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The Canadian Engineer

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SOME IDEAS IN SEWER WORK

THAT HAVE BEEN FOUND TO INCREASE THE EFFICIENCY OF THE WORK DONE BY THE SEWER SECTION OF THE TORONTO DEPARTMENT OF WORKS.

By **W. G. CAMERON, B.Sc.,**
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IN the natural course of events, in sewer construction in the city of Toronto, a few ideas have been developed which, although not entirely new, are greatly in advance of methods formerly used. Although these new schemes have not entirely eradicated the faults which they are intended to correct, they have proved efficient in 99 per cent. of the cases where they have been used. Accordingly, they have been universally adopted in the city. The more important of these developments are detailed herewith.

Canvas Covers.—In the case of tile-pipe sewers in wet trenches it was found almost impossible to prevent leaky joints. The universal practice is to place a rope of gaskets around the spigot end of a pipe, and when this pipe is pushed home into the socket of the pipe previously laid, the gasket is pushed into the back end of the joint, thus sealing the opening. The remainder of the joint is then filled with neat cement. In a wet trench this cement will be washed out unless measures are taken to prevent it. In some cases grass ropes, sods, clay ropes, pieces of burlap, etc., are wrapped around the joint; but they require a great deal of labor and prove successful only where there is a small amount of water present.

The necessity thus presented itself of finding a method which would require less labor and be efficient in all cases, including the most difficult; that is, in running-sand trenches.

Canvas covers were designed, were tried out, and upon proving successful were put into general use. These covers, made of medium weight canvas, are turned under on each side, making a ¾-inch hem through which No. 14 soft iron wires are passed. One side is fastened (by tightening the wire) behind the collar of the pipe before it is lowered into the trench, and the other side is turned inside the collar. (See Fig. 1.) When the next pipe is ready to be placed, this side is pulled out, and when the joint is made, is fastened over the spigot end. Thus the joint is completely covered and protected. (See Fig. 2.) A different width and length of cover is required for each size of pipe. Fig. 1 shows how efficient are these covers. These covers were invented and designed by Mr. Worthington, chief sewerage engineer, Toronto, as was also the template described below.

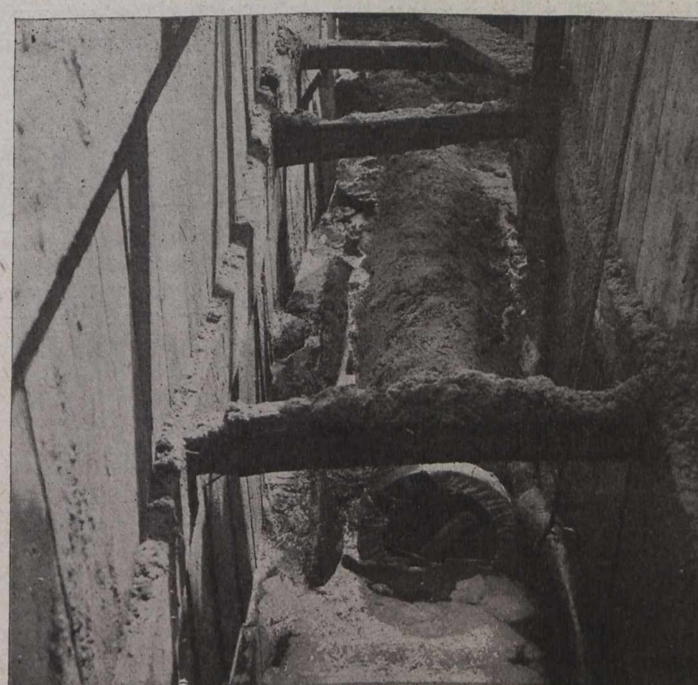


Fig. 1.—Showing Canvas Cover in place on bell end of pipe, ready for spigot end of next pipe. This view shows the efficiency of these covers. Note the water in the trench, kept out of pipe by the covers over the joints in background, which are concealed under 3 inches of concrete.

Template.—In Toronto, as in many other places, the Works Department requires 3 inches of concrete around all sizes of tile pipe over 12 inches in diameter. It has been found difficult to get the pipe-layer always to trim the sides of the trench so as to get a uniform 3-inch thickness of concrete. Most of these men are foreigners and do not clearly understand when the inspector requests them to trim the trench properly. A collar or template goes over the pipe behind the bell and always shows clearly the width of trench required to give the necessary 3 inches of concrete around the pipe. The body of the template consists of four pieces of wood, each 2¾ inches wide by ⅞ inch thick, the length depending upon the size of the template which, of course, depends upon the size of pipe. Two of these pieces are straight, for the sides. The two others, for the top, are cut so as to form a semicircle. A light angle-iron ⅛ inch x ⅞ inch is placed around the inner side and the outside is covered by a ⅛-inch steel strap ¾ inch wide. This outer strap is raised at the top to form a handle.

Service Supports.—Where a trench is opened in a built-up street, there are always numerous gas and water services crossing the trench. These must be supported. If they are not, a sag will invariably occur when the weight of the back-fill comes on top of them. When these services are of iron, a low spot is formed and probably they will pull out at the main, thus causing a leak. In the case of gas, moisture condenses and stays in the low spot, and in time causes interruption in the flow of gas. When the service is of lead, which is now generally used for water services, there is no danger to be feared from sagging, but it may pull out at the main and thus cause a leak. To avoid these troubles, it has been found advisable to use the following support which is less expensive than repairs:—

Fig. 2.—Completed Canvas Cover on Joint.

Two legs 2 ins. x 8 ins. x length; one sill 2 ins. x 8 ins. x length under the tile pipe; one cap 4 ins. x 4 ins. x length; one strut 4 ins. x 4 ins. x length between the legs, to prevent them from buckling. (See Fig. 3.)

The size of this support may be increased when it is necessary to protect a main. For services the average bill of material is 30 ft. B.M. lumber and requires from ½ to 1 hour's labor to cut the pieces and put them in place. The average cost is $1 for each service protected, while if the service is not protected and is subsequently damaged, the repair will cost from $5 to $10. Breaks or interruptions invariably occur either in the trench, union or main where proper protection is not given, while they practically never occur where the above-mentioned protection is used.

Protection Given to a Sewer in Soft Ground.—Where the ground is of a soft nature a pipe would unquestionably settle or perhaps rise as soon as placed. Under such conditions it has been found advisable to use the following construction:—

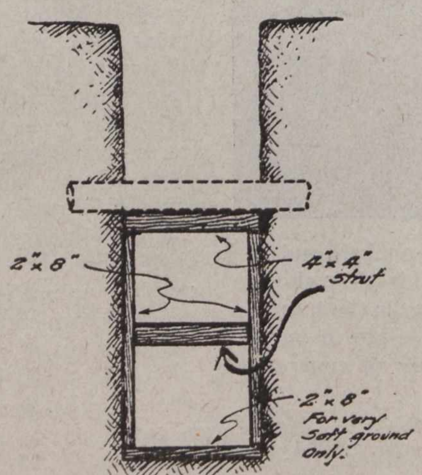


Fig. 3.—Protection Against Mains Settling.

The earth is taken out to a depth of 7 inches below grade and the trench made wider by 4 inches. A box or trough is then made as shown in Fig. 4, 2-inch plank generally being used. This box is 6 feet or more in length, according to convenience. It is lowered to the bottom of the trench and set to grade 5 inches below the grade of the pipe. Four inches of concrete, 1 : 3 : 5 mix, is then placed in the box, the pipe set to grade, then the sides filled with concrete. Sometimes, where the ground is very soft, such as in the case of running-sand, it has been found advisable to drive small stake-piles to resistance on either side of the trench, and about 3 feet apart. Sills are placed on them across the trench and then the box is placed on these sills.

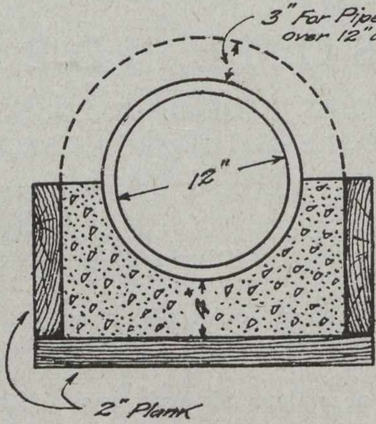


Fig. 4.—Type of Construction to be Used in Soft Ground.

SEWAGE TREATMENT FOR CHIPPAWA, ONT.*

Chippawa is a village of 700 people, situated on both banks of Welland River at its confluence with Niagara River. The community is essentially rural and obtains its water supply from wells, which fact leads to a local feeling that drainage of some kind is needed, for at present any sanitary drainage is limited to two or three private lines to the branch river.

Owing to the presence of the dividing river, sewage treatment for this community would be somewhat costly, involving the construction of parallel interceptors on the two banks, and, if duplicate treatment is to be avoided, requires a siphon from one side to the other. These factors, together with the scattering development, would probably entail the construction of 7,000 lineal feet of intercepting sewer, of which 2,500 feet on each side of the river is applicable to the collection, with 2,000 feet of outfall to a treatment site, which has been placed tentatively at the northerly edge of the village. With interceptor lengths as stated, and to treat the sewage from a population of 850, a rough first-cost estimate would run about as follows:—

SEWER.	
7,000 lineal feet interceptor, at $3	$21,000
Extra for siphon crossing	2,000
1 automatic pump	800
TREATMENT.	
850 persons at $5	4,250
Total	$28,050

Annual charges would be about $2,200, of which $520 are allowed for labor, material and power.

*Abstract from report to International Joint Commission, by Prof. Phelps, consulting sanitary engineer to the commission.

RESEARCH ORGANIZATION.*

By W. R. Whitney,
Director Research Laboratory, General Electric Company.

WHEN the war is over it will probably be found that there has been established in many countries a much more methodical and extended interest in, and support of, research than existed before. While it was Germany that set the example for half a century, there was a tendency in America to follow her example even before the war. The American Association for the Advancement of Science had, in 1914, appointed a Committee of One Hundred to promote coöperation between the industries and universities. Scientific journals frequently published articles upon the subject, but the advance was slow. The awakening which the war produced has led to vigorously renewed activity, and a partial summary of the efforts already made among the English-speaking nations may be interesting. This is the more fitting at this time because of the United States Senate Bill 4874, recently introduced into Congress by Senator Newlands, of which the substance is as follows:—

"That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with engineering and the other branches of the mechanic arts, and to promote the scientific investigation and experiment respecting the principles and applications of the mechanic arts, there shall be established under the direction of the land grant college in each State or Territory. . . . a department to be known and designated as an 'engineering' or a 'mechanic arts experiment station.'

"That it shall be the object and duty of said experiment stations to conduct original researches, to verify experiments and to compile data in engineering and in the other branches of the mechanic arts as applied to the interests of the people of the United States, and particularly of such as are engaged in the industries; also to conduct researches, investigations and experiments in connection with the production, transportation, extraction and manufacture of substances utilized in the application of engineering and of other branches of the mechanic arts to industrial pursuits. . . .

"That bulletins giving results of investigations or reports of progress shall be published. . . .

"That for the purpose of paying the necessary expenses . . . the sum of fifteen thousand dollars per annum is hereby appropriated to each State and Territory. . . .

"That in order to secure, as far as practicable, uniformity of methods and economical expenditure of funds in work of said stations, the supervision of the proposed experiment stations shall rest with the Secretary of the Interior."

In other words, this Bill proposes to so supplement and extend the reseach bureaus of the United States Government that all branches of industry shall have the same advantages that agriculture already enjoys. It gives recognition to the fact that, as the basis of all industrial progress and substantial prosperity, scientific research is as much a governmental function as is education, of which it is, indeed, merely the creative phase.

In Great Britain the Board of Education is putting forth a "Scheme for the organization and development of scientific and industrial research." It "is designed to establish a permanent organization for the production of industrial and scientific research," and particulars were given in a report issued on July 26th, 1915. [Journal of the Society of Chemical Industry 34, 783 (July 31st, 1915).]

The scheme provides for the establishment of:—

(*a*) A Committee of the Privy Council responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research;

(*b*) A small Advisory Council responsible to the Committee of Council and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research.

The Committee of Council will consist of the Lord President, the Chancellor of the Exchequer, the Secretary for Scotland, the President of the Board of Trade, the President of the Board of Education (who will be Vice-President of the Committee), the Chief Secretary for Ireland, together with such other Ministers and individual members of the Council as it may be thought desirable to add.

. . . .

The first members of the Council will be:—

Rayleigh, Beilby, Duddell, Hopkinson, M'Clelland, Meldola, Threlfal, with M'Cormick as administrative chairman.

The present scheme is designed to estabish a permanent organization for the promotion of industrial and scientific research.

It is no way intended that it should replace or interfere with the arrangements which have been or may be made by the War Office or Admiralty or Ministry of Munitions to obtain scientific advice and investigation in connection with the provision of munitions of war. It is, of course, obvious that at the present moment it it essential that the War Office, the Admiralty, and the Ministry of Munitions should continue to make their own direct arrangements with scientific men and institutions with the least possible delay.

It is clearly desirable that the scheme should operate over the kingdom as a whole with as little regard as possible to the Tweed and the Irish Channel. The research done should be for the kingdom as a whole, and there should be complete liberty to utilize the most effective institutions and investigators available, irrespective of their location in England, Wales, Scotland, or Ireland. There must, therefore, be a single fund for the assistance of research, under a single responsible body.

It is obvious that the organization and development of research is a matter which greatly affects the public educational systems of the kingdom. A great part of all research will necessarily be done in universities and colleges, which are already aided by the state, and the supply and training of a sufficient number of young persons competent to undertake research can only be secured through the public system of education.

The primary functions of the Advisory Council will be to advise the Committee of the Council on

(i.) Proposals for instituting specific researches.

[*In view of the new industrial problems that must confront Canada as a result of the war, we have on several different occasions advocated a more intelligent effort in research work in Canada. The accompanying article from the "General Electric Review," outlines what is contemplated in this direction in other countries.—Editor.]

(ii.) Proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.

(iii.) The establishment and award of Research Studentships and Fellowships.

The Advisory Council will also be available, if requested, to advise the several Education Departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

Arrangements will be made by which the Council will keep in close touch with all Government Departments concerned with or interested in scientific research and by which the Council will have regard to the research work which is being done or may be done by the National Physical Laboratory.

It is essential that the Advisory Council should act in intimate co-operation with the Royal Society and the existing scientific or professional associations, societies and institutes, as well as with the universities, technical institutions, and other institutions in which research is or can be efficiently conducted.

It is proposed to ask the Royal Society and the principal scientific and professional associations, societies and institutes to undertake the function of initiating proposals for the consideration of the Advisory Council, and a regular procedure for inviting and collecting proposals will be established. The Advisory Council will also be at liberty to receive proposals from individuals and themselves to initiate proposals.

It is contemplated that the Advisory Council will work largely through sub-committees reinforced by suitable experts in the particular branch of science or industry concerned. On these sub-committees it would be desirable, as far as possible, to enlist the services of persons actually engaged in scientific trades and manufactures dependent on science.

The Advisory Council will proceed to frame a scheme or programme for their own guidance in recommending proposals for research and for the guidance of the Committee of Council in allocating such state funds as may be available. This scheme will naturally be designed to operate over some years in advance, and in framing it the Council must necessarily have due regard to the relative urgency of the problems requiring solution, the supply of trained researchers available for particular pieces of research and the material facilities in the form of laboratories and equipment which are available or can be provided for specific researches.

Office accommodation and staff will be provided for the Committee and Council by the Board of Education.

This is Great Britain's first step toward a general correlation of her industries with science, the necessity for which has been made overwhelmingly apparent by recent experiences.

In accordance with the tendency of the times the Commonwealth of Australia has initiated a similar movement, and an Advisory Committee appointed to formulate proposals to the Government in regard to the establishment of a "Commonwealth Bureau of Science and Industry" has already reported. [Nature 97, 38-40 (March 9th, 1916)].

"The proposals of the Committee are on lines somewhat similar to those of the British Government's scheme for the organization and development of scientific and industrial research. Primary as well as secondary industries are included, and particular notice may be directed to the recommendations as to the governing body of the proposed institute, by which, as consistently advocated in our columns, the balance of power is placed in the hands of men of science."

. . . .

The Committee, in formulating the following scheme, has been greatly impressed with the magnitude and the possibilities of the proposals made by the Prime Minister, and is strongly of opinion that the time has arrived for initiating the extensive scheme of scientific research work in connection with industry which he has outlined.

The Committee is convinced that the results of properly conducted investigations into many of the subjects referred to in his address will amply repay considerable expenditure and fully justify a bold and comprehensive policy being adopted. Not only will the results be a greatly increased productivity and output in many directions—in both primary and secondary industries—but the stimulus generally given to scientific research in relation to our industries will exert a powerful influence on our educational institutions and bring them and the industrial community to realize the commercial value of science more fully than hitherto. In fact, the initiation of the scheme will, in the opinion of the Committee, go far to inaugurate a new era in the economic and industrial life of the Commonwealth.

The proposals which follow will provide for the formation of a Commonwealth Institute of Science and Industry under the control of directors of the highest business and scientific attainment, acting with the advice and co-operation of a council representing science and the primary and secondary industries of Australia.

Recommendations.

(1) There should be established under Act of Parliament a Commonwealth Institute of Science and Industry.

(2) The functions of the institute should be:—

(i.) To consider and initiate scientific researches in connection with, or for, the promotion of primary or secondary industries in the Commonwealth.

(ii.) The collection of industrial scientific information and the formation of a bureau for its dissemination amongst those engaged in industry.

(iii.) The establishment of national laboratories.

(iv.) The general control and administration of such laboratories when established.

(v.) To promote the immediate utilization of existing institutions, whether federal or state, for the purposes of industrial scientific research.

(vi.) To make recommendations from time to time for the establishment or development of special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.

(vii.) The establishment and award of industrial research studentships and fellowships, to include either travelling fellowships or fellowships attached to particular institutions.

(viii.) To direct attention to any new industries which might be profitably established in the Commonwealth.

(ix.) To keep in close touch with, and seek the aid of, all Commonwealth and State Government Departments, learned and professional societies, and private enterprises concerned with, or interested in, scientific industrial research.

(x.) The co-ordination and direction of scientific investigation and of research and experimental work with a view to the prevention of undesirable overlapping of effort.

(xi.) To advise the several authorities as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

(xii.) To recommend grants by the Commonwealth Government in aid of pure scientific research in existing institutions.

(xiii.) To seek from time to time the co-operation of the educational authorities and scientific societies in the states with a view of advancing the teaching of science in schools, technical colleges and universities, where its teaching is determined upon by those authorities.

(xiv.) To report annually and from time to time to Parliament.

(3) The Committee gave careful attention to the relation between the proposed institute and the existing Commonwealth Laboratory. It was recognized that the daily routine of customs, naval and military stores, and other departments requires the performance of a great deal of important scientific work, particularly chemical analysis of material, and that the laboratories in which such routine scientific work is carried out must necessarily remain under department control, though they might with advantage be co-ordinated and their equipment increased. On the other hand, as the work of the proposed institute develops there will be an increased scope for work in national laboratories devoted to special branches of research and experimental investigation which are not otherwise provided for. Such laboratories and their scientific staffs should, in the Committee's opinion, be kept distinct and placed under the control of the institute.

In the future it will be necessary to undertake experimental work in connection with the growth of our naval and military defence, the testing of materials with regard to the physical reasons underlying deterioration and change of structure due to mechanical and heat treatment, and as to failure in operation under varying conditions, the testing and trying out of processes in connection with the metallurgical industry and biological and geological problems.

The highly specialized intricate work of standardizing electrical instruments and other scientific apparatus for use as substandards by different Government departments and other institutions in which research work may be carried on would also naturally fall within the functions of the institute.

A convincing reason for drawing a line of distinction between laboratories primarily for scientific research and laboratories primarily for the necessary routine work of departmental testing is that any attempt to combine the two would lead to confusion and hamper and weaken both branches of activity, and would tend to drown the research work for which the institute is being created.

It cannot be too strongly insisted that the qualifications of a staff for "researching" are different in character from those of a staff which is to carry out scientific routine testing.

(To be concluded in next week's issue.)

THE GREATER WINNIPEG WATER SUPPLY.

THROUGH the courtesy of W. G. Chace, B.A.Sc., chief engineer, we are able to present herewith some photographs of the work being carried out by the Greater Winnipeg Water District, together with some information as to the progress being made.

Fig. 1.—East End of Siphon at Boggy River Crossing.

During the season of 1915 work was carried forward on the concrete aqueduct at the following points:—

	Mile No.	Progress in 1915.
Contract No. 30	23	6,525 lin. ft.
	24	7,405 "
Contract No. 31	33	5,925 "
	40	*1,800 "
	43	3,055 "
Contract No. 32	51	4,995 "
	57	8,925 "
	65	†9,401 "
Contract No. 33	71	6,060 "
	77	4,033 "
Contract No. 34	85	5,266 "
		65,390 lin. ft.

* Circular pressure section.
† Including Whitemouth River crossing.

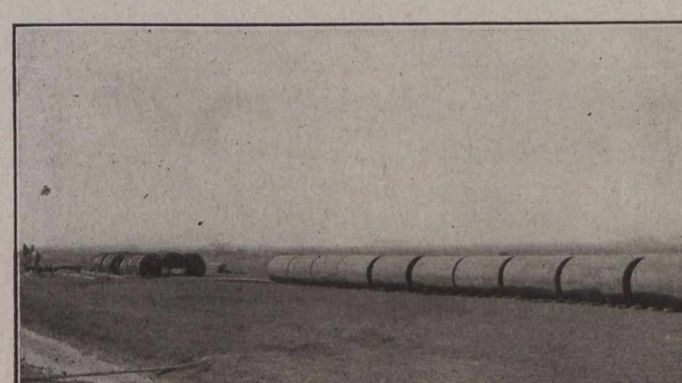


Fig. 2.—Steel Forms for Circular Pipe.

Throughout the winter, work was carried forward by the contractors at the following river crossings: Birch River, Boggy River No. 1, Falcon River.

The east end of the siphon at Boggy River crossing No. 1 is shown in Fig. 1. The boat-house structure is shown on the east bank of the river. A similar boat house is located on the west bank of the river. These boat houses afford facilities for the inspection of the aqueduct. In the boat house on the east bank a blow-off pipe is provided for draining the aqueduct.

Fig. 3.—Bucyrus Drag Line Bucket.

In order to overtake their schedule the following camps have been opened up: Contract No. 30, Mile 17; contract No. 34, Mile 89 and Mile 97.

Fig. 2 shows the Blaw steel forms for the circular pipe at Mile No. 17.

Fig. 3 shows the bucket of the class No. 24 Bucyrus drag line used by the contractors on contract 34 at camp

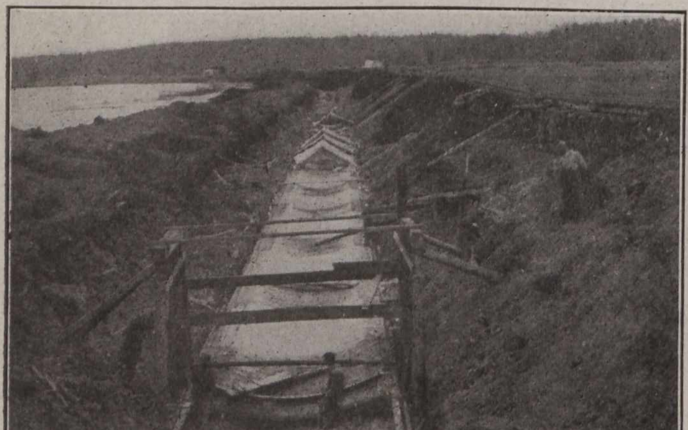


Fig. 4.—Inverts—Just West of the Intake Along Indian Bay.

7, Mile 89. General Superintendent Wm. Smaill, of the Winnipeg Aqueduct Co., is shown beside the bucket.

Fig. 4 shows the inverts laid just west of the intake along Indian Bay. In the foreground a railway trestle is shown in process of erection for railway connection to dock where supplies are brought by boat and barge from Kenora. The tent covers over the invert are used to protect the inverts for finishing from the effects of bad weather.

Fig. 5 shows the arch completed on the inverts shown in Fig. 4. A travelling chute is shown in foreground for depositing the concrete.

In order to furnish aggregate for concrete to meet the increased progress on the various contracts the Water District made certain changes in their gravel plant at pit

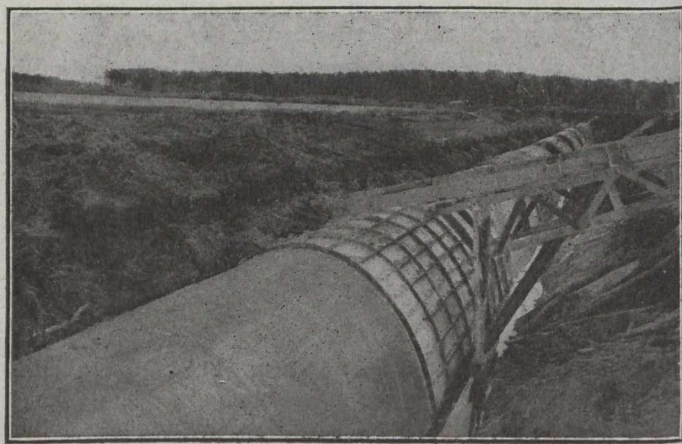


Fig. 5.—Completed Arch.

No. 1 and opened up pit No. 2, Mile 80, and a rock plant at Mile 95.5.

Rock is added to the government pit gravel in order to reduce the sand content in the aggregate. Fine sand, government pit gravel and rock are used to make the aggregate for concrete at the east end of the work. The western portion is supplied from the District's gravel plant at pit No. 1.

At the end of December, 1915, 65,390 lin. ft. of arch had been laid, and at the end of June, 1916, this had been increased to 85,340 lin. ft. The total length of the concrete aqueduct is 449,000 feet.

NEW INCORPORATIONS.

Regina, Sask.—Harris Engineering Company, Limited, $20,000.

Victoria, B.C.—Victoria Gravel Pit Company, Limited, $100,000.

Vancouver, B.C.—Mahwitte Dredging Company, Limited, $250,000.

Edmonton, Alta.—Crown Sand and Gravel Company, Limited, $150,000.

Toronto, Ont.—Wright-Hargreaves Mines, Limited, $2,500,000. M. McDowell, G. R. Sproat, C. H. Kemp.

Quebec, Que.—The Victor Quarry Company, Limited, $25,000. V. Mercier, Jeanne Turcotte, Berthe Blanchet.

Woodstock, Ont.—The Woodstock Reinforced Concrete Post Company, Limited, $40,000. B. Blair, J. W. Clark, R. Gibb.

Montreal, Que.—The Oka Gold and Lead Mining Company, Limited, $1,000,000. T. Scott, J. E. Moranville, J. J. Trickey.

Port Arthur, Ont.—Canadian Conley Frog and Switch Company, Limited, $150,000. W. F. Langworthy, G. A. McTeigue, Laura McComber.

Toronto, Ont.—The Caswell Mining Company, Limited, $1,000,000. B. F. Fisher, W. N. Robinson, Ida B. Lynn; the Arnot Construction Company, Limited, $40,000. D. Arnot, O. Rouse, J. B. Nicholson; North Victoria Lead Mines, Limited, $49,500. W. H. O. Mercer, Irene O. Allan, Lily Guylar, Ethel M. Gallagher; Peerless Artificial Stone, Limited, $40,000. G. H. Shaver, E. A. Harris, Gertrude B. Marrin.

THE CONSTRUCTION OF HIGHWAY BRIDGES.*

By Lucius E. Allen, C.E.,
Engineer, County of Hastings.

A CONSIDERATION of any scheme of highway development must include as a component part of such system its highway bridges, which in many highways bears no small part of the total cost of the road. In view of this fact, a careful study on the part of highway officials and engineers should be given to the designing and construction of bridges that in point of cost and durability, combined with the utmost safety, will best conform to present and future conditions upon our highways.

While the wearing surface of the roadway will wear out and require renewal from time to time, the bridge structure should be so constructed as to be practically permanent. To attain permanency in bridges as in other structures requires not only careful designing at the start, but also the judicious selection of those materials best adapted for that particular bridge, and finally, experienced workmanship in combining the materials at hand into a finished structure.

It would be of little interest to many attending this Congress to enter into a technical discussion of the engineering of bridge design, but there are certain facts common to almost every bridge that is to be constructed, which have an important relation to the life of a bridge, which should be of interest to everyone connected with highway work. One common error often made in the construction of a bridge is the lack of attention paid to securing a good foundation. It matters not what the superstructure may be, whether of steel or reinforced concrete, unless the foundation is sound, the superstructure may be damaged beyond repair. Accurate and careful soundings should always be taken to determine the character of the bottom upon which the abutments or bridge piers will rest. This may be done by the use of steel rods driven until either solid rock or a sound foundation is found. In some cases a wash drill outfit may be used consisting of a drill point attached to short sections of iron pipe which may be connected together as the drill penetrates into the soil. Water is forced through this pipe by means of a force pump and in this way the character of the subsoil can be determined. In rivers or streams where ice conditions are severe, it is usually necessary to trench into the rock bottom so that the pier will have proper and secure footing to withstand ice jams. This also prevents underwashing of the pier from the currents existing in the stream.

As a general rule it is not advisable to construct the arch type of reinforced concrete bridges upon anything less than a good rock foundation or its equivalent. Where the foundation conditions are not suitable for the use of the arch type of bridge, the girder-beam type of reinforced concrete may be used. In this type, should settlement subsequently occur in the abutments, the concrete slab would still be intact, the reinforced concrete beams acting in a similar capacity to the steel girders in the girder type of steel bridge.

Due attention should also be given to the size and type of piers and abutments. In some cases it is economy to use reinforcement in the piers and abutments, thereby reducing the size of the pier and abutment and adding to its strength and ability to withstand heavy lateral strains. The wing or revetment walls connected with the abutments should be constructed of such height and length as to prevent backwashing of the abutment, and also retain to a proper slope the earth approaches to the bridge. In some cases it is advantageous to start the growth of willows along the edge of the stream adjoining the wing walls to further restrict washing, etc. It is important to remember that as in many sections of this country the forests are being depleted, the watersheds of many rivers and streams, while not being changed in area, yet the spring run-off of water is much quicker than formerly, thereby increasing the danger of washouts to bridge foundations. It is therefore good practice to anticipate such conditions, and so construct the foundations of our bridges as to withstand the test of time.

Selection of Type of Bridge.—Unlike highway construction, there can be no standard type of bridge that will be adapted for every locality. Local conditions should in every case govern the choice or selection of the type of bridge. This will, in most cases, resolve itself into a consideration of three points: length of span and head room; character of river or stream as well as traffic conditions; and the character of the foundation available.

The length of span will depend largely on calculating the relative cost of long spans with fewer piers, or shorter spans with an increase in the cost of the foundation. The cost of the superstructure should be made to balance as near as possible the cost of the substructure. In some cases the lack of head room or elevation of the approaches to the bridge will prevent the adoption of the reinforced concrete arch type, in which case the girder-beam type may be used to advantage.

If steel is selected as the best material to use for a bridge, the length of span will determine the type of truss. Usually in bridges with spans up to 75 to 80 feet the low truss type is the most economical, above 80-foot span length the high truss type is usually used. The use of pin-connected truss bridges is being displaced to a large extent to the use of riveted sections, either singly or made up of angles, channels and plates.

The girder-beam type of reinforced concrete bridge above 45-foot span is not usually as economical as the arch type. In the construction of reinforced concrete bridges too great care cannot be exercised in the selection of the best materials entering into the concrete. Many concrete bridges have been made failures simply from the use of poor material or inexperienced workmanship. The work of pouring the concrete should be as continuous as possible, especially in the slab or rib of the arch. A careful check should be made during construction to see that every piece of steel reinforcement is placed in its proper location in the bridge. Many times a careless workman, not realizing the importance of the location of a steel reinforcing bar, will displace it from its proper location, thereby weakening for all time the strength of the bridge. Sufficient camber and grade should be given the concrete floor slab to drain the water from the bridge floor. If solid concrete side walls are used, short sections of iron pipe may be placed at the bottom of the floor and through the side wall to drain the water quickly away from the floor.

As before stated, the character of the river or stream will in many cases determine the best type of bridge adapted for the locality, but the character and amount of traffic passing over a bridge should always be taken into consideration in determining the character and width of the bridge. While it is difficult in all cases to anticipate future traffic conditions on a given highway, on main con-

*Paper read before the Third Canadian and International Good Roads Congress.

necting roads or roads leading into large cities or towns, the traffic is very likely to increase. For ordinary country roads, a clear roadway of sixteen feet is sufficient for ordinary traffic. For main roads, where the motor traffic is heavy, a bridge width of twenty feet is not too great. In England, many of the old masonry arch bridges have in recent years been widened to accommodate the large increase in traffic.

It may be of interest to note that in a report presented by Mr. H. Howard Humphreys and Mr. W. J. Taylor, county surveyor, Southampton, England, at the Third International Road Congress in London, it is stated that of thirty-three engineers of county councils, who furnished information regarding the use of reinforced concrete for bridge work, eighteen reported that reinforced concrete had been used for the construction of bridges and culverts carrying main roads within their respective counties, while others were considering its use.

The reasons chiefly advanced by these county engineers in favor of reinforced concrete bridges, as compared with steel and masonry, were "economy in first cost" and "economy in maintenance." If the floor slabs of reinforced concrete bridges are kept properly covered with from five to six inches of gravel or crushed stone, there will be little wear on the concrete surface of the slab itself.

The artistic design and finish of a reinforced concrete bridge should also not be neglected. With little, if any, additional expense artistic effects may be given to the concrete side walls by panels or open balustrades and suitable panelled end posts. If surfaced lumber is used for forms and the forms are removed before the concrete is too hard, the surface can be brushed and given a uniform appearance which will add much to the general effect of the bridge structure.

If steel has been chosen as the best material suited to the locality, the engineer for the municipality should prepare suitable plans and specifications which may be submitted to the various bridge builders for tender. The old practice of allowing each bridge builder to submit his own plans should be avoided, as in this way there is no uniformity of design, and many times price is the main consideration. The fabrication of the steel work should also be inspected, especially the riveted connections. While ordinary shop riveting is usually well done, the riveting done in the field in erecting the bridge is often poorly done. All rivets, after being driven and inspected, should be immediately painted in the field, previous to the painting of the entire bridge. Two coats of paint in the field in addition to the shop coat should be given the steel work, each successive coat being of a different color to insure every portion being covered.

Too much stress cannot be put upon the matter of painting steel bridges. Many steel bridges in Canada which when constructed were first-class bridges, through neglect to properly repaint them, have practically been destroyed. The writer has examined some steel highway bridges which were constructed from 12 to 15 years ago, which have had to be replaced by new bridges owing largely to the lack of proper painting. Steel is not often put to a more severe test than when used in bridge work, the action of moisture, water, the acids from the bridge floor, etc., all tending to contribute to rapid corrosion unless protected by paint.

The matter of the best type of floor covering for a given bridge is also of great importance. While the use of concrete as a floor covering adds greatly to the weight of the floor system, and thereby increases the size of the trusses, etc., it is generally considered to be better than wood floors on account of the lower cost of maintenance. On main highways, or in cities a combination of concrete and wood blocks makes a very durable bridge floor. The wood blocks should be creosoted, and the joints filled with pitch or asphalt to seal the joints. One advantage of wood block bridge floors is a reduction of vibration due to traffic, as well as being noiseless.

The capacity or safe load that a steel bridge is designed to carry is an important factor, and should be given attention before designing the structure. The future traffic requirements should again be borne in mind, as it is much easier to design a bridge for a 20-ton moving load than after having been constructed to reinforce or strengthen it for increased loads. Owing to the increased use of heavy road-making machinery, such as traction road rollers, etc., which pass over bridges, it is necessary to design the bridge to safely take a maximum load equivalent to the weight of this machinery.

The load capacity for different highway bridges may very conveniently be divided into two or more classes, depending upon traffic, and ranging from bridges capable of carrying 10 tons up to 20 tons or more, which will ordinarily be sufficient for any heavy moving load as above mentioned. Allowance should also be made for decrease in strength due to age, so that at the end of, say, 50 years what was originally designed as a 20-ton capacity bridge, may have fallen to 15 tons loaded capacity.

There are many other details which time will not allow me to mention that must be considered in selecting and constructing a highway bridge that combines economy of design with permanency. It is, however, a source of much gratification to highway engineers that more careful attention is being given to this important branch of highway work than formerly, and great advancement has been made within the past few years in methods of construction, so that when the construction of a great Canadian national highway from east to west is commenced, as we believe it will be, the construction of its bridges will conform in beauty and permanency with that of the highway itself.

Discussion.—D. D. Gray, experimental farm superintendent, Ottawa: I would like to ask Mr. Allen what he thinks the depreciation of value would be of a well-built concrete bridge per year.

Mr. Allen: I always estimate that a properly constructed reinforced concrete bridge, assuming that your foundations are good, is practically a permanent structure; the only depreciation will be in your floor slab. If that is kept properly covered with gravel or stone, even that will be practically nil. I may say there is an instance of one bridge in France, which is now probably fifty years of age, which is in just as good a condition to-day as when it was built, and the materials of that time, such as cement, were not as good as the cement which is made to-day.

Mr. Gray: That is a question I wanted answered because a great many of us, making roads and bridges, forget permanency in the jobs we are doing, and I think that one of the prime things we should consider is whether it is going to last forever.

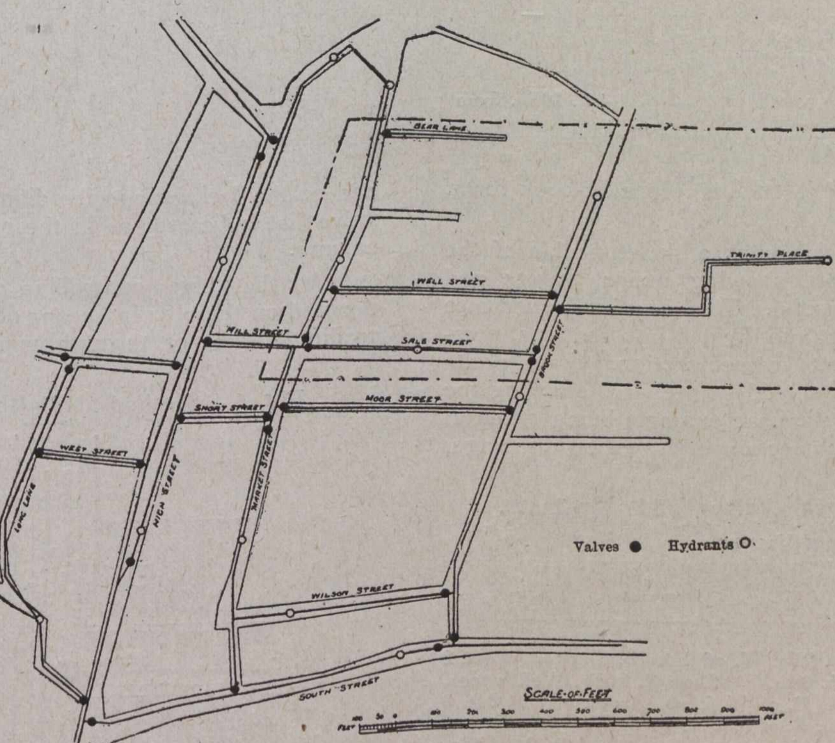
Mr. Allen: That is the great advantage of reinforced concrete for bridges; they may cost more, but, if properly built, they are established for all time.

PLANS AND RECORDS OF WATER DISTRIBUTION SYSTEMS.*

By William P. Walker, A.M.I.Mech.E.

THE keeping of correct plans and records of underground mains is very necessary for the successful management of waterworks distribution systems, yet it is exceptional to find this important work properly done. Some undertakings have no records kept at all, and are therefore almost entirely dependent upon the memory of the turncock, foreman, or other official in charge of the mains for information in connection therewith, a state of affairs which is certain to lead to confusion at some time or other. Under such circumstances time and money are often wasted in opening up roads or paths to locate the mains or service connections, which would be entirely avoided if correct records of the mains had been systematically kept.

When main or service laying is in progress the fullest information regarding the same should be carefully noted by the foreman or the inspector in charge of the work in a notebook kept specially for the purpose. Scraps of paper should never be used, owing to the ease with which they may be lost. The information should include the date when the work is carried out, the internal diameter and length of every pipe laid, and the depth and position of the main or service. It may also be an advantage to note the position of any other pipes or electric cables which cross the water mains. The position of the main may be conveniently measured from the nearest curb-line.



Skeleton Plan of Distributing System.

To locate the position of valves, plugged branches and other special fittings, at least two measurements should be taken from permanent objects, such as curb lines, centres of doorways, or corners of buildings. Such measurements are especially useful in the case of valves, because these are sometimes inadvertently paved over when roads are being remade or repaired, and thus become inaccessible as well as difficult of location.

Mains Record Register.—A mains record register should be compiled from the information contained in the foreman's notebook previously described, and should be kept at the manager's office for reference. A convenient size for the book is 8 ins. by 13 ins., the pages being ruled and headed as in the sample given. It should be provided with an alphabetical index in which the names of the streets or roads are entered.

The information on the register is recorded on the plan shown. The folio number at the top of the register refers to the record of the 6-in. main in High Street to which the 3-in. main is connected.

It will be seen that a record is kept of every pipe laid, and the length of every pipe is also given. This is found to be exceedingly useful in the event of leakages occurring at the joints of mains, owing to the facility with which joints may be found by measurement from the nearest valves or other fittings which have their positions recorded, thus saving any unnecessary excavation. Records of the services may be kept in similar books. These should show the length of the service from the stop-cock to the main, and would indicate the position of the main at that point. These registers may be books on the loose-leaf system, which admits of the insertion of explanatory tracings or sketches of intricate crossings, also of the addition of new pages when alterations or extensions have been made to the original mains.

Plans of Mains.—The plans of mains should be plotted upon large-scale ordnance maps, from the detailed information in the mains register. Pipe lines may be indicated by firm blue lines. No useful purpose will be served by plotting every individual pipe on the plan, but special pieces, such as tees, valves and bends, should be shown and their positions accurately plotted to scale. Valves can be denoted by red circles, and hydrants by blue circles, and exceptional depths of the main may be noted in red figures, also the radii of bends in the mains. It is of the greatest importance that the plans should be kept thoroughly up to date and whenever alterations are made in the mains or street lines the new positions should be accurately measured and the plans altered accordingly. The plans should be numbered, and may be kept flat in drawers or folded into four and mounted in stiff board covers, the latter method economizing space for storage. For the sake of durability they should be mounted upon linen, or preferably upon three-ply board which, being stiff, not only protects them but enables them to be handled with more ease. These plans, used in conjunction with the records register, will give all the necessary information for the location of any particular pipe.

If desired, the premises occupied by each consumer may be colored or cross-hatched on the ordnance maps, and its number in the service register noted thereon, as shown on Fig. 1.

Valve-Location Books.—On occasions when a new turncock or foreman is placed in charge of any given portion of a distribution system, unless he has served under his predecessor, some time may elapse and a great deal of inconvenience be caused before he has learned the positions and uses of the valves controlling his district. In such a case a valve-location book, which consists of a

*Paper read before the Institution of Water Engineers.

Mains Record Register: Specimen Page.

<— 8 inches —> <— 8 inches —>

Off 6 in. × 3 in. branch North, Folio 20, Volume I Mains Register.

Date.	Street.	Pipes.		Depth.	Position.		Remarks.
1915. Sept. 1	Weston Street working North	1	3 in. ×2 ft.	3 ft. 2 in.	—	Centre of Book	———
		1	3 in. S.V.	—	4 ft. from line E. kerb of Weston Street		3 in. valve 4 ft. S. of line of N. kerb in High Street.
		15	3 in. ×9 ft.	—			Service off 4th pipe to No. 4, Weston Street.
		1	3 in. ×6 ft.	—	—		
		1	3 in. ×3 in. T (West)	—	—		3 ft. 6 in. N. of line of S. kerb Station Street.
		4	3 in. ×9 ft.	—	—		Off branch of Tee 3 in. main along Station Street, Vol. I., Folio 36.
		1	3 in. ×3 in. T (East)	—	—		1 ft. 6 in. S. of centre doorway, No. 20. Off branch of Tee supply to hydrant. Hydrant Register I., Folio 6.
		3	3 in. ×9 ft.	—	—		
		2	$\frac{1}{16}$ bends (W and straight)	—	—		
		4	3 in. ×9 ft.	—	4 ft. 10 in. from E. kerb		

sectional skeleton plan of the mains in pocket-book form, will prove invaluable.

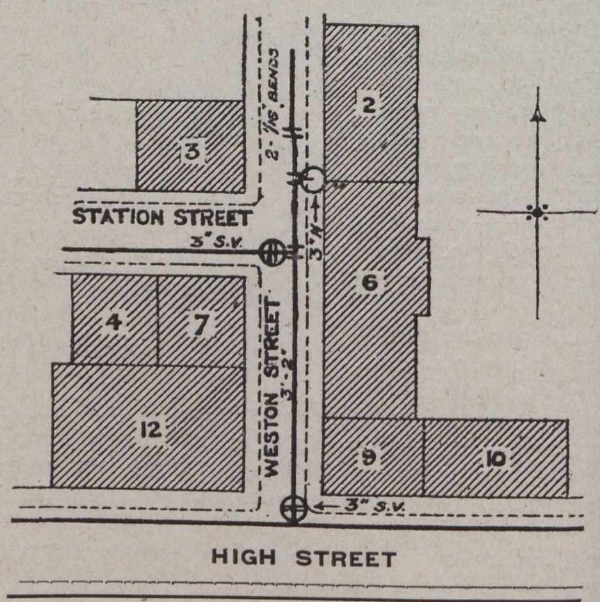
In connection with this book a skeleton plan of the whole distribution system, showing mains, valves and hydrants, will be found useful. This may be divided into districts, and each district sub-divided into sections, comprising three or four streets in each section. Small skeleton plans of each section should be prepared showing the valves controlling the section, an example being given in Fig. 2. The plan of each section is drawn on one page, and on the facing page the diameter and position of each valve is indicated, as in the example printed in next column.

All the valves controlling dead ends of mains are denoted on the plan by means of letters, while valves controlling circuit or through mains are numbered. The figures enclosed by circles at the ends of the mains in the sectional plans (Fig. 2) denote the pages in the valve-location book where the adjoining sections may be found. The names of the streets in the section are shown above the plan, and the book is provided with a suitable index. A valve-location book of this character should be provided for the turncock or foreman in charge of each district, as by its aid he would be in a position to take charge of a

Main Valves, Branch Valves and Hydrants.

No.	Size.	Street.	Remarks.
			MAIN VALVES.
1	3 in.	Well Street...	3 ft. 2 in. W. of E. kerb, Market Street, 2 ft. 9 in. S. of line N. kerb, Well Street.
2	,,	Well Street...	4 ft. E. of W. kerb, Brook Street, 2 ft. 9 in. S. of line N. kerb, Well Street.
3	,,	Market Street	Opposite centre door No. 101, 3 ft. 3 in. W. of E. kerb, Market Street.
4	,,	Sale Street ...	4 ft. 6 in. S. of N. kerb, Sale Street, 1 ft. 4 in. W. of E. kerb, Market Street
5	,,	Brook Street	11 ft. S. of centre of door, 42 Brook Street, 4 ft. E. of W. kerb.
6	,,	Brook Street	6 ft. N. of line S. kerb, Sale Street, 4 ft. E. of W. kerb, Brook Street.
			BRANCH VALVES.
A	,,	Bear Lane....	In line of kerb, Market Street, 2 ft. S. of N. kerb, Bear Lane.
B	,,	Trinity Place	1 ft. 6 in. N. of S. kerb, Trinity Place, 3 ft. E. of W. kerb, Brook Street.
			HYDRANTS.
1	,,	Market Street	On W. footway, 3 ft. S. of centre of doorway, 24 Market Street.
2	,,	Sale Street ...	On N. footway, opposite centre doorway of 16 Sale Street.
3	,,	Brook Street	4 ft. E. of W. kerb, 2 ft. 9 in. S. of centre of doorway of No. 1 Brook Street.
4	,,	Trinity Place	On E. footway, 4 ft. south of centre of gateway of No. 4 Trinity Place.
5	,,	Trinity Place	3 ft. S. of N. kerb, Trinity Place, in line with dividing wall of Nos. 14 and 15.

Fig. 1.—Method of Plotting Mains on Maps.



The numbers of the buildings refer to the folios of the house services in the service register.

new district at short notice, and could be moved from one district to another without inconvenience. Incidentally, this system does away with the necessity for indicator-plates to show the location of valves.

The system of keeping records above described was adopted by the London Hydraulic Power Company at its inception, and has been applied to their system of upwards of 180 miles of distribution mains with great success. The writer can appreciate the value of the system, having been

No. 2 East District.
Market Street, Well Street, Sale Street,
Brook Street, Bear Lane, Trinity Place.

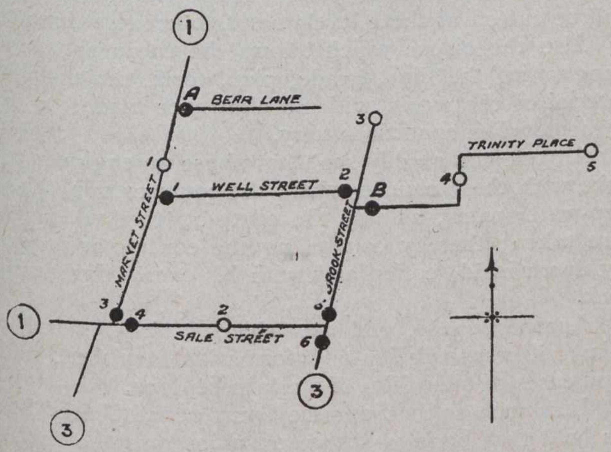


Fig. 2.

engaged with the London Hydraulic Power Company for a number of years.

In conclusion, the writer tenders his thanks to Mr. E. C. Haarer, M.I.Mech.E., engineer to the London Hydraulic Power Company, for his permission to describe the system and for the information he has given him concerning recent improvements in the methods of keeping the records.

He has brought the subject before the institution feeling confident that this system could be adopted with advantage by water authorities generally.

RAILWAY EARNINGS.

The following are the transcontinental railway earnings for the first three weeks of July:—

Canadian Pacific Railway.

	1916.	1915.	
July 7	$2,616,000	$1,666,000	+ $ 950,000
July 14	2,738,000	1,635,000	+ 1,103,000
July 21	2,641,000	1,670,000	+ 971,000

Grand Trunk Railway.

July 7	$1,155,029	$ 990,278	+ $ 164,751
July 14	1,211,393	989,629	+ 221,764
July 21	1,140,226	980,998	+ 159,328

Canadian Northern Railway.

July 7	$ 885,100	$ 429,400	+ $ 455,700
July 14	874,900	449,700	+ 425,200
July 21	866,900	447,700	+ 419,200

The Canadian Northern Railway's statement of earnings and operating expenses for June is as follows:—

	1916.	1915.	Increase.
Gross earnings	$3,377,200	$1,779,600	+ $1,597,600
Expenses	2,392,200	1,386,300	+ 1,005,900
Net earnings	985,000	393,300	+ 591,700
Mileage in operation ..	9,296	7,761	+ 1,535

THE RELATION BETWEEN ENGINEERS AND CONTRACTORS.*

By J. W. Rollins.

THE engineer and contractor of the present day are both technical men—the one designing the work and then superintending its construction; the other working out the best method for doing the work and then carrying out the actual construction under the direction of the engineer.

This relation has materially changed in the last few years owing to the great development in modern engineering. In the old days when work was done mainly by hand labor the engineer was "boss" in many ways, and the successful contractor was the one who could drive his men to the limit, but who had no technical knowledge and in many cases no education, but was guided by that greatest of all gifts, "common sense." He looked up to the engineer as his superior and expected from him such instruction and direction as was necessary to keep him out of trouble.

To-day, however, the situation is entirely changed, and the contractor is often obliged to have more technical knowledge in order to execute work than the engineer who designs it.

It is not a difficult proposition for an engineer to draw a plan showing a foundation for a bridge in water 100 feet deep, possibly in a swift current and in the midst of navigation; or to show a subway 50 feet below heavy buildings in a crowded thoroughfare, under the surface of which may be an electric conduit of 20,000 or 30,000 volts, large water mains under 200 pounds pressure, steam pipes with 500 pounds of live steam, added to sewers, telephone and telegraph lines without number and possible electric conduits for street car traffic; but to construct such work successfully requires a contractor with great technical skill and knowledge, a man with great resources and strong nerves to meet all the troubles which may arise.

The writer heard Colonel Goethals, of Panama, make this statement: "The people think the Panama Canal is a great engineering feat, but it isn't a particularly great work of that kind, but rather a job of handling a great amount of material; and as an engineering proposition the Panama Canal does not compare with the work done on the New York subways."

When the engineer gives out contracts for work of this kind he should have confidence in the contractors who will do the work; and in turn, the contractors should have full confidence in the engineer. That is, to get the best results there must be the heartiest co-operation between the man planning the work and the man doing it.

The medium between the contractor and the engineer is, of course, the contract and specification, and to these matters I would ask your particular attention.

A contract as defined by John Casson White "is a meeting of the minds of the contracting parties," and with this one definition in mind, I think the engineers and contractors could easily settle their disputes, if they could keep the lawyers out of the case. But they cannot, and the result is that most engineering contracts have many clauses which are most unjust to the contractors, who by signing them give up almost their "birthright."

That a contract in its terms should comply with the definition before given, "a meeting of the minds of the contracting parties," its terms should be so plain and explicit—as free as possible from legal verbiage—that any

*Abstracted from an address delivered before the Massachusetts Highway Association.

contractor of reasonable intelligence should understand what he is agreeing to do, when he signs the contract.

It should be assumed that when a contract has been awarded, the contractor expects to do the work called for in accord with the terms of the contract and specifications, and to make a profit on his work; that the engineer also expects to have his work done as he has specified, and if so done is willing to have the contractor make his profit. That is, he will do justice to his clients or employers by getting the work done well, and to the contractor in seeing that he is paid justly for what he has done.

There are often many terms and conditions in a contract, of which neither party knows the meaning, and often the lawyers who put in all the blind, blanket clauses make them so blind that their true meaning has to be settled by the courts.

Here is one of those legal clauses which the writer is certain never originated in the brain of an engineer:

"The said contractors hereby declare and agree that they shall be accountable for the full performance of this contract, and by signing hereof admit that the said plans, elevations, sections, specifications and parts before referred to are sufficient therewith, without any additional or extra work other than that set forth thereby or necessarily inferred to be done from the general nature and tendency of the plans, drawings and specifications aforesaid, upon a fair and liberal construction thereof."

This apparently innocent clause which at the time was looked upon as one of a lawyer's ideas of a proper contract and was not expected to be understood by the contractors, cost us $10,000, and a railroad company an equal amount.

We agreed to build the masonry for two abutments and a pier for a railroad bridge across a river. The plans showed the two abutments directly behind the old ones, with a clearance of about two feet at the foundation lines.

The abutments were 36 feet high and when the excavation got down to the footings it developed that the old masonry projected into the line of the new work, so that a cofferdam could not be driven to get the new foundations in. It so happened that the bridge was in a mill pond, so that by drawing the water off on Sundays we finally got the bottom in.

We also got into trouble with the pier, which was on piles with concrete deposited under water for a foundation. The piles were driven and the concrete deposited, and after a week or so an examination of this concrete showed it had not "set." We waited another week, then a month, and finally tried to pump the cofferdam out, with the result that the bottom "blew up," showing the concrete worthless.

Tests were made of the cement and it was proved to be all right, but in making tests using the river water the samples would simply "slump," and seven different brands showed the same result. Tests of the water showed it to be polluted by mills above the bridge so that the cement was ruined.

We had to drive a 6-inch dam under the bridge girders at an enormous expense, pump the dam out, deposit the concrete in the dry, and then build the pier.

Meanwhile we were discussing with vigor the matter with the engineers—finally, at the completion of the work, making a claim for extra pay on account of the conditions developed during construction.

Our attorneys, however, called our attention to the clause in the contract above read, whereby we had practically "guaranteed" that the work could be done according to plans and that we would not make any legal claims for variations.

The railroad people were fair in the matter and paid half the loss, which we were glad to get in face of the adverse legal opinion given us by our own counsel. But such a clause, in the opinion of the writer, is an absolutely unjust one.

There are other clauses and conditions for which, in the opinion of the writer, the engineer is responsible, and which completely nullify the drawings and general specifications and make absolutely indefinite the amount of work to be done. For instance:

"Excavations shall be made of dimensions indicated upon plans, where dimensions are given, or as otherwise directed."

"Piles shall not be driven below elevation 102 and shall be cut off at these levels unless otherwise directed."

Also the clause which allows the engineer to make changes in the line, grade, plan, form, dimensions or material of the work, with no allowance made for extra payment, when conditions vary.

Anyone can readily see what abuse an engineer could make with these clauses where the contract might be for deep-water work, as was the contract from which these were taken; thereby compelling the contractor to go to any depth inside cofferdams with his excavation and pile work.

Another clause, and one which is also general, disclaims all responsibility of information furnished, and in some cases of quantities of work to be done.

Inasmuch as the Supreme Court of the United States has held that borings shown on plans must be taken as the basis of the contract for such items as are covered by them, it would seem that this decision would be broad enough to cover all information given.

And why shouldn't information given be held as the basis of the contract? The engineer spends months in making plans and estimates and getting information upon which to base them. This information is, in the judgment of the engineer, correct, and on his part is the basis of the contract, and on this information the minds of the contracting parties "meet." It is an impracticability for a contractor to spend the time and money to investigate conditions of a contract as thoroughly as the engineer does, and he doesn't do it, although the contract says he must from his own knowledge make his bid.

So, when conditions change, why should not the conditions be met in a man-to-man fashion, and paid for in full justice to both parties? This is a vicious clause, one which causes much trouble and which should be eliminated from all contracts.

As to the matter of guaranteeing quantities: This is often a difficult matter, for unless investigations are very complete it is almost impossible to make even approximate estimates.

It generally does not hurt a contractor to have quantities increased, but many cause trouble to have them materially decreased, for this reason: On some jobs there is a large overhead, general and plant expense, and this expense in an itemized bid must be divided up among the items, and we generally try to add this expense to the items which are fixed or may be increased, but if some of these items are decreased these general expenses will not get paid for.

The writer is of the opinion that where quantities are given, even as "approximate," the courts have held that they must not vary more than 20 per cent. either way, and if they exceed this variation, may be subject to additional payment if this variation causes loss to the contractors.

"The quantities of the various classes of work to be done and materials to be furnished under this contract, which have been estimated as stated in the Information for Bidders attached hereto, are approximate and only for the purpose of comparing, on a uniform basis, the bids offered for the work under this contract, and neither the Commonwealth nor the Directors are to be held responsible if any of the said estimated quantities shall be found not even approximately correct in the construction of the work. The Directors further reserve the right to increase or decrease the quantity, or to omit entirely, any item or portion of the work as they may deem necessary without change of price per unit of quantity, provided that the net increase or decrease of the sum of all said items, as determined by the Engineer's final estimate, does not exceed twenty-five (25) per centum of the total of the original bid."

Here is another such clause:

"The Directors reserve the right to suspend the whole or any part of the work herein contracted to be done, if they shall deem it for the interest of the Commonwealth so to do, without compensation to the Contractor for such suspension, other than extending the time for completing the work as much as it may have been delayed by such suspension."

Two or three years ago we took a contract to build a railroad in New England in an inaccessible country, and spent $300,000 in plant, equipment and in getting it onto the line of work.

About this time came the crash in New England railroads, and we expected to be ordered to stop work. We were not, however, although I think there was a "stop clause" in our contract; and if trouble had come, where do you think we would have "gotten off"?

The idea of mutuality—the meeting of minds—is all forgotten. The intelligent engineer understands the contract, what it means and requires, but in case of dispute the lawyers come in, and the legal lights settle, or try to settle, with no idea of the mutuality.

The Supreme Court of the United States in overruling a decision of the Court of Appeals held that misleading boring records are ground for recovery of damages by contractors.

"This item is based on a charge of erroneous and deceptive borings and misrepresentations in the specifications and drawings."

"The specifications provided: 'The material to be excavated as far as known is shown by borings, drawings of which may be seen at this office, but bidders must inform themselves and satisfy themselves as to the nature of the material.'

"The material actually to be excavated consisted largely of stumps below the surface of the earth, buried logs, or cemented sand and gravel, none of the sand or gravel being described in the said drawings as cemented, and of sandstone conglomerate; and such materials were far more difficult and expensive to penetrate and excavate than ordinary sand and gravel as described in the drawings."

"The claimants were forced to rely wholly upon the information furnished them, the time not being sufficient to permit them to make their own borings, and they believed the information furnished them to be accurate and reliable."

The opinion of the court in concluding was: "For the error in not allowing the demand for greater expense of excavation and pile driving due to misrepresentation of material in the specifications and drawings, the judgment is reversed and case remanded for further proceedings in accordance with this opinion."

There is always much discussion as to clauses which for their execution call for what practically is an impossibility, and as to whether they can be enforced, or compel the contractor to pay the penalty.

DESIRABILITY AND PRACTICABILITY OF REGULATING LEVELS AND OUTFLOW OF THE LAKE OF THE WOODS.

By Arthur V. White and Adolph F. Meyer.

(Continued from last week's issue.)

Interests Using Lake for Domestic and Sanitary Purposes.—So far as the use of the waters of the Lake of the Woods for domestic and sanitary purposes is concerned, the interests primarily affected at the present time appear to be the Greater Winnipeg Water District and the town of Warroad. The Greater Winnipeg Water District is at present constructing an aqueduct from Indian Bay on Shoal Lake, as part of a gravity water supply for the city of Winnipeg and its suburbs. This diversion of water from the Lake of the Woods, for domestic and sanitary purposes, was authorized by the International Joint Commission on January 14th, 1914, with the following reservation:—

"That the present permission and order shall not be invoked or relied upon in any manner against the recommendations or report to be made by the Commission on the reference to it respecting the levels of the Lake of the Woods, and shall in no way interfere with the action of the Commission in that regard."

The bottom of the aqueduct at the intake is at elevation 1,050.82, sea-level datum. In order to be able to draw the contemplated 85 million Imperial gallons per day, or 158 c.f.s., from Shoal Lake, it will be necessary for the level of this lake to be at an elevation of not less than 1,058, sea-level datum. Under natural conditions, however, the level of the Lake of the Woods would have dropped very much lower, and the level of Shoal Lake could have dropped to about 1,055. In a state of nature, Shoal Lake, at least for the greater portion of the time, was undoubtedly a tributary water, and not an arm or inlet of the Lake of the Woods, as it virtually is under the present conditions of control. Shoal Lake might have been maintained at a high level by the construction of a dam at the outlet, at Ash Rapids.

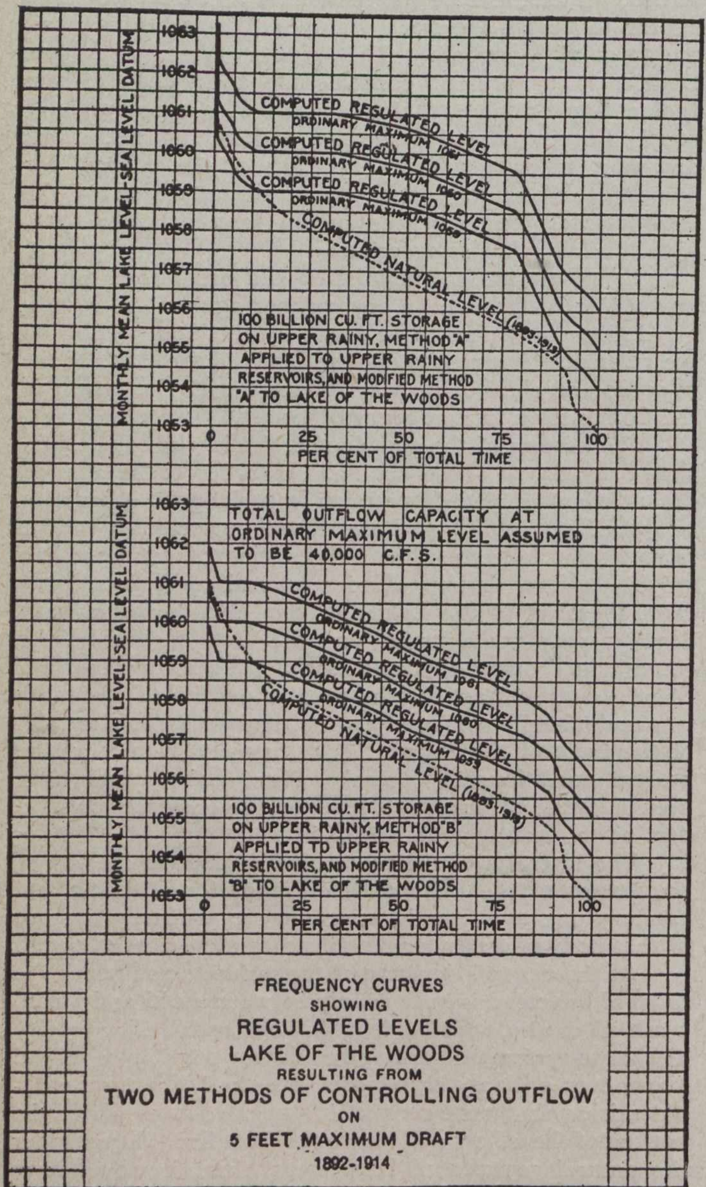
The interests of the town of Warroad, in the use of the waters of the Lake of the Woods for domestic and sanitary purposes, would appear to be primarily the use of that body of water for the purposes of sewage disposal.

As the general elevation of the ground upon which the town of Warroad is built is only between 1,066 and 1,068, sea-level datum, it is evident that the outlet of a gravity discharge system of sewerage could not possibly be placed above even ordinary high water in a state of nature, without raising the house connections of the sewers above the bottom of the cellars and above the frost line. Even under the natural regimen of lake levels, then, it would have been necessary for the town of Warroad to install some form of sewage lift for use during high water. For perhaps half the time, in a state of nature, the sewage might have been by-passed and discharged into Warroad River by gravity.

The present sewerage system at Warroad collects merely the house sewage, storm water being excluded. The sewage flows by gravity into a septic tank from which it is subsequently ejected by means of a siphon operated by a water jet. The discharge pipe is, approximately, at elevation 1,062.5, sea-level datum.

The increased cost of sewage disposal to the town of Warroad, directly attributable to increased lake stage, would appear to be about half the total cost of maintenance and operation of the sewage lift.

Navigation and Power Dam at Long Sault Rapids.—So far as navigation on the Rainy River is concerned, the outflow from Rainy Lake rather than the stage in the Lake of the Woods is the controlling factor in determining the ruling depth on this stream between the Lake of the Woods and the Fort Frances and International Falls dam. A combined power dam and navigation lock at the Long Sault Rapids would permit satisfactory navigation of the river, irrespective of the outflow from Rainy Lake. To be commercially valuable as a power development, however, such a dam would require to be built to an elevation which would result in additional backwater at International Falls and Fort Frances at certain seasons of the year. At present the backwater at this point, resulting from the constructed channel at the Manitou Rapids, averages 1.5 feet for the six months from December 1st to June 1st, and 0.5 foot for the six months from June 1st to December 1st, or an equivalent of practically 2 feet for six months. By prolonging the backwater throughout the open season, an additional head of virtually 2 feet would be gained at the Long Sault Rapids; *i.e.*, more head would be gained at the Long Sault dam than would be lost at the Fort Frances dam.



FREQUENCY CURVES SHOWING REGULATED LEVELS LAKE OF THE WOODS RESULTING FROM TWO METHODS OF CONTROLLING OUTFLOW ON 5 FEET MAXIMUM DRAFT 1892-1914

High discharges from the Big Fork and the Little Fork Rivers result in occasional short periods of extreme backwater at the Fort Frances dam. These extremes are not here given special consideration, other than to point out that it might be feasible to blast out part of the rock ledge forming the Manitou Rapids, so as to reduce, somewhat, the occasional extreme backwater at the Fort Frances dam.

With proper co-operation a 10 to 12-foot power development at the Long Sault Rapids would appear reasonably feasible. Such a development would produce an average of about 9,000 horse-power.

Water Powers on Winnipeg River Below Outlets.—The limitations upon the extent to which Nature's method of regulating the outflow from all large lakes can be improved upon by artificial methods of regulation, have already been mentioned in discussing reservoir control in general. (See *The Canadian Engineer*, July 13th, 1916, issue.) Apart from those considerations which involve the preservation of the equity of the various interests, large or small, affected by the levels of the Lake of the Woods and the outflow from that lake, it would appear that the principal consideration affecting the "development of all the interests involved on both sides of the boundary," and one which we regard as probably paramount, favoring some intelligent method of regulating the "volume, use and outflow of the waters of the lake" (of the Woods), and which, so far as practicable, should include the equalization of such outflow, is found in the great amount of water power which can economically be developed on the Winnipeg River below the outlets of the lake. A regulated flow of 16,000 c.f.s. falling through the 290 odd feet of fall available on that stream, at 80 per cent. efficiency, will develop over 420,000 continuous horse-power. These water powers, both developed and undeveloped, on the Winnipeg River below the outlets of the lake, are not directly affected by the level of the Lake of the Woods, so long as they secure adequate range in lake stage to permit of satisfactory equalization of outflow.

As a general rule, it does not pay to utilize water for power development which is available less than 50 per cent. of the time; that is, it is cheaper to operate an existing steam or oil power plant,—whose installation is required, in every case where more than the maximum continuously available stream flow is utilized in a water power plant, to supply power demands which must be met the year round, and also in those instances where some insurance against break-downs in the hydro-electric plant or transmission lines must be provided—than it is to pay the fixed charges and operating costs of a water power plant which can be operated less than half the time. The higher the price of coal, and the lower the additional cost of installation for the increased hydro-electric development, the higher will be the rate of discharge which, on a given stream, may be economically utilized. Under conditions prevailing in Canada, particularly on account of the rather high cost of coal delivered in the prairie provinces, it would probably be feasible to utilize water which is available a somewhat small portion of the time. Much would depend upon the conditions surrounding each particular development and the utilization of the power generated.

On the basis of the computed outflow from the Lake of the Woods, which would have prevailed under natural conditions during the past twenty-one years, it may be stated that 16,000 c.f.s. would have been available for nearly 50 per cent. of the time. The average amount of water which could have been utilized under natural conditions during this period of time by an installation capable of utilizing 16,000 c.f.s. is 13,980 c.f.s. Under the conditions of control which existed during the same period, about 14,000 c.f.s. would have been available 50 per cent. of the time, and the average amount of water which could have been utilized by an installation capable of utilizing 14,000 c.f.s. is 12,174 c.f.s. By regulating the outflow from the Lake of the Woods according to Method B (see *The Canadian Engineer*, July 13th, 1916, issue), so as to secure the maximum possible increase in the ordinary seasonal low-water flow, by means of a maximum range of 5 feet in the level of the lake, and with 100 billion cubic feet of total storage on the Upper Rainy reservoirs; in other words, by regulating the outflow so as to make available the greatest possible amount of water, capable of economical utilization in power development, there would have been an average of 14,742 c.f.s. available during the same period of time. While the increase in utilizable flow over that available under natural conditions amounts to only about 5.5 per cent., nevertheless, at $10 per horse-power per year, the average increase in utilizable flow, effected by regulation, would, under the 290 odd feet available fall in the Winnipeg River, represent a possible annual return of about $190,000.

Prevailing Levels Under Regulation.—The levels which would have prevailed on the Lake of the Woods if the outflow had been regulated according to either modified Methods A or B, by providing, for Method A, about 2.5 feet of reserve storage capacity to be used only at times of extraordinary high rates of inflow into the lake, and for Method B one foot of reserve storage capacity, and on the assumption that a total discharge capacity of 40,000 c.f.s. would have been available at the ordinary maximum level, are shown by means of the frequency curves of the accompanying diagram. Three parallel curves are drawn so as to show the levels which would have prevailed in the ordinary maximum level had been 1,059, 1,060, or 1,061, respectively. For purposes of comparison, the curve of natural levels covering approximately the same period of time has also been added.

Regulation according to modified Method B, while necessitating considerable fluctuation in lake level, nevertheless would result in a smaller range, both of yearly and of extreme fluctuation in level, than prevailed under natural conditions.

In case the meteorological conditions which resulted in a natural extreme high-water level of 1,062.5 should recur, under the condition of control by means of modified Method B, the lake would rise about two feet above the ordinary maximum level.

From What Basis Shall Advantage be Measured?—In order to determine what practical method of regulation will result in "the most advantageous use of the waters of the Lake of the Woods and of the waters flowing into and from that lake," and "of the shores and harbors of the lake," it is necessary, first of all, to determine from what basis advantage shall be measured. Without presuming to establish this basis, we desire to indicate that the regimen of lake levels and outflow which prevailed in a state of nature, at least from the viewpoint of certain riparian owners who, for years, have been protesting against the maintenance of higher than natural lake stages, would appear to afford an appropriate basis from which to measure the effects of levels which would prevail under various methods of regulation.

In this connection, however, the paramount right of the Federal Government of the United States to hold the level of the lake at "ordinary high-water mark" for the improvement of navigation, must be taken into consideration when ascertaining the net effect of certain regulated levels on the riparian owner. A stage of 1,059 appears to be fairly representative of ordinary high-water stages under natural conditions. The curves on the lower half of the accompanying diagram show that in case the outflow from the Lake of the Woods were regulated with a view to securing the maximum increase in the ordinary seasonal low-water flow, without attempting to store water which can be used only once in twenty or thirty years, and with similar regulation on Rainy Lake; and further, if an ordinary maximum level of 1,059 were established and if, whenever that level were reached, the controlling works at the outlets would be opened so as to discharge at least 40,000 c.f.s. if necessary, then the regimen of lake levels resulting from this modified Method B would not be disadvantageous to the riparian owner, when compared with the levels which prevailed in a state of nature. The average level would be a little higher, but the extreme high level would actually be lower than in a state of nature, and the ordinary high level would not be substantially changed.

If, under the same method of regulation, an ordinary maximum level of 1,060 were established, the *ordinary* high level would be raised about one foot, but the *extreme* high level reached perhaps once in twenty or thirty years under natural conditions, would not be exceeded. Similarly, if an ordinary maximum level of 1,061 were established, the *ordinary* high level would be raised about two feet and the *extreme* high level, occurring perhaps once in twenty-five years, would be raised a little less than one foot above the highest level which would have been reached, under natural conditions, during the period between 1893 and 1913. In other words, with an ordinary high level of 1,061, the land between the 1,059 and the 1,061 contours would ordinarily be submerged for a part of most seasons, and most of the land between the 1,061 and the 1,062 contours would be submerged for a few weeks perhaps once in twenty years, in addition to being frequently subjected to overflow for a few hours during storms.

If an ordinary maximum level, higher than 1,061, were established, correspondingly higher lands would be similarly affected.

WATER SUPPLY FOR TROOPS IN THE FIELD.*

By Jack J. Hinman, Jr.

It is quite as necessary to supply a water of unobjectionable quality for troops in the field as it is to supply water of like quality for cities and towns in time of peace. Conditions in the field make the provision of satisfactory water dependent upon a very different set of factors. In the field the selection of a supply is directed by expediency. It is often impossible to secure water from unpolluted sources. Owing to the exceptionally large temporary population, with comparatively meager sanitary arrangements for excreta disposal, the pollution of the water may be of a particularly dangerous character as well as of high concentration. The great number of men gathered into a locality may call for an amount of water in excess of that which has been provided by the local inhabitants in time of peace, thus necessitating the fullest use of all wells and streams.

The accidental and deliberate befouling of the water of streams and wells by a retiring enemy is to be expected. It is easy to conceive of the poisoning of water supplies by means of chemical poisons. Cultures of pathogenic organisms might be used.

Permanent camps in the vicinity of towns possessing waterworks may have potable water supplied by pipe lines or carried to the camp in tank-wagons. It would be necessary to have control of the operation of the plant and to keep them under careful guard to avoid interference. Rapid sand filtration plants, such as are used in city water-

*Abstract from Engineering and Contracting.

works, could be constructed in a few weeks' time. For a rapidly advancing army their use would be impracticable.

The advance troops are dependent for the most part on raw water or water which has been treated by chemical sterilizing agents alone, rather than by the more satisfactory process of coagulation and filtration followed by such sterilization. The water of streams has usually been protected merely by posting guards to see that all fording, bathing and watering of animals is done well down-stream from the designated source of the drinking water. Wells and springs known to be bad are carded or preferably put under guard. Men on patrol duty, advance parties, and men occupying exposed trenches or rifle pits must carry with them enough pure water to last until they can be relieved, or they must depend on the water of any available well, ditch or trench. The use of hot drinks, such as tea and coffee, is encouraged.

It is essential for any army advancing into unknown or hostile territory to know the condition of the water of all available supplies. This must be quickly accomplished, and until the actual knowledge is at hand, the water must be treated as if it were known to be heavily polluted. This work must be entrusted to specially trained men, and since they must work up to the first line, their duties are quite hazardous. I know of one German chemist who has lost his life in Belgium while collecting water samples. The British army entrusts this work to a combatant organization known as the Sanitary Corps. In the United States army the Medical Corps is responsible.

Many schemes have been proposed for the field examination of water. Most of these are attempts to make a rapid chemical examination, since the chemistry of polluted waters received attention long before the bacteriology of such waters.

The British army has for years had an official water-analysis case which could be carried as a part of a man's pack. It provided for the determination of chlorine, nitrites, nitrates, oxygen consumed and even the total solids and the ammonias. The Nessler's solution was provided in sealed tubes, but the other chemicals were furnished in tablet form. In this detail the outfit resembles the U.S.G.S. field analysis case, which likewise furnished the chemicals in tablets. The writer's experience with this case was that while the analyses could be readily carried out, the method required more time and was much more cumbersome than the ordinary laboratory procedure. To attempt to determine the ammonias in the field would seem unnecessary and consuming too great an amount of time, unless direct nesslerization were all that was attempted.

The present European war has brought out a variety of field analysis procedures. Vergnoux recommends that only the nitrite (Griess' method) ammonias and chlorine be determined. He properly notes that the chlorine determination is not indispensable. The Annales de Falsification prints a set of instructions for analysts in the field. This includes directions for the nitrite, ammonia, chlorine, oxygen consumed, and even the hardness determinations. Since chemical poisoning is to be reckoned with, special methods applicable to the detection of these have been devised. Kohn-Abrest has prepared an ingenious scheme in which he looks for chlorine, sulphur dioxide, bromine, organic iron salts, arsenic, nickel, cobalt, barium, lead, cyanogen, alkaloids and the glucosides. Fleury uses four reagents, hydrochloric acid, sodium sulphide, strontium sulphate and sodium picrate paper, Grignard's reagent for hydrocyanic acid. With the aid of these he is able to detect in the field arsenic, antimony, mercury, copper, lead, tin, zinc, aluminum, barium, cyanides and nitroprussides.

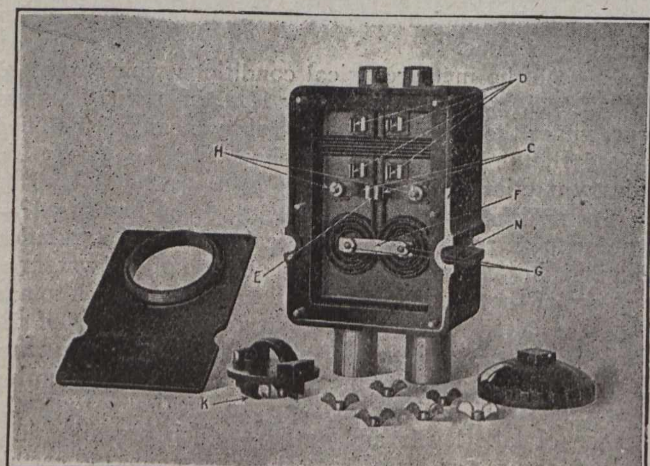
The bacterial examinations may be carried out in base laboratories or in mobile field laboratories. A number of rapid methods are available in addition to the usual laboratory procedure. Muller has a method for counting bacteria after precipitation from a known amount of water by use of basic ferric chloride. The micro-plate devised by W. D. Frost might be useful. This depends upon staining with methylene blue the colonies growing on a very small agar plate, after 6 or 8 hours' incubation. The count is made at a low magnification. Attempts at identification of bacteria would naturally take a longer period of time.

One method by which the sterilization of a water is verified consists in planting the same amount of water in each of a series of flasks of nutrient broth. Decreasing amounts of chemical have been added to each sample of the water. The last flask to remain clear on 24 hours' incubation contains the right amount of sterilizing agent.

NEW TYPE OF DISCONNECTING BOX.

A new disconnecting box which is especially adapted for use on series ornamental street lighting systems, has recently been developed by the Northern Electric Co., Limited, for use on series circuits, operating at potentials of 7,000 volts or less. Its function is to provide a means of disconnecting the lamps from circuits supplied with current by two conductor cable, and its greatest field of application will be found on ornamental street lighting circuits where the boxes will be installed in the pedestals of the standards.

An important feature of the design is the arrangement which allows both conductors of the circuit to be disconnected at each lamp post. This provides an easy means of testing the circuit in case of trouble, which is impossible with



View showing construction details of the S.J.B. Disconnecting Box.

other types of cut-outs where only one conductor is accessible. If the lighting system goes out of operation on account of trouble in the circuit, due to crosses or breaks in the conductor, the circuit can be opened up at any lamp post by unscrewing the nuts on the studs marked "H" and removing the phosphor bronze clips. The second conductor can be opened up at any lamp post by removing the link marked "F." If it is desired to test the circuit for continuity, it can be closed at any post by using the link "F" to connect between studs "G" and "H." This arrangement provides a miniature testing switchboard at each lamp post, which allows the circuit to be tested in sections until the trouble is located.

Another special feature of the design of the box is the provision of the grooves at the side "N," which allows it to be supported from the rear of the pedestal by suitable studs. The boxes have an ample factor of safety, and are tested at 20,000 volts before shipment.

Editorial

INDUSTRIAL PREPAREDNESS FOR PEACE.

Canada, like all other parts of the Empire, has had its trade very sorely dislocated by the war. The fact that we are far removed from the actual scene of hostilities does not remove the fact that the withdrawal of both men and money from their normal employment has had and will continue to have a far-reaching effect on the general industry and commerce of the Dominion.

Finding ourselves engaged in this war in a very real sense, it behoves us as a people to be ever on the look-out and prepare ourselves for the time when peace shall arrive.

This war has, without doubt, awakened Canadians to a fuller realization of the natural resources of their country. It has thrown us back upon ourselves in a way which perhaps no other one thing could possibly have done.

It is true some industries have been hard hit, many have been interrupted—some have been lost. At the same time, it can be said very truthfully that as Canadians we are standing the strain remarkably well.

If, however, we are to retain our place industrially we must learn to do for ourselves what others have been doing for us—we must be less wasteful in the use of our resources and devote more attention to their more adequate development. The natural products of the Dominion have been sent abroad only to be worked into finished articles and reshipped to us. Why not learn to manufacture more of them here?

The time has surely arrived when we should work out our industrial independence more fully than we have in the past.

The time to prepare for the industrial struggle that must follow the war is now. If we do not attend to it now it is more than likely we will lapse into our old helpless dependence and may never realize the destiny of becoming a really great industrial nation.

EFFICIENT ECONOMY.

There is no doubt that the present abnormal conditions call for abnormal measures in connection with municipal and commercial undertakings in all parts of the Empire, and in most neutral countries. There is a tendency in some parts of Canada to adopt somewhat harsh measures to reduce the financial burden resting upon ratepayers, and while the city aldermen are supposed and expected to know what is necessary for the welfare of their electorate, it is a question whether due regard is paid to the effect of their decisions upon their cities in a more indirect manner. Shortly after war broke out, it is reported that in at least one Canadian city the council decided to dismiss the entire civic staff, excepting those on active military service. This was done, it was stated, for economy. It was further reported that the majority of the staff would be re-engaged at more economic salaries.

It is regretable that such incidents should occur, for they do not contribute to efficient economy. The term "economy" is often misinterpreted as retrenchment. It would be desirable to call a spade a spade and thus make clear what is the object in view, for dismissal en bloc and later reinstatement of the officials not only leads to discontentment among those reinstated but also engenders a lack of confidence by the public. It may be necessary to retrench and doubtless a better and less public method could be devised. The reputation and character of the officials constitute their main asset in the securing of other appointments and the aldermen should bear this in mind when dealing with the staff.

Efficient economy should always be a permanent attribute of municipal government and generally the engineering staff is imbued with desire to have various services rendered efficiently at the least possible cost. It is no credit to an engineer to carry out works at an excessive cost, for anyone can do that, and no engineer has a desire for an ill reputation in this direction. Municipal service, however, under democratic representative government, does not always permit of efficient economy. Influence, pressure and interest often have potent powers in directing members to give decisions, which would not obtain in well regulated public organizations. Under conditions such as above indicated, engineers are perforce to do things which they would prefer to omit, but later on another set of members will have seats on the council, sit in judgment, and visit the penalty not on those who gave the directions, but on those who fulfilled them.

Efficient economy is what pays in every business. What business would dismiss the whole staff and reinstate some members? It is highly necessary in most commercial concerns to economize, and it is done with as little disturbance as possible of cordial relations and commercial organization,—otherwise business will suffer, and creditors will be watching events with uneasy vigil. What applies to ordinary business applies with at least equal force to municipalities.

True economy involves having due regard for the needs of the people and their ability to pay, and not over mortgaging the future which does not break as brilliantly as is frequently anticipated. Unforeseen circumstances occur which upset "the best laid schemes of mice and men," but the prudent alderman will carefully analyze the pros and cons of all "economies" as well as of all new expenditures of money.

LABOR ORGANIZATION IN CANADA, 1915.

The fifth annual report on labor organization in Canada, containing statistics, etc., for the calendar year 1915, has been issued by the Department of Labor.

The opening chapter is devoted to showing the extent to which the trade unionists of the Dominion contributed to the Canadian expeditionary forces, and contains also the pronouncements which various central labor bodies have made on the war. Of the 1,883 local branch unions in Canada, 961 have had one or more members enlist for overseas service since the beginning of the war. The trade unions furnished 11,972 recruits and 439 reservists, making in all 12,411 members in the ranks.

The war has evidently subjected Canadian trade unionism to a severe strain, the returns received for 1915 showing a loss of 120 local branches and 22,820 members. The total numerical strength of organized labor in Canada at the close of 1915 stood approximately at 143,343, made up as follows: 1,661 local branches owing allegience to international organizations, comprising a membership of

114,722; 191 local branches of non-international bodies with a combined membership of 23,664; and 31 independent units with a reported membership of 4,957. These figures as compared with those of 1914 indicate a loss for the year 1915 of 113 local branches and 25,760 members of international organizations; a reduction of five branches of non-international bodies, but a gain of 2,729 in membership; the independent units, a loss of two, but a gain of 211 in the membership reported. The membership of all classes of organized labor in Canada as reported to the department for the past five years has been as follows: 1911, 133,132; 1912, 160,120; 1913, 175,799; 1914, 166,163; 1915, 143,343.

Nearly one-half of the local trade union branches are found in twenty-two cities, and these branches comprise over 40 per cent. of the entire trade union membership in the Dominion. Montreal, as in 1914, stands in first place as to the number of local branches, but the proportion of branches reporting was not so good as in some other localities. Toronto, with a reduction of thirteen branches, still retains second position.

A table showing the expenditure on account of benefits paid during the year 1915 by the various central labor organizations operating in Canada is included in the report. Of the international bodies 81 have benefit features on a varying scale. The total disbursements for 1915 amounted to $14,565,365, an increase of $1,727,378, as compared with the amount paid in 1914.

The report follows closely along the lines of former reports on labor organization in Canada, the various phases of the scheme of organization which have been developed being given due consideration.

A chapter is given to a review of some of the leading building trades organizations, showing the progress and achievements of the various bodies discussed.

The report serves as a directory of trade unions for the Dominion for 1916, including as it does particulars not only of every known local trade union in Canada, but also a list of all international and non-international central organizing bodies, together with the names and addresses of the chief executive officers.

It is reported that a sensational find of copper running $100 to the ton, has been made northwest of The Pas in the Beaver Lake district. The Hayden-Stone company of New York, has taken an option on it at $3,500,000. Ten million tons have been blocked out by diamond drill tests. A great mining industry is expected in that region.

A bill has been approved by the council and ministers of Petrograd, Russia, providing for the expenditure of 600,000,000 rubles (normally $300,000,000) per annum for a period of five years for construction of railroads in Russia. It is proposed to build 6,000 versts (4,000 miles) of roads per year during that term.

In cold weather frequently it is difficult to start the gasoline engine of a motor truck, road roller, etc. Even in warm weather there are occasional difficulties of this sort, particularly where the engine is large. It has been found advantageous to use ether for priming, instead of gasoline, for a heavy motor may thus be started with very little effort. A very small quantity of ether inserted in the cylinders will enable the operator to start the motor on the first quarter-turn.

Notwithstanding the war, and its disastrous effects on the export trade, due to the high freight rates that are prevailing, the iron-ore mining industy in Morocco continues to make excellent progress. According to some recently issued figures, 89,190 tons of hematite ore were last year shipped from the port of Meillila; of this quantity 71,739 tons came from the mines of the Compania Espanola de Minas del Rif, 13,601 tons from those of the Sociedad La Alicantina, and 3,850 tons from those of the Sindicato Minero de Mellila.

PERSONAL.

GILBERT PREECE, of the firm of Wales and Preece, electrical contractors, Toronto, who is at present on active service at the front, has been wounded. He holds the rank of bombardier in the British army.

Lieut.-Col. C. J. BURRITT has been appointed assistant director of engineering services with headquarters in Ottawa. Lieut.-Col. Burritt is an architect and engineer by profession, practising in Ottawa.

A. V. REDMOND, formerly in service of N.T.R. Commission, has been appointed resident engineer, District 2, Cochrane, Ont., vice H. J. Black, enlisted for overseas service with No. 1 Construction Battalion.

H. M. ASHMAN, formerly of the electrical distribution department of the Montreal Light, Heat and Power Company, has been appointed electrical superintendent of the St. Lawrence Brick Company's plant, Laprairie, P.Q.

MacALLISTER MOORE, well known throughout Canada as representative of the Simplex Electric Heating Company, has resigned that position and joined the sales force of the National Electric Utilities Corporation, New York.

Prof. ALBERT LEDOUX, of the University of Brussels, is collecting for the Ontario Bureau of Mines mineral specimens for exhibition purposes. Prof. Ledoux, during the past year has been on the staff of the Department of Mineralogy, University of Toronto.

C. H. SPEER, who for a long time has been associated with the Algoma Steel Corporation, has been appointed chief engineer in succession to J. D. Jones, who has been engaged to fill a similar position in the large Gary steel plant of the United States Steel Corporation.

C. H. McMILLAN, manager of the steel department of the Canada Cement Co., Montreal, has resigned. C. STENDOL, who was formerly with the Dominion Steel Corporation, and at a previous period held an important position with the Algoma Steel Company, will succeed Mr. McMillan.

Lieut. ALEX. WILSON, of the 244th Battalion, C.E.F., has been presented with an automatic Colt revolver, suitably inscribed, by the electrical distribution department of the Montreal Light, Heat and Power Company, of which he was head, prior to joining the colors. The presentation was made by Mr. Kenyon, assistant engineer of the department.

D. A. VALLEAU, for many years superintendent of the Oshawa Electric Railway System, has resigned. J. J. CALLAGHAN, formerly with the Montreal Tramways as chief inspector, and later superintendent of the Montreal and Southern Counties Railway System, succeeds Mr. Valleau. For a time Mr. Callaghan was operating superintendent of the London and Port Stanley Railway System after its electrification by the Hydro-Electric Power Commission of Ontario.

D. LYTTON MACDOUGALL, an engineer, has enlisted in the Railway Construction Corps (239th of British Columbia), for which recruits are being received in London. Mr. Macdougall was recently engaged in appraisal work for the United States Government on the Old Dominion Railway of Virginia, and upon completion of his task immediately came to Canada to enlist. Mr. Macdougall was born in Winnipeg 34 years ago. He spent seven years as engineer with the Chesapeake and Potomac Telephone Company of Baltimore, five years with the National Transcontinental Railway during the construction period, and was also locating engineer for the Alberta and Peace River Eastern Railway.

W. A. DAVIDSON, M.E., M.Sc., manager of the International Coal and Coke Company, of Coleman, Alta., has been appointed supervisor of technical instruction in mining for the province and head of the department of mining in the Institute of Technology. Mr. Davidson graduated in mechanical engineering from McGill University in 1909 and after some years of practical experience took his master of science degree at the same university with coal mining as his major subject of study. In the practical field Mr. Davidson had served for three years as draughtsman and assistant engineer with the Dominion Coal Company at Glace Bay, Nova Scotia. He served also as engineer in charge of a survey party on the Soo line and as mining engineer at Lille, in the Crow's Nest Pass. For the past five years he has been with the International Coal and Coke Company at Coleman, acting as engineer and later as manager.

OBITUARY.

R. W. TURP, district superintendent of the Hydro-Electric System for Beaverton and Brechin, Ont., died recently.

Lieut. H. DALZIEL BROWNE, the general purchasing agent of the Northern Electric Company, has been killed in action.

ROBERT McCALLUM, formerly city architect, Toronto, died at his home last week at the age of 65 years. Mr. McCallum was born in Toronto and for twenty-one years was in the employ of the Ontario Government as civil engineer, and entered the service of the city as architect in 1903, retiring a few years ago owing to ill-health.

ALBERT E. McLEOD, manager of public utilities and superintendent of public works at Kenora, Ont., died on August 2nd. Born in Cornwall, Ont., thirty-seven years ago, he went to Kenora in 1897, and joined the town staff in 1904. He was appointed superintendent of the town's utilities six years ago, and two years ago was made manager of all town services, including power, electric lighting, telephone, etc.

Private JAMES J. CAMPBELL, who represented the Swedish General Electric Company in Montreal at the outbreak of hostilities, is reported as having died a prisoner of war. He was awarded a first-class medal by the Czar of Russia for bravery on the field of honor. This Russian Medal of St. George has just been received by his father, who resides in Ottawa. Mr. Campbell joined the first contingent and was paymaster sergeant of the 13th Battalion, Fifth Royal Highlanders, Montreal, but on going to the front reverted to the ranks in order to get into the firing line.

CHARLES A. STOESS, one of the best-known engineers in British Columbia, died recently at his home on Nelson Street, Vancouver. He was one of the pioneer civil engineers and land surveyors of the province, having helped in the construction of the Canadian Pacific Railway over the Rockies in the early days. He was also prominent in connection with the Kelowna irrigation scheme, which was carried out by him about four years ago. He was born at Liverpool, England, in 1853, and came to Canada about 27 years ago. He went west as a civil engineer for the C.P.R.

W. W. BLAIR, formerly an architect at Winnipeg, Man., died recently at Victoria, B.C. Mr. Blair was born at Anktelle Lodge, Stewartson, County Tyrone, Ireland, and had reached the age of 63 years. He received his education at the Academical Institute, Belfast, and practised architecture at Middlesborough-on-Tees, England, for two years following the completion of his studies. He came to Canada in 1874, residing in Hamilton and Toronto until 1884, when he returned to Ireland as resident engineer of the Londonderry and Ballymena waterworks system until 1889. He moved to Chicago and practised until 1905, when he moved to Winnipeg. He was a Fellow of the Royal Architect Institute of Canada and a Licentiate of the Royal Institute of British Architects, London.

CHARLES WILLIAM HENRY KIRCHHOFF died in New York City July 20th at the age of 64 years. He was editor-in-chief of the Iron Age from 1889 until 1910. He was connected with the publication for 29 years and was prominent for years in the mining industry, being at one time president of the American Institute of Mining Engineers. Mr. Kirchhoff was born in San Francisco, Cal. In 1878 he joined the Iron Age, with which he remained until 1881, when he became managing editor of the Engineering and Mining Journal. Three years later Mr. Kirchhoff returned to the Iron Age, being successively associate editor and editor-in-chief. Mr. Kirchhoff was the special agent of the U.S. Geological Survey for the collection of statistics of the production of lead, copper and zinc during 1883-1906. He was a member of the American Iron and Steel Institute of Great Britain, the American Society of Mechanical Engineers, and an honorary member of the Franklin Institute of Philadelphia.

GREAT BRITAIN'S BLACKLIST.

As no official or complete list of foreign firms blacklisted by Great Britain has been published as yet in Canada, *The Canadian Engineer* feels that special interest will be taken in the list of United States firms published herewith. This list is complete and official, having been transmitted to *The Canadian Engineer* from London, England, by mail. Changes or additions in the list will be noted in *The Canadian Engineer* from time to time as they are announced by the British government. The proclamations containing these lists prohibit "all persons, or bodies of persons, incorporated or unincorporated, resident, carrying on business, or being in the United Kingdom, from trading with any of the persons or bodies of persons" mentioned in the lists. These proclamations and others respecting trading with the enemy come into force in Canada from time to time as the Canadian government passes orders-in-council in regard to them.

The complete list for all countries includes several hundreds of names. All persons and firms who are resident or carrying on business in Persia, Morocco or Portuguese East Africa are blacklisted. Besides the United States firms mentioned below, the list also includes a number of firms in South America, Cuba, Japan, Netherland East Indies, Philippine Islands, Denmark, Greece, Netherlands, Norway, Portugal, Spain and Sweden.

Complete and official lists of the firms who are blacklisted in countries other than the United States will appear in *The Canadian Engineer* in forthcoming issues. Readers are advised to clip these lists and file them for reference in dealing with foreign sales or purchases. The United States list is as follows:—

Bauer, Philipp, & Company, 68 Broad Street, New York City.
Beer, Sondheimer & Company, New York.
Blumenthal, Simon R., (of Zimmerman & Forshay).
Botzow, Herman (of O. C. Kenzow & Company).
Brasch & Rothenstein, Inc., 32 Broadway, New York.
Bunge, Mauricio, (of Maclaren & Gentles, Inc.).
Burin, Alf., (of Brasch & Rothenstein, Inc.).

Carlowitz & Company, 82 Beaver Street and 35, West Houston Street, New York.
Cullen, Charles, Ocala, Florida.
Czech, Armin, (of International Import & Export Company).
Dietzgen, Eugene, Company, 166 W. Monroe Street, Chicago; and 218 E. 23rd Street, New York.
Electro Bleaching Gas Company, The, Buffalo Avenue and Union Street, Niagara Falls; and 25 Madison Avenue, New York City.
Erlanger, E. H., 60 Wall Street, New York.
Falk, Carlos, (of Maclaren & Gentles, Inc.).
Goldschmidt Chemical Company, 60 Wall Street, New York.
Goldschmidt Detinning Company, 60 Wall Street, New York.
Goldschmidt Thermit Company, 90 West Street, New York.
Gravenhorst & Company, 96 Wall Street, New York.
Grubnau, Carl, & Son, 144 Arch Street, Philadelphia, Pa.; 74 Wall Street, New York; and Boston, Mass.
Gubelman, Oscar L., (of Knauth, Nachod & Kuhne).
Hardy, Charles, 50 Church Street, New York.
Hasenclever & Company, 24 State Street, New York.
Hasenclever, Joh. Bernhardt & Soehne, 21 State Street, New York.
Hauser, Morgan H., (of Zimmerman & Forshay).
Hirsch, Alfredo, (of Maclaren & Gentles, Inc.).
Hirschland, Franz H., (of Goldschmidt Thermit Company).
Howe, Robert W., (of Brasch & Rothenstein, Inc.).
Humburg, William E., 25 Beaver Street, New York.
International Hide & Skin Company, 59 Frankfort Street, New York.
International Import & Export Company, 136 South Fourth Street, Philadelphia, Pa.
Isaacs, J., (of John Simon & Brothers).
Jaffe, Max, 15 William Street, New York.
Kahl, J. A., 82 Beaver Street, New York.
Kanzow, O. C., & Company, 11 Broadway, New York.
Kanzow, Otto C., (of O. C. Kanzow & Company).
Kempner, H., Cotton Exchange, Galveston, Texas.
Knauth, Nachod & Kuhne, 15 William Street, New York.
Knauth, Mary I., (of Knauth, Nachod & Kuhne).
Knauth, Wilhelm, (of Knauth, Nachod & Kuhne).
Kupper, Hermann C., 52 Murray Street and 536 West 111th Street, New York.
Maclaren & Gentles, Inc., 222 Produce Exchange, New York.
McNear, George W., Inc., Insurance Exchange Building, 433 California Street, San Francisco, California.
Magenheimer, A., 68 Broad Street, New York.
Maier, Marx, 200 Fifth Avenue, New York.
Merchants Colonial Corporation, 45 William Street, New York.
Muller, Carl, (of Muller, Schall & Company).
Muller, Ernest, (of Schuchardt & Schutte).
Muller, Schall & Company, 45 William Street, New York.
Muller-Schall, Frederick, (of Muller, Schall & Company).
Nachod, Maris, 15 William Street, New York.
National Zinc Corporation, New York.
Neuhaus, Richard, (of the Electro Bleaching Gas Company).
Neumond, K. and E., 25 Broad Street, New York.
Newton, Rollin C., 15 William Street, New York.
Norfolk Refining and Smelting Company, Virginia.
Orenstein and Koppel, Pennsylvania.
Pavenstedt, Edmund, (of Muller, Schall & Company).
Perutz, Leopold, 17 Battery Place, New York.
Petroleum Products Company of California, Inc., San Francisco, California.
Rees, Louis J., (of Zimmerman & Forshay).
Reuter Broeckelman & Company, 59 Pearl Street, New York.
Richter, Alfred, (of Reuter Broekelman & Company).
Roessler & Hasslacher Chemical Company, 100 William Street, and 14 Jay Street, New York.
Rubber & Guayule Agency Inc., 108 Walter Street, New York.
Rushmore, Townsend, 82 Beaver Street, New York.
Schall, William, Junior, (of Muller, Schall & Company).
Schenker & Company, 17 Battery Place, New York.
Schloetelborg, G. F., 218 Globe Buildings, Seattle, Washington.
Schmidt, Paul, (of Rubber and Guayule Agency, Inc.).
Schuchardt & Schutte, 90 West Street, New York.
Schutte, Bunemann & Company, 15 William Street, New York.
Scully, John S., (of Zimmerman & Forshay).
Siemssen & Company, 82 Beaver Street, New York.
Simon, John, & Brothers, Cotton Exchange Building, 15 William Street, New York.
Sonneborn, L., Sons Inc., 262 Pearl Street, and 206 Water Street, New York.
Southern Products Trading Company, Cotton Exchange Building, 15 William Street, New York.
Stegemann, Edward, Junior, (of Brasch & Rothenstein, Inc.)
Superior Export Company, Inc., 90 West Street, New York.
Texas Export & Import Company, Galveston.
Ulrich, Ernst, 15 William Street, New York.
Weber, Edward, (of Rubber & Guayule Agency, Inc.).
Wehrenberg, Otto, (of Phillipp Bauer & Company).
Weingardt, Arend H., 15 William Street, and 120 Broadway, New York.
Zimmerman & Forshay, 9 Wall Street, New York.
Zimmerman, Leopold, (of Zimmerman & Forshay).

A French chemical journal has published an analysis of the alloys used in the construction of a Zeppelin brought down in France. For the angle brackets it was found that aluminum entered into the composition to the extent of 90.27 per cent. with 7.8 per cent. of zinc, 0.73 per cent. of copper, and small amounts of iron, silicon, manganese and tin. For the channel sections an alloy composed of 88.68 per cent. of aluminum, 9.1 of zinc, and about the same quantities of the other elements as for the angle brackets was used. The braces were evidently of commercial aluminum, that element entering into their composition to the extent of 99.07 per cent.

TRADE INQUIRIES.

The following inquiries relating to Canadian trade have been received by the Department of Trade and Commerce, Ottawa. The names of the firms making these inquiries, with their addresses, can be obtained only by those especially interested in the respective commodities upon application to: The Inquiries Branch, the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Hamilton, Kingston, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Edmonton, Calgary, Saskatoon, Chambre de Commerce de Montreal and Moncton, N.B. Please quote the reference number when requesting addresses:—

816. Barytes, zinc oxide, cobalt, etc.—A London firm is in the market for supplies of Canadian barytes, zinc oxide, cobalt and other minerals.

817. Barytes—A Liverpool firm is in the market for barytes and asks for names of Canadian producers.

820. Steel pipes, machinery and machine tools, etc.—A London firm is desirous of obtaining the representation of Canadian manufacturers of steel pipes, machinery and machine tools, and similar lines.

858. Mining supplies—A Johannesburg firm of engineers now representing a large Canadian firm, are prepared to take up Canadian agencies in mine supplies, such as light and heavy rails, machinery, ore cars, pumps, drill hose, rubber, leather and Balata beltings.

859. Railway supplies—A Johannesburg firm of engineers in close connection with the South African railway's requirements, are prepared to take up agencies for heavy rails, coaches, steel cars, wheels and all railway supplies, except locomotives.

861. Balata belting—An agency for Canadian-made Balata belting can be placed with an engineering firm in Johannesburg.

862. Mining supplies—A Johannesburg firm dealing in mining supplies are prepared to handle such lines as cast-steel hammers, 4 pounds, mining buckets, piping and mining machinery of all kinds.

866. Steel cars—A Johannesburg firm with engineering department, old connection with the mines, are prepared to take up agency in any mining or electrical machinery or supplies. At the present moment they are particularly interested in steel mine cars and dump cars. Blue prints and particulars for steel cars may be inspected at the Department of Trade and Commerce, Ottawa.

867. Steam heating appliances and hot water boilers, G.M. vales which are used on hydraulic rams, etc.—An Aberdeen firm will be pleased to receive catalogues and prices c.i.f. Glasgow.

872. Steel tires—A leading manufacturers' agent in Newfoundland asks for the names of Canadian manufacturers of locomotive steel tires.

875. Magnesite—A manufacturing company in the West of England invites offers of magnesite ($Mg\ Co_3$) from Canadian producers.

884. Electrical supplies—A Leeds firm of manufacturing electricians, 75 per cent. of whose requirements were supplied by Germany previous to the war, inquires as to Canadian manufacturers of electric cables, switch-gear, insulators and general electrical supplies. The importation of many of these is now prohibited, but the inquiry is made in view of future business.

896. Steel joists, channels, angles, tees, etc.—A Leeds firm of iron and steel merchants wishes quotations, stating time of delivery, on several hundred tons of channels, joists, angles, tees and rounds. Detail specifications may be obtained on application to the Department of Trade and Commerce, Ottawa.

897. Steel billets—A Leeds firm of steel and iron manufacturers are in the market for 1,000 tons of steel billets, 3 inches to 7 inches square and from 56 pounds to 1,000 pounds.

British coal production in 1915 amounted to 253,000,000 tons, of which 40,500,000 tons were exported, 23,000,000 going to the Allies and 17,000,000 to neutrals.