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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

LONDON AND PORT STANLEY RAILWAY

THE FIRST RADIAL LINE OF THE HYDRO-ELECTRIC POWER COMMISSION OFFICIALLY OPENED ON JULY 22ND—A 24.46-MILE ELECTRIC RAILWAY CONNECTING LONDON AND ST. THOMAS WITH LAKE ERIE AND OPERATING UNDER NIAGARA POWER.

On Thursday of last week the first hydro-radial railway of the province of Ontario was formally opened to traffic by Sir Adam Beck, chairman of the Hydro-Electric Power Commission. All the municipalities of the province were represented at the opening. The line has been under electrical operation since the first of the month and during the three weeks prior to the official event, it had carried 40,000 passengers in addition to its freight traffic.

It is not a new line of railway, being, in fact, one of the earliest built in the province. The project came under consideration, and a company was incorporated to construct and operate it under its present name, in 1853. It was originally provided with 56-pound iron rails placed at 5 ft. 6 ins. gauge. This gauge was changed shortly afterwards to standard 4-ft. 8½-inch gauge to facilitate connections with other railways.

Fig. 1.—Concreting Outfit for Pole Footings.

In 1874 the Great Western Railway leased the London and Port Stanley line for a term of 20 years. It was then that the change of gauge was effected. In 1882 the Grand Trunk Railway System absorbed the Great Western Railway and operated the line under consideration until the completion of the lease in 1894. Then the Lake Erie and Detroit River Railway leased the line and operated it until 1906, when the L. E. & D. R. itself was leased by the Pere Marquette Railway. When the London and Port Stanley lease expired on January 1st, 1914, a temporary arrangement for the operation of the line was made with the Pere Marquette pending the electrification of the line, which the city of London had in contemplation at that time. In fact, the city already had power to equip and operate it as an electric road, and proposed using Niagara power for the purpose. The London Railway Commission was formed to control it. Sir Adam Beck is chairman of this Commission.

An exhaustive study of systems of interurban electrification resulted in the selection of a 1,500-volt direct current system. The overhead system of power supply was adopted, the cables being supported by galvanized structural steel poles, as illustrated. These poles are of triangular design, about 35 ft. in height and are bedded in triangular concrete bases, which are 7 ft. deep and project 1 ft. above the ground. The general type of pole is made up of three 60-degree angles with flanges 3/16 in. thick and tied together by batton plates 4½ ins. wide and 3/16 in. thick at about 30-inch centres. The cross-arm used is a 5¼-pound 4-inch channel shape with suitable bracing and extends horizontally from the pole at a distance of 26 ft. above rail level. The poles are at 140 and 160-ft. centres on the curves and 180-ft. centres on tangents. They are designed to resist 2,500 pounds tension. As indicated in several of the illustrations, catenary suspension of power cables is employed on the main line. The trolley wire which is at a height of 23 ft. 2 ins. above the top of rail is a 0000 grooved copper wire suspended at 20-ft. centres from a copper catenary cable.

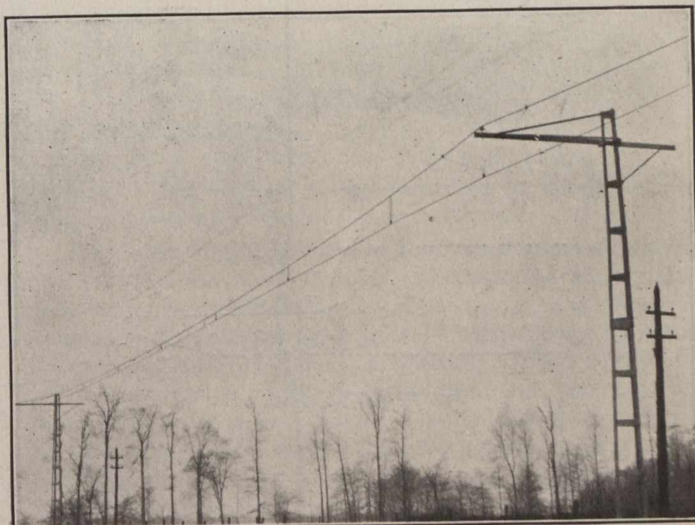
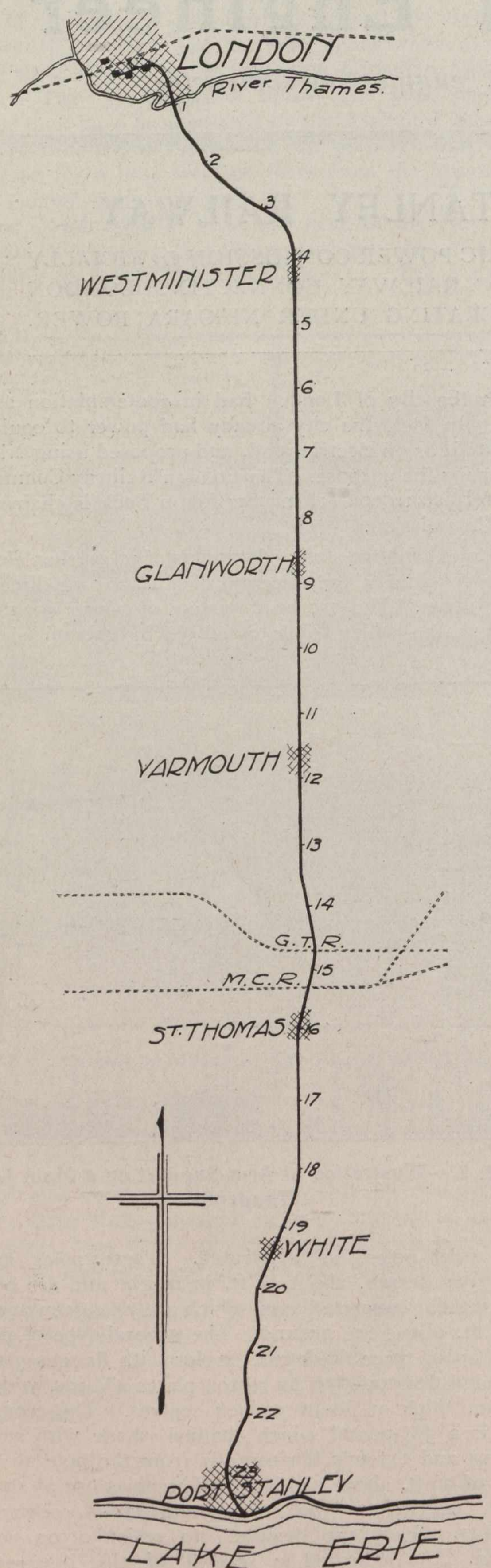


Fig. 2.—Illustration of Arm Support on a Main Line Tangent.



Route of the London and Port Stanley Railway.

Steel anchor poles are located about ¾ of a mile apart, the method of anchoring the line being to connect this pole, which is on the opposite side of the track, to the transmission pole nearest it by means of an anchoring wire and attach the catenary wire to it. The methods of concreting the pole bases, bonding the rails and erecting the overhead work are shown in the accompanying illustrations.

The line is equipped with three electric freight locomotives of the 4-0-4 type, built by the Canadian General

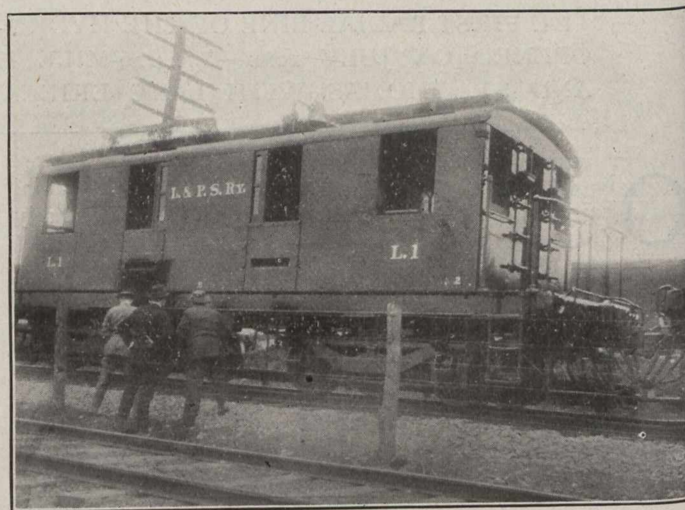


Fig. 4.—One of the Locomotives (Pantograph Trolley Not Shown).

Electric Company, each provided with four 750-1,500-volt motors, two of which are connected permanently in series and capable of further connection in series or parallel. Each motor has a standard one-hour rating of 245 h.p. at 1,500 volts, furnishing a tractive effort of 21,500 pounds. Pantograph slider trolleys were adopted, having double contact with the trolley wire.

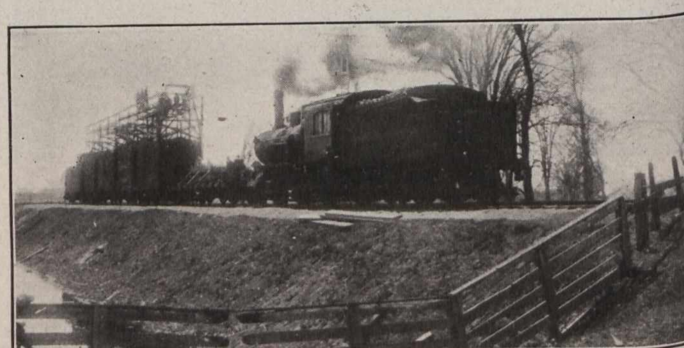


Fig. 5.—Method of Stringing Overhead Equipment.

The car equipment consists of five steel motor cars and three wooden trailers. The motor cars are of most modern design and are generally recognized as the best furnished and equipped cars operating on electric railways in America. Each is driven by four 750-1,500 commutating pole motors connected two in series, with an hourly rating of 125 h.p. on 750 volts. These cars were constructed by the Jewett Car Company, of Newark, N.J. The wooden trailer cars were built by the Preston Car and Coach Company, which company also supplied one 60-ft. motor baggage car of wooden construction.

The electrification of the line has necessitated a number of improvements to road-bed and tracks as they were not in suitable condition for efficient operation. New 80-pound rails have been laid on the entire main line, the old rails being relaid on sidings. Most of the ties have been replaced and the track has been completely re-ballasted. The bridges were in good condition, but several reinforced concrete culverts have been built to replace old stone and wooden ones, while a number of masonry culverts were reinforced or reconstructed.

This rehabilitation of the line was partly carried out last year while the line was still under lease to the Pere Marquette Railway. The balance has been completed this spring.

The work of electrification and the selection and governing features of design of the rolling stock has all been carried out under the direction of the Hydro-Electric Power Commission of Ontario, of which Mr. F. A. Gaby is chief engineer. Mr. H. L. Bucke had charge of the field operations.

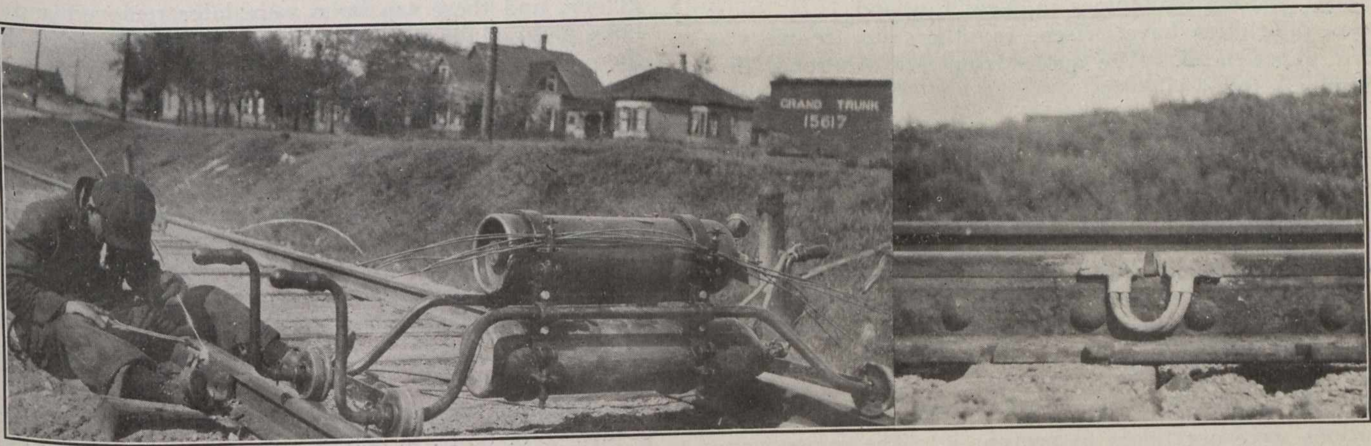


Fig. 6.—Views of Traveling Oxy-Acetylene Rail Bonding Outfit and of Finished Rail Bond.

REINFORCED CONCRETE STANDPIPES.

THERE are some exceedingly interesting types of reinforced concrete standpipes in service in Canada and the United States. The number ranges between 40 and 50, as the accompanying table shows, although the exact figure has not been computed. One of these is the standpipe for the waterworks system of Penetanguishene, Ont. It is a 300,000-gallon tank 50 ft. in diameter and 21 ft. deep, with side-walls of 1:1:2 concrete 12 ins. thick at the base and 8 ins. thick at the top. This tank was designed and constructed during the fall of 1912 by Mr. L. J. Mensch, of Chicago. The tank has a reinforced concrete dome and its flat base is about 6 ft. below ground level. It was described in February 20, 1913, issue of this journal.

Another, designed for Berlin, Ont., by Mr. Mensch, and constructed under the supervision of Mr. Connor, of Bowman & Connor, Toronto, was described in *The Canadian Engineer* for January 9th, 1913. It has a capacity of 600,000 gallons and is supported by a reinforced concrete shell cylindrical in shape, 76 ft. high with walls 12 ins. thick. The bottom of the tank is a dome of 24 ft. radius. The roof is also of dome construction, almost spherical. The tank is 50 ft. in inside diameter, 41 ft. in height with walls 12 ins. thick. The height over all is 127 ft. 4 ins.

Another, with a diameter of 160 ft., a height of 29 ft. and a capacity of 3,250,000 gallons, has recently been constructed at Halifax, N.S. In this instance the walls are 36 ins. thick at the bottom, tapering to 18 ins. at the top. It was designed by H. W. Johnston, assistant city engineer of Halifax. Mr. F. W. W. Doane, city engineer of Halifax, supervised its design and construction. The Standard Construction Co., of Halifax, were the contractors. This structure was described in detail in *The Canadian Engineer* for March 25th, 1915.

The foregoing examples of reinforced concrete standpipe construction have all been in connection with municipal water supply systems. There is a surge tank at Niagara Falls constructed by the Ontario Power Co., the design of which is extremely interesting. It is a reinforced concrete structure 75 ft. in inside diameter and 71¼ ft. high, with walls 24 ins. thick. Its purpose is to regulate the flow in a 6,400-foot reinforced concrete conduit. The tank was designed in 1911 by Mr. R. D. Johnson, then hydraulic engineer of the Ontario Power Co., and is of what is known as the Johnson differential type. It has a vertical riser in the centre which is 18 ft. in diameter.

The most interesting feature of its construction lies in the design of its base. The cylindrical wall is not rigidly constructed to the base. The designer points out that if such were the case a thickness of about 5 ft. or more at the base of the cylinder would have been required to provide a cantilever of sufficient thickness to withstand the stresses to which it would have been subjected, while the shell would have had to be thicker for a considerable height in order to take up the stress. This increased thickness would have diminished the capacity of the structure. Owing to the fact that it is located in a prominent part of Queen Victoria Park, the park commissioners insisted upon as small a structure as possible.

At a recent meeting of the New England Waterworks Association a very interesting topical discussion followed a paper on reinforced concrete standpipes. Evidently the first of this type was constructed in 1899 at Little Falls, N.J., and the adoption of the reinforced concrete type was very gradual up to 1910, as is shown from the accompanying table, abstracted from the journal of the Association, and added to with respect to data on Canadian plants. The following information regarding construction experiences in the United States is a summary of the discussion referred to above:—

Mr. H. B. Andrews, engineer of the Simpson Bros. Corporation, stated that his company has built 17 reinforced concrete standpipes in New England. In some cases difficulties have arisen, in others no trouble has been experienced. We quote from Mr. Andrews' discussion as follows:—

Waltham, Mass.—We commenced our work by building the Waltham reservoir in 1904 (see Table I. for dimensions). We had nothing to say in regard to the design of this reservoir. It was designed by the city engineer of Waltham, and the plans were gone over by Mr. Worcester, consulting engineer. There was not very much precedent at that time for the design of reinforced concrete standpipes. The proportion of concrete was 1 : 2 : 4, and the aggregate was especially selected to make it waterproof. The reservoir was built in successive lifts of about 3 ft. We anticipated some trouble at the joints if special precautions were not taken to prevent it. The joints were cleaned as we went up, and recesses were made in the preceding day's work by putting in strips of wood entirely round the tank to form a slot to engage the next day's work. The reservoir was plastered on the inside with ½ or ¾-in. plaster, and in the top half was painted with a neat cement wash. We found after the water was turned into the reservoir that the concrete in itself was not entirely waterproof and that the joints leaked to a certain extent. We decided to make some changes in the next reservoir we built.

Manchester, Mass.—This reservoir was 50 ft. in diameter and 72 ft. in height. We increased the richness of the mix to 1 : 1.5 : 3; we also increased the amount of the reinforcement between base and walls. We plastered this reservoir also on the inside, and when it was filled there was but very little leakage. Subsequently two or three cracks developed on the south side of the reservoir, caused by the unequal expansion due to the rigidity of the base and the expansion of its circular shell above, which caused a shear in the concrete and opened up a joint perhaps 30 ft. in length. That was repaired by putting a lead lining over that joint. But the continued change in expansion, due to the filling and the refilling of the tank and the change in the temperature, caused that joint to open again and some water to get in it, so that the leakage reappeared. This reservoir has been repaired by lining it with asphalt and felt over a certain extent of it, so that no leakage appears there now. But it was found necessary to increase the amount and length of vertical reinforcement as cracks appeared at the end of the rod which joined the floor to the wall.

Lisbon Falls, Me.—This we did in the succeeding tank which we built at Lisbon Falls. That tank also was built with 1 : 1 : 2 mix, and plastered, and it has not shown any leakage. That was built in 1909. I saw it last summer, and there was no water that leaked out through the tank and reached the ground. There was but one little spot half an inch in depth and the size of the hand where the frost had scaled off the surface. We found some vertical cracks in the reservoir at Manchester in the plastering and decided that the concrete was not thick enough. That is, there must be thickness enough of concrete to resist the tension in the tank, or else the tank will crack.

Rockland, Mass.—In the one we built at Rockland we built the tank with concrete walls thick enough and strong enough to resist all tension. We did not plaster the tank. The forms used consisted of movable wooden sections connected by a bolt extending to 1½ ins. from surface fitted with threaded sleeves. Into these threaded sleeves were screwed tap bolts fastening the forms together, and these tap bolts were later removed and the holes plugged for the 1½ ins. depth. We found that after the pressure had exceeded some 60 or 70 ft. of water there was enough pressure to force the water through at the plugs that we put in. There was a little channel under the bolts caused by settlement of concrete, and the water filtered through there to the outside plug and caused some trouble through the freezing of water near the surface, causing the scaling off of quite an area. We took out some of those bolts and replugged the holes, and had no further trouble in that respect. We had had some trouble with the joints in the first reservoir built. The Rockland reservoir was 104 ft. in height, and the Lexington reservoir was the same.

The later reservoirs that we have built have not exceeded 50 or 60 ft. in height. In those we used a 1 : 1 : 2 mix of cement, and we find that is impervious to water. We have had no leakage through the concrete whatever, and we have found that that proportion of cement is as good waterproofing material as we can put in concrete. We find that it also increases the strength of the concrete against cracking. The only trouble we have now—and we have had very little of that—is in the joints. Since we built our first reservoirs we have made some experiments on the protection of joints that have worked out very well.

I do not think we have had any leakage whatever in the standpipe at Winchester, Mass. On the one at West Falmouth, Mass., there has been no leakage. On the one at Woonsocket, R.I., there was a little efflorescence that showed around the joints when the tank was first built; it has now disappeared, and I do not think there is any there now. The one that was built at Jamestown, R.I., shows some seepage. There is a peculiar thing about that. I was down there three months after the tank was filled this winter. The superintendent of the waterworks, Mr. Kent, said there was no leakage of water whatever. I went over there, and as I approached I could see absolutely no seepage on that side of the tank, but there was a little seepage on the other side. Mr. Kent says these spots show more prominently on days when the humidity is high.

In these reservoirs up to 50 or 60 ft. in height we have had no trouble with surface damage by the frost—only in three reservoirs that I know of. That is the Rockland reservoir, the one that was built in Manchester, and the one that was built at Lexington—for the first 30 or 35 ft. in height, above that no trouble.

Mr. Bertram Brewer, city engineer of Waltham, Mass., made the following statement relative to the performance and present condition of the Waltham standpipe:—

The first year or two there was very little seepage; some at the joints, and a good deal of efflorescence and some stalactite formation on the outside of the wall. After being in use for a year or two the seepage began to increase considerably, so that when the tank was full (it is 35 ft. high) a considerable portion of it has been and is quite wet. It never has leaked or seeped sufficiently to cause the water to run down the sides to any extent. It has mostly evaporated before it got to the bottom. After the first two years this seepage has continued about the same every year.

The question is vital as to whether this seepage has endangered the tank enough to affect its stability. We do not believe it has. On the lower 2 ft. of the tank, and in one spot higher up, there has been some frost action, so that in places pieces of the concrete have spalled off. In two places around the base of the tank there are small areas where the spalling has reached a depth of 3 ins. I think that on its ninth birthday it will need a little repairing.

An attempt was made the summer before last to do some repairing on the inside by applying a waterproof film. The work was done by a local contractor, and no engineer was consulted in connection with it. As I understand it, it cost something like six or seven hundred dollars. A brush coat of hot tar was painted upon the interior wall. This attempt at waterproofing does not appear to have reduced the seepage at all.

Mr. Raymond C. Allen, civil engineer, Manchester, Mass., reported his observations on the Manchester standpipe as follows:—

The standpipe at Manchester was built very carefully, and of the best materials. Shortly after it was filled a fracture appeared at the first joint at the base, which in a short time extended a length of about 30 ft. Through this fracture the water in a short time came in a sheet, over a length of from 10 to 12 ft., and trickled through at other points. One other leak of quite considerable proportions appeared about 15 or 16 ft. up. This was not as wide as the other, but similar. There was no other leak, but there was a seepage at many of the joints.

We tried first a cement coating. We found it unsuccessful. Then the two joints which were in the worst condition were repaired by putting a layer of lead with tar over them, as Mr. Andrews has described. This sealed these joints until a year or two ago, when the pressure forced the water into that crack to the extent of fracture, and the leaks again appeared.

Those two leaks were repaired about a year ago by an asphalt and felt waterproofing process, and the standpipe has been protected within by some further construction against ice and other damage.

I have noticed that the greatest amount of seepage and of leaks has occurred on the south and west sides, where the expansion seems to be most unequal. I have also noticed that as from time to time the standpipe is lowered entirely and filled again, the successive fillings have produced new points of seepage. At all events, they act a little differently, and are cumulative in their effect. Thus each time a standpipe is emptied and filled, I believe that a slight increase in seepage for a time at least takes place.

We at first feared the action of frost—although our fears were somewhat allayed at the time by others who had built concrete standpipes. Last year we had a piece about 8 ft. square thrown off at about the location of the upper leak to which I have referred. This was clearly the action of frost, and the action of it upon the concrete was completely to disintegrate it. It was just so much sand. That was true upon some portions of the base upon which the water had been constantly running and freezing, but behind the reinforcement, where no movement of concrete had taken place, there was no disintegration. It was only in the outer shell where disintegration took place or any damage appeared in the concrete.

I have come to the conclusion, myself, that such standpipes as are over about 50 ft. in height should be entirely waterproofed on the inside by some preparation. I will go a little further and say that I feel that the outside of the tank itself should be protected from the elements. For, while the greatest danger from frost comes from the freezing of seepage through the structure, I believe that in time at least the action of snow and rain and the water coming down from the roof will have the same effect as it will when a larger amount of water comes through from the inside in the form of seepage.

Mr. Francis W. Dean, of Boston, gave the following information relative to the standpipe at Lexington, Mass.:—

If I remember rightly, an effort was made to prevent leakage in the first place by pasting canvas on the inside, using marine glue. It was supposed not to dissolve, but some months later it was found that most of the canvas was at the bottom of the standpipe.

Furthermore, the leakage was confined to quite a small area, and chiefly on one side, about 25 ft. from the bottom, as I remember it. Afterwards, when cold weather came, a small part of it spalled off, and that has been repaired. I believe the leakage now is almost nothing.

Mr. William S. Johnson, civil engineer, Boston, Mass., gave his views on concrete standpipe as follows:—

My experience has been limited to rather low tanks, and unless I change my opinion very materially, my future experience will have the same limitations. None of the tanks which I have built is over 40 ft. in height, but they all leak more or less. There has been no spalling off of the outside surface, and the actual quantity of water passing through the concrete is very small, but it is enough to make the tanks unsightly, and, of course, arouses a certain suspicion as to the safety of the structure in the minds of those who know little about these matters.

I am convinced that high standpipes are much better built of steel than of concrete. To be sure, the steel tanks are unsightly, but so are concrete structures, discolored by leakage. The repairs on a steel tank are expensive and annoying, but they cannot be more so than the repairs to concrete tanks. As to the durability, the evidence indicates that concrete tanks are far from indestructible, and there is much uncertainty as to how long they will really last.

Until some better method of designing and constructing concrete tanks is found, it seems to me very unwise to install them to hold more than 50 ft. of water.

Lisbon, Me.—Mr. Stephen Litchfield, city engineer of Bath, Me., gave the following information relative to the Lisbon standpipe:—

The standpipe for the town of Lisbon was completed in October, 1909, and put into commission in January, 1910. The diameter is 50 ft.; the height, 62 ft. (internal dimensions); capacity, 190,600 gals.; thickness of shell at base, 20 ins.; at top, 12 ins.

The structure is designed on the basis of the steel reinforcement, taking all tensile stresses at a working unit stress of 12,000 lbs. per square inch in the steel with the standpipe full.

The structure rests on a hard-pan bottom. Floor slab is 20 ins. in thickness, of 1:2:4 concrete reinforced with 3 ins. No. 10 standard expanded metal. Over the concrete base or floor is a 1-in. granolithic surface 1:1 mortar with 2 per cent. of Medusa Compound added to the mix.

The walls are composed of 2:1.5:3 concrete. Bank gravel, screened and washed, was used in the mixture. In the top of the floor and in walls 5 per cent. of hydrated lime added to the weight of the cement was used. The entire inside perimeter of the standpipe is plastered with ½ in. of cement mortar mixed 1 : 1, with 2 per cent. of Medusa Compound added to the weight of cement. The plaster to a height of 30 ft. is painted with waterproofing compound.

Forms were constructed in three sections, the lower section being transferred to the top each day, one day's work consisting of one lift or section of 30 ins.; in one instance, however, two lifts were placed in one day.

Horizontal steel bars or hoops varying in size from 1¾ ins. to ¾ in. were held in place by 14 latticed steel columns.

The tank is roofed with a Gustavino dome, outer covering of which is plastic slate. Dome has a rise of 8 ft. The standpipe was designed and built by Simpson Bros. Corporation, Boston, Mass.; contract price, $19,288. There have been no items of repair or maintenance since the work was completed.

There is more or less seepage apparent at times, which shows at joints or where one day's work ends and another begins. Many places where seepage has occurred in the past are now entirely free from it, which leads us to believe that the structure is improving with age.

We are well pleased with the standpipe and consider it as near an approach to a permanent structure as it is possible to obtain. We feel, however, that if we had made the placing of concrete continuous, or nearly so, we would have eliminated the cause of seepage. Instead of depreciation, as is the case when other materials are used in similar structures, we consider that this one is improving. As stated above, there has been no item of maintenance to date, and there is every reason to indicate that this item is practically eliminated.

Topsham, Me.—Mr. Chas. L. Bowker described the design and construction of the Topsham standpipe as follows:—

The Topsham standpipe of the Brunswick and Topsham Water District is 97 ft. inside diameter, with a conical bottom, the incline from the bottom to the beginning of the wall being 3.25 ft. rise in 10 ft. The foundation rests on solid ledge and was filled with rubble masonry laid in Portland cement mortar. The wall at the base is 3 ft. thick, and at the top 16 ins. The water line is 46.25 ft. from the floor; 18 ins. more to the roof. The roof is a concrete slab 7 ins. thick, sloping ½ in. to the foot, supported by nine concrete piers, eight of which are 18 ins. in diameter, and the ninth, having an 8-in. overflow pipe embedded in the concrete, is 24 ins. in diameter. The top of each pier is cone shaped, the top being 5½ ft. in diameter and having a rise of 24 ins. An iron ladder is fastened to the outside of the wall. There is no ladder inside, neither is there a manhole in the wall. The 16-in. intake pipe is embedded in concrete and is elevated 12 ins. above the floor. There is an 8-in. flush pipe connected in the gatehouse with the 8-in. overflow, operated by opening an 8-in. gate, and the opening of this pipe is about an inch below the floor of the standpipe. There is a ventilator at the peak of the roof, with four ports, and numerous 4-in. holes for ventilation in the wall, close to the roof. All openings are screened.

In the construction of the standpipe particular care was taken to remove all loose rock under the foundation. In the centre, considerable blasting was done. The bottom of the standpipe was built in two layers, each 6 ins. in thickness, after first levelling to the proper grade, the second layer being reinforced with ½-in. round iron. The floor was troweled to a smooth surface, the finishing coat being cement mortar, 1 : 2 mixture, with the addition of 5 per cent. of hydrated lime, the same amount of lime also being added in the second layer of concrete.

The wall was reinforced horizontally with iron rods of various diameters, from 1¼ ins. at the base to ¾ in. near the top, supported on lattice work which was built into the wall. The proportion of the concrete mixture for the wall was 1 : 2 : 3.5, with 5 per cent. of hydrated lime. A "T" iron, 6 ins. by 12 ins., was built in the foot of the wall, circling the standpipe, reinforcing rods anchoring this to the floor of the standpipe.

TABLE I.—Data on Reinforced Concrete Standpipes.

Location.	Inside Diam. in Feet.	Height of Tank in Feet (Shell).	Capacity in Thousand Gallons.	Date Constructed.	Total Cost.
Little Falls, N.J.[1] ...	10	43	25	1899	
Milford, Ohio	14	81	93	1903	
Fort Revere, Hull, Mass.[2]	20	50	118	1903	$4,000[3]
Attleboro, Mass.	50	102	1,500	1904	35,000
Waltham, Mass.	100	37	2,000	1906	26,000
Bondsville, Mass. ...	70	20	576	1908	
Empalme, Senora, Mex.	30	90	475	1908	
New Haven, Conn. ..	50	25	375	1908	
Lenoir, N.C.			500	1908	
Bridgewater, Mass. .	30	78	413	1909	
Manchester, Mass. ..	50	72	1,060	1909	30,291
Lisbon Falls, Me. ..	50	62	911	1909	19,288
Westerly, R.I.	40	70	650	1910	18,722
Rockland, Mass.	46	104	1,300	1910	36,300
Cherry Valley, Mass.	40	21′ 4″	195	1910	4,976[4]
Rochdale, Mass.	40	21′ 4″	195	1910	4,976[4]
Kensington, Conn. ..	50	21	300	1910	5,100[5]
Niagara Falls, Ont..	75	71¼		1911	
Key West, Fla......	78	40	1,500	1911	24,950[6]
Laconia, N.H.	28	46′ 1″	200	1911	6,575[7]
Brockton, Mass.	160 each	26′ 6″	3,760 each	1911	82,200[8]
Western, Mass.[9]	50	38	441	1911	6,706[4]
Waverley, Ohio	16	82	120	1911	4,500
Ashland, Mass.	40	32′ 2″	298	1911	5,810[4]
Northbridge, Mass. .	25	28	90	1911	2,899[4]
Suffern, N.Y.	69	20′ 6″[10]	559	1911	6,500
Berlin, Ont.	50	41	600	1912	23,500
Lexington, Mass. ...	30	104′ 6″	550	1912	19,900
Belton, Tex.	24	75	254	1912	6,000
Winchester, Mass. ..	29	43′ 6″	200	1912	8,000
Penetanguishene, Ont., Can.	50	21	300	1912	
Austin, Minn.	40	29′ 8″	300	1912	
Topsham, Me.	97	47′ 9″	2,500	1913	38,000
Fulton, N.Y.	40	100′ 4″	940	1913	24,335
San Francisco, Cal..	60	35′ 10″	750	1913	
St. Louis, Mo.	153′ 6″[11]	33	4,250	1913	51,850
Chelmsford, Mass. ..	40	20	188	1913	5,180[4]
West Falmouth, Mass.	30	45	238	1913	9,800[4]
Woonsocket, R.I.	79	45	1,600	1913	23,514[4]
Sioux City, Ind.	142	33′ 1″		1913	
Duxbury, Mass.	40	35	328	1914	7,115[4]
Webster, Mass.[12] ...	46	20	249	1914	5,260
Jamestown, R.I.	35	50	350	1914	10,010[4]
Halifax, N.S.	160	29	3,250	1914	56,000

[1] Inside filter house. [2] Inside concrete, brick tower. [3] Excluding tower. [4] Contract price. [5] Construction only. [6] Including roof, $5,000. [7] Excluding foundation. [8] Two tanks, cost of both. [9] Partly below ground surface. [10] Lower half is constructed below ground. Earth backing for retaining wall. [11] At top, 23′; below top diameter = 151′ 6″. [12] Protected by earth bank.

The method of building the wall was by placing the concrete in movable forms, the forms being held in place by bolting one section to the next, depending on the bolts entirely to hold the outside forms in place. An elevator was used to hoist the concrete to a runway around the wall, and the concrete was placed with wheelbarrows.

The roof was built during cold weather, and on the night it was finished it collapsed. There were various opinions as to the cause of this. During the time the concrete was being placed live steam was discharged into the standpipe to keep it warm underneath the roof. The supports for the forms were built and used as staging for the wall, and it is possible that the carpenters might have been careless in their work, perhaps weakening some place where strength was needed. Only one pier fell, the others being in use to-day. The roof was rebuilt in the spring of 1913 on exactly the same lines as before, even the reinforcing rods being straightened and used again. The roof appears perfect at this date.

When the standpipe was first filled, various small leaks developed, on one horizontal ring in particular. To remedy this, the contractors cut a recess into this joint with sharp chisels and caulked it with lead wool. At this date the condition of the standpipe is very good and it is practically tight. A few damp spots appear at times, depending on the weather, but they could not be called leaks. Thus far there does not appear to be any damage to the wall from frost, and the concrete is apparently as good as when first completed.

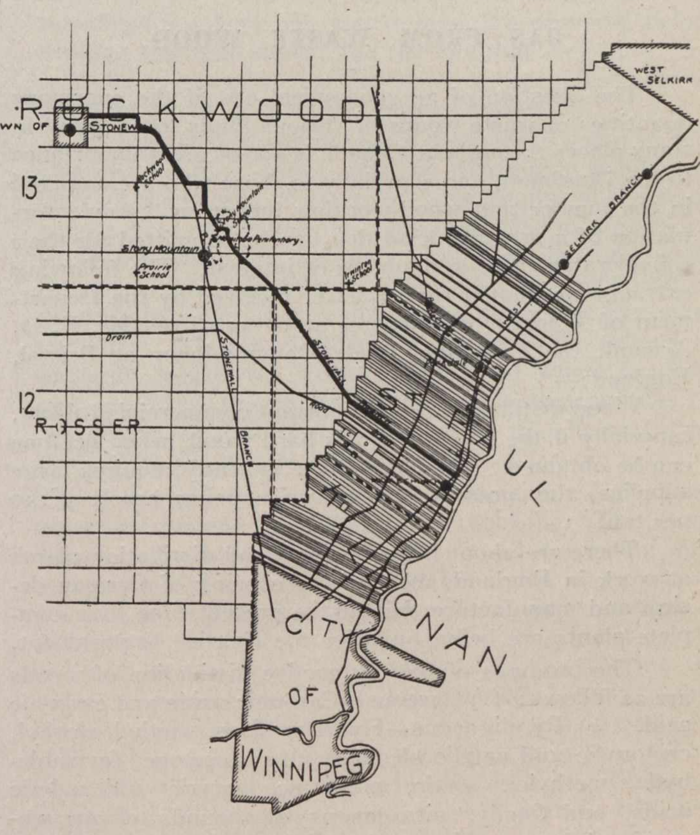
It might be possible to construct a standpipe by building an outside wall of cement blocks, built on a batter, using them in place of a form of wood. The inside forms, being vertical, could be made of wood and their position easily and quickly changed, filling in the concrete from a spout fed by an elevator, pouring it continuously, and by this means having no dry joints to bond together. In Brunswick and Topsham there are four concrete watering troughs, each of which was built in one pouring, and there is yet one to be found that is damp on the under side. If the same principle could be carried out in building a concrete standpipe there would be no leaks. The water in the standpipe would keep the wall at an even temperature, and if the wall was built strong enough there would be little danger from expansion and contraction.

Milford, O.—The concrete standpipe at Milford, O., described by S. S. Gatch, was erected in 1903 and is apparently in better condition to-day than when finished. After using it about two years some seepage was noticed. The water was drained out and the inside dried and coated with a cement wash. Since then there has been no seepage. The seepage was evidently caused by joints in the construction because of delaying the work at night and over Sundays.

During the fiscal year 1915 the imports from all foreign countries amounted to $472,091,576, as against $479,164,298 in 1914, showing a decrease of $7,072,722, but if the imports of coin and bullion were eliminated the imports of merchandise amounted to about $340,103,606 in 1915 and $463,930,835 in 1914, showing a decrease in the imports of merchandise of nearly $123,829,229. The imports from the United States were as follows:—In 1915, merchandise, $296,632,506, coin and bullion, $131,984,421, total, $428,616,927; in 1914, merchandise, $395,565,328, coin and bullion, $15,220,763, total, $410,786,091, showing a decrease in the imports of merchandise of $98,932,822, and an increase in the imports of coin and bullion of $116,763,658. The imports from other principal foreign countries, in order of importance, were as follows:—France, 1915, $8,449,186, 1914, $14,276,378; Germany, 1915, $5,086,986, 1914, $14,586,223; Switzerland, 1915, $3,979,256, 1914, $4,314,805; Argentine Republic, 1915, $3,364,787, 1914, $2,603,128; San Domingo, 1915, $3,193,796, 1914, $2,942,333.

STONEWALL BRANCH, W. S. & L. W. ELECTRIC RAILWAY.

THE Stonewall branch of the Winnipeg, Selkirk and Lake Winnipeg Railway, to the construction of which we have occasionally referred in these columns, has been recently completed and placed in operation. The extension is a little over seventeen miles in length connecting near Middlechurch with the main Winnipeg-Selkirk line, an electrified steam road, and proceeding northwesterly through a portion of the municipalities of St. Paul and Rockwood, as illustrated by the accompanying map. It passes through Stony Mountain, at which place, as well as at Stonewall, very productive stone quarries are located. It parallels the Canadian Pacific Railway Stonewall branch for the last several miles.



Map Showing Stonewall Branch, Winnipeg, Selkirk & Lake Winnipeg Railway

The main line of the company, with which this branch connects near Middlechurch, extends northerly from Winnipeg to the residential town of Selkirk, a distance of 22½ miles, for the most part along the west bank of the Red River. The line makes connection at the northern limits of the city of Winnipeg with the cars of the Winnipeg Electric Railway Company. Power for both the main line and Stonewall branch is obtained from the latter company at 2,200 volts, and is stepped up to 13,200 volts for transmission to the three sub-stations located at Middlechurch, Lockport and Stony Mountain. At these stations the current is converted into d.c.

The right-of-way of the Stonewall branch varies from 45 to 90 feet in width and is practically all privately owned. At Stony Mountain there is a grade of 2.6 per cent. which is practically the only one on the line except for the Masters Junction subway. There are no bridges on the line, but a subway at Masters Junction provides a crossing under the Lake Winnipeg branch of the C.P.R. This subway is about 250 feet in length, and is of heavy construction. The reinforced concrete work rests on pile foundations placed at 3½ feet centres. The abutments are reinforced with steel rails. The subway is provided with 5 per cent. grades at either end, necessitating drainage which is provided by a drain about half a mile in length to the Red River.

The curves on the line are few in number, there being only two 16-degree curves that are of any consequence.

The track consists of 60-pound rails (American Society of Civil Engineers specifications), resting on tamarack ties spaced 2 feet 3 inches and with gravel ballast. The transmission system is carried by 45-foot cedar poles.

GAS FROM WASTE WOOD.

The question of an economical use of the enormous quantities of waste woods of various kinds to be found in many places throughout Canada is one of great importance to the Dominion, and especially to those who are engaged in the lumber and wood-working industries. Any information of a practical kind that can be submitted for their consideration will no doubt be of interest. The following extracts are quoted from a letter received by the Department of Trade and Commerce at Ottawa from Mr. E. D. Arnaud, the Canadian Trade Commissioner at Bristol, England:—

Wood distillation is an important commercial problem, especially if the waste wood is hard wood, when acetone can be obtained. The War Office urgently requires large supplies, the present market price being nearly £130 per ton.

There are about half a dozen wood distillation plants at work in England, most of these being of German design and manufacture, but at the present time four complete plants are being built for the English Government.

The products of the destructive distillation of woods are as follows: (1) Gaseous—Carbonic oxide and carbonic acid. (2) Pyroligneous—Hydrocarbides, methyl alcohol, crotonylic and amylic alcohols, ether, acetone, formaldehyde, methylol, acetic, propionic, butyric and valeric acids, and finally, nitrogenous compounds of an ammoniacal type, amine and pyridine. (3) Tars—Hydrocarbides (benzenes and paraphines), methylic alcohol and acetic acid, higher fatty acids, momophenols and diphenols, a little pyrogallol, dimethylic ether and homopyrogallol. (4) Residuum—Wood charcoal.

The following figures relative to prices of plant and distillation products are given in the Times Engineering Supplement:—

Approximate Prices of Complete Plants.

For 25 tons per week	£ 4,000
" 50 " "	7,000
" 100 " "	13,000
" 500 " "	40,000

Distillation Products.

	Yield per ton of wood.	Price.
Boiled Tar	15 gals.	7d. per gal.
Wood Oils	4 gals.	10d. per gal.
Charcoal	6 cwt.	40s. per ton.
Wood Naphtha	5 gals.	2s. 9d. per gal.
Acetate of Lime	1¼ cwt.	9s. 6d. per cwt.

The prices represent a total of 50s. per ton of wood.

SUBMARINES AND TORPEDOES.*

By Lieut. C. N. Hinkamp, U.S.N.

Up to 1898 the submarine was in the embryonic state. From then up to the present time it has developed rapidly, and great strides have been made in its design with advances in the military features as well as sea-keeping qualities. In the United States the present appropriation for the building of submarines calls for two distinct types, sea-going, of 1,200 tons, and coast or harbor-defence submarines of about 400 tons, and contracts for these have recently been awarded. These types present added features making for increased comfort for the crew, and embody many features to increase the military efficiency.

In the construction of a submarine consideration has to be given to two kinds of tanks, namely, ballast tanks and trimming tanks. The ballast tanks are divided into main ballast tanks and auxiliary ballast tanks. The trimming tanks are tanks in the bow and stern of the boat used for trimming the vessel in the fore-and-aft line. The ballast tanks destroy the maximum part of the reserve buoyancy when completely filled. The smaller ballast tanks are used finally to trim the vessel to a predetermined amount of buoyancy. In addition to the ballast and trimming tanks the vessel is fitted with fuel tanks to carry the necessary fuel for the main engines. The torpedo tubes are located in the bow of the submarine. In some classes there are surface tubes and tubes in the stern, but ordinarily they are fitted only in the bow. In any case, it is necessary to aim the boat whenever a torpedo is to be fired.

It should be understood that there is nothing mysterious in the operation of a submarine. The orders used in the handling of a boat are few; they are made as comprehensive as possible and are so given as to eliminate any possible confusion. Preparing to submerge includes all preliminary work up to the closing of the conning-tower hatch. This comprises the stowing of the deck gear, taking down the bridge, unrigging the radio, closing the hatches, unlocking the valve-operating mechanism, securing the engines; in fact, a clearing ship for action. This operation requires from two to twenty minutes, depending on the amount of rigging to be taken down.

The actual submerging of the boat can be done in two ways, one called the "static" dive, the other the "running" dive. In the static dive, also known as "balancing," the boat is submerged, but does not move except in the vertical plane. This dive may be accomplished in two ways: By trimming the boat and maintaining her trim by adjusting the ballast, or by dropping the anchor, trimming the boat to within a few hundred pounds positive buoyancy, and the heaving in or veering on the anchor cable. The latter way is the simpler method for easy control and can be used where there is no current or only a small amount of current, if the sea is not too rough. Before submerging, the vessel is generally brought to a fore-and-aft trim which will cause the boat to be level when submerged. This is done by flooding or filling the forward or after trimming tanks.

Balancing by means of the anchor is, roughly, accomplished as follows: The anchor, which weighs about 1,000

*From a paper appearing in the Journal of the American Society of Naval Engineers.

lb., sometimes more, is dropped. The boat is then trimmed down until it is in practically a neutral state, or has an amount of buoyancy equivalent to 200 lb. to 300 lb. It can readily be seen that with a reserve buoyancy of 300 lb. and a weight of 1,000 lb. on the bottom there is a preponderance in favor of the anchor of about 600 lb. to 700 lb. By slowly heaving in on the anchor cable, the positive buoyancy of the boat is easily overcome and she may be drawn down to any depth desired.

The static dive by adjustment of ballast is made as follows: After getting the fore-and-aft trim, as already described, the main ballast tanks are flooded. These tanks are flooded through large Kingston valves, the operation requiring from one to two minutes. There is an enormous volume of air in the ballast tanks that must be freed before the tanks can fill with water, and the process of getting rid of this air is called "venting." The main ballast tanks "vent" overboard, as the large volume of air, if admitted into the interior of the boat, would cause the barometric pressure in the boat to rise to such a point as to be uncomfortable. All the other tanks, being comparatively small, vent inboard. The boat being trimmed down as far as the main deck, still has too much buoyancy to run submerged. The tank next flooded is the auxiliary ballast tank. This tank holds enough water to destroy the remaining buoyancy and is flooded generally until the top of the conning tower is just under the surface of the water. The final trimming is done by slowly flooding or filling the adjusting tank. When the vessel is trimmed until there is about 200 lb. to 300 lb. of positive buoyancy, it can be readily handled submerged. This is considered the best trim for all-round work, and completes the static dive. From this condition any operation submerged can be commenced.

The state of the sea affects balancing. In trimming, the boat oscillates until it strikes a condition of comparative equilibrium, when it comes to rest. With a "sea" on, this state of equilibrium is never reached, and the amount of water taken in to approach a neutral state is difficult to estimate owing to the fact that the amount of positive buoyancy depends on the area of the water-line plane, which varies with every wave that passes. Suppose a vessel rising to the effect of a passing wave adds a little water in the ballast tank. As soon as the wave passes the boat has a tendency to sink, and, with the added impetus caused by additional ballast, it falls rapidly. If the "downward send" is sufficient, the only thing that will stop the vessel is the bottom. The downward velocity may be even great enough to overcome a fairly large amount of buoyancy. To be able to determine when to stop is almost the entire secret of the art of balancing. For strategical purposes it is better to have a small amount of headway on the boat, just enough to overcome the effect of the sea, which, being rough, would hide the wake of the periscope in the foam of the white caps.

The running dive is made from the awash condition. In the awash condition the trimming tanks and auxiliary ballast tanks are flooded to the amount necessary for the proper trim when submerged; the main ballast tanks are empty. The running dive is used for all tactical purposes except balancing. The vessel being under way "awash," the order is given to submerge. All hands get into the boat, the engines are stopped and the electric motors started. As soon as the engines are stopped the conning tower is closed, all ventilators housed, and the main ballast tank flooded. Knowledge that the trim will be approximately correct when totally submerged renders careful adjusting of ballast unnecessary. The boat is inclined slightly, about one-half of a degree down by the head, and the inrush of the water controlled by manipulation of the valves. All this is done in the short period of from one to two minutes. Seven boats have been known to average about two minutes for this evolution during manœuvres. If the control of the boat is difficult, ballast is taken on until the boat "handles" correctly, then trimming is stopped.

The duties of each member of the crew are clearly defined. At least two and sometimes all the men are thoroughly familiar with each station, so that when an order is given it is intelligently and promptly carried out. All orders are repeated. When an order has been executed the fact is reported to the commanding officer. In submerging a boat all precautions are observed before flooding the main tanks, and the fact that they have been followed is reported to the commanding officer or his assistant by the men at the various stations.

Submerging a submarine is distinctly a one-man job. The commanding officer must be thoroughly conversant with all the details of the actual submerging of the boat, and he must at all times be thoroughly informed as to existing conditions in the boat. None of the important features can be delegated to anyone else, as each condition or state of affairs has a distinct relation to every other condition. The second officer assigned to the submarine generally assists the commanding officer where possible, and endeavors to acquire all the information possible on the details of the operation in order that he may take charge in case of any emergency.

Those who have observed an aeroplane in flight have, no doubt, noticed the rolling of the machine. This is apparent in a puffy wind. In a submarine running submerged we have the same condition if the water on the surface is rough. A submarine rolls a slight amount at a depth of 50 ft. if the surface is very rough, but practically all motion is lost at a depth of 75 ft. During the recent manœuvres in the English Channel, however, commanding officers of submarines reported that it was difficult to find a depth at which there was no motion. This is readily understood, as the waters in that vicinity are somewhat shallow and the ground swells can be felt quite near the bottom.

Depth is maintained by the use of the diving rudders. Down rudder sends the stern up and the bow down. As soon as the boat is inclined downward the plane of the deck gives a large surface for the water to act on, and the power delivered to the propellers may be resolved into two components, the horizontal, driving the boat ahead, and the vertical, driving the boat downward. The amount of the vertical component of the power delivered is controlled entirely by the diving rudder. The hull is so built that normally there is a tendency for the boat to rise, brought about by the angle of the hull and the unbalanced pressures caused by inequalities in the areas of the surfaces on the bottom of the boat and on the top of the boat. This tendency must be counteracted by the trimming of the vessel and the action of the diving rudders. In some designs of submarines there are hydroplanes, forward diving rudders, and other devices to perform the same work, the difference being in diving at an angle or on an even keel. Control of the submarine is affected by speed. The effect of rudder manipulation varies in direct proportion to the speed of the boat. It is possible to handle a badly trimmed boat if sufficient speed is used.

The periscopes are the eyes of the submarine. There are many styles of periscopes—monocular, binocular, stationary, revolving, rotating eyepiece, stationary eyepiece, and "walk around." There are also devices known as omniscopes in which the entire horizon is reflected on a ground glass, and any part can be separated from the rest by means of screen sectors. The periscopes are long tubes with lenses in the top and bottom and so fitted with prisms that the rays of light are paralleled. The general impression one gets is that of looking through a telescope. The periscope that is in most general use in the United States navy is the walk-around type with normal and magnifying eyepieces. Each boat is required to have at least two periscopes, one for the commanding officer and one for the helmsman or the second officer. In the recent boats, fitted with gyroscopic compasses, the helmsman takes his station at the compass while the lookout is at the periscope from which he directs the helmsman. The commanding officer usually stations himself at the after periscope and directs the movements of the vessel. Should he leave the periscope for any purpose, such as to consult chart or to get signals, someone always takes his place, so that there is never a time that both periscopes are not manned. When totally submerged, however, no one is needed at the periscope, for it is impossible to see more than a few feet through the water.

Signalling while submerged is a subject of much interest. In the early days of submarine navigation signalling under water was done in a most crude manner, for which the hull of a vessel was found to be peculiarly adapted. Sending was accomplished by tapping on a rivet with a hammer and receiving by holding the forehead to a frame of the boat. For several years inventors have investigated and experimented extensively, with the result that there are now in practical use in submarine signalling the submarine bell, the Fessenden oscillator, and the vibrating wire, by which it is possible to signal effectively at distances greater than five miles under favorable conditions. All these systems set up vibrations in the water, which are detected by microphones and heard through the ordinary telephone receiver. Inventors are now endeavoring to devise means for increasing the speed of transmission.

Each submarine is equipped with one bell, some with two, and on every submerged run, in peaceful manœuvres, these bells are rung, so that it is possible for those in one boat to know the approximate location of other boats. The fact that no signals were received from the F 4 has caused a belief that the vessel was so damaged that the crew remained alive for but a very short time after the accident which sank her occurred. A phenomenon is the submarine "echo." The sound waves strike an obstruction, are reflected, and are picked up at the source. This could be used to determine approximately distances from obstructions, dangers, etc., but is not recommended, as the possibilities of error are many.

The equipment of a submarine for the comfort of officers and crew is not very extensive. Officers generally sleep on cots and the crew in hammocks. Ice boxes are installed on the later boats, enabling them to carry fresh meats and vegetables. Meals on these vessels are, therefore, more satisfactory than on the earlier boats. In addition to the fresh provisions carried, each vessel has a dry-food supply constituting an emergency ration sufficient to last five days. Fresh water is carried in tanks, and it is necessary that the crew be put on an allowance when at sea and that bathing be done over the side. The submarine of the present day can operate at its maximum speed submerged for about one hour. At about one-third of this maximum speed she can operate practically twenty-four hours.

The primary object of a submarine is to fire torpedoes, and all other considerations must be subordinated to this as far as the tactical value of the vessel is concerned, but not to such an extent as to lose sight of the fact that the torpedoes cannot be fired at a target unless the vessel arrives on the scene of action. The efforts of the crew are aimed towards one thing, sinking the enemy, and the placing of the boat in position to accomplish this end calls for the co-operation of all the departments in the boat.

An attack on a hostile vessel can be made in so many ways, and would have to be made under so many different conditions, that it is impossible to lay down any hard-and-fast method of procedure. The best time to attack is at dawn or twilight, or at a time when there is enough sea running to make the detection of the presence of the boat most difficult. Submarines have been known to approach within 500 yards of a battleship in a choppy sea and in a fog to come up under the stern before being discovered, notwithstanding the fact that look-outs were stationed on the battleships to watch for the submarines. On smooth days the wake of a periscope may be picked up at a distance not greater than 5,000 yards. A submarine cannot, however, be distinguished at much more than five miles distant, at which point the boat would usually submerge and prepare to attack. The best situation for an attacking submarine is forward of the enemy's beam and approaching her. From such a position it is possible to get within range most easily and lie in wait until the enemy crosses the path of the submarine. In such a case it is possible for the submarine to pick the time for firing with some degree of assurance that the torpedo will reach the enemy and destroy her. Should the enemy be very much faster than the submarine, tactics become a case of hare and hound, with the advantage in favor of the enemy, as the speed of a submarine is limited.

The subject of safety in the submarine has received much attention, and many devices have been invented designed to obviate the dangers said to attend the operation of this type of vessel. Each designer and builder has his own method of escape for the crew in case of accident. It is believed that the one most effective and most nearly positive means of safety is eternal vigilance. In reviewing all the accidents that have occurred in the last twenty years, hardly any are found that cannot be attributed to some one thing that could have been prevented had the commanding officer been able to correct the fault. Submarines should be so operated, and it can be done, that all except remote possibilities are provided for.

It is true that accidents can and will happen, but conditions which make for catastrophe generally do not arise so rapidly that some means cannot be taken to get the boat up and the crew to a place of comparative safety before the actual accident takes place, provided, of course, that the vessel does not get beyond her safe depth. In case of accident at a depth exceeding 100 ft., the chances of getting out are remote. Even if a man escaped, he would have little chance of getting to the surface alive owing to the sudden changes of pressure. The mental condition of officers and crew in the event of accident should receive most careful consideration in the design of any means for escape, and the aim should be to produce a device that can be operated with certainty by even the panic-stricken. As submarine design improves, however, dangers of operation are becoming fewer. To-day the submarine possesses no more inherently dangerous features than are possessed by any ship. In fact, they are safer to cruise in than a surface craft, and for the same tonnage are far more comfortable in a heavy sea.

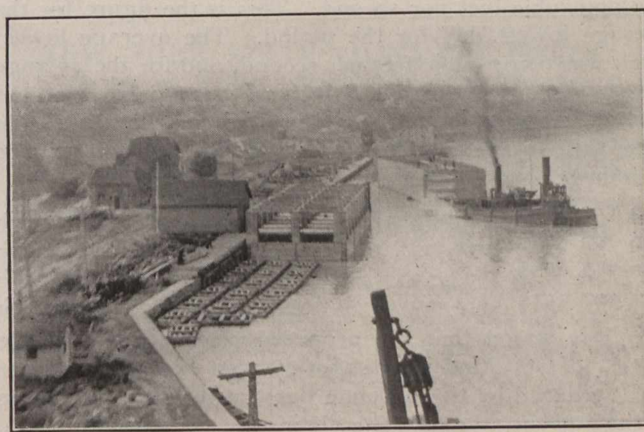
The personnel of a submarine depends for air for breathing purposes while submerged on the free air in the boat at the time of submerging and the compressed air carried in storage flasks, which is used in freeing ballast tanks of water as well as for breathing. In the average submarine in commission to-day, the air contained in the boat at the time of submerging is sufficient to last officers and crew, numbering eighteen men, for a period of from nine to twelve hours. The air carried in the storage flasks is about sufficient to replenish the entire volume of air in the boat twice at atmospheric pressure, provided it is used for no other purpose. The maximum time during which all the air available can be breathed without serious effect is, therefore, from thirty to thirty-six hours. In computing this time, the safe amount of CO_2 that should be allowed to accumulate in the air at any time is taken at 2 per cent. Men vary, however, in their ability to withstand the effects of CO_2, the average man being able to withstand about 2½ per cent., while an exceptionally strong man can withstand as much as 5 per cent. Therefore, the time during which life can be sustained by the air in a given boat will depend somewhat upon the powers of resistance to the effects of CO_2 on the part of the personnel.

The air is maintained in condition for breathing by two methods. First, by slowing bleeding from the main air supply into the boat and pumping air out very slowly; and, secondly, by allowing the air to become foul and then pumping a part of it out of the boat and replenishing it from the air flasks, at the same time maintaining a normal atmospheric pressure in the boat. The former method has been found more economical of air. The air in the boat is kept in circulation, as it has been demonstrated by experiment that air in circulation may be charged with a much greater percentage of CO_2 than still air without evil effect on the person breathing it.

The future of the submarine opens a large field for speculation. It is believed that the size of the boats, the general design, the motive power, and the principal characteristics will not change materially in the next few years, except in the case of the sea-going submarine which is now being built and which departs greatly from all previous designs. As far as can now be foreseen, the future power of submarines may be expected to be the oil engine or some modification of it. However, engineering fields have not been sounded to their depths in the determination of adequate power for these vessels, and it is believed that the future may see some development and improvement, and perhaps a material departure from any methods of propulsion heretofore adopted or proposed. With several flotillas of the sea-going type of submarines above to cruise with the fleet, they might one day be found in the line of battle with the destroyers. Some authorities claim that this type of submarine will eventually supplant the torpedo-boat destroyer. This is considered most improbable, however, as owing to their shape, high speeds call for prohibitive powers, and, with the methods of propulsion now in use or contemplated, it is not reasonable to expect a speed greater than 25 knots on the surface or 15 knots submerged.

PROGRESS ON CRIB CONSTRUCTION FOR PORT WELLER HARBOR.

THE large reinforced concrete cribs to provide dockage and protection along the sides of both entrances to Port Weller harbor, the Lake Ontario terminus of the new Welland Ship Canal, are being constructed by J. H. Tromanhauser Company, of Toronto, at Port Dalhousie, about 2½ miles distant. The unique design of these cribs and their equally notable construction was described in *The Canadian Engineer* for April 8th, 1915. Some 55 of these cribs are being built. They are 110 ft. long, 38 ft. wide and 34 ft. in height, with 18 interior compartments. Each is built upon a wooden pontoon and when the concrete walls have been constructed to a sufficient height for floating, each compartment is provided with a removable wooden bottom after which the pontoon is ballasted and floated out from under the constructed crib for further use. The crib may then be towed



to its final position and sunk, with remarkable precision, by manipulation and removal of the wooden bottoms. These bottoms were designed by Mr. J. L. Weller, the chief engineer of the canal.

The accompanying illustration is an interesting one in that it shows various stages of the work. A tug is proceeding in the direction of Port Weller with a completed crib. This crib was sunk a few weeks ago and is the first to be placed in its final position. Back of it may be seen a line of completed cribs awaiting similar treatment. In the foreground are a number of the removable bottoms mentioned above, while immediately behind them a crib is under construction with the lower part of the concrete in place and the form work ready for further concreting.

The exports from Canada to all countries during the fiscal year 1915 amounted to $490,808,877, as compared with $478,997,928 in the year 1914. The exports to British countries in 1915 were valued at $237,558,704 and in 1914 at $246,061,994, the principal countries of destination being as follows:—United Kingdom, 1915, $211,758,863, 1914, $222,-322,766; Australia, 1915, $5,551,686, 1914, $4,705,666; British South Africa, 1915, $4,481,176, 1914, $4,770,200; British West Indies, 1915, $4,366,792, 1914, $4,489,869.

During the same period the exports to all foreign countries amounted to $253,250,173, as against $232,935,934 in 1914, divided among the principal countries as follows:—United States, 1915, $215,409,326, 1914, $200,459,373; France, 1915, $14,505,705, 1914, $3,810,562; Netherlands 1915, $5,-254,829, 1914, $5,508,806; Belgium, 1915, $3,259,359, 1914, $4,819,843; Germany, 1915, $2,162,010, 1914, $4,433,736; Italy, 1915, $1,840,910, 1914, $655,256.

WATER STORAGE ON THE ST. MAURICE RIVER, QUEBEC.

THE contract has just been let by the Provincial Government of Quebec, through the Quebec Streams Commission, for the construction of a dam across the St. Maurice River, 2⅓ miles above La Loutre Falls. The award was made to the St. Maurice Construction Company, Limited, at a figure approximating $1,500,000.

The project, one of the first to be taken up by the Commission, has for its object the regulation of the river flow, and the proposed dam will provide a storage reservoir with a capacity of 160,000,000,000 cubic feet of water. It has for its object an extensive improvement of the water power facilities of the river; and also a decided impetus and benefit to the lumbering industries of that section of the province.

The minimum flow of the river, according to records of daily observations at Shawinigan from 1900 to 1912, is 6,000 cubic feet per second. This is the figure for the average lowest day for the period. The average lowest week was 6,907 cubic feet per second, and for the average lowest three months the flow was 8,477 cubic feet per second. It is estimated that the minimum flow available after the storage reservoir at La Loutre is built will be as follows:—

For 150 days	12,345 cu. ft. per sec.
For 200 days	9,317 cu. ft. per sec.
For 250 days	7,407 cu. ft. per sec.
For 300 days	6,172 cu. ft. per sec.

It is stated that the proposed reservoir will be the largest of its kind in the world, even exceeding in size that produced by the Assouan dam on the Nile, whch, up to the present, has held the distinction by a wide margin. Beyond the regulation works constructed by the Dominion Government on Lake Timiskaming and the Upper Ottawa River, Canada has not executed extensive storage works of this kind.

The site of the proposed dam is 120 miles from Escalona by the canoe route; 52 miles from Manouan by the river, and 45 miles by the proposed route on the east bank of the St. Maurice River. It is 37 miles in a straight line to the north of Parent Junction, a divisional point on the line of the Transcontinental Railway, and 240 miles from the St. Lawrence, following the course of the river.

The main features of the work will include the following: A storage dam about 1,720 ft. in length, the plan of which is a broken line, formed of four straight lines intersecting under an obtuse angle; a measuring weir of reinforced concrete, 375 ft. in length and its abutments and wing walls; a power house, two gate houses and gauge house, a sluice for logs and rubbish; ten gates 7½ ft. by 10 ft., capable of discharging 18,000 cu. ft. of water per second; generators driven by two turbines, and a heating system for the gates.

The storage dam will be of the gravity type and will have a maximum height of 80 ft. above the foundation. It will have a width of 20 ft. at the crest. The spillway portion of the dam will have a total length of 865 ft. and its top will be 10 ft. below the crest of the remaining part of the dam. The bulkhead portion of the dam will be about 435 ft. in length, and the section containing sluice gates and power plant will be about 365 ft. in length. The bulkhead section will have a base width of about 60 ft.; the base width of the spillway will be about 48¾ ft. The dam will be constructed of cyclopean masonry laid on concrete of a 1 : 2½ : 5 mix. A detailed description of the dam and of the storage possibilities of the river appeared in *The Canadian Engineer* for August 13th, 1914.

As may be inferred from the above outline of the location of the project, one of the principal difficulties with which the contractors will have to contend and one which materially affected the bidding on the project, is the matter of transportation of material and supplies. Various routes have been investigated. During its preliminary work the Quebec Streams Commission, fully recognizing the transportation difficulty, made a thorough investigation in this regard for the consideration and assistance to the builders. It is understood that the St. Maurice Construction Company, Limited, has decided upon a road to be opened from Weymontachingue along the east bank of the St. Maurice to the head of the Chaudiere Falls, where it will cross the river by means of a bridge and proceed along the western bank to the site of the dam, a distance of some 45 miles.

It is interesting to note that at the site of the dam the temperature varies from 80 degrees F. in summer to about 60 degrees below zero in winter. Ice begins to form in the early fall and attains a thickness of over 25 feet at mid-winter.

It is expected that the regulation, as projected, will put an end to devastating floods which annually occur in the valley of the St. Maurice, damaging highways, bridges, railway works, farm lands and severely handicapping lumber activities.

The enterprise is the direct result of special studies made by the Quebec Streams Commission, under the chairmanship of Hon. S. N. Parent, to develop the water courses of the province. Mr. Olivier Lefebvre, C.E., is chief engineer of the Commission. As noted in a recent issue of *The Canadian Engineer*, the Commission has similar projects, including the St. Francis storage, under consideration, but the St. Maurice regulation is the first extensive piece of construction undertaken under their direction.

MONEY RAISED FOR NEW UNION STATION, TORONTO.

An arrangement has been made for advances of $4,000,000 by the Bank of Montreal in connection with the new railway terminals at Toronto. This information coming to *The Canadian Engineer*, Canadian Pacific Railway officials were asked to confirm. Mr. E. W. Beatty, K.C., vice-president and general counsel of the Canadian Pacific, states that information "as to the concluding of the financial arrangements looking to temporary advances to the Terminals Company, is substantially correct."

There are, however, he added, other matters as yet unsettled, and which the Terminals Company is hurrying to completion.

Contracts for the work were awarded about a year ago, but the financial disturbance created by the war necessitated a postponement of all arrangements. The P. Lyall and Sons Construction Company was the successful tenderer for the larger portion of the work.

The president of the Toronto Terminals Railway company is Mr. Howard G. Kelly. This company is composed of officials of the railways interested in the terminals.

It was stated in Toronto on good authority early this week that construction work would begin at an early date. A dispute as to the terms of the contract for the post office building at the station appears to have been the final cause of delay and this has now been settled.

WATER POWER EXHIBITS AT SAN FRANCISCO.

IN connection with the Canadian Pavilion at the Panama Pacific International Exposition, the Dominion Government has had an elaborate and extensive water power exhibit prepared by the engineers of the Dominion Water Power Branch. This exhibit has been installed and in operation for some time in a large room adjoining the main rotunda of the Canadian Pavilion and has been attracting a great deal of favorable attention. It consists primarily of a tremendous aeroplane view painting of Canada from coast to coast, eighty-four feet long and twelve feet high. This painting conveys to the observer a comprehensive conception of the whole country. The location of each Canadian city is shown by an accurate bird's eye view. The network of railways and the navigation routes are interestingly indicated. The location of all developed and undeveloped water powers are indicated by colored buttons. Ranging in front of this large painting are eleven working models in relief of typical power plants serving the various important Canadian cities from coast to coast.

An engineer, thoroughly informed in engineering, industrial, and commercial conditions in Canada, is in constant attendance, advising and assisting visitors.

The government has also arranged to have a true conception of the water power resources of the Dominion conveyed in the best possible manner to the delegates who will attend the International Engineering Congress at San Francisco next September. Two technical papers setting out in detail the engineering and industrial aspects of water power development, have been prepared by Lieut.-Col. C. H. Mitchell, one of the consulting engineers to the Dominion Water Power Branch. Arrangements are being made to have these papers supplemented by a discussion during the congress by eminent Canadian authorities on water power matters.

In addition to the two technical papers to be prepared for the International Engineering Congress, arrangements have been made for the publication of several monographs on the water powers of the various provinces.

The water powers of British Columbia are being dealt with by Mr. G. R. G. Conway, until recently chief consulting engineer to the British Columbia Electric Railway Company, of Vancouver, B.C. The water powers of the Prairie Provinces have been written up by Mr. P. H. Mitchell, consulting engineer, Toronto. The water powers of the province of Ontario have been described by Mr. H. G. Acres, chief hydraulic engineer of the Ontario Hydro-Electric Power Commission. Quebec water powers have been described by Mr. F. T. Kaelin, assistant chief engineer of the Shawinigan Power Company. Mr. K. H. Smith, engineer of the Nova Scotia Water Powers Commission, has covered the water powers of the Maritime Provinces. These five monographs have been prepared expressly for distribution at San Francisco.

Canada is generally recognized as one of the foremost power-producing countries of the world. Her numerous rivers have immense potentialities, and within the area of population reasonably to be anticipated in the near future, is estimated to have water power possibilities aggregating 18,000,000 horse-power, while nearly 2,000,000 horse-power of this amount has already been developed. Comparison with other countries establishes our standing among other industrial nations; power development on such a scale is significant of corresponding industrial activity. It is notable that many of the foremost hydraulic advancements in water power engineering have found their application, if not their inspiration, in Canada. Several of the largest power plants in the world have already been constructed and the many hydraulic plants, approaching two million horse-power in aggregate capacity, have permanently established markets while over eight times this amount is within reasonable zones of commercially economic development. The large cities of Canada are fortunate in being liberally endowed with adjacent water power sources.

In view of the fact that funds for the extension to present developments or for the instigation of new developments will, in a large measure, probably have to come from American sources, the Dominion Government has adopted an exceedingly wise policy in spending every reasonable effort and expense in having Canada's unusually favorable water power and industrial opportunities made known in the best possible manner, at the Panama Pacific Exposition.

NEW YORK STATE CONCRETE ROADS.

According to Mr. H. E. Breed, Deputy Commissioner of the New York State Highway Commission, during 1914 all their concrete roads were built of plain concrete of the 1 : 1½ : 3 mix. This year they are building with the same proportions, but some reinforcing is being tried where this pavement goes over clay sub-soil.

New specifications were adopted September 15, 1914, and the concrete roads being constructed during 1915 are built under these specifications. The sizes of coarse aggregate remain the same but the use of gravel is strictly specified so that it is confined to restricted regions of the state where the best quality of the material is available. The fine aggregate is more definitely specified on gradation and compressive strength.

Last year the Commission used a 7-in. depth at centre and 5-in. at the sides. In order to obtain a parabolic section without increasing the quantity of concrete the engineers are now using 6¾-in. at centre and 4¾-in. at the sides. The crown remains the same at ¼-in. per foot. The conditions coped with thus far require no reinforcement, except as stated for clay sub-soil.

Thorough spading of the concrete is insisted upon to remove air bubbles, to increase the density and to bring the mortar to the surface. Consolidation of the concrete and the form of the finished surface is obtained by means of heavy screeds which rest upon the side forms and are drawn back and forth over the surface. The screeding is followed by rubbing down with a wooden float, after which the surface is roughened by brooming. When initial set has taken place, the surface is covered with sand to a depth of one inch or with the material composing the shoulders, and thoroughly dampened morning and night for a period of 10 days.

The Prince Edward Island Railway, a Government line operated under the Department of Railways and Canals, Ottawa, is of 3 ft. 6 in. gauge. It extends from Tignish to Georgetown, 158.60 miles, and from Charlottetown to Murray Harbour, 52.30 miles, with branches to Souris, Elmira and Cape Traverse. The length of the road operated was 275.2 miles. In 1914 the Government expenditure on capital account, for this line, amounted to $129,574.95, and on revenue account $571,415.27, making a total of $700,990.32. Its earnings amounted to $409,616.74.

ELECTRIC BLASTING AND LIGHTNING.

WHILE electric blasting has been very successfully used in quarry work of various kinds, there is some degree of danger in its use for shaft-sinking operations, at least in a district which is subjected to frequent and severe lightning storms, which, unfortunately, are prone to occur during the afternoon hours, when it is most customary to blast.

This subject was under discussion at a recent meeting of the Institute of Electrical Engineers of South Africa, following a paper by Mr. A. E. Val Davis on the practice and methods of electric blasting. In the discussion it was pointed out that the average current required to fire each of the series of fulminate of mercury primers was 0.35 amperes at 0.165 volts, or 0.047 watts. With an average of 50 primers in series in the system about 2.35 watts would be required to obtain ignition and promote explosion. This is a very small amount of power, when it is figured out that in one second it will generate 0.002 B.t.u., which would raise the temperature of a gramme of water about 0.056° C.

Connected to these primers there are 10, 20, or even 150 feet of more or less insulated wire ready to receive energy as the result of one or more of the following conditions: conduction, induction, electro-static influence, the reception of electro-magnetic waves, local electrolytic action.

The possibility of induction can be fairly easily eliminated by ensuring that all lighting circuits in any way associated with sinking operations are disconnected some time previous to blasting. This is the practice at quite a number of the shafts using the method.

The elimination of induction is more difficult, according to Mr. Val Davis. Some means of signalling between sinker and driver is necessary up to the moment the sinker leaves the shaft bottom, and as the signalling gear will involve the use of either a mechanical bell rope or electrical leads, the possibility of inductive effects via headgear, skip rope and signalling gear is very great, and since lightning conductors are recommended to be used on the headgear, it is, according to certain authorities, practically certain. There are numerous instances on record of skipmen and underground workers having received violent shocks from the ironwork of the skip when several thousand feet below the surface, in spite of the fact that the steel headgear constituted a particularly good earth connection. The possibility of these induced currents exploding the charge could, however, be circumvented by the use of a common alarm clock arranged to connect the detonator circuit to the blasting cable fifteen minutes after the sinker had reached the surface. The charge could then be fired by the sinker in the ordinary way. This, of course, involves the destruction of an alarm clock every shift. The charge might even be fired by a local circuit, *e.g.*, a pair of dry cells with the alarm clock to connect them to the circuit after the sinker had got safely away. These methods do not, however, altogether preclude the possibility of premature explosion.

Electro-static effects pure and simple would be practically non-existent if there were no cable or ropes in the vicinity of the detonators.

The crux of the whole question is described as follows: From the Eiffel Tower in Paris wireless time signals are sent out at certain times. In London it is possible to receive these signals with an ordinary wireless receiver with no antenna in the accepted sense of the word, but by merely using a cycle or a bedstead as the receiving antenna. Now, what operates the receiver? It is energy which is radiated from the transmitting station in the form of electro-magnetic waves, some of which, impinging on either the cycle or the bedstead, gives up sufficient energy to operate the receiving apparatus; faintly, it is true, but nevertheless the fact remains.

The kilowatt rating of the Paris wireless station does not exceed 500 kilowatts. The distance between London and Paris is of the order of 200 miles. Surely, then, a lightning discharge representing millions of watts, perhaps less than a mile away, may cause 2.35 watts to be dissipated in the detonator circuit itself without the assistance of either head-gear, bellrope, skiprope or blasting cable. The fact of the circuit being 2,000 feet down a shaft won't protect it.

This argument may be tested by placing on the ground a metal ring, say, 10 feet in diameter, having a detonator in circuit. If the argument is true, any lightning flash within reasonable distance will explode the detonator. The circuit need not necessarily be closed, providing there is a point of weak insulation in some part of it.

As far as electrolytic effects are concerned, to explode fifty detonators requires 2.35 watts, and one detonator needs only 0.047 watt. It is realized that by merely connecting up a detonator and placing it in the hole where, with its leads, it is soon dampened with the acid water of the shaft, we have the necessary elements of a primary cell—the iron skip guides being the other electrode.

We know far too little of the action and effects of lightning to say, with certainty, that we have eliminated it from any further consideration in an electrical problem such as this. The whole matter is one on which opinions as to what constitutes safety differ.

During the fiscal year 1915 the total exports of merchandise were valued at $461,442,509, as compared with $455,437,224 in the previous year 1914. The increase was confined to the exports of foreign produce as the exports of Canadian produce show a decrease of $22,169,603. The increase in the exports of foreign produce of $28,174,888 is confined principally to horses, oats and wheat. From 1914 to 1915 the exports of Canadian produce—viz., the mine decreased from $59,039,054 to $51,740,989; the fisheries, from $20,623,560 to $19,687,068; the forest, from $42,792,137 to $42,650,683; and agricultural products, from $198,220,029 to $134,746,050; while animal produce increased from $53,349,119 to $74,390,743; manufactures, from $57,443,452 to $85,539,501 and miscellaneous articles, from $121,088 to $663,802. The following articles of Canadian produce show a decrease from 1914 to 1915—viz., wheat, from $117,719,217 to $74,293,548; planks and boards, from $19,514,128 to $18,921,445; silver, metallic, contained in ore, from $20,971,538 to $13,516,390; flax seed, from $24,816,333 to $10,359,703; oats, from $13,379,849 to $8,961,126; hides and skins, from $9,262,972 to $7,729,920; copper, fine, contained in ore, from $9,489,729 to $7,545,246; deals, from $7,956,563 to $7,542,158; pulpwood, from $7,388,770 to $6,817,311; nickel, fine, contained in ore, from $5,374,738 to $5,063,656; salmon, canned, from $6,631,437 to $4,948,723; codfish, dry salted, from $4,564,731 to $4,171,962.

The following articles show an increase—viz., wheat flour, from $20,581,079 to $24,610,946; cheese, from $18,868,785 to $19,213,501; gold-bearing quartz, dust, etc., from $13,326,755 to $15,406,510; printing paper, from $11,386,845 to $14,091,662; bacon, from $3,763,195 to $11,811,825; cattle, from $7,906,794 to $9,267,534; wood pulp, from $6,364,824 to $9,266,161; clothing, from $446,524 to $7,344,388; coal, coke, etc., from $4,040,130 to $4,711,839; sole leather, from $2,336,491 to $4,096,081; harness and saddlery, from $21,288 to $3,981,959; settlers' effects, from $2,841,408 to $3,681,709; and lobsters, canned, from $2,983,987 to $3,013,782.

Editorial

ONTARIO COMMISSION ON NICKEL.

The controversy which arose last fall out of numerous intimations to the effect that the enemy was securing through certain channels such nickel as he desired from the Ontario nickel-producing region has doubtless to some extent resulted in the recent appointment of a nickel commission by the Provincial Government. This commission will inquire into the whole nickel situation in Ontario with a view to establishing in the province an industry that will be under observation from the time it leaves the mines to the time it is marketed. While assurances have been given to the Imperial authorities and the Dominion and Provincial Governments that not an ounce of Ontario's nickel is finding its way into the enemy's hands, the Provincial Government views the situation from a larger standpoint and has instructed the new commission to ascertain whether it is not possible to complete the refining of nickel ore from the mines of Ontario entirely within the province without having to ship it to American refineries. The question of the province receiving an adequate return from its nickel deposits is regarded as of much importance, and on this point the commission will also advise the government.

The personnel of the commission is such as to indicate a thorough investigation by fully competent metallurgists. The chairman, Mr. George Thomas Holloway, is a distinguished metallurgist and chemist, and an associate of the Royal College of Science, London, Eng. The secretary is Mr. Thomas W. Gibson, Deputy Minister of Mines for the Province of Ontario. The other members are Mr. Willet G. Miller, Provincial Geologist, and Mr. McGregor Young, K.C., Toronto.

The new commission has a very important work to perform, one not by any means devoid of difficulties. For Ontario is producing nearly 85 per cent. of the world's supply of the metal, and the demand for it covers a wide range of industries, from nickel steel in armor plate and war munitions to coinage, nickel plating and the like.

The metal is not refined in Canada, but in the United States and England. There is a duty of 6 cents per pound against shipments of refined nickel into the United States from Canada. There is no duty, however, on the ore or matte shipments.

CANADIAN SHELL ORDERS.

The Canadian Shell Commission, which has been placing orders in Canada for shells and explosives on behalf of the British and Canadian governments, is not being dissolved as a rumor had it last week. On the other hand, the activities and scope of the commission are being extended. At a recent meeting of Canadian manufacturers held in Ottawa, it was decided by them to do all their business with the British government and its representative, Mr. D. A. Thomas, through the Shell Commission. For this purpose, a complete inventory has been made of all the factories in Canada, capable of assisting in the production of fixed ammunition and other war munitions. Since the distribution of the last shell order, on receipt of applications from any factory for work, an inspector has been sent, and complete information gathered regarding the factory, until now the information is complete, and was ready to place before Mr. Thomas upon his arrival in Ottawa. On the receipt of further orders, the Shell Commission is in a position to make an immediate distribution of them.

In regard to the use of trinito-tololume, cordite, and fuses, made in Canada, all are being used by the Canadian government in the production of fixed ammunition, except in the case of trinito-tololume. Any surplus of that is being shipped to England for the use of the British government. Some fuses made in the United States were imported before the industry was developed here, and to meet a pressing emergency.

On receipt of the large shell order from the British government, the Shell Commission immediately got options on the material required to fill this order. They have, therefore, enough brass on hand to complete the order already given, and any anxiety regarding the supply of material, is for future orders. By optioning this material at that time, the government saved a large sum of money, as the advance in price since then has been very great.

WINNIPEG POWER POSSIBILITIES.

An interesting indication of the changed viewpoint of Canadians regarding the bountiful supply of water power and its relation to the industrial and manufacturing fabric of the country, is shown by a pamphlet gotten out by the commissioner of the Winnipeg Industrial Bureau, on the water powers of Manitoba. It was the desire of this commission to have prepared, information respecting the tremendous development of the city of Winnipeg and its future possibilities, for distribution at the Panama-Pacific International Exposition. Instead of the pamphlet containing elaborate photographs of public buildings, banks, residences, etc., with a mass of statistical data regarding bank clearings, manufacturing, population, assessments, etc., the commission has devoted its efforts to exhibiting in a dignified and clear manner, the fortunate situation of the city of Winnipeg with respect to developed and undeveloped water power within. economic transmission radius.

The maps, photographs and general engineering information in this pamphlet were supplied by the Dominion Water Power Branch of the Department of the Interior. This pamphlet is potent of great possibilities for Canada, indicating as it does adequate appreciation of such an important Canadian organization as the Winnipeg Industrial Bureau, of the basic connection that water power has had and will always have in the future industrial and manufacturing advancement of the country, and also indicating the ability of a technical government organization, such as the Dominion Water Power Branch, of having technical and engineering data put forth in a manner that can be appreciated by the man on the street.

The surveys of the water powers of the Winnipeg River in the Province of Manitoba, and of the storage possibilities in the upper waters of this river in the Province of Ontario, show that it is economically feasible to develop, at eight power sites, over 409,700 continuous 24-hour w.h.p., all within eighty miles of the city of Winnipeg, and within feasible transmission distance of all the commercial centres of the present settled portions of the Province of Manitoba. Of these eight power sites, there are three now under development representing a total power capacity of 199,024 h.p. One site is completely developed by the Winnipeg Electric Railway Company, producing 28,000 h.p. The municipal plant of the city of Winnipeg at Point du Bois Falls has at the present time installation capable of producing about 47,000 h.p. This plant is capable of extension to a maximum of nearly 80,000 24-hour h.p. Development at the third power site, at Great Falls, with a maximum possibility of 99,500 24-hour h.p. is now under way. At the two completed power developments there is therefore about 75,000 h.p. produced at the present time, and which can be increased to 108,000 24-hour h.p. The six remaining sites on the Winnipeg River are under the absolute control of the Dominion Government and can furnish a further amount of 24-hour power to the maximum extent of 210,700 h.p. In addition, there are several important power sites on the Winnipeg and English rivers within the Province of Ontario within easy transmission distance of the city of Winnipeg. Considering all the water power sites on these two rivers in the provinces of Manitoba and Ontario, there is within transmission radius of the city of Winnipeg, a grand total of 570,000 24-hour h.p.

LARGE WATER POWER DEVELOPMENTS.

THE water power resources of eastern and north-eastern Canada have commanded a great deal of attention of late. The Cedars Rapids development, the Shawinigan extensions, the St. Maurice storage scheme and other enterprises bespeak remarkable exploitation and opportunities for industrial advancement. The exceedingly large proposals that have come to light during the past few months are equally indicative of the extent of undeveloped water powers in unsettled portions of the country.

In last week's issue reference was made to the enormous quantity of power available in the vicinity of Grand Falls on the Hamilton River. A total head of 760 ft. is stated to be capable of producing over 3½ million h.p. on a 12-mile section of the river. In *The Canadian Engineer* for July 1st, 1915, we commented upon the Lake St. John and Saguenay River scheme to develop about 600,000 h.p. In our issue of May 13th a summary appeared of an agreement between the legislature of Newfoundland and a new corporation involving an $18,000,000 industry to include a considerable water power development for industrial purposes.

We have it on good authority that the three gigantic schemes just mentioned are being promoted by one and the same company. The American Tobacco Company, a $75,000,000 concern, is undertaking in a wholesale manner the manufacture of phosphates, nitrates and other products. Chief among them are fertilizers which the company propose devoting to their own plantations.

The Saguenay River development, as stated in a recent issue, will manufacture products by the fixation of nitrogen method, including nitric acid and nitrates, through a special process originated by Mr. Thomas L. Willson, formerly of the International Marine Signal Company, Ottawa, and the originator also of the calcium carbide process in general use. This enterprise is under the control of the Quebec Development Company.

The other two, *viz.*, the Hamilton River and the Newfoundland developments, are controlled by the Newfoundland Products Corporation, Limited, of which Mr. Willson is an official. With him is associated the Reid-Newfoundland Company. This enterprise for the manufacture of ammonium phosphate, ammonia, cement, wood pulp and lumber, involves an industrial plant estimated to cost $3,745,000; a water power development costing $6,440,000; a phosphoric acid plant and an ammonia plant to cost $900,000 and $450,000 respectively. An interesting feature of the enterprise is the fact that phosphate rock will be brought from Florida for treatment in Newfoundland. This rock consists of calcium phosphate with a considerable percentage of calcium carbonate.

There is a considerable degree of indefiniteness surrounding as yet the development of Grand Falls on the Hamilton River and other falls on the North West River. The company agrees to survey both within two years and the government agrees, providing certain conditions relative to extension of business are complied with, to grant the company the water power rights providing also the latter spends the sum of $10,000,000 within five years.

Considerable progress is being made with the preliminaries of the Saguenay River development. Mr. W. S. Lee, of 200 Broadway, New York, is the consulting engineer to the Quebec Development Company. There are to be 12 units of 50,000 h.p. each. The Swedish General Electric Company, the Canadian Westinghouse Company and the Canadian General Electric Company have the plans in hand and will shortly submit prices for the electrical apparatus. The turbines and hydraulic accessories are under the consideration of the I. P. Morris Company and the Canadian Allis-Chalmers Company, Limited. One of the great problems in connection with such a development at any time is the matter of transportation of the extraordinarily large units. In this instance the difficulty will be particularly acute. As far as we have been able to learn, no definite scheme has been decided upon.

PROPOSED RAILWAY EXTENSIONS IN NEWFOUNDLAND.

The operative mileage of the Newfoundland Government Railway will be considerably increased, if the Legislature approves of the proposal now before it to borrow $2,000,000 for railway extensions. The sum is to be devoted to the construction of six branch lines of railway to connect with the Newfoundland Railway between St. John's and Port aux Basques, as follow: (1) From a point on the Newfoundland Railway near Shoal Harbor to Bonavista; (2) from a point near Broad Cove to Heart's Content and Grate's Cove; (3) from Carbonear to Grate's Cove; (4) from a point on the West-End branch of the Newfoundland Railway to Trepassey; (5) from a point between Come-by-Chance and Northern Bight to Fortune Bay; and (6) from a point near Howley or Bay of Islands to Bonne Bay.

The Ontario government had to give a guarantee to the British war office before some captured German guns would be loaned to the Canadian National Exhibition, Toronto. The Association is also under heavy bond for the return of the trophies.

The Engineer's Library

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto.

CONTENTS.

BOOK REVIEWS.

Design of Steel Bridges—Theory and Practice for the Use of Civil Engineers and Students. By F. C. Kunz, C.E., formerly designer for the Bridge and Construction Department of the Pencoyd Iron Works and the American Bridge Co., and chief engineer of the Bridge and Construction Department of the Pennsylvania Steel Co. Published by McGraw-Hill Book Co., Inc., New York and London. First edition, 1915. 472 pages of text, 227 text figures, 15 single-page plates and 37 folding plates, size 6 x 9 ins., cloth. Price, $5.00 net. (Reviewed by David A. Molitor, C.E.)

The present book comprises one of four volumes on "Structural Engineering," contemplated by the author, though it is not stated which volume it represents and numerous references to Vol. I. mentioned in the text, would indicate that it is not the first volume of the series. The following comments are offered on the 17 chapters and appendices:

Chapter 1, on external forces, contains much useful information pertaining to dead loads, live loads and impact, though in many instances the omission of axle spacings is regrettable. It is difficult to understand why the author should adhere to the impact formula $300 \div (L + 300)$, which was originally based on very meagre data. The results found from elaborate experiments recently conducted by the American Railway Engineering Association certainly warrant a change in the impact formula as the old formula gives impacts too small for floors and short spans, and values too large for trusses of long span bridges, a defect which can and should be remedied.

Chapter 2, headed "General About Reactions and Influence Lines," covers a very important subject in a rather hurried manner.

Chapter 3 gives a very complete treatment of the subject of maximum moments and shears in simple spans with numerous tabulations as generally employed by expert computers.

Chapter 4 treats very fully of the stresses in simple trusses, showing the ordinary methods of stress computations and influence lines, which latter are not, however, especially useful for simple structures. In his discussion of trusses with subdivided panels the author might have shown more clearly the effect produced by varying the arrangement of the diagonals in the four cases which occur in practice.

Chapter 5 is a rather brief discussion of lateral and sway bracing, sufficient for most purposes, but by no means exhaustively treated.

Chapter 6. Types of bridges and principal dimensions are discussed in concise but able manner, dealing more particularly with practical considerations.

Chapter 7, "Design of Floor." The various types of railway and highway bridge floors are described rather briefly and as this is a subject which has received little consideration in theoretic treatises, the author might have contributed much more illustrative matter of practical usefulness. Also, the floor sections shown on Plates V., VI. and VII. do not give panel lengths, nor is the stringer spacing dimensioned on Plate VII. These omissions are rather serious and detract from the practical usefulness of the subject matter. Also buckle plates, which deserve a conspicuous place in the treatment of highway bridge floors, have received little consideration outside of a table on commercial sizes of the American Bridge Company.

Chapter 8, on beam and plate girder bridges, is very complete and abounds in practical data pertaining to railroad bridges, while highway bridges receive only passing comment. A few more illustrations would not have been out of place, as the field is large and offers many variations in practical details.

Chapter 9 gives the general principles of designing simple truss bridges in very able manner. The detailing of riveted connections would, however, deserve more attention than was given.

Chapter 10. Skew bridges and bridges on curves are treated quite fully, dealing more particularly with the general layout, panel arrangement and spacing of trusses and stringers. The stresses in bridges on curves are best found with the use of influence lines which are not given.

Chapter 11, "Weights of Simple Span Bridges." A great deal of valuable information is contained in the 16 pages devoted to this subject though it is nearly all of a special character. Unless the designer is working under the same specification and employs the same floor system, the weights given for trusses would be incorrect. The writer has found weight curves most useful when based on relations between span length, total load carried including impact, and weight per lineal foot of one truss. Such curves can be used for any case of loading so long as the allowable working stresses and type remain unchanged.

Chapter 12, "Viaducts." This chapter is very complete and discusses the calculation of stresses in the towers and the general design of viaducts very fully.

Chapter 13 deals briefly with elevated railroads, taking up chiefly the stresses in the columns.

Chapter 14, on movable bridges and turntables, actually relates only to swing bridges, as other types are passed over by a mere mention. This subject, while it involves many intricate and perplexing problems, should have received much more attention, as movable bridges of the present day constitute a large percentage of all bridges built. Little or nothing is said regarding the operating machinery. As ordinary swing bridges have been gradually replaced by better types of movable bridges, this chapter must be regarded behind the times.

Chapter 15, on arch bridges, treating only two and three-hinged spandrel-braced arches. The stress analysis is the same as given in standard works and assumes the reader to be familiar with the underlying principles of the work equation and deflections. Solid web arch ribs are not treated, while for smaller bridges these always lend a more pleasing aesthetic effect. The real beauty inherent in the arch principle is largely destroyed by the spandrel bracing. The chapter closes with descriptions of a number of large arch bridges, giving their principal dimensions and the allowable unit stresses employed in their design. Notable among these examples are the two-hinged and fixed arches with braced ribs and nearly parallel chords, comprising exactly the types which are not theoretically treated in the book.

Chapter 16 deals with long-span bridges in general, including arch, cantilevers and suspension types. This chapter represents a valuable collection of data pertaining to the famous large bridges of the world but more particularly to American bridges with several plates showing outline elevations and cross-sections.

Chapter 17, on cantilever bridges, briefly takes up the calculation of stresses by influence lines and gives one example. Some discussion of dead load assumptions and a few pages on design conclude the chapter.

The book concludes with 8 appendices covering 34 pages devoted mostly to information and tables already published in steel handbooks, and the general bridge specifications of the American Railway Engineering Association.

In general, the book is well illustrated and contains many examples and numerical problems, though the connection between the numerical solutions and the principles upon which they are founded is not at all clear in many of the stress calculations.

The absence of any general discussion of the fundamental theorems of structures and deflections prevents the author from laying a proper foundation for the analysis of stresses in swing bridges, turntables and arches where redundancy is involved. However, this may be a pardonable omission as the author in his preface announces his intention to deal more particularly with the practical side of his subject.

In the selection of methods of calculation best suited to a given case, the author generally shows good judgment and for the most part adopts those methods which have received general acceptance among bridge specialists. However, many innovations already available on this subject in standard works on theory, have been overlooked. As the author does not profess to treat the theoretic side of bridges exhaustively within the limited space available in the present volume, frequent references to standard works would have been most valuable to the average reader. The references given under the head of "Additional Information" at the ends of Chapters 12, 13, 14, 15 and 17 relate to professional papers and current literature only, and deal mostly with descriptive articles, while standard works on bridges are not mentioned.

Few, if any, authorities are cited for formulas and methods employed which are not original with the author.

Regarding the best modern practice in designing and estimating steel bridges which the author aims to present, it might be said that the book gives the author's exposition of the standard practice of the American Bridge Co., the Pennsylvania Railroad Co., and the Norfolk and Western Railway, besides general descriptions of notable structures. However, the most progressive work resulting from the labors of consulting bridge engineers has been treated rather lightly.

Some of the nomenclature employed is not that which has generally been accepted as standard.

The typography and text figures are good and the full-page and folding plates are generally good except in a few instances of excessive reduction.

The book as a whole represents a compilation of much useful data not generally contained in theoretic treatises. The illustrative matter pertaining to details is very valuable, but in this particular field the author might have given much more, especially along progressive lines and better practice. The treatment of the theoretic side of the subject is not especially creditable to the author and there are at least three standard American works on the theory of structures outclassing the present one both in point of best methods of analysis and in exhaustive treatment.

Manual of Public Utilities, 1915. Published by Poor's Manual Company, New York.

This book is the second of the series of three books devoted to the reports of American corporations—the first (Manual of Railroads) was issued in January; and the third (Manual of Industrials) will be issued in a few weeks. This year's manual is much larger and more complete than previous editions and the inquirer will search a long time for a more comprehensive summary of public service corporations. The book shows statements of subsidiary, controlled, and affiliated companies in conjunction with the statement of the parent company. Each statement gives, where available, the latest published annual income accounts and balance sheets, in most cases in comparative form for a number of years, showing at a glance any change in the trend of the companies' business.

All consolidations and reorganizations which have taken place up to June 1, 1915, are recorded in the book. The names of these merged companies are listed in the general index, so that they may be referred to readily.

Manual del Ingeniero. By Trautwine. (Spanish Edition of Engineer's Pocket Book.) Translated into Spanish and converted to the metric system by Alberto Smith, C.E., Professor of the Central University of Caracas. Published by A. Smith, New York City; Canadian selling agents, Renouf Publishing Co., Montreal. 1,273 pages, illustrated, 4½ x 7 ins., flexible cloth. Price, $5.00 net.

This translation was undertaken with a view to accelerating the professional work of Spanish speaking engineers. There has been no such handbook written in Spanish and the value of the present translation of a work that has sold nearly 120,000 copies, is obvious. The chief characteristic of "Trautwine" is the vast and laboriously collated assortment of the results of experiment and practice, achieved during recent years, by eminent engineers and by the foremost engineering associations. These results have placed modern engineering construction upon a firm basis of experience.

The publication of the Spanish "Trautwine" places the Spanish engineer in touch with the important and active progress made by North American and English engineers and with the admirable work of their scientific societies. Until now, these matters have remained but little known to Spanish-speaking engineers, a majority of whom learn French, while but very few learn English.

In typography, in the arrangement of its material, in the numbering of its paragraphs, etc., the Spanish "Trautwine" is identical with its English original. This will enable engineers, knowing either of the two languages, to familiarize themselves with the terminology of the other, by comparing the two texts.

Conservation of Water by Storage. By George F. Swain, LL.D., Professor of Civil Engineering in Harvard University. Published by Yale University Press, New Haven, Conn. 384 pages, 91 illustrations, 7 x 10 ins., cloth. Price $3.00 net. (Reviewed by T. H. Hogg, C.E., assistant hydraulic engineer, Hydro-Electric Power Commission of Ontario.)

This volume is made up of a collection of addresses delivered in the Chester S. Lyman Lecture Series, 1914, before the senior class of the Sheffield Scientific School of Yale University.

Without question, Dr. Swain's book on the conservation of water by storage is the most comprehensive and enlightening that has ever been published. All his readers may not agree with his conclusions, particularly as outlining his views on the desirability of the immediate use of water power. On page 109, Chap. V., "Water Power on the Public Domain," he states: "From the point of view of conservation, it is, of course, far better for the public that water power should be used instead of steam, even at the same or a somewhat greater cost; and this, too, even if such use results in unduly large profits to the water power owners; for it saves an equivalent consumption of coal, and so tends to prevent the rise in its price which must inevitably result from exhaustion of supply. Here, again, from the conservation standpoint, *any* use is better than *no use at all*." In the abstract, no doubt this statement is true; but very often "any use" would mean the skimming of the cream of a possible development by using the concentrated fall and thus prohibit the future use of the total capacity of the site until the initial plant had become obsolete. This condition of affairs has arisen at Niagara Falls. In many cases it would be better to defer development until conditions warrant the complete use. With this point of view, Professor Swain does not agree, and throughout the volume a strong appeal is voiced for more lenient treatment of capitalists interested in water power development, on the part of the government.

The discussion throughout is intensely illuminating A wealth of information is most concisely presented. It is doubtful whether in the last decade another volume on an engineering subject has appeared that presents the material discussed from such a broad viewpoint and with such freedom from technical quibble.

The first chapter deals with the general subject of conservation. The next four chapters are devoted to the relation of the conservation of water to the conservation of other resources, and to a discussion of the water power question and federal control of water powers. The sixth chapter is devoted to the technical aspects of water power development. The seventh chapter deals with the question of the relation of forests to stream flow. The discussion is particularly good and should aid the reader materially in obtaining a clear idea of their effect on stream flow, a subject on which there is much misunderstanding among the profession.

The last chapter deals with floods and their prevention. This is followed by seven appendices dealing with various legislative acts.

Purchasing. By C. S. Rindsfoos, C.E., President United States Purchasing Corporation. Published by McGraw-Hill Book Company, New York City. First edition, 1915. 165 pages, illustrated, 6 x 9 ins., cloth. Price, $2.00. (Reviewed by John E. Burns, Toronto.)

It is a trite, if hackneyed, proverb that experience is a dear school, but fools had best go through it; certainly learning to buy by buying is an expensive experience, so much so, in fact, that it is strange how little has been written concerning this art of getting value for the money. In reading Mr. Rindsfoos' book perhaps the first lasting impression, or shock, one gets is produced by an account of how the buyer can be "stung," which tallies with a remarkable degree of closeness with an unpleasant experience of one's own. Reading further, you are presently conscious of another occasion on which you were "stung again," and so it goes, until with reading of what you have already discovered of the art and of what you might have come to know in the same painful way you smile and wonder how much Rindsfoos' education cost him.

Most books on business are hopelessly vague compared with the precise and definite text book with which the engineer is familiar. It is, therefore, a pleasure to read such a book as the one in hand. Written by an engineer, it conveys throughout the impression of a full knowledge on the part of the writer,

Numerous quotations from two American writers on the subject are used and the object of these insertions is not at all clear. For the most part they consist of opinion unsupported by any reference to cases, and weaken, if anything, the author's work. Where Mr. Rindsfoos cites actual experience his illustrations are very apt indeed, and it is a pity that in certain instances he chose the theory of other writers rather than the facts of his own experience.

Taken as a whole "Purchasing" is a keen analysis of human nature in buying and selling. Buying is discussed from almost every angle and in nearly every chapter the author sums up in some such pearl of business psychology as: "It is no less essential to know the failings of the seller than it is to conceal one's own desires, weaknesses and thoughts." It goes right to the heart of every purchaser's business. In addition, it contains a wealth of practical helps in a very large collection of the printed forms in use by purchasing departments and recognized as standard practice. The book is well worth careful study.

Test Methods of Steam Boiler Plants. By Edward H. Tenney, B.A., M.E. Published by D. Van Nostrand Company, New York City. 244 pages, 85 figures, 5 x 7 ins., flexible binding. Price, $2.50 net. (Reviewed by Mr. A. J. McDougall, Department of Mechanical Engineering, Toronto Power Company.)

This book deals with test methods of equipment and fuels, and with the operation of power plants so as to obtain maximum efficiency and economy. The first chapter deals with the purchase and testing of coal. The author strongly recommends the purchase of coal on a B.t.u. basis. The specifications of the Cleveland Transit Company and the United States Government for buying coal on that basis are given. The purchase of coal from the heat it is capable of producing is admirable and should be in much more general practice.

The second chapter deals with the methods of determining economy of combustion, the chemical reactions of coal combustion and how to operate a chain grate stoker to best advantage.

Chap. 3 takes up the important matter of water for boiler use. The minerals found in waters and their solubilities at different temperatures are given with easy methods of analysis. Exception is taken to the statement that magnesium sulphate deposits and forms a hard scale. This statement is contrary to the general belief as to its action in boilers. Most authorities claim that magnesium sulphate does not deposit and make a hard scale.

Apparatus for purifying and softening water is then taken up. Plants for the removal of sediment and organic matter from impure waters are first described and then three types of continuous water softening plants. We do not consider that plants solely for the purpose of removing suspended or organic matter from boiler waters, are necessary in a boiler plant, as any well designed water softening plant will not only soften the water but also remove the greater portion of sediment and organic matter in the water. We think that the author instead of describing three water softening plants of one type should have confined himself to one of the continuous type and also described the intermittent type which is in perhaps as extended and successful use as the continuous. Feed water heating and heaters is also considered in this chapter.

Chap. 4 gives a good form for running boiler tests with directions for conducting test. Methods of determining moisture by means of several described steam calorimeters are also outlined. Several makes of Orsat apparatus for the analysis of flue gas are described, as well as continuous CO_2 recording apparatus.

Chap. 5 deals with prime movers, reciprocating engines, steam turbines, and condensers, their operation, testing, apparatus for testing and forms for running test. Under the heading "Tests of Vacuum Pumps," the statement is made that "Proper operation of these auxiliaries means that they shall do the work for which they are installed." One might ask, Why confine such a laudable condition to vacuum pumps?

The last chapter takes up the important subject on which the operating engineer has little accessible knowledge—lubricating oils. This chapter gives briefly and well, materials entering into the composition of lubricating oils, their detection and value. Somewhat fuller descriptions of specifications of oils for different power plant purposes would be of value.

In the appendix, various tables of more or less value are given. In Table 28, on the effect of heat on various bodies, we question the correctness of the following: "Ammonia boils at 140 degrees Fahrenheit and freezes at 40 below zero. Brandy, a distilled liquor, freezes at 7 degrees below zero while strong wines, which are only fermented, freeze at 20 below zero"; also, "Wrought iron melts at 2,980, copper melts at 2,548," and "the greatest known cold, 166 degrees below zero."

The book as a whole contains much information of value to the operating engineer and we believe that the second edition of this book will be of even more value.

Surveying and Building Construction. By A. H. Haines and A. F. H. Daniel. Published by Longmans, Green & Company, London, Eng. First edition, 1915. 339 pages, 222 illustrations, 6 x 9 ins., cloth. Price, $3.00. (Reviewed by J. C. Murton, Department of Works, Toronto.)

This book is intended as a practical aid to agricultural students and farmers in surveying and building construction. Part I. is devoted to surveying entirely and Part II. deals with a general description of building construction as applied to a well-to-do farmer who could afford to spend considerable money in the improvement of his land.

Chapter 1 contains several valuable tables on mensuration. Chapter 2 is devoted to general survey work with both the engineer's and Gunter's chain. Chapter 3 deals with plan drawing, use of scales, the planimeter, etc. Chapter 5 is a useful chapter on subdivision of areas. Chapter 6 takes up the description and use of the dumpy and wye level with a brief description of contour work. Chapters 7 and 8 are devoted entirely to logarithms and trigonometry. Chapters 9, 10 and 11 give a general description of the use of the box sextant, the plane table, and the theodolite. Chapters 12, 13 and 14 contain methods of traversing, tachometry and lining out curves. Chapter 15 deals with excavation, foundations, use of concrete, etc. Chapter 16 covers bricklayers' and masons' work, with a brief description of roof coverings. Chapter 17 is devoted entirely to carpentry and joinery. Chapters 18 and 19 give a general description of plumbing and sanitation. Chapters 20 to 29 give designs and specifications for cottages, barns, stables, and general farm buildings.

The book on the whole gives rather a complete description of the problems which confront the average farmer who is desirous of getting the best results from his own labors.

PUBLICATIONS RECEIVED.

Ultra-Violet Rays.—A 20-page catalogue of reference to literature on this subject in the New York Public Library, 1915.

Canadian Society of Civil Engineers.—Report of annual meeting, 1915. 116 pages; 6 x 9. Also charter, by-laws, and list of members, 216 pages; 6 x 9.

Ontario Land Surveyors.—Annual report and proceedings of the 23rd annual meeting of the Association, including the papers read and the discussions.

Franklin Mining Camp, B.C.—By C. W. Drysdale, Geological Survey, Department of Mines. A 246-page illustrated description of its physiography, geology, petrology, etc.

Roads.—An interesting illustrated pamphlet, issued by the Garford Motor Truck Co., Lima, Ohio, descriptive of the influence of roads upon economic and social conditions.

Gay Gulch and Skookum Meteorites.—A 32-page illustrated museum bulletin (No. 15) of the Geological Survey, Department of Mines, Canada; prepared by R. A. A. Johnston.

Geological Survey, Department of Mines, Canada.—Summary report for 1914, comprising reports from the geological, topographical, biological, anthropological and geographical divisions.

Road Models.—Bulletin No. 220 of the U.S. Department of Agriculture, prepared by L. W. Page, director, office of public roads. A concise illustrated description of these well-known models.

Telephone Systems.—Extract from report of Ontario Railway and Municipal Board, covering specifications for construction, forms of petitions, by-laws, etc. It contains the Ontario Telephone Act and amendments thereto.

Standard General Specifications for Concrete and Reinforced Concrete.—A 24-page pamphlet containing these specifications as adopted by the Canadian Society of Civil Engineers at its annual meeting in January, 1915.

Ungava, or the Territory of New Quebec.—An illustrated 208-page publication, issued by the Department of Colonization, Mines and Fisheries of the Province of Quebec, being a compilation of extracts from various government reports on this northern territory.

Coal Fields of Manitoba, Saskatchewan, Alberta and Eastern British Columbia.—Memoir 53, prepared by D. B. Dowling, Geological Survey, Department of Mines, Canada, estimating the areas and coal contents, production, markets, character of regions, general and economic geology. 142 pages; illustrated.

The Cubical Expansion of Vitreous Quartz.—By N. E. Wheeler, M.Sc., lecturer in physics, McGill University. A reprint from the Transactions of the Royal Society of Canada, comprising a résumé of available literature dealing with measurements of the thermal expansion of fused quartz. 18 pages; 6 x 9 ins.; illustrated with tables and charts.

Coking of Coal at Low Temperatures.—Bulletin 79 of the Engineering Experiment Station, University of Illinois, Urbana, Ill., prepared by Messrs. S. W. Parr and H. L. Olin from a series of studies which show that coking at low temperatures may be carried on successfully on a commercial basis and which indicate the especial value of certain specific properties of coke, tar and gas.

Clay and Shale Deposits of Quebec.—Memoir 64, prepared by J. Keele, of the Geological Survey, Department of Mines, Canada, describing the shale-bearing formations and deposits, with their characteristics, in the more settled districts. It also treats of the clay-working industry, the origin and properties of clay, the effects upon it of heat, its examination and testing, methods of manufacturing clay products, etc. 280 pages; fully illustrated.

CATALOGUES RECEIVED.

Slotting Machines.—Catalogue 49 of the Newton Machine Tool Works, Inc., Philadelphia, describing stationary and portable slotters of various sizes and drives.

Vibrator Cleaners.—Catalogue of the Lagonda Manufacturing Co., Springfield, Ohio, describing with illustrations their Lagonda vibrator cleaners for return tube boilers.

Weber Chimneys.—A new catalogue of the Weber Chimney Co., Chicago, describing and illustrating numerous reinforced concrete chimneys built by them in Canada and the United States.

Centrifugal Compressors for Blast Furnaces.—A Canadian General Electric Company bulletin of 12 pages, describing the use and convenience of these compressors in blast furnace operations.

Lightning Arresters for Electric Railways.—A 12-page leaflet, issued by the Canadian General Electric Co., Toronto, fully illustrated and descriptive of arresters, their selection and ground connections.

Power Transmission Machinery.—A 4-page bulletin issued by the Mesta Machine Co., Pittsburg, Pa., comprising a horse-power chart for power transmission machinery, including gears, pulleys, rope wheels, etc.

Steel Poles.—An illustrated catalogue of 20 pages, issued by the Carbo Steel Post Co., Chicago. These poles for telephone, trolley, transmission line, etc., service, have special anchorage and are made of high carbon steel.

Poles, for Telegraph, Telephone, Electric Light and Railway Systems.—A 30-page pamphlet issued by the W. F. Goltra Tie Co., Cleveland, O., containing detailed specifications and price lists for poles of various woods.

Building Construction.—A very handsomely illustrated book, issued by the Stone and Webster Engineering Corporation, describing industrial plants, power stations, warehouses, educational and office buildings, constructed by them.

Automatic Concrete Mixers.—A 32-page illustrated booklet, issued by the Automatic Concrete Mixer Co., of Providence, R.I., describing the Hains-Weaver patent automatic mixers, and giving numerous illustrations of notable concreting jobs upon which they have been used, including several important Canadian works.

Lackawanna Steel Sheet Piling.—A well-illustrated and fully descriptive 78-page booklet, issued by the H. A. Drury Co., Limited, Montreal, agents for Canada of the makers of this brand of arched-webb, straight-webb, centre-flange, protected and plate types of piling with numerous views showing their various uses.

Flushers, Sprinklers and Municipal Vehicles.—A 16-page booklet issued by the Tiffin Wagon Co., Tiffin, Ohio, describing their lines of street sprinkling and flushing machines, also dump wagons and municipal carts. Considerable space is devoted to illustrations and descriptions of a new auto flusher which is a combination constant pressure flusher and sprinkler, capable of pumping its own charge from streams.

Centrifugal Blowers and Compressors.—A 64-page illustrated book issued by the De Laval Steam Turbine Co., Trenton, N.J., describing this equipment for all pressures from 5 ins. of water, as in mechanical draft service, up to 125 lbs. per square inch, as for compressed air distribution in mines, machine shops, ship yards, etc. Charts are given showing curves for the isothermal, adiabatic and actual compression of air, also the theoretical power required to compress air and characteristic curves of single and multi-stage blowers and compressors. The influence of impeller design upon the form of the characteristic is discussed and particulars given concerning the application of centrifugal blowers and compressors to forced draft, coal gas manufacture, coke oven plants and water-gas plants, sugar factories, cupola and blast furnace work, Bessemer converters, supplying compressed air in mines, ship yards, etc.

FURTHER PROGRESS IN THE TORONTO-OSHAWA ROAD PRELIMINARIES.

A committee meeting at Whitby last week agreed to adopt 4 per cent. as the maximum grade in the improvement of the Kingston Road, eastward from Toronto to Whitby and Oshawa. It also decided on the elimination of grade crossings, of which there are three—one over the Grand Trunk main line and two over the Scarboro' division of the Toronto & York Radial Railway.

Mr. W. A. McLean, C.E., Provincial Engineer of Highways, Department of Public Works, reports that the cost of completing the macadam road from where it stops on the Kingston Road near Pickering to Oshawa may be estimated at $290,452.57. This amount is made up as follows: 20 miles of macadamizing at $7,798.63 a mile, making a total of $155,972.60; 20 miles of tar or oil surface at $328.72 a mile, making a total of $6,574 for this item, which, with the $127,905.57 needed for reducing the hills to 5 per cent. for the 26-mile stretch and for repairs to the bridges, made the total $290,452.57.

To cut the grades all down to 4 per cent., the same as that on the Toronto to Hamilton roadway, Mr. McLean reported, would involve an additional expenditure of $22,000. This figure does not include cutting down the Highland Creek hill to any less than a 6 per cent. grade. In all, according to this latest plan, six hills will be cut down and 28,900 cubic yards of earth removed.

PAN-AMERICAN ROAD CONGRESS.

The programme committee of the Pan-American Road Congress has practically completed its work, and the advance official programme is now in the hands of the printer. The Pan-American Road Congress will convene Monday, September 13, at "The Municipal Auditorium," Oakland, Cal. The opening address will be made by Hon. Charles W. Gates, Governor of Vermont and chairman of the Executive Committee of the Congress. Addresses of welcome will then be made by Hon. Hiram W. Johnson, Governor of California; Hon. John L. Davis, Mayor of Oakland, and Hon. James A. Barr, Director of Congresses of the Panama-Pacific International Exposition. Responsive addresses will be made by George W. Tillson, president of the American Road Builders' Association, and by Fairfax Harrison, president of the American Highway Association.

Exclusive of the opening and closing sessions there will be eight sessions devoted to the presentation of papers on various subjects, and their discussions. There are twenty-seven of these papers, each of which has been prepared by some authority actively engaged in the work concerning which his paper treats. The discussions which follow will be led by road builders and engineers of high standing who have been carefully chosen by the committee with a view to bringing out to the fullest extent all possible information on the subject under discussion.

About forty of the leading authorities on road and paving subjects in the United States and Canada have already accepted designations on the programme. The Pan-American Road Congress of 1915 is expected to give a great impetus to the road and paving construction of the immediate future.

COAST TO COAST

Quebec, Que.—The new location of the projected extension of the old Montford & Gatineau Colonization Railway has been approved from Huberdeau, Que., to a point near St. Remi d'Amherst. The route is along the east bank of the Rouge River to the Argenteuil county line, thence crossing to the west side of the river joins the originally approved route, about 6 miles from Huberdeau.

Edmonton, Alta.—A Central Canada Railway subcontract is reported to have been let to J. Timothy for grading the last 22 miles to Peace River Crossing, Alta. Track laying has already been completed, it is said, to mile 28 from McLennan, where connection is made with the Edmonton, Dunvegan & British Columbia. The grading work yet to be carried out will be heavy. It is expected that the grading work will be finished by October 1, and track laying completed and the line ready for operation this year.

South Lorrain, Ont.—It is said that the Teck-Hughes in Kirkland Lake and the Wettlaufer in South Lorrain are to be restarted. A company has been formed to take over and operate these properties and work will commence within a short time. Nothing has been done at the Kirkland Lake property since the Nipissing dropped its option on the mine early in the spring. The Wettlaufer has been closed down for some time, but the recent developments at the other South Lorrain properties may have encouraged the new company.

Montreal, Que.—The industrial wharf, which has been in the course of construction for the past two years for the Canada Cement Company at Pointe aux Trembles, is now nearing completion. The order for this wharf was given in September, 1913, and although most all the dredging required for the channel approach and 400 feet of concrete wall to one-half level had been finished in 1913, the greater portion of the work remained for 1914 and 1915. A description of it appeared in *The Canadian Engineer* for June 17th, 1915, in connection with an article on the development of Montreal Harbor.

Windsor, Ont.—A rumor is abroad in Detroit that the new owners of the Wabash Railroad, recently sold under foreclosure, have under consideration a proposition to sell to the Canadian Pacific its Chicago-Detroit division. The Canadian Pacific has always been anxious to secure a direct line of its own from Detroit to Chicago, but legal entanglements have invariably interfered with the transfer of the Wabash property. With its own trackage as far as the Detroit River on the Canadian side, the acquisition of the old Wabash line to Chicago would give the C.P.R. an exclusive all-rail line. No figures have yet been made public.

Montreal, Que.—Mr. Morley Donaldson, vice-president of the Grand Trunk Pacific Railway, announces that the installation of oil-burning locomotives on the mountain section of the line has now been completed. These locomotives are of the most modern type, and were placed in service for passenger traffic for the first time last week. They are operating from Jasper to Prince Rupert, over 719 miles of main line. Especial interest attaches to the installation of this class of motive power, as it marks the first use of oil-burners on an extensive scale in Canada. Great oil storage tanks have been erected at various points along the line for supplying locomotives with the necessary fuel.

PERSONAL

WILLIAM WILLIAMS, of Thorold, Ont., has been appointed superintendent of the present Welland Canal, to succeed Mr. Sullivan, who died recently.

E. S. DICKINSON, formerly assistant professor of mining at the University of Kansas, has taken a position on the mining staff of the Canadian Copper Company at Copper Cliff, Ont.

A. G. WORKMAN has been appointed chief dispatcher of the British Columbia Electric Railway Company, of Vancouver, B.C., to succeed Mr. G. R. G. Connon, resigned.

C. H. MATHEWSON, resident engineer for the Department of Public Works, Ottawa, on the Toronto Harbor improvement project, has been appointed district engineer for the Department at Winnipeg.

JOHN SWEENEY, formerly district engineer for the Department of Public Works, Ottawa, at Winnipeg, succeeds Mr. C. H. Mathewson as resident engineer for the Department on the Toronto Harbor Improvement Board.

Sergeant GUY R. TURNER, formerly of the engineering staff of the St. John and Quebec Railway, and a resident of Fredericton, N.B., and now with the Third Field Company, Canadian Engineers, was wounded recently in France.

F. McARTHUR, the new city engineer of Guelph, Ont., has been city engineer of Regina for the past few years, prior to which he occupied the same position in Guelph. Mr. McArthur is a graduate of Queen's University, Kingston.

PREVOST HUBBARD has recently accepted the position of chief of the division of Road Material Tests and Research in the U.S. Office of Public Roads and Rural Engineering, and has resigned as chemical engineer in charge of the division of Roads and Pavements of the Institute of Industrial Research.

M. S. GIBSON has been appointed general manager of the National Fireproofing Co. of Canada, Limited, with headquarters at Toronto. Mr. Gibson, who succeeds the late Mr. Weisner, has been plant manager at Hamilton for the company for the past four years, and had previously been connected with the firm's Pittsburgh office.

J. T. BRECKON, waterworks engineer for the city of Vancouver, B.C., has tendered his resignation to take effect July 31st. Under his supervision the Point Grey pipe line was completed, including the laying of two 2,000-ft. cast iron mains across the First Narrows. Mr. Breckon will resume private practice as consulting and construction engineer.

R. H. PARSONS, superintendent of the municipal power plant at Edmonton, Alta., has tendered his resignation to the commissioners. Mr. Parsons has returned to Manchester, Eng., where he now is connected with a large factory engaged in the manufacture of the munitions of war. Mr. C. E. Cope, chief engineer of the plant, has been recommended to succeed Mr. Parsons.

M. J. BUTLER, C.M.G., immediate past president of the Canadian Society of Civil Engineers, has been appointed consulting engineer to the city of Montreal with respect to the waterworks department and extensions. He will supervise the construction work and alterations now in progress for the widening of the aqueduct. Mr. George A. Janin, the city engineer, was in direct charge of these improvements prior to his departure for the front.

WILLETT G. MILLER, Provincial Geologist of Ontario, has been awarded the gold medal of the Institute of Mining and Metallurgy of Great Britain. The medal is the highest award of the institution for conspicuous service in the advancement of the science and practice of mining or metallurgy without distinction of nationality. Prof. Miller is the eleventh recipient, and this is the first time the medal has been awarded to a resident of Canada.

OBITUARY.

One of our pioneer railway engineers and scientists passed away on July 22nd in the person of Sir Sandford Fleming. In addition to his numerous professional attainments, the deceased was a devoted statesman and to him much credit has been due in the solution of early Canadian national and political problems. He came to Canada in 1845 at the age of 18, Fifeshire, Scotland, having been the place of his birth. He was first connected with the engineering staff of the Northern Railway, Toronto, subsequently becoming chief engineer. Later he practised engineering in Ontario, and was elected a member of the Institute of Civil Engineers, London, and of the American Society of Engineers, and elected as honorary member of the Canadian Society of Civil Engineers. In 1863 he was chosen by the governments of Canada, Nova Scotia and New Brunswick, and Great Britain, to conduct a survey for the first link of a railway which would join the Atlantic and the Pacific. His survey showed the practicability of the scheme, which developed, when carried out, into the Canadian Pacific Railway System. He helped to build the Railway system of Newfoundland.

He had much to do with the adoption of the Greenwich time as the standard for the world, reading two papers on the subject before the Canadian Institute, Toronto, and visiting Washington in this connection.

In 1879, Mr. Fleming began to investigate a scheme for spanning the Pacific Ocean by cable in an effort to link the British Empire by an all-red telegraph system. He visited Australia and England in connection with this work.

In recognition of his public services, Queen Victoria made him a Companion of the Order of St. Michael and St. George in 1877, and a Knight Commander in 1897.

Among the many business and other important positions Sir Sandford has filled are: Member of the Ottawa Improvement Commission, director of Hudson Bay Co., director of C.P.R., vice-president Canada Cement Co., president of the Ottawa branch of the Imperial Federal League, and vice-president of the United Empire League.

He was one of the representatives of Canada at the Colonial Conference in London in 1888, and Ottawa in 1894, and in 1892 represented Ottawa at the congress of the Chambers of Commerce of the Empire.

He was an honorary doctor of laws of the following universities: St. Andrew's, Scotland; Columbia College, New York; Toronto, and Queen's.

When the news of his death reached Ottawa, Sir George E. Foster, acting Premier of Canada, paid the following tribute:

"The death of Sir Sandford Fleming deprives Canada of one more of its outstanding men. His connection with the early history and construction of the Intercolonial Railway, his intelligent and very useful contribution to the construction of the first transcontinental railway, and his eminent services in respect of the Pacific cable connecting the Australasian and the Canadian colonies entitled him to high rank among the pioneer builders of the Empire, and gave him a distinguished place in the history and development thereof. As a man and a citizen he had enjoyed long years of respect and esteem, and had contributed worthily to the upbuilding and ideals of the communities in which his labors were so faithfully bestowed."

A drowning fatality occurred at Hamilton, Ont., last week, when Mr. Clyde Robinson, of the Canadian Westinghouse Co., lost his life. The deceased was a graduate of the University of New Brunswick, with the degree of Bachelor of Science in electrical engineering. His home was in Harvey, N.B.

The death occurred on July 19th of Mr. J. Frank Chapman, general manager of the Thousand Islands Railway and the Oshawa Railway. The deceased, who was 52 years of age, entered the employ of the former railway when 17 years of age. He was general manager of the Bay of Quinte Railway, prior to its being taken over by the C.N.R. He was a past president of the Canadian Freight Association.

The death occurred on July 25th of Mr. William R. Willoughby, superintendent of the Marble Rock plant of the Gananoque Water Power Company.

VANCOUVER BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

At a special meeting held a week ago the members of the Vancouver Branch of the Canadian Society of Civil Engineers paid tribute to the work of Mr. G. R. C. Conway, for several years chairman of the Branch, who resigned recently as chief engineer of the British Columbia Electric Railway Co. to establish an office as consulting engineer in Toronto.

The establishment of a provincial division was also discussed, and Messrs. R. H. Hayward and A. D. Creer were elected delegates from the Vancouver Branch for a provisional committee to consider such an organization.

DEMAND FOR STEEL CAR RAILS IN GREAT BRITAIN.

According to the report of Mr. J. E. Ray, Canadian Trade Commissioner at Birmingham, Eng., the municipalities of Great Britain periodically call for tenders for street car rails, and as contracts are frequently placed with United States manufacturers there appears to be no reason (except it be that of cost) why Canada should not endeavor to procure some of such contracts. The most conspicuous difficulty to surmount is that of delivering quotations on time. When tenders are called for there is always a time limit for delivery, usually from two to four weeks from date of issue. Apparently the one course open is for manufacturers of rails to be represented in England by a capable firm in constant touch with municipal requirements, as business would necessarily have to be transacted by cable. Several municipalities state that they will be pleased to give Canadian manufacturers an opportunity to quote when they are again in the market.

ENGINEER FOR DAVIDSON, SASK.

Mr. Arthur J. Robertson, town clerk of Davidson, Sask., is receiving applications for the position of engineer and electrician for that town. One experienced with gas producer plants is preferred.

COMING MEETINGS.

PACIFIC HIGHWAY ASSOCIATION.—Fifth annual meeting to be held in San Francisco, Cal., August 11th and 12th, 1915. Secretary, Henry L. Bowlby, 510 Chamber of Commerce Building, Portland, Ore.

PROVINCIAL ASSOCIATION OF FIRE CHIEFS.—Annual Convention to be held in Ottawa, Ont., August 24th to 27th, 1915. Secretary, Chief James Armstrong, Kingston, Ont.

NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in New York City September 7th to 9th, 1915. Secretary, Willard Kent, 715 Tremont Temple, Boston, Mass.

AMERICAN ROAD BUILDERS' ASSOCIATION and AMERICAN HIGHWAY ASSOCIATION.—Pan American Road Congress to be held in Oakland, Cal., September 13th to 17th, 1915. Secretary, American Road Builders' Association, E. L. Powers, 150 Nassau Street, New York, N.Y. Executive Secretary, American Highway Association, I. S. Pennybacker, Colorado Building. Washington, D.C.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

AMERICAN ELECTROCHEMICAL SOCIETY.—Twenty-eighth annual general meeting to be held in San Francisco, Cal., September 16th to 18th, 1915. J. M. Muir, 239 West 39th Street, New York City, Chairman of Transportation Committee.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Calvin W. Rice 29 West 39th Street, New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, F. L. Hutchinson, 29 West 39th Street, New York City.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Annual convention to be held in Dayton, O., October 11th and 12th, 1915. Secretary, Will P. Blair, B. of L. E. Building, Cleveland, O.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual convention to be held in Dayton, O., October 12th to 14th, 1915. Secretary, Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind.