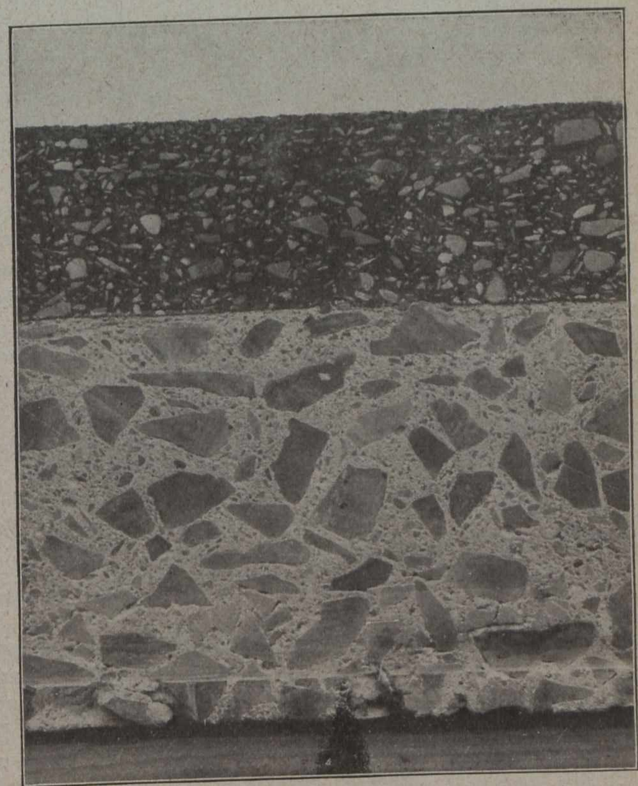
All sands are not suitable, even if a satisfactory grading can be secured. We must consider the shape of the grains, the character of their surfaces, the cause of the coloring, and any foreign matter that is present. Sands that are the result of the incomplete disintegration of rock, and contain lumps of fine grains, must be avoided.

The shape of the sand grains is of considerable importance. They should be neither too rounded nor too sharp, but irregular, with flattened sections on the sides. What is desired is an aggregate that will pack well and resist displacement under traffic. The reason for avoiding round grains is obvious; and a mixture, the sand grains of which are very sharp, is believed to suffer by the excessive scratching of the bitumen film of one grain by its neighbors.

The surface of the sand grains is of some moment in that a film of bitumen will adhere to some surfaces better than to others. A rough, pitted surface is superior to a smooth, glassy one; and sand of the former type will carry more bitumen to a given grading than a smooth-surfaced sand. For this reason, the proper bitumen content of a standard asphalt surface mixture is dependent principally upon the materials available for compounding the mineral aggregate.

The color of the sand grains may be due to a surface film of clay, lime, iron oxide or other substance,—easily removed by mechanical means in the laboratory,—or to iron in the chemical composition of the sand grains. In the first instance, the sand should be avoided as a possible cause of failure in the pavement; but, otherwise, there is no reason for not using a sand because of its color.

The sands for asphalt paving are to be found in almost every locality if one will only look for them. We were told they were not to be had around Montreal, but a survey of the country for fifty miles about uncovered abundance, some in the very deposits from which the city had been getting its supply. Later, the fine sand that had previously been neglected was found within the limits of the city of Montreal, and on city property at that. We have had the same experience with Quebec City and Quebec Province work; and recently J. A. Baird, city engineer of Sarnia, Ont., in following our suggestion that

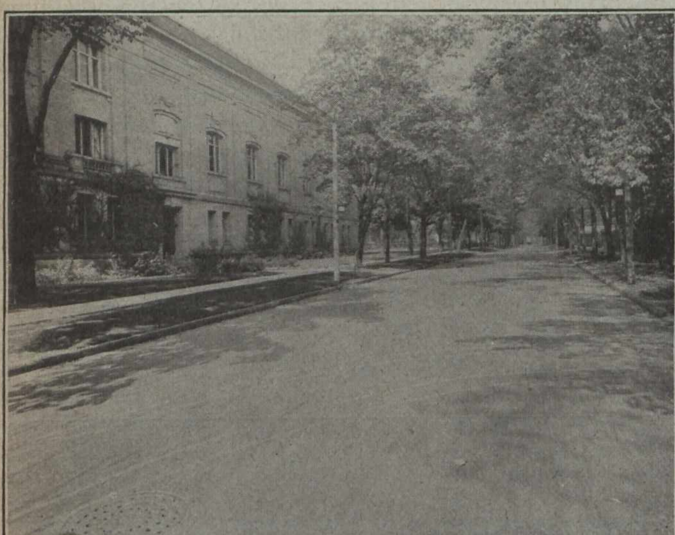


**Sectional View of "Fine Type" Asphaltic Concrete Pavement (Often Termed "Stone-Filled" Sheet Asphalt or Improved Topeka). 2-in. Wearing Surface on 5-in. Concrete Base**

he search his own city, has found excellent grades of all the sands required.

The asphalt paving plant has never been more than a very crude machine at its best. Wherever possible, we are inclined to insist upon the standard type, especially the twin-plug mill mixer with a batch capacity of at least one thousand pounds and means arranged above for proportioning the materials entering every batch by the weighing of each material separately.

The mixers should be covered to prevent the loss of the very finest particles of the inorganic dust filler, which are very valuable in the pavement and costly to buy, and so that the mixer platform may be a place where one does



**St. George Street, Toronto, sheet asphalt, laid 1912, photo 1917. No repairs to date**

not hesitate to ask another human being to work. Most mixers are left uncovered, however, either because the owners do not appreciate the loss of material that is resulting or do not care enough about the men who must work around them. It is time cities required covers on all mixers.

Steam melted asphalt cement is never burned in the kettles, therefore direct firing should be avoided whenever possible and watched with great care where not avoidable. Precautions should also be taken not to maintain the asphalt in a molten condition for too long a period, as this will cause it to become harder and lose some of its ductility.

Asphalt cement in tank cars should be arranged for whenever possible. The material may usually be had cheaper this way, and is easier to handle. If there is not sufficient storage capacity at the paving plant, a small quantity of the cement in iron drums should be kept on hand in case of the delay in transit of one of the tanks. Asphalt plants cannot afford to stop work during the busy season, for the overhead expense is too high.

Thoroughly mix the aggregate before pouring the asphalt cement into the mill. The practice of putting in the cement before or at the same time as the dust is dangerous. The sand is hot enough before being combined with the dust so that after it has lost some of its heat to this cold material, the aggregate will still be of the desired temperature, and this original heat of the sand is too great for a thin film of asphalt cement to stand without damage. If the mixer is covered, there will not be this tendency on the part of the mixer man to put in the asphalt cement first to keep the dust from flying into his face.

All temperatures at the plant should be watched with the greatest of care, and reasonable uniformity should be insisted upon. The purchase of a few thermometers, enough so that one may be placed at every point where it seems desirable, may save the loss of a very large investment in burned asphalt pavement. Even the most experienced workmen will sometimes overheat the materials.

The analyses of the mixture should approximate as closely as is possible in good practice the following standard or model:—

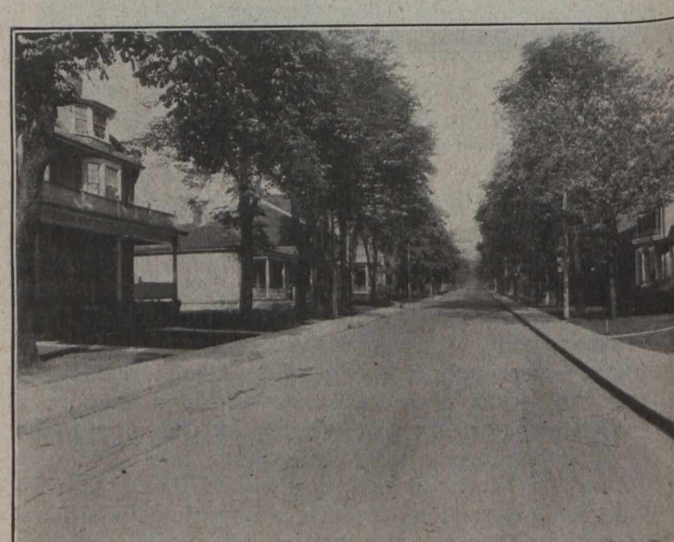
| | Model asphalt mixture. | Model sand grading. |
|---|---|---|
| Bitumen | 12% | |
| Mineral aggregate: Sieve test. | | |
| Passing 200-mesh | 13% | *N% |
| Passing 100-mesh held on 200-mesh | 13% | 17% |
| Passing 80-mesh held on 100-mesh | 13% | 17% |
| Passing 50-mesh held on 80-mesh | 23% | 30% |
| Passing 40-mesh held on 50-mesh | 10% | 13% |
| Passing 30-mesh held on 40-mesh | 8% | 10% |
| Passing 20-mesh held on 30-mesh | 5% | 8% |
| Passing 10-mesh held on 20-mesh | 3% | 5% |
| Passing 8-mesh held on 10-mesh | 0% | *N% |
| Totals | 100% | 100% |

*For "N" read the words "Not over five."

The model sand grading is but the reduction to 100 per cent. of the 75 per cent. of the mixture model that is supplied by the sand aggregate free from dust filler.

An asphalt paving formula, to produce the approximation of the foregoing mixture, with the usual materials, would be as follows:

| | | |
|---|---|---|
| Asphalt cement, pure bitumen | 120 lbs. or | 12% |
| Stone-dust filler, 80% 200-mesh | 150 lbs. or | 15% |
| Sand, specially graded and mixed | 730 lbs. or | 73% |
| Batch of mixture | 1,000 lbs. or | 100% |



**Seaton Street, Toronto, sheet asphalt, laid 1908, photo 1917. No repairs to date**

Hauling mixtures to the street is not attended with any very great difficulty. Cities should insist that the wagons be tight enough to prevent the material being dropped all along the route from the plant to the job. The rest may be safely left to the contractor or the manager of the city plant, a minimum temperature for laying being provided as a check against poorly compressed work.

Whether wagons or auto trucks will prove more economical is always a local problem. The auto trucks are good for long hauls with steep grades, but there is frequently greater economy in the wagon for short hauls with flat grades. Provisions should be made for the rapid loading and unloading of either, but especially the automobiles. The writer remembers figuring on one job that it cost one cent a minute to have a horse-drawn wagon of three tons capacity stand for its load, and five cents per minute for a five-ton auto truck. After that we built a loading hopper.

### One Cent Per Inch-Yard-Mile

Canvas covers on the trucks are very good at all times, and especially in chilly weather when the crust of the mixture would otherwise become too stiff for proper raking. They should be so arranged that there is a three-inch or four-inch air space between the cover and the load, as this not only saves the cover but also provides much better protection for the hot mixture.

"One cent per inch-yard-mile" is a good formula to remember when considering the cost of hauling asphalt paving mixtures. That is, it costs about one cent to haul enough mixture to lay one square yard of asphalt pavement one inch thick and weighing about one hundred pounds, on a street one mile from the mixing plant. Multiply one cent by the thickness in inches of the pavement, and that by the number of miles between the plant and the job. This is a rough and ready rule that should not be used as a basis for a bidding estimate, but it will help in quickly considering the comparative advantages of various available plant sites. It was the basis of a large asphalt hauling contract in New York City at a time when team hire was six dollars a day.

The mixture should be dumped on the street on some spot outside of where any part of that particular load is to be laid, and all of it should be handled into place for raking by upturning the shovel at the place of deposit. Asphalt mixtures should not be cast long distances through the air to scatter over the foundation upon which they are to be placed. This is particularly true of those mixtures ranging from stone-filled sheet asphalt to bitulithic, in which such a casting about is likely to cause serious segregation.

### Laying Asphalt In the Rain

Painting abutting surfaces of headers, curbs, manhole and handhole boxes, and so forth, is an old custom, and, we think, a very good one. The asphalt cement used for this purpose should be the same as that with which the mixture is made, and sufficient of it should be applied to be effective. If this detail of the work is worth doing at all, it is worth doing well, and not in the skimpy, careless way we so often witness on both contract and city work.

Sweep the foundation clean before placing the surface upon it. The investment is too great to be endangered by the neglect of a detail that costs so little. The roughened concrete surface that is preferred for asphalt paving requires some care in sweeping to make certain that all the small depressions are reasonably free from dust and dirt and loose material.

Laying asphalt in the rain is not so serious a matter as one would at first suppose. Experience has demonstrated that sections of pavement laid during quite heavy rainfalls have lasted quite as well as other sections placed when the weather was more favorable. This is not a plea for selecting rainy weather to lay asphalt surfaces, but for the costly mixture that is frequently hauled to the dump because some inexperienced engineer thinks a little moisture from above during the laying will cause an asphalt pavement to fail. We do not recommend laying in puddles of water, however, and every possible precaution should be taken to avoid bad weather.

Levelling and raking mixture requires more skill and attention than it usually gets. The raking process should be a kneading into place with the tines of the rake so that about the same weight of mixture will cover each square inch of the foundation. Only in this way can a pavement be laid that will get equal compression under the roller and that will be of equal density throughout. We believe that the depressions in asphalt surfaces are frequently due to the further compression under traffic of those parts of the pavement that are spanned by the wide wheels of the asphalt roller at the time of laying. Certainly a roller riding on two dense knobs of mixture cannot properly compress the loose material between.

### Asphalt Gutters Should Have Proper Rise

A true surface is essential in any good paving job, but especially is this necessary with asphalt, where every little fault may be seen so easily. Also, if there are no waves, there can be no rolls, and we often think that many surfaces displace partly because the original workmanship left the beginning of the wavy condition that later becomes so objectionable. A long straight-edge, ten feet or more, constantly in use, will do much for any paving job.

The straight-line crown is used more extensively each year with all types of pavements, but it has special advantages in the case of asphalt where there is so much objection to the little shallow puddles of water that form on the centre of other crowns directly following a rain storm. The purpose of the crown is to shed water, and it should be made to do that as effectively as possible with the least necessary drop from a horizontal line. One-quarter of an inch to the foot is sufficient where a straight-line crown is used and the surfacing work well done.

Gutters should be asphalted to the curb. There is no reason for placing a cement or brick gutter on an asphalt street. Whether of asphalt, cement or brick, the gutters should rise at the rate of one inch to the foot or better for the first two or three feet from the curb in order to form a decided dish that will confine the water in a narrow stream against the curbing instead of permitting it to spread several feet therefrom. If the same care had been used in forming asphalt gutters with the proper rise that was used in laying cement or brick gutters on asphalt streets, no one would ever have thought it necessary to employ the other materials. The flat asphalt gutters of early construction have much for which to answer. Proper gutters can be formed and compressed with a tamper, and an experienced roller man can get in to them effectively.

### Make Needed Repairs Promptly

Lay asphalt to the street car rail wherever the street railway road-bed is good. Where it is poor, compel the company to make it what it should be, if possible. There is something very disfiguring about a ribbon of blocks along an outer rail on an asphalted street, and it is absolutely unnecessary in most cases. The way in which the asphalt promoters have persuaded cities to lay block pavements along car rails on asphalted streets, has always appealed to me as diabolically clever. These men know that whatever is laid will go to pieces where the rail construction is bad, and, by shunting it over upon the other material, they avoid the discredit that would, unavoidably, though unjustly, fall upon asphalt.

First construct, then maintain your asphalt pavements. They should not require any repairs for a number of years after laying, except where some defect in construction comes to light, but whatever they do need they should get. Repairs should be carefully made, with perpendicular edges and properly painted joints. An asphalt patch should not be left higher than the surrounding surface. If properly compressed in the making, there will be no sinkage under traffic that will require an allowance. Do not leave the surface higher than the car rails, manhole boxes, and so forth, against which it is laid. This has been tried and abandoned.

Three methods of maintenance for asphalt pavement surfaces should be considered. There is the simplest way, the cutting out of the defective section and replacing it with new mixture. The surface burner method has been used extensively, with fair results; and the remelting and remixing process has been successfully employed in many places. Needless to say, all three methods can be used to advantage in every large city, each being fitted to different conditions that are sure to confront the engineer.

### Remelting Old Pavements

The remelting and remixing of the old surfaces has always seemed to the writer the one way that should be more carefully developed, with a view to the future maintenance of our asphalted streets. The re-use of the old material, which can be made as good as ever at little cost by remelting and remixing, with possibly a little added soft asphalt to rejuvenate it, will effect great economies in pavement maintenance over a period of years. The cost of new material is saved and the expense of hauling the old surface to a dump is avoided. The trucks must return to the mixing plant anyway, and they may as well carry a load of old asphalt surface as go back empty for the next load of mixture.

Asphalt is in its infancy as a paving material. Each year sees larger tonnages of it used for this purpose, and, as paving economy is more carefully studied by our public authorities, the very clear reasons for its extensive employment as a road surface material will be fully appreciated. The more universally it is used in any city, the more economically it can be handled.

---

## A SIMPLE WAY OF DETECTING ORGANIC IMPURITIES IN SANDS*

**By Prof. Duff A. Abrams and Oscar E. Harder**

EXPERIENCE in concrete construction and numerous tests have shown that the appearance of a sand is not a safe criterion for determining its suitability for use in concrete. For example, a sand which appears dirty may be entirely free from organic impurities and give excellent results, providing the characteristics of durability and grading are satisfactory. On the other hand, many sands which appear to be clean are coated with organic impurities of a nature that will produce very inferior concrete.

Numerous tests have been used for determining whether or not a sand possesses the requisite cleanness for use in concrete. The most common tests which have been used for this purpose are the determination of silt, and the loss in weight resulting from heating the sand to a red color. The silt test gives a measure of the amount of fine material—generally clay or loam—which is contained in the sand, but furnishes no information as to the probable effect of such materials on the strength and durability of concrete or mortar made from the sand. Experimental work carried out in the Structural Materials Research Laboratory, Lewis Institute, Chicago, have shown that it is the presence of organic impurities of a humus nature that is responsible for the effects observed from using sand of this kind. This humus material usually comes from the over-burden of soil which is found in most sand pits; it may find its way into the sand in other ways. It has been pointed out by many writers that the detrimental effect of silt in concrete is not proportional to the quantity of silt in the sand. The explanation for this result lies in the fact that it is only the impurities of an organic nature that have a decidedly injurious effect in retarding or preventing the setting and hardening of the cement; consequently, a considerable proportion of clay may be present without producing any effect other than a reduction in the strength which may be expected from the change in the grading of the aggregate.

Researches carried out in the Structural Materials Research Laboratory at Lewis Institute have shown that a simple colorimetric test may be used for detecting the presence of organic impurities of a humus nature in sands. (It is seldom that organic impurities other than those of a humus nature are found in natural sand.) This experimental work was begun through the co-operation of the Laboratory and Committee C-9 on Concrete and Concrete Aggregates of the American Society for Testing Materials.

Two methods of testing for organic impurities have been developed: (1) An approximate test for field use; (2) a more exact method for use in the laboratory.

The laboratory method differs from the field method principally in that comparison is made with definite color standards (or bottles containing colored solutions).

### Mix the Sand With Sodium Hydroxide

The field test consists of shaking the sand thoroughly in a dilute solution of sodium hydroxide ($NaOH$) and observing the resultant color after the mixture has been allowed to stand for a few hours. Fill a 12-oz. graduated prescription bottle to the 4½-oz. mark with the sand to be tested. Add a 3 per cent. solution of sodium hydroxide until the volume of the sand and solution, after shaking, amounts to 7 ozs. Shake thoroughly and let stand for 24 hours. Observe the color of the clear liquid above the sand. A good idea of the quality of the sand can be formed earlier than 24 hours, although this period is believed to give best results.

If the solution resulting from this treatment is colorless, or has a light yellowish straw color, the sand may be considered satisfactory in so far as organic impurities are concerned. On the other hand, if a dark-colored solution results, the sand should not be used in high-grade work such as is required in roads and pavements, or in building construction.

Washing sands has the effect of greatly reducing the quantity of organic impurities present. However, even after washing, sands should be examined in order to determine whether the organic impurities have been reduced to harmless proportions.

The test made in the manner described above will be found useful for prospecting for sand supplies, checking the cleanness of sand received on the job, and preliminary examination of sands in the laboratory.

This test is now being used by a large number of testing laboratories, engineers and contractors in passing on the suitability of sands for use in concrete. In certain instances the test has been made the basis of specification requirement for sand.

---

*Abstracted from article in Concrete Highway Magazine.

## ALBERTA ENGINEERS DISCUSS ENGINEER'S STATUS AND PROPOSED LEGISLATION

PROPOSED legislation defining the status of the engineer, and the appointment of engineers to government commissions and offices, were the principal subjects discussed at a general meeting of the Alberta Division of the Canadian Society of Civil Engineers, held in Edmonton during the afternoon and evening of April 27th.

F. H. Peters opened the discussion on the former subject. He reviewed the steps which had been taken in the Calgary and Edmonton branches in the discussion of this subject up to the present time. He stated that it now appears that it will not be possible to secure Dominion legislation, and in view of that condition it is desirable to secure a provincial act which could be accepted by all the provinces, and afterwards if necessary, affirmed by the Dominion Government, thus providing a uniform law all over the Dominion.

A. G. Dalzell, of Vancouver, described the feeling of the British Columbia members of the society. He stated that when the matter was presented to the Vancouver Branch, some of the members claimed that legislation had been tried in two provinces and had been a failure. Objection had also been made on the ground that legislation meant a "closed shop," and the matter was further complicated because just at that time a certain group of engineers in British Columbia were asking for provincial legislation which had some objectionable features and which could not receive the support of the society. He believed, however, that legislation along the lines suggested by the Calgary Branch was now receiving favorable consideration. The entire question was fully discussed by a number of the members, the result being the appointment of a committee consisting of F. H. Peters, W. Muir Edwards and S. G. Porter to study the entire question, to draft a scheme of incorporation of engineers by provincial authority, and to report to the summer meeting at Saskatoon.

Sam. G. Porter, secretary of the Alberta Division of the society, opened the discussion on the appointment of engineers on government commissions. He called attention to the importance of the engineer's work in bringing about the necessary readjustment of social conditions due to the war and to the engineer's claim for greater recognition in appointment to positions of public service. He also outlined the efforts that the Alberta Division had been making to advance the interests of the society in this respect.

### Abstract of Speech by Sam. G. Porter

"In the 'Literary Digest' for March 30th, 1918," said Mr. Porter, "an article appeared which described some of the unfortunate conditions which have arisen in the United States, and which that paper attributed to the employment of financial men instead of engineers in the direction of the production and transportation of war materials. As a result, says the article, a great deal of energy and enthusiasm and patriotic effort have been expended without, however, having them properly co-ordinated, and now they find that there is an enormous congestion of materials in some lines, far in excess of requirements or shipping facilities, and a corresponding shortage in others. It claims, however, that the ability of the engineer to organize and direct war production with a proper regard for the necessary sequence and co-ordination of the various processes, is being recognized and that the engineer is coming into his own. Let us hope that it is true; true not only in the United States, but also in Canada.

"It may be that engineers are largely to blame for conditions that now exist. Possibly they do not take the interest in public and political matters they should take; that they do not make themselves so well known as their importance in the community would justify. Is that the reason that among the four men considered by President Wilson for the important position of United States Railway Dictator, no engineer's name appeared? Is that the reason that for such offices as Minister of Public Works, or the head of a commission to report on the reconstruction of a destroyed city, or a commission to control the expenditure of public money on public utilities, our government seldom even gives thought to the idea of appointing engineers? Has not the engineer in this war demonstrated beyond dispute the importance of his profession and his right to proper recognition, not only in the prosecution of the war but also in other government and public service?

### More Sound Development, Less Exploitation

"I think we all realize that in the social readjustment which will follow the war—which in fact is in progress even now—the business of the world is going to be handled on a more scientific basis than before, with labor having more voice and capital less dictatorial power, with the engineer and other scientists directing their efforts and adjusting their differences. Governments are often slow to recognize changed conditions, even where the changes are radical, and it becomes one of our duties both to ourselves and to our government, to interpret these social changes and insist that they be met in a businesslike way.

"Another condition which must be recognized is that the government is assuming more and more the control and operation of the resources and utilities of the country. It should, therefore, have the best business and technical ability of the country in charge of them instead of permitting professional politicians to blunder the job. Let us have more sound development and less exploitation.

"In insisting that the government should appoint engineers to public commissions and offices, we should insist also that they be good engineers, properly qualified for the work they are called upon to do; otherwise the end in view will be defeated and both the interest of the public and the prestige of the profession will suffer. It should be remembered that the duties of an engineer, particularly in public service, are often of a judicial character as well as technical, requiring sound judgment based on thorough training and experience. Engineers on their part should be prepared to assume these responsibilities, while the government on its part should provide remuneration adequate for such service.

"This phase of the question dovetails into the question of legislation for engineers. There is need of intelligent regulations to define a certain minimum standard in order to eliminate incompetents, create a high standard of service and inspire public confidence. The public is entitled to a knowledge of the fitness and capability of the engineers it employs. By having a compulsory registry, the government would be furnished with complete information relative to the special ability of every engineer in the country."

J. L. Cote, M.P.P., was asked to speak on the Civil Service Act in Alberta. He explained that an act had been passed by the provincial legislature providing for the appointment of an efficiency officer, but that the officer had not yet been named.

## PAINTS—HISTORY AND PROPERTIES*

By Robert Job, A.B.
Vice-President, Milton Hersey Company, Ltd., Montreal

FAR back into history dates the use of paint for decorative and for preservative purposes; but in the brief time at our disposal we will consider only some of the most prominent types of modern paints and their most important properties.

Paint is described, in a general way, as the mixture of finely divided particles of solid matter called "pigment" in a liquid called the "vehicle." Asphalt paint is merely solid asphaltum dissolved in benzine or some other vehicle.

**Fig. 1—White Lead Paint, Showing Chalked Condition**

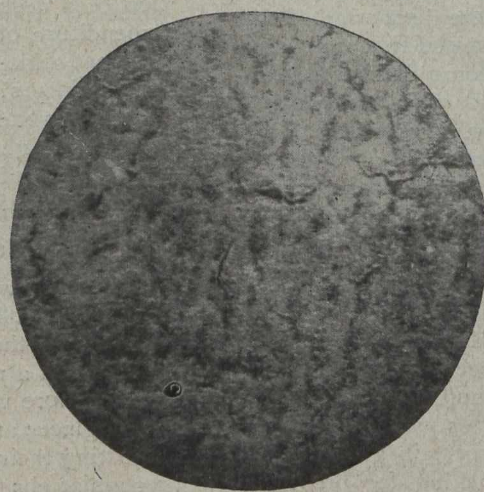


**Fig. 2—Better Proportioned Paint After Same Exposure**

The pigment functions to hide the surface over which the paint is applied to resist the action of weather and wear, and to give color. The selection of the most suitable pigment or combination of pigments depends very largely upon the relative importance of these functions under the conditions for which the paint is intended to be used.

The vehicle functions as the carrying and cementing body, and dries and binds together the solid particles of pigment in somewhat the same way that Portland cement and water unite sand and broken stone to form concrete.

The types of paints best known are three, differentiated by the vehicles used to carry and cement their pigments. The most important are the oil paints; but the enamel paints are now used quite extensively and cold water paints are daily becoming more popular for interior walls.

Asphalt paint is really a varnish. The varnishes differ from the paints in that they do not ordinarily have a pigment; though occasionally a little is added to give color, and we then approach what is known as "enamel paint."

The oil paints consist of pigment ground in a paint mill with oil as a vehicle, to which is added a small proportion of Japan drier to cause a fairly rapid solidification when the paint is applied.

Linseed oil, which is pressed from flaxseed, is the best known vehicle used in the oil paints. Until recent years, it was employed for all the better paints of this type, but it has the defect that a film of it is readily penetrated by water.

Other vehicles, as substitutes and improvements, were diligently sought, because of this unfortunate non-waterproof property of linseed oil. Among others, fish oil, Soya bean oil, and corn oil have been carefully tested and successfully used under certain conditions, but the greatest advance has been made by using China wood oil.

China wood oil, when properly manufactured, is very resistant to water, and it is largely employed at the present time in the manufacture of both paints and varnishes.

The enamel paints consist of pigment ground in a vehicle of varnish, which consists ordinarily of gum or resin, oil and turpentine. The evaporation of the turpentine leaves the gum and oil as a strong cementing medium for the pigment. Some of these enamels are very serviceable and resistant to weather, and the coating dries with an excellent gloss.

Cold water paints consist of pigment combined with gum, casein, etc., that dissolves in water to form the vehicle at the time of application. The evaporation of the water leaves the gum to serve as the cementing medium for the pigment. Some paints of this type have very fair weather resistance.

White lead pigment is one of the oldest and best-known. It was originally made from pieces of metallic lead called "buckles" that were corroded to form the white powder termed "basic carbonate" and known as "white lead." This process is largely used at the present time, though other methods have been adopted to shorten the period required for manufacture and to improve the product. White lead, as first produced, is purified, dried and powdered before being sent to the paint mill.

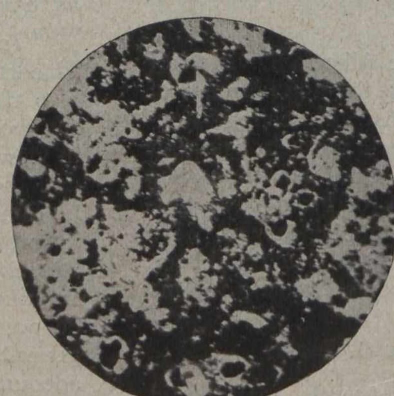


**Fig. 3—Short-Lived Coarse-Particled Pigment Paint**

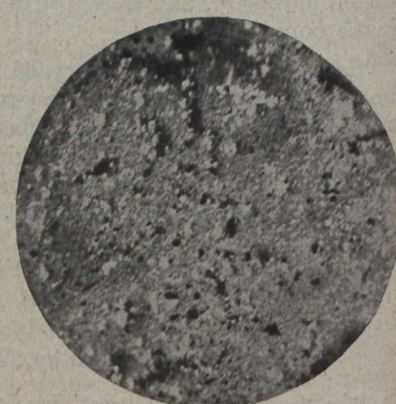


**Fig. 4—Long-Lived Fine-Particled Pigment Paint**

White lead paint, when the pigment is properly ground with an oil vehicle of good grade, has very great covering and hiding qualities. Unfortunately, it also has certain disadvantages. It is very poisonous and on exposure to weather it has the property of "chalking." When one's hand is rubbed over a board which has been painted with it for a year or more, the hand becomes coated with a white powder.

Chemical action between the white lead and the oil causes the change in a white lead paint film; and this

*Lecture delivered as part of the Extension Course on Industrial Chemistry at McGill University.

action is so marked that in the course of a few years the house which has been covered with an excellent quality of white lead paint may be but poorly protected, especially if it is exposed to salt sea air.

Figure 1 shows the general appearance of this condition when examined with a magnifying glass, while Figure 2 shows the condition in contrast of a better proportioned paint subjected to exactly the same exposure and use.

Zinc oxide pigment is another which is well and favorably known. Owing to its non-poisonous properties, it is more desirable than white lead for interior work. This pigment used alone is also unsatisfactory as it produces a brittle coating that is likely to crack.

Other pigments commonly used are red oxide of iron, ochre, sienna, ultramarine, Prussian blue, chrome yellow, lamp black, and many besides, too numerous to mention.

Co-operation is as effective in promoting efficiency with pigments as with people, and by far the best results have been obtained with paints in which suitable pigments have been properly combined.

Little was known about the reactions between pigments and vehicles, or the reasons for good or bad service of paints made from given materials, until comparatively recent times. Certain bad combinations were shunned from sad experience. It was learned, for instance, that white lead paint mixed with ultramarine blue, will darken owing to the formation of black sulphide of lead, and that a sign coated with white lead paint will sometimes change from white to yellow within an hour if exposed to the sulphur fumes from a locomotive.

The study of paints was given great impetus about the year 1890, through the published investigations of Dr.

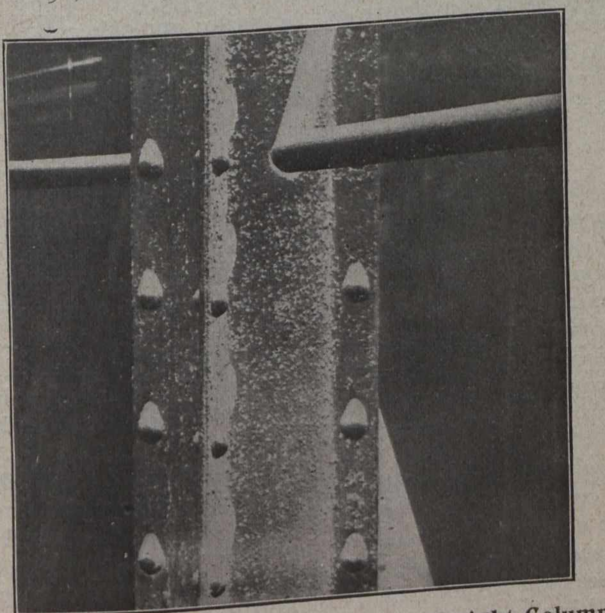


**Fig. 5—Coarse-Particled Pigment on Upright Column, Fine-Particled on Horizontal Railing**

Charles B. Dudley, for many years the able, widely known and respected chemist of the Pennsylvania Railroad. In his studies, among other things, the properties of paint materials were systematically investigated, and what was learned brought about radical changes in the composition and manufacture of paints.

The Pennsylvania Railroad gained much valuable information as the result of Dr. Dudley's work. It was clearly realized, for example, that the effectiveness of a paint did not by any means depend upon its cost per gallon or pound. As a matter of fact, it was proven that some of the most durable paints could be had at a minimum cost.

Other railroads were not slow to follow the lead of the Pennsylvania, one of the first to start on this work being the Philadelphia and Reading, now known as the Reading Railway. The results of some of these investigations were presented by the writer before the Franklin Institute, and elsewhere.

The size and form of the particles of the pigment were shown to have a great influence upon the life of a paint

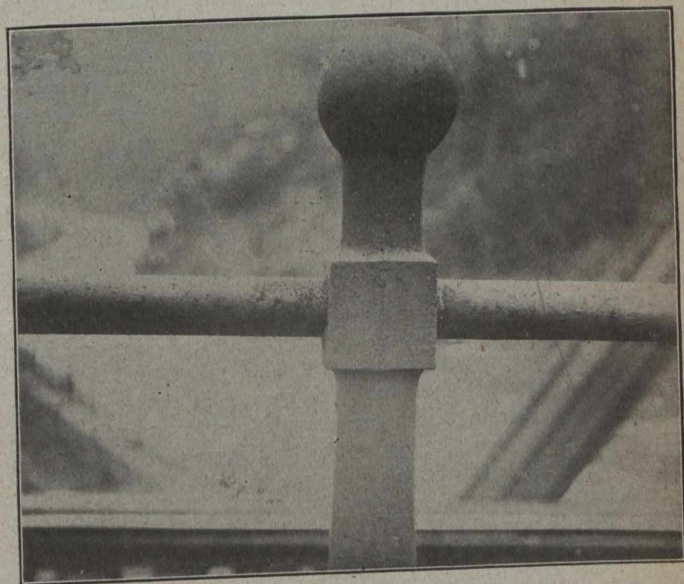


**Fig. 6—Coarse-Particled Pigment on Horizontal Railing, Fine-Particled on Upright Post**

coating, though this subject had not previously received any attention. A brief description of a case that clearly illustrates this point may be of interest:

Two bridge paints had been used upon the lines of the Reading for a period of about ten years. These paints were made by the same manufacturer, and contained almost the same proportions of the same materials. Though they were exposed side by side and under like conditions all along the road, one of them became known for its good service, and the other for very poor service. The life of one was twice that of the other.

The difference between the service rendered by these paints was so marked that we determined to get at the real causes, so as to bring the quality of all our paint deliveries to the same high standard of durability represented by the better paint.

The discovery that the main difference between the two paints was in the relative size of the particles of the pigments resulted from this investigation. In the long-lived paint, these particles ranged from two to ten ten-thousandths of an inch in diameter, with comparatively few of the maximum sizes; while in the short-lived paint the diameters ranged from two to one-hundred-and-eighty ten-thousandths of an inch.

The average diameter, as nearly as we could estimate, of the particles of the pigment of the satisfactory paint was four ten-thousandths of an inch, against eighty ten-thousandths of an inch for the unsatisfactory paint; and, as the volumes of spheres are to one another as the cubes of their diameters, it follows that the average particle of the pigment of the good paint was eight thousand times smaller in volume than that of the bad.

The composition of these two paints was about 25 per cent. oxide of iron combined with inert matter, such as clay and gypsum, as a filler, ground in pure linseed oil, with a small proportion of Japan drier, as a vehicle. The details of the investigation may be found in the Journal of the Franklin Institute for July, 1904.

The reason why this difference in the size of the particles of pigment makes so marked a showing in the service of the two paints is that where the particles are coarse, relatively large oil spaces surround them; and as linseed oil is by no means waterproof, as we have mentioned, the effect of the weather is soon noticed in such paints.

Surface tension also operates in favor of the paint having the finer-particled pigment, on the same principle that causes fine sand, when wet, to hold together, where coarse sand or gravel will not.

Figure 3 shows the appearance of a paint film of the short-lived coarse-particled pigment, and Figure 4 shows that which had fine-particled pigment and was long-lived.

### Fine-Particled Pigments the Best

Figure 5 shows a portion of a bridge after the paints upon it had been exposed for four years. The upright column had been coated with the bad paint, and the horizontal railing with the good. Figure 6 is another part of the same bridge in which the upright post was coated with the good paint and the horizontal railing with the bad. In both pictures and in both positions, the paint with the fine-particled pigment is seen to be in good condition, while the other is not.

These tests demonstrated that some of the most durable paints were composed of the simplest and least expensive of pigments, and created a good deal of interest because the findings ran counter to the preconceived ideas of many who had assumed that in order to be really good and give long service a paint must be composed of one of the more expensive pigments, such as white lead, and that those which contained the so-called "inert materials" were to be looked upon as "doped" products.

Because of misbranding and wholesale and indiscriminate adulteration, the manufacturers were in some cases to blame for this. For example, we have seen a supposedly oil paint that contained 30 per cent. of water. Another paint labelled "pure white lead" contained no white lead. Many other cases could be cited, and it is small wonder that such abuses led to a public outcry and legislation that was sometimes carried too far.

It became necessary, because of these conditions, to determine the truths about the properties and characteristics of the different paint materials, and the work was finally undertaken by the Scientific Section of the Paint Manufacturers' Association of the United States.

### Experimental Iron and Steel Panels

A fence was built at Atlantic City, and several hundred panels were coated with paints of different formulæ in order to determine the value under exposure to the weather at the sea shore of the more important materials used as pigments, and also to show the most durable combinations of the various pigments under such conditions. Exposures were made on both iron and steel panels as well; and, subsequent test fences were erected in other parts of the country in order to get varying climatic conditions.

The tests were made under the supervision of the American Society for Testing Materials, and a vast fund of information regarding the service value of various compositions and combinations was obtained. Materials that many considered as adulterants not long ago are now known to have a definite value in the design of high-grade paints.

Misrepresentation still exists under the stress of competition, but the general plane of the paint industry is distinctly better for the simple reason that the principles of manufacture, the relation between cause and effect as applied to paints, and the properties of paint materials are all far more thoroughly understood than was the case even at the beginning of the twentieth century.

It will be clear from what has now been said that in order to be serviceable a paint must be composed of a pigment that is of a character well adapted to the conditions under which it is to be used, that this material must be in the most effective physical condition, and must be carried in a vehicle which will form an effective bond between its particles and at the same time be as nearly weatherproof as possible.

The spreading quality is a factor that should be very carefully borne in mind when purchasing paints. That having the pigment composed of the most finely divided particles, other things being equal, will spread farthest.

Specific gravity is another important factor, and should be studied accurately by the purchasing agent who is buying by the pound. The paint of the least specific gravity will be the greatest in bulk; and it is bulk, not weight, that counts in determining the spreading capacity of paints.

The labor cost of applying the paint is usually far greater than the cost of the paint itself; and it is important to remember this as a special incentive for the purchasing of the most durable paint for the purpose.

Specifications for various types of paints were the natural outcome of all the foregoing investigations and experiments with paints and paint materials. Such specifications have been drawn by the writer and others to cover paints for use under many different conditions, and these can be filled by any manufacturer who is willing to give care and attention to the work. Some of them, in fact, now carry these preparations in regular stock.

### Specifications Lead to Economies

By purchasing wisely, under carefully drawn specifications, real competitive prices that represent the true market value of the paint materials plus a reasonable allowance for the costs and profits of manufacture, can be secured.

Marked economies have been effected by some of the principal railroads and by many smaller users of paints, through lowered costs and increased service as a result of working along these lines.

Large purchasers know they can not afford to do otherwise than buy according to specifications specially drawn to cover the needs of the service. It would be much to the advantage of many of the smaller purchasers who use quantities that would warrant the small expense connected therewith, if they would do likewise.

Final testing is, of course, absolutely necessary, for it is useless to buy according to specifications, or even on promises, unless the paints actually delivered are tested to determine whether they are as specified or represented.

---

## VISIT TO OTTAWA PUMP HOUSE

Through the courtesy of J. B. McRae, consulting engineer, Ottawa, and by invitation of the mayor and board of control of that city, the members of the Ottawa Branch of the Canadian Society of Civil Engineers and their friends, including ladies, visited the new city pumping plant last Saturday afternoon. The plant was shown in operation under various loads.

# Letters to the Editor

## Mr. Dick Answers Mr. Newton

Sir,—Owing to absence from Ottawa, the attack on my pamphlet, "Briquetting of Lignite," was brought to my notice only a few days ago. Were it not for the expenditure on this plant that is being undertaken by the Dominion, Manitoba and Saskatchewan Governments, I would not consider it necessary to refute Mr. Newton's erroneous statements and deductions.

Mr. Newton states that he is not a "coal-chemist" nor a "mining engineer" but that he speaks as a "member of the public, who has looked a good deal into the fuel situation for the last few months from a commonsense point of view," and that he has burned lignite through the whole of one winter.

Most people consider that lack of technical knowledge respecting a purely technical subject disqualifies a man from discussing such subject. Mr. Newton, however, does not share that opinion. Mr. Newton seems to think that the best man to settle a disputed point is one who does not know anything about it because he is not biased either way.

Before discussing the erroneous statements and deductions in Mr. Newton's letter, I desire to correct his misunderstanding of the position of the Commission of Conservation, particularly as a knowledge of certain basic facts will demonstrate that he had absolutely no ground for many of his gratuitous assumptions.

Over a year ago, the Research Council requested the Mines Branch of the Department of Mines to investigate the carbonized lignite briquetting process and to supply cost data respecting same. The report was prepared for the Mines Branch by Mr. B. F. Haanel, who, I understand, was assisted by an expert fuel engineer. The Mines Branch transmitted a copy of this report to the Research Council.

Later, Mr. R. A. Ross, on behalf of the Research Council, requested the Commission of Conservation to report on the "market" possibilities of carbonized lignite. I was instructed to prepare this report and a copy of same was transmitted to the Research Council. On page 13 there is an estimate of cost, of fixed charges, etc., for a 30,000-ton plant, based, I understand, upon data contained in the report made by Mr. B. F. Haanel to the Mines Branch.

The Commission of Conservation is in no wise responsible for any statements respecting the costs of construction or operating the lignite briquetting plant, nor has the Commission reported on the practicability or efficiency of such plant.

The Commission of Conservation did not recommend that $400,000, or any other sum, be expended on a briquetting plant, nor that such plant be constructed, and the Commission was not asked to make any recommendation. Any recommendations of this nature were, I understand, made by the Research Council.

The selection of the site for the briquetting plant and its construction and operation, and the selection of the process are entirely in the hands of the Research Council, and the Commission of Conservation has no responsibility in connection therewith and has not been consulted in any way respecting same. All basic data, respecting the foregoing, contained in my report were received from the Research Council.

Mr. Newton states that on page 13 of my report the cost of United States anthracite in Winnipeg is given as $9.50 to $10 per ton, and that on page 17 the same report shows the cost as $11.25 per ton, and that no dates are given as to what year these figures apply.

These statements are made in this form although it is clearly stated that prices on page 13 are for the two years, 1916 and 1917, and are "f.o.b. cars," whereas the prices on page 17 are for coal "delivered" and are, of course, prices prevailing at date of writing the report, which, as shown on page 3, was prior to October 24th, 1917. Why does Mr. Newton ignore this difference?

Mr. Newton objects to the freight tariff figures and quotes the higher tariff in force to-day. What he omits to state is that the tariff he quotes only went into effect one month ago. Is it fair criticism to quote a tariff that was not in effect till five months after my report was written?

With regard to the B.t.u. value of the Souris coal, nothing that Mr. Newton can say will increase it. The analyses are given on pages 20 to 23 and can be consulted by anyone desiring accurate information respecting same.

Respecting the ash content of the coal from the larger operating mines, I refer your readers to the analyses referred to above. These samples include the so-called black-jack, seams of clay, etc., referred to by Mr. Newton.

Respecting detailed costs for carbonizing, briquetting, etc., and data respecting the proposed plant, I refer Mr. Newton to Mr. R. A. Ross, from whom these figures were obtained. No allowance for the by-products was made in my report, as it was the purpose to err rather on the safe side than otherwise.

To take up all Mr. Newton's statements and treat them seriatim would require more space than would be justified, but I think enough data have been cited above to demonstrate that Mr. Newton should acquire at least a superficial knowledge of the subject he discusses before rushing into print.

In concluding this communication, I desire to voice a protest against the language used by Mr. Newton respecting a brother engineer. Under any circumstances the use of such epithets as "inconsistent, inaccurate, too vague to be of any service and misleading," "most extraordinary proposition I ever came across," etc., is inexcusable. It is doubly so when based upon an ignorance of basic facts that could easily have been ascertained had Mr. Newton cared to make the attempt, and when made by a man who states that he is not a "coal chemist" nor a "mining engineer."

WM. J. DICK, M.Sc.

Ottawa, Ont., May 11th, 1918.

## Engineering Ethics and Salaries

Sir,—The writer was pleased to see in your issue of the 9th inst., a letter from Mr. Goldman criticising the code of ethics laid down by the Canadian Society of Civil Engineers, for it is certainly a glaring fact that the consulting engineers are the only ones provided for in the present code, whereas it is patent to all engineers that a code of ethics is very necessary for the guidance of the engineer-employees, perhaps more so than for the consulting engineers, even though it might not be accepted as a guide by a large number of employed engineers who are not members of the society.

Were we to look closely into the matter, we might find that it is this lack of ethics for the guidance of the employed engineer, that is keeping a large number from becoming members of the society. There is nothing so degrading and disgusting to an engineer when he is applying for a position where the usual request is made, "State salary expected," as to feel that he cannot consider what is a fair value for his services but must consider chiefly as his guide in answering the question, the lowest figure that some other engineer will offer his services for.

Mr. Goldman says that one of the main objects of the "Canadian Association of Engineers" is to raise the standard of ethics among the engineers in Canada. The writer takes it that he means both the consulting and employed engineers, and were it to do that alone, it would be worthy the support of all engineers. But why not go a step further and endeavor to form some rules that would assist in answering the salary question as mentioned above; some rule that would be a sort of general standard to measure the value of an engineer's services? For instance, take the position of a city engineer. Is it not possible to base, in a general way, a standard of remuneration by (*a*) the population; (*b*) the difficulties attending sewage disposal; (*c*) the difficulties of obtaining a pure and adequate water supply; etc.; or may there not be other and better ways that discussion would bring to light? Of course, the question of over-supply will be a great factor with many in deciding the remuneration to be given an engineer in return for his services, and this is a subject that will have to be considered very seriously in the near future.

How would it do for our colleges to publish a syllabus containing a comparative remuneration table, as follows:

Civil engineer—Transitman, \$75 to \$90; resident engineer, \$100 to \$125; division engineer, \$150 monthly.

Locomotive engineer—\$140 to \$175 monthly.

Railway conductor—\$130 to \$175 monthly.

Brakeman—\$125 to \$140 monthly.

Boss carpenter—\$180 monthly.

Boss mason—\$180 to \$225 monthly.

Such a table might not be a pleasing embellishment to a college syllabus, but it would present the naked truth.

WM. CROSS, M.Can.Soc.C.E.

Toronto, Ont., May 14tn, 1918.

---

### Armor Plates in Concrete Road Joints

Sir,—While reading the various interesting articles in your issue of May 2nd, my attention was drawn to an article describing a series of recommendations decided upon by a committee appointed by the American Society of Civil Engineers.

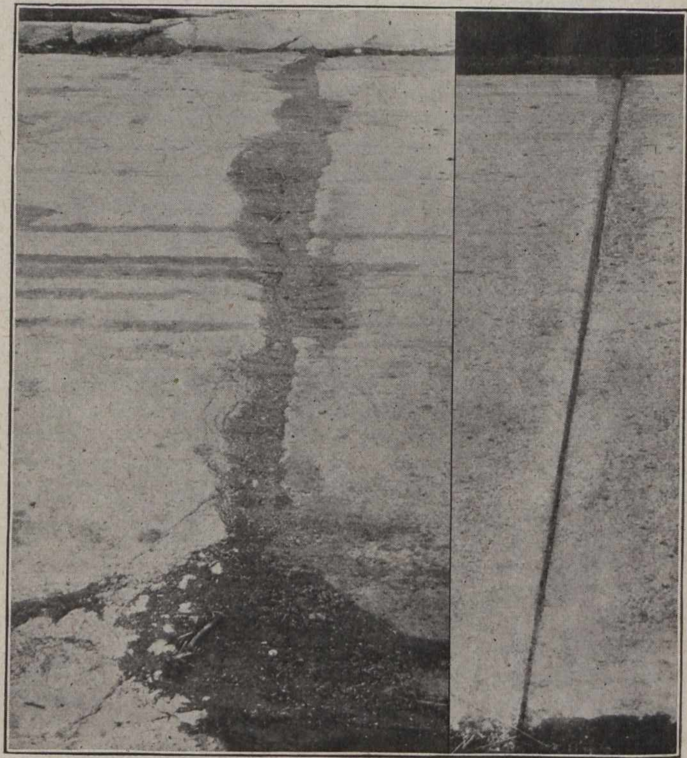
This committee was, I notice, appointed some years ago to consider the whole question of road construction, and in your article we have their findings.

The paragraph referring to armor plates at expansion joints is the one point to which I take strong exception, and I would like to ask those gentlemen if they ever compared an armored joint with an unarmored one a few years after the work had been executed.

For the purpose of shedding light on the two methods of constructing an expansion joint, I am enclosing two photographs. Both these pavements were constructed in 1913, and are samples of numerous instances illustrative of both methods.

From my viewpoint, when forming an expansion joint, it is desirable to have and retain a perfect arris on both sides of the jointing material, and my experience leads me to the conclusion that this is impossible unless you have some form of plate.

There are, of course, plates and plates; but I submit that if the members of the committee had tried an armor plate properly designed and made from dead mild steel, they would, I venture to think, have returned quite a dif-



**Unprotected Expansion Joint. Note Reinforcement Showing Through the Broken Concrete** — **Expansion Joint Protected by Truscon Armor Plate**

ferent finding. The photographs sent herewith are not by any means solitary examples. They can be found right here where the writer is located; both armored and unarmored joints may be seen, and a very slight study of the results ought to convince any engineer that it is economy to use armor plates.

A. J. RIDDELL, A.M.Can.Soc.C.E.

Walkerville, Ont., May 15th, 1918.

---

### "Canadian Association of Engineers"

Sir,—Will you kindly allow me space in your valuable paper to place before the engineers of this country the aims and objects of the "Canadian Association of Engineers," so far as the writer understands them. This association has been forced into existence by conditions as they have been in the past and are at present, and intends to carry on a progressive movement to meet conditions in the future as they arise, to the best interests of the engineer.

To remedy the present conditions in the engineering profession in such a manner that the effect will be to give the proper status to the engineer and place him on that plane to which he rightly and justly belongs, and gain for him the respect to which he is entitled and which obtains in the other professions, will require drastic measures.

Drastic is a hard word, and herculean efforts will be required, but the writer feels sure that an association especially formed to carry on this great and necessary work, not hampered by old conservatism, precedents and moss-covered ideas, can accomplish much.

The faith in an ideal, the strength of will to persevere to an accomplishment of that ideal, the vigor and audacity of youth, are great assets in the uphill fight to overcome the old idea that the engineer is a necessary evil (indeed, a great many consider him an evil whether necessary or not) in the commercial life of any country.

The fields of greatest need in which the association will be most active are at present four in number:—

First, the relation of the engineering profession to the community.

Second, the engineer in political life.

Third, the financial remuneration of the engineer.

Fourth, the establishment and maintenance of a service bureau.

This question of the relation of the engineering profession to the community is as vital to the non-professional man as to the engineer. It has been discussed to a very considerable extent by engineers of both the United States and Canada. The community is here taken to mean the local municipal centre as distinct from the larger centres, the federal and provincial parliaments.

R. O. Wynne-Roberts, in *The Canadian Engineer* of April 18th, tells us that Dr. G. F. Swain says, "The engineer is the advance agent of civilization"; and as the advance agent's business is the advertising of his organization, it follows that the engineer should advertise. Therefore a practical high order of publicity should be resorted to and the public made acquainted with engineering problems and their method of achievement.

The engineer and his organization in the different commercial centres could and should be collectors of statistics and all useful information. They should seek out and co-ordinate all facts appertaining to the problems of their city or district, and thereby become a central point to which each and every member of the community, the collective bodies as well as the individual, would of a necessity gravitate to seek help and guidance in the solution of their engineering difficulties.

Secondly, the engineer in parliament; and why not! Is he inferior in intellect or intelligence? Is he less capable of using his special knowledge of the laws and forces of nature than his brother of the other professions? Why, then, does he not take his place on parliament hill?

The problems confronting this country are greater to-day than they ever have been in the past, and they are essentially engineering ones. Transportation, both lake and rail; conservation of power and fuel; mining and mining laws; these are the very elements of an engineer's existence. He lives in them; he lives for them; they are part and parcel of himself; yet in these he has been ignored, has been relegated to the minor positions, and has had to look on while other hands have been attempting that which is for them the impossible.

The new association will encourage the engineer to enter parliament and take his place, that of leader, in the forefront of the fight for the advancement of civilization. Surely the trained engineer, with his wealth of knowledge of engineering; experience of organization; keenness and faculty for hunting, classifying and co-ordinating facts; and habit of sticking with a thing till success crowns his efforts, would give better service as head of a department of public works, railways and canal, etc., than would a layman whose fertile brain is concerned mostly with after-dinner speeches and party politics.

The engineer's clean, wholesome mind, the sterling character derived from his close association with nature, would in a great measure tend to elevate the trend of politics in this country. It is inconceivable that an engineer at the head of a great public service department would advocate undertakings for which there was no justification for the sake of party welfare. It is abhorrent and altogether foreign to his being to make political playthings with the bounties of nature.

Thirdly, the financial remuneration of the engineer is an important object of the association and one that touches us all very closely at present. The engineer is the most poorly paid of all the professions, while his responsibilities are infinitely greater. The engineers, senior and junior, who designed and built the Quebec Bridge, the railways, the tunnels under the Hudson River, the tubes of London, and many other engineering enterprises, had on their shoulders the safety of more lives in one month than any member of any other profession has on his in a whole lifetime. Is not this responsibility of the highest order? Is it, therefore, fair and just to ask an engineer to accept a salary lower than that of the other professions or even trades? Rather the reverse, I should think.

An ex-counsellor or ward politician is foisted into a position with a large salary attached as head of a department which is essentially an engineering one, and employs engineers at small salaries to help him keep his head above water.

A certain municipality cuts in half the salary of its engineer and reduces his staff, thereby lowering the efficiency of the whole organization for the sake of "economy," while precious lives hang in the balance. There can be no doubt but that it should lie within the power of the engineering profession to regulate the degree of efficiency to the maximum of safety in any engineering department in this country, and not leave to the tender mercies of a non-engineer, matters of such vital importance.

Someone, the writer believes, has defined the engineer as one who can make a dollar do the work of two, but this refers entirely to his engineering problems and not to his wife's purchases of the necessities of life.

The remuneration for the services of those in other professions and trades has been steadily increasing during the last ten years; the salary of the engineer has remained at practically the same level for the last twenty-five years; which fact, together with the increased cost of living, has made it a very serious and difficult problem indeed for the engineer to make both ends meet and still retain his respectability.

Lastly, the establishment and maintenance of a service bureau is a very important move in the right direction and one which will meet with the approval of and be appreciated by all in the profession, both employers and employees.

The following absurd condition came to the writer's notice a short time ago and has since been confirmed: An engineer residing in Montreal had to apply to an engineers' employment bureau in Cleveland, U.S.A., for a position in his own city of Montreal, not four blocks from where he resided. At the present time there are no headquarters, no central point to which the engineer seeking employment may go to for information relative to his requirements or needs. He is like a ship without a rudder, drifting hither and thither, buffeted by wind and tide till by haphazard he gets a position. Generally he takes the first one he finds, whether he is likely to do justice to it or not. Maybe he will be a square peg in a round hole; but, discouraged by his endeavors, he seeks no further. Unsatisfied and unsatisfying, the service he gives will be directly proportional to his satisfaction in his new position, consequently the employer has a lower opinion of his abilities than he otherwise would have.

A service bureau where the experience and capabilities of the engineer are tabulated and indexed, where the employers could list their requirements, would tend to obviate this extremely annoying and unprofessional condition. The labor unions have their headquarters—the labor temples—to which they may go for news of the trade. Is the engineering profession too proud to emulate the good points of the trade unions?

Without such a bureau, the engineer seeking a position is to a certain extent restricted to the locality in which he resides, unless he is directly connected with the conditions and requirements of the profession throughout the whole country. Would not such a bureau tend to elevate the individual as well as the profession, and increase the value of the services rendered?

Mr. Stinson, speaking at a recent meeting of the Canadian Society of Civil Engineers in Toronto, said, "The engineer needs a selling agency for his services." A service bureau fills this requirement by bringing the employer and employee into close touch. Each may choose the other; both are satisfied customers; and satisfied customers are the essentials of good business.

FREDERICK B. GOEDIKE,
B.Sc., A.M.Can.Soc.C.E.

Toronto, Ont., May 16th, 1918.

## CALGARY WILL SUPPORT CITY LABORATORY

LAST winter a resolution was forwarded by the Calgary Branch of the Canadian Society of Civil Engineers to the mayor, commissioners and city council of Calgary, requesting that in view of the very excellent work being performed by the laboratory of the city of Calgary under the able management of its chemist, F. C. Field, they grant their utmost support, financial and otherwise, to it.

The following reply from the city clerk has just been received by the secretary of the Calgary Branch:—

"I beg to advise you that council at its regular meeting, held on the 29th ult., adopted clause 6 of the report of the city commissioners of the 27th ult., as amended, and which reads as follows:—

" 'Re communication from the Calgary Branch of the Canadian Society of Civil Engineers re city laboratory. From what information we have received we find that the resolution of the Canadian Society was intended to bring more prominently before the city and the public generally the value of the city laboratory to this community, and to point out how it might further assist in advancing research work and future development of the city and province. It was pointed out to us that there have been a large number of failures in concrete work in the prairie provinces, which is costing governments, private and public institutions large sums of money. Investigations are being made by the Canadian Society of Civil Engineers and other organizations with a view to determining the cause and the remedies to be applied. There are also many other questions with regard to the economic utilizations of the provincial resources, and it is the wish of the Canadian Society of Civil Engineers that the city should lend its assistance through its laboratory and, if necessary, grant some small financial support in carrying on some experimental work which would be to advantage to this city and community.

" 'We, therefore, recommend that all support possible be given by this city to any legitimate research work that will be for the general benefit of our community. Any moneys necessary in this connection to be reported to the council.' "

## THE PERSONAL PROBLEM OF THE ENGINEER IN WAR TIME*

**By Edmund B. Kirby, New York City**

WAR, tearing away the habits and formulæ with which we are accustomed to veil the fundamentals of existence, has set us face to face with these realities. In their presence trivial matters vanish and the questions, "What is my duty; am I doing it?" press themselves upon the soul of everyone. Whether they are but vaguely felt, or, on the other hand, are clearly defined, the demand cannot be evaded. Every man must justify himself to himself, and do it now.

But with the technical man, whose special distinction is a long training in clearness of thought, these questions are specially insistent, and yet strangely difficult.

In a war of engineering the men who apply science to the industries of the country and who direct the development of its machinery and processes, should be of peculiar value. Their knowledge and experience has a special fitness for the task in hand. Why, then, are not all such men, both young and old, taken from the non-essential industries and put into the war service of the government? In Germany every chemist, engineer and handler of men is assigned to the war work to which his special ability is best adapted.

While the enemy does this, we do not. With us a few distinguished specialists are invited to do certain things for the government, but the great mass of the technical men of the country are left to their own devices. They serve as usual in the commercial industries of the country, but beyond this their vast total of knowledge and ability has no means of expressing itself. As engineers and chemists they do not count. As ordinary citizens the young men go to the front, while older ones assist in bond selling, in Red Cross work, and in the many other public war movements, but as technical men their reserve capacity is unused.

Now, somebody must stay at home and furnish food, coal, steel, munitions, transportation, and, under the practical conditions of industry as it is now organized, the technical man usually finds himself doing these things at a more or less comfortable salary for a corporation which is making a more or less comfortable profit. No exception can be taken to his part in this. To care for his family, to pay his bills, and to lay up what reserve he can—these are the normal duties of every man. Why, then, do they not satisfy the engineer now? Why is he everywhere so uneasy, so discontented with his relation to the war?

### How May He Satisfy This Obligation?

Is it not because he sees, whether vaguely or clearly, the difference between his position, proper as it may be, and that of the man who imperils the safety of his family and offers his own life in service at the front for $30 a month and expenses. For this difference is fundamental. It cannot be camouflaged to his own soul by the smug excuse that he is part of a necessary industry.

*From "Bulletin" of the Canadian Mining Institute.

Money-making and patriotism have nothing in common. One is material, the other sacred. One is self-interest—and the fact that the nation is often able to turn this self-interest to account does not alter its character; the other is self-sacrifice, that highest expression of duty, and to it the hearts of all men go out in reverence. Patriotism, then, requires that a man shall do something other, or something more, than the mere filling of his accustomed place in industry. The altar of one's country can receive only sacrifice.

The personal problem of the technical man is, therefore, a specially difficult one. How, with indifference on the part of his government, may he satisfy this obligation of honor in some way which will be effective? In this he cannot expect help from his government, because the latter is not sufficiently organized to consider such problems as making the most effective use of its technical men. The answer must come from these men themselves. Government has not the attributes of an individual. It is at best a crude and imperfect mechanism, efficient only in certain routine directions. Unfamiliar problems simply encounter a succession of ordinary men at desks, each harried by people to see and letters to write. The higher the position, the less there is of opportunity for consideration of new things.

But it is the genius of our race to be able to supply from below whatever lack there may be in the government above, and in doing this, technical men can obviously be most effective in co-operation with each other. The first step has naturally been the spontaneous effort to get as many as possible directly into the army and navy. The next has been the attempt to induce the utilization of selected specialists in civilian councils, boards, etc. But these measures have brought only a small percentage of the technical brains of the country into war service. Their vast reserve capacity is still practically untouched. To partly meet this situation a third step is now being taken in the United States, which is to bring war work to all technical men at their own homes, and for this purpose the technical societies have recently organized the War Committee of Technical Societies, which is just beginning its task.

## War Committee of Technical Societies and Its Work

The work which the War Committee of Technical Societies has undertaken is to distribute war problems to the technical men of the country at their own homes, and to bring into action upon these problems the inventive ability of the country which is now latent.

By stimulating these trained men, over 100,000 in number, together with the wider circle to be also reached through them and by the aid of the journals, it is hoped to concentrate the attention of American inventors upon the matters which are most important and in which they can be most effective, and to aid them in the rapid development of their work.

The problems, selected from every available source, are to be prepared with the aid of specialists and issued to the membership (about 35,000) of the societies already represented, accompanied by such a presentation of the state of the art as will best interest and stimulate inventive ability. As rapidly as effective arrangements can be made, it is expected to reach the membership of all other technical societies, and also the general inventive ability of the country.

Certain kinds of war problems, such as those requiring secrecy and others relating to the development and perfecting of devices, require the most eminent specialists and the best equipment that the country can command.

Most problems, however, are suitable for general presentation to that vast reserve capacity of knowledge, inventive ability and equipment which cannot be identified and selected. The work of the committee, aided by the prominent specialists, is to bring this unknown capacity into action and to secure quickly the best it can furnish to the cause. This will be utilized in such ways as the government may direct.

The necessary trials and experiments will be conducted upon ideas and inventions which are of value. Ample funds for such purposes are available through the affiliation of the War Committee with the Naval Consulting Board, which is acting officially as a national board of inventions. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular department of the Army and Navy Service where they may be most profitably utilized.

### Collect Problems from Whole Allied Front

It is hoped that the technical societies of Canada, Great Britain and France may see their way to co-operate in this work by organizing in some similar way. The ideal which it is hoped to reach is the creation of joint machinery by which war needs and problems may be collected continuously from the whole front and within two weeks be in the hands of every technical man of the Allied nations.

But the above undertaking, important as it is, is only a partial solution of the personal problem confronting every man. The rest seems to be up to the individual and his own initiative. The essential difference between the professional man and the average man on the street is certainly not in the nature of their occupations. That of the laborer is just as important to society as that of the engineer. The vital difference, if one exists, must exhibit itself in their respective actions at times of public need.

If, with elaborate training and long experience in clear thinking, in the sense of responsibility and in the guidance of others, the engineer or chemist does not meet a crisis by showing more initiative than others, he is simply a useful workman, and not the superior citizen that his expensive training should have created. He cannot escape from being measured by the standards common to all humanity.

If, then, he cannot function professionally so far as he would like, he can at least show exceptional activity as a citizen. The sacrifice he substitutes for a personal appearance at the front will be money or service, or both, but it must be enough to hurt. As to choice, there are so many things which require doing: work to be found right at hand and undertakings at a distance. Those movements already under way need helpers, while unnumbered others wait for someone to initiate and to push them. The genius of the engineer is creative power, and there can be no better exercise of it than to start something.

### Every Fault a Call for Somebody

Where things are going wrong, it is useless to point out what "They" ought to do. "They" means I. Every fault in the public machinery is a call for some individual to start the work of repair. Difficult as it seems for an unknown and distant man to affect large affairs, he can work apparent miracles in this direction by taking advantage of a certain sentiment, following a certain process and exhibiting a certain characteristic. The sentiment is the eagerness of others to assist in everything that will help to win the war. The process is the time-honored one invented by the old woman to get her pig to market, as duly recorded in the chronicles of Mother Goose. The characteristic which completes the formula is plain, dogged persistence.

Never has the call to action been so insistent as now, when that hideous monster called Germany threatens every corner of the earth and everything that we hold sacred.

In the throes of parturition, a new and a better world is being born. By the touch of elbows on the long battle front, a new comradeship is being created, the union of everything that is good in humanity, for war to the end against everything that is evil. It is a comradeship which is extending back into the very souls of our nations, one which will eventually reach every class and touch every individual.

And, at last, through that power which sways the destinies of nations, the United States is coming to take the place of fallen Russia. Slowly, with many mistakes, with heartbreaking delays, we are coming, Canada!

## THE NEW ERIE CANAL

LAST week the enlarged Erie Canal, connecting the Great Lakes and the Hudson River, was opened for traffic, though the formal opening will take place, with elaborate ceremonies, at a later date. The original canal, begun in 1817 and completed in 1825, had a minimum depth of 7½ feet. In 1903 it was decided to rebuild it on a larger scale, and $150,000,000 has been spent on the project.

The main channel is from Buffalo to Troy, 352 miles, and there are tributary canals to the Hudson from Oswego and Lake Champlain. In all, the State of New York will have 532 miles of canalized inland waterways. For the greater part of the distance, rivers and lakes have been utilized. Between Buffalo and Troy there are lift locks with a total lift of 210 feet. In order to raise the water level, thirty-nine artificial dams have been constructed.

Despite the enormous outlay, the Erie will remain a barge canal, with a minimum depth of 12 feet compared with 23 feet in the new Welland Ship Canal which Canada is constructing. It is impossible to predict the extent to which Great Lakes traffic for the Atlantic seaboard will be diverted to United States routes by the deepening of the Erie Canal.

The attraction of a deeper waterway from Buffalo to the Atlantic seaboard via the Hudson River will be offset partly or wholly by the new Welland, which will take the largest class of freighters. But when cargoes have passed the Welland, there will be competition between the 14-foot St. Lawrence Canal system and the 12-foot Erie Canal from Oswego to the Hudson. If the results are unfavorable to the Canadian route, the deepening of the St. Lawrence Canals will no doubt be hastened.—(Editorial in the "Toronto Globe.")

Tenders are being called by the Department of Railways and Canals, Ottawa, for rebuilding of the lower entrance piers, Lock 25 and Lock 23, respectively, on the Galops and the Rapide Plat canals.

The Brantford, Ont., gas committee presented a report to the City Council recently calling for the securing of an engineer to investigate gas purification, the supply of gas available and the cost of an artificial gas plant.

The Turbine Equipment Co., Ltd., Toronto, Ont., have the contract from the Otis-Fensom Elevator Co., for a 50 horse-power motor-driven De Laval centrifugal pump, for use in connection with a hydraulic elevator, to be installed in the Bell Telephone Building, Toronto.

## NEW ASSOCIATION SUSPENDS MEETINGS

AT a meeting of the "Canadian Association of Engineers," held last Monday evening at the Engineer's Club, Toronto, it was unanimously decided to suspend all meetings during the summer.

After there had been considerable discussion regarding whether the association should be purely Canadian or a branch of the American Association of Engineers, a representative of *The Canadian Engineer* who attended for the purpose of reporting the proceedings, pointed out that the aims and objects of the proposed new association appeared to be identical with those of the Engineering Institute of Canada. He summarized the manner in which the Toronto and Ottawa branches of the Institute propose to deal with some of the problems that seemed to be of greatest interest to the prospective members of the new association, and urged that the Institute be given a fair chance to show what it can do along the lines of increased pay, closed profession, employment bureau, national status, etc., before dividing the efforts of the engineers by the formation of another association. After thorough debate, this viewpoint was supported by H. W. D. Armstrong, Thos. Taylor, F. B. Geodike, C. E. Tilston and others.

F. B. Goedike moved that the meetings of the proposed association be suspended *sine die* but that the "constitution committee" continue its work so that the association will be in shape to resume its activities at a later date should the prospective charter members feel that the Engineering Institute of Canada was not fulfilling expectations. This was unanimously carried and the meeting was then immediately adjourned.

## AT AMERICAN WATER WORKS CONVENTION

AMONG the delegates who attended the convention of the American Water Works Association, held last week in St. Louis, Mo., were the following from Ontario:—

R. L. Dobbin, superintendent of waterworks, Peterborough; W. H. Randall, waterworks department, Toronto; H. Hyman, superintendent of waterworks, Kitchener; W. E. Macdonald, waterworks engineer, Ottawa; C. D. Brown, Walkerville Waterworks Co., Walkerville; C. W. Schiedel, Waterloo Water & Light Co., Waterloo; Geo. Geddes, water commissioner, St. Thomas; Robt. Hicks, water commissioner, Peterborough.

The British Columbia Provincial Public Works Department inspection of the flood damages in the Bella Coola section shows that the necessary repairs and construction of roads and bridges will total about $66,000.

The Hydro-Electric Power Commission of Ontario, have awarded the contract for six De Laval single and multi-stage motor-driven pumps for the Ontario Power Co., to the Turbine Equipment Co., Ltd., of Toronto.

Supplementary estimates of the Federal government, tabled on May 20th, total $46,957,312. Railway estimates include the sum of $3,489,313 to acquire the Quebec and Saguenay Railway and $518,000 for the acquirement of a number of short railways located in the Maritime Provinces. Harbor and river votes include $386,000 for St. Charles River improvements, $250,000 for St. John, N.B., harbor, and $152,000 for Toronto harbor. There is also a vote of $175,000 for the construction of a bridge on the Canada Central Railway over the Peace River crossing, and $100,000 for Fraser River improvements.

# The Canadian Engineer

Established 1893

*A Weekly Paper for Canadian Civil Engineers and Contractors*

Terms of Subscription, postpaid to any address:

| One Year | Six Months | Three Months | Single Copies |
|---|---|---|---|
| $3.00 | $1.75 | $1.00 | 10c. |

Published every Thursday by
The Monetary Times Printing Co. of Canada, Limited

*JAMES J. SALMOND*, *President and General Manager*
*ALBERT E. JENNINGS*, *Assistant General Manager*

HEAD OFFICE: 62 CHURCH STREET, TORONTO, ONT.
Telephone, Main 7404. Cable Address, "Engineer, Toronto."
Western Canada Office: 1208 McArthur Bldg., Winnipeg. G. W. GOODALL, Mgr.


## Principal Contents of this Issue



## PRINTED COPIES OF PATENTS

SIR ROBERT HADFIELD, president of the Society of British Gas Industries and head of the great firm of Hadfield Limited, of Sheffield, England, in a recent address on patent law reform, made the following statement:—

"As an example of the antediluvian policy of our Empire on this question, an Englishman in this country cannot get a copy of a Canadian patent without sending to Canada, and even then he gets only a typewritten copy, as patent specifications are not printed there."

This condition of affairs in the Patent Office at Ottawa has been brought to the attention of the Minister of Agriculture, of whose department the Patent Office forms a branch, by Mr. Hanbury A. Budden, a well-known patent attorney of Montreal. Mr. Budden marshals some very strong arguments for the attention of the government, and it is to be hoped that his efforts will be successful.

The Canadian patent office has issued over 180,000 patents. Canada ranks seventh among the countries of the world in this respect. A copy of a British patent costs 8 pence, while the U.S. Patent Office sells copies at 5 cents each. A copy of a Canadian patent costs an average of over two dollars and can be obtained only after considerable delay.

In the U.S. Commissioner of Patents' report to Congress for the year ending December 31st, 1917, the following figures are given:—

"Printed copies of specifications and drawings of patents to the number of 2,511,082 were sold at five cents each, bringing to this office on this account $125,554.10. For 1,277,184 copies sold to libraries, the office received $1,612.50. The total received from the sale of copies of patents was $127,166.60.

"Copies to the number of 1,097,550 were shipped to foreign governments, and 142,640 copies were drawn for office use. The total number of printed copies of patents distributed during the year was 5,354,133."

These figures show that there is a great demand for printed copies.

The public is interested in the publications of patents because it has the right to know the terms of the grant of a monopoly in order to avoid infringement while the monopoly exists, and it has also the right to know what has become public property when that monopoly ceases.

The patentee is interested in the publication of patents as he would readily purchase a number of copies of his patent to assist him in exploiting his invention.

The patent office is urgently in need of printed copies, not only to supply the examiners' files, but also to fulfil an agreement with the U.S. Patent Office to exchange copies.

In Great Britain and the United States, the libraries in all the great centres contain copies of patents for reference. In Canada it is necessary to go to Ottawa to make a search, and even then the cumbrous typewritten copies, which are not properly classified, make a search difficult and tedious.

The Canadian Patent Act, as it now stands, provides for the printing of specifications and drawings subject to the approval of the Governor-in-Council.

Undoubtedly it will take a long time to print the 180,000 patents which have been already issued, but that is a matter for special consideration. There is no doubt, however, that the system of printing specifications and drawings should be adopted at once and thus prevent the increase of arrears.

Canada has reached such a stage in her development that she should endeavor to be among the progressive nations, particularly in matters that concern her intercourse with other nations. The present time of rapid industrial and technical advance demands a change from old methods which may have been suitable for a young country. The contrast between our methods and those of the United States is very striking. An earnest effort should be made to reorganize our primitive system and bring it up-to-date.

## DISTANT CONTROL OPERATION

IN the design of the new hydro-electric generating station at Cedars Rapids, Iowa, a radical forward step has been taken in the elimination of operator's wages in a station of considerable size, without sacrificing complete control. The station consists of three 400-kw., 60-rev. per min., 2,300-volt vertical generating units, tied in to a system of which the main generating station contains about 20,000 kv.a. in steam turbo-generators. One striking feature is the entire omission of the usual governors, the waterwheel gates being motor-driven and controlled by contact-making ammeters. Each unit has its individual control panel, consisting of the necessary contactors and relays to connect it to the bus at the proper time. A motor-driven drum controller gives the proper time element between the different steps in the operation of placing the generator on the line. Any generator can be started either by a float switch when the pond level reaches the proper height or by a remote control button in the steam station. The starting of the first generator throws on the line the motor of one of the two exciter sets, and the generator cannot be connected to the bus until the excitation voltage has reached the normal value. The waterwheel gates are then partly opened and the generator comes up to approximately normal speed. It is then connected to the bus without field through an iron-core reactance. Then a weak field is applied. Next it is raised to full normal value, and then the reactance is short-circuited. The contact-making ammeter opens the gates to full gate opening and the generator then carries full load in about forty seconds after either the control button or the float switch is closed.

## PERSONALS

W. R. Worthington, engineer of sewers, Department of Works, Toronto, was successfully operated upon last week at the Wellesley Hospital, Toronto, for appendicitis.

Lieut.-Col. George G. Nasmith, director of laboratories of the Department of Public Health, Toronto, received the degree of D.P.H. (Doctor of Public Health) last week at the University of Toronto. Col. Nasmith, who returned from France where he was in charge for some time of British army sanitary work, passed the examinations for this degree with a high mark. Col. Nasmith is now entitled to the very distinctive letters of C.M.G., M.A., Ph.D., D.Sc., (an honorary degree conferred a year ago) and D.P.H. He was born in Toronto forty years ago and graduated from the University of Toronto in 1900. Since his return from France he has written a book on army sanitation work. Among other research work which he has directed since his return, were the experiments regarding the fertilizer value of activated sludge, which were described in a recent issue of *The Canadian Engineer* in an article by Col. Nasmith and G. P. McKay.

James Hunter, of Toronto, has discontinued the operation of the Hunter Structural Steel Co., Toronto, and has joined the Submarine Boat Co. at Newark, N.J., having charge of two ways.

R. P. Dryer, assistant sales manager, Canadian Allis-Chalmers Limited, Toronto, has resigned to accept a position in the Pittsburgh office of the Allis-Chalmers Mfg. Co., of Milwaukee, Wis.

James H. Spicer, recently chief draftsman and shop superintendent of the bridge department of Canadian Allis-Chalmers Limited, is now works manager for C. W. Hunt Co., Inc., West Brighton, N.Y.

C. Hayward, formerly of the city engineer's department, Sault Ste. Marie, Ont., has been employed by Morris Knowles, Limited, Windsor, Ont., in connection with the proposed construction of the Essex Border sewerage intercepter.

Morris Knowles, consulting engineer, of Windsor, Ont., and Pittsburgh, Pa., has incorporated his Canadian firm. Mr. Knowles will be president of Morris Knowles, Limited; Chas. W. Tarr, vice-president and general manager; J. M. Rice, secretary.

J. G. Seyfried, C.E., lately of the Lackawanna Bridge Co., and formerly structural engineer of the Grand Trunk Railway, Montreal, and at one time connected with the bridge department of the Canada Foundry Co., has been appointed structural engineer of the Submarine Boat Co. at Newark, N.J., and will have charge of all structural design.

F. A. Danks, who has been in charge of the field work at both the slow and rapid sand filtration plants at Toronto Island, has resigned from the works department of the city of Toronto to join J. B. Nicholson, Limited, Hamilton, Ont., in superintending the construction of reinforced concrete reservoirs, coal storage plants, grain elevators, etc. Mr. Danks is a graduate of S.P.S., Toronto, class of 1908.

J. H. Billings, B.A.Sc., University of Toronto, will read a paper on the "Strength of Cast Iron in Bending as Affected by Variations in Cross-Sections," at a meeting of the Ontario Section of the American Society of Mechanical Engineers, to be held next Monday evening at the Engineers' Club, Toronto. Mr. Billings' paper will deal particularly with the research conducted during the past year at the University of Toronto. The meeting will be attended by Mr. Rice, of New York, who is the general secretary of the society.

Capt. R. H. Nichols, formerly partner in the firm of Vandeleur & Nichols, electrical and mechanical engineers, Toronto, spent a few days in Toronto this week on furlough preparatory to leaving for India, where he has been appointed general manager of the Bengal Iron and Steel Co., Limited. Capt. Nichols enlisted within a month after the declaration of war and was attached to the medical corps. He has been in service for forty-four months in various positions, both at the front and in British Government departmental work. He has not been wounded or sick for a day since he left Canada. His former Toronto firm was wound up within a few months after the declaration of war, as Mr. Vandeleur also decided to enlist, and is now serving in France as a captain in the Army Service Corps.

## OBITUARIES

David Webster, chief engineer of the Brantford waterworks system since its inception over 40 years ago, died at his home in Brantford on May 17th, as a result of gangrene. He retired from the civic service a couple of years ago, and was succeeded by his son.

James Boyd, C.E., resident engineer at Hamilton, Ont., for the Grand Trunk Railway, died Monday evening, May 20th, at St. Joseph's Hospital, Hamilton. Mr. Boyd had been ill with pneumonia for eight days. He was born in 1877 in Airdrie, Scotland, and was a graduate of Glasgow University. He was engaged in railroad engineering in Great Britain before coming to Canada seven years ago to join the Grand Trunk. He was an assistant engineer on the G.T.R. staff at Toronto for four years, then receiving the appointment at Hamilton. Interment was in Mount Pleasant Cemetery, Toronto. Mr. Boyd is survived by a mother and two sisters, all resident in Scotland.