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The Canadian Engineer

ESTABLISHED 1893.

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TORONTO, CANADA, OCTOBER 1, 1909.

CONTENTS OF THIS ISSUE.

TRACK ELEVATION.

We give elsewhere in this issue an abstract from a report on "Track Elevation in Chicago." The elimination of grade crossings in Canada has just commenced. As the population becomes more dense the demand for subways and viaducts will increase. As the time element becomes a greater factor in railway competition and as the volume of traffic increases the railroad companies will more willingly undertake this work.

In this country some care must be exercised in the demands we make on the railway in connection with such work. In the case of new roads and branches being built a certain amount of grade crossing elimination may be provided for. To require railways to spend millions to protect crossings that may be effectively protected more cheaply in other ways will always be a waste and misfortune.

Chicago has been fortunate in the track elevation work because the railways were as anxious as the municipality to undertake the work. The time saved, the fewer accidents and their costs, which include investigations, wreckage and damages paid, and the more certain connections lessen the strain and tend for efficient railway operation.

ENGINEERING EDUCATION AND COMMERCIAL LIFE.

This week sees our colleges of Applied Science opening for another year of academic work. These colleges have achieved such splendid success in the balancing of their course of study, in the efficiency of their teaching, and their graduates have attained such prominence in the world of affairs and business that it is not to be wondered at a large number of young men desirous of securing a university training before entering business and commercial life should of their volition choose a training in a science college.

It is fortunate that at least one department of our universities has enough of the "practical" to attract and enough of the "theory" to train. Not that practical subjects do not train nor theory attract, but it requires a judicious combination of the two to interest the young man of to-day.

The closer the courses of study and the methods of teaching parallel the conditions found in actual affairs, the more popular will the course become.

FREE ENGINEERING ADVICE.

In our issue of September 3rd Mr. T. S. Scott, Assistant City Engineer of Toronto, had a most interesting letter on "Free Engineering Advice." In his communication Mr. Scott pointed out the fact, well known to many engineers, that members of the engineering staff of cities were frequently requested to give free much advice that should be paid for with a large fee.

Mr. Scott's letter drew forth many replies, but unfortunately these sending the communications with

but one or two exceptions would not allow their names to appear with their letters; therefore we have thought it wise not to publish any of the opinions expressed anonymously.

One of the engineers employed by a Canadian railway writes:—

> In connection with applications of the various rural telephone companies for approval of overhead wire crossings, we receive many drawings which might be quite appropriately described as pictorially diagrammatic. In many cases they almost require a cipher code to make them explanatory. These works of art certainly never came from the pen of a draftsman, and are done in this way simply to save the expense of having some local engineer prepare them. At times we receive pencil sketches and are asked to furnish plans, which, of course, we do not do. We inform the applicant to have the plans prepared by some local engineer. The above is, perhaps, not a parallel case to that referred to by Mr. Scott, but it simply goes to show that the general attitude prevailing is to try to eliminate, if possible, the engaging of professional help.

A city engineer in the West finds that the inquiries from outsiders are so numerous that he has not the time for outside work, and writes:—

> It seems to me that engineers in the employ of municipalities usually find that the nominal office hours are not sufficient to do the work incumbent on them, and depend on the time when the day's routine work is over to solve the really difficult engineering problems. And so, while professional ethics demand that "visiting or corresponding engineers be treated with every courtesy," to all other enquirers my reply is a polite but firm refusal.

A county engineer who has had wide experience on drainage work relates a story of a laborer who came up to where he was working with the level and said: "Where can I get one of those machines to look through. If I could get one I could make lots of money."

Evidently he did not realize that the mechanical doing of work was a very small part of engineering.

Another engineer tells of an interesting experience in municipal work, and, although it does not come under the head of "Free Engineering Advice," yet it is worth giving, illustrating, as it does, the mistakes many municipalities make in not employing engineers.

> I recall one instance, he says, where the council deemed it advisable to place a farmer in charge of the construction of concrete abutments and piers. A local contractor on the work juggled the mixture of the ingredients, resulting in poor concrete elevation of the top of piers, and the bridge seats were all wrong. I asked why a township engineer had not been instructed to lay out and look after the work, and was informed that they did not consider the proposition would warrant having their engineer look after it. This case resulted, I understand, in the rebuilding of all the work and the ultimate supervision of the township engineer, so I feel certain that the township council will not in future launch out for themselves in such matters.

Although there is not in the eyes of the law any such person as an engineer, yet gradually the community is learning to appreciate their work and status.

PERSONAL NOTES.

MR. JOHN GALT, C.E., of Galt & Smith, Consulting Engineers, Toronto, who has been in the West for over a year is again in Toronto, on a short visit. Mr. Galt expects to return to British Columbia shortly.

MR. RAOUL MONSERAN, of the Department of Public Works, in France, arrived in Montreal this week with instructions to make a study of the harbor works with a view to applying the knowledge to the improvement of seaport towns in France.

MESSRS. CHAPMAN & WALKER, who have lately formed a partnership and located at 69 Victoria St., Toronto, Ontario, are representing a number of large Old Country firms. The following are some of the companies: Messrs. Dick-Kar & Co., Preston, Eng.; Crossley Bros., Manchester, Eng.; Henley's Telegraph and Cable Co.; Messrs. Pritchetts & Gold, manufacturers of storage batteries; Messrs. Holder Bros. & Thompson, electrical instrument manufacturers; The Z. Tungsten Lamp Co., etc., etc. Messrs. Chapman & Walker have the sole Canadian agency for all of these firms.

The School of Mining, of Kingston, Ontario, recently made the following appointments: Mr. W. O. Walker, M.A., who had been offered the professorship of chemistry in a western college was advanced from the position of lecturer to that of Associate Professor. The positions formerly held by Dr. Firth and Dr. Dickson have been filled by the appointment of Walter D. Bonner, M.A., and Rodger J. Manning, M.A. Mr. Bonner graduated at Nebraska, Wesleyan University, where he obtained the degree of M.A. During the past year he has been completing his work for the Ph. D. degree, as well as assisting with the teaching at the University of Toronto. Mr. Manning is a Canadian and received his education in Chemistry at the University of Toronto. Since graduation in 1906, he has been teaching the subject, as well as working for the Ph. D. degree, at his Alma Mater. He comes to the School of Mining with the best of recommendations. The Fellowship in Chemistry established by

Dr. Milton Hersey of Montreal, has been filled by the appointment of Mr. J. A. McRae, M.A., a recent graduate of Queen's. Mr. McRae will do research work and assist with the teaching. Mr. J. K. Robertson, M.A., who has been appointed lecturer in Physics, was born in Perth in 1885 and was educated in the public schools and collegiate institute of Perth. He matriculated at the University of Toronto, in 1903, receiving scholarships in mathematics, classics and general proficiency. During his first year he was scholarship man in mathematics and physics. He received the degree of Bachelor of Arts in 1907, with first class honors in the department of physics. In 1908, he received the degree, Master of Arts, his thesis being "On the Charges Gained by Insulated Metallic Conductors, surrounded by other Conductors, and the Relation of these charges to the Volta Effect." This paper was published in the Physical Review. Mr. Robertson has also worked with Professor McLennan on "The Magnetic Properties of Heusler's Alloys," the results being published in the Physical Review, and with H. A. McTaggart on "The Temperature Variations in the Specific Resistance of Heusler's Alloys." the results being published in the Transactions of the Royal Society of Canada. Mr. Robertson comes very highly recommended and will undoubtedly be a valuable member of the Science Faculty.

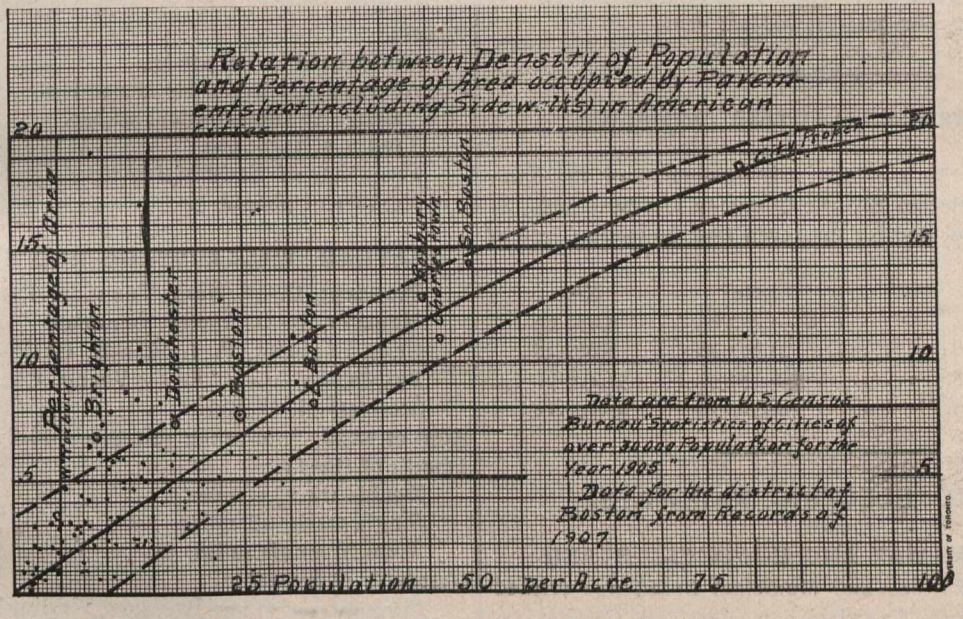
MR. LEO. F. GUTTMAN, Ph. D., F. I. C., A. C. G. I., has been appointed as assistant professor. Dr. Guttman has had a distinguished career both as a student and as a teacher. He is a son of Dr. Oscar Guttman, the English authority on Explosives. He spent three years at Central Technical College, London, where he obtained the Diploma as Civil Engineer (A.C.G.I.) He then attended the University of Heidelberg, Germany, where he studied Chemistry for four years, obtaining the degree of Ph. D. (multa cum laude.) After this he was assistant to Sir William Ramsay, University College, London, for two and one half years. He then left England as Chief Carnegie Research Assistant to Professor Baskerville at the College of the City of New York, where after six months, he was appointed to the teaching staff of the same college. After four years teaching experience in New York he now comes to the School of Mining. The extent and completeness of Dr. Guttman's training should make him a highly valued member of the staff of the department of Chemistry.

RELATION OF PAVEMENT AREA TO POPULATION.

For the purpose of determining the relation existing between the population of a given community and the requisite amount of street surface, Metcalf & Eddy, consulting civil engineers of Boston, recently prepared a diagram showing the relation of the density of population to the percentage of the area of the city devoted to pavements in all cities in the United States having a population of 30,000 or more. This diagram, recently published in the report of the engineers to the Boston Finance Commission, is reproduced herewith. Based upon these data a curve was drawn showing the average conditions in cities of various densities of population. Two additional lines, one above and the other below the curve, varying from each other by from 6 per cent. at the lower densities to 2 per cent. at the higher densities, show that a large proportion of the cities fall within these limits, thus indicating that the variation from the plotted curve showing the average conditions is comparatively small.

The data for this diagram were taken from the Special Report of the Department of Commerce and Labor, Bureau of the Census, giving the statistics of cities having a population of over 30,000 in 1905. It is quite probable that the figures indicating the amount of street pavements in various cities, as given in these reports, include unimproved streets, whereas the figures used for Boston and the subdivisions of Boston represent only public streets. If, however, this difference exists, the diagram would indicate more rather than less the normal amount of pavement on public streets.

The districts having the densest population are those of Manhattan, Boston (city proper), Hoboken, South Boston, Charlestown and Roxbury. Unfortunately, these are the only very densely populated communities from which data were



obtainable with which to establish the curve of relation of population to the proportionate area of street surface. On this account it is obviously unfair to base on such meagre data a curve showing the proper relation of street areas to population, unless it is deemed that the existing relation in Boston is proper and requisite to the public needs.

COMING MEETINGS.

American Society of Engineering Contractors.—Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secretary, Daniel J. Hauer, Park Row Building, New York, N.Y.

American Society of Mechanical Engineers.—December 7-10, 1909. Annual meeting New York City. Secretary, Calvin W. Rice, 29 W. 39th Street, New York, N.Y.

American Street and Interurban Railway Association.—October 4-8, 1909. Annual convention at Denver, Colo. Secretary, Bernard V. Swenson, 29 W. 39th Street, New York, N.Y.

National Municipal League.—November 15-19, 1909. Annual meeting Cincinnati, O. Secretary, Clinton Rogers Woodruff, 705 North American Building, Philadelphia, Pa.

(Continued on Next Page).

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Sept. 21		STOCK QUOTATIONS TORONTO				STOCK QUOTATIONS MONTREAL			
				1909	1908	Price Sept. 24 '08	Price Sept. 16 '09	Price Sept. 23 '09	Sales Week End'd Sep.23	Price Sept.2 08	Price Sept. 16 '09	Price Sept. 23 '09	Sale Week End'd Sep.23
Canadian Pacific Railway	8,920.6	$150,000	$100	$1,885 000	1,471.000	.....	182½ 181¾	182¾ 182	300	172 171⅝	182¼ 182	182¼ 182	1605
Canadian Northern Railway	2,986.9	.....	.....	270.000	209,700	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	933.213	855.192	.....	.....	*1st. pref. 107½, 3rd pref. 68⅜, ordinary 24¾		.....	.....	.....	.....
T. & N. O.	334	(Gov. Road)	.....	33,814	17,669	.....	.....	.....	.....	.....	.....	.....	.....
Montreal Street Railway	138.3	18,000	100	80,881	72,459	.....	.....	.....	.....	.....	.....	.....	.....
Toronto Street Railway	114	8,000	100	75,080	70,331	102½ 102½	124½	124½ 124¼	85	183 181	214 213½	215 214½	302
Winnipeg Electric	70	6,000	100	.....	.....	162½ 161	187	187½	90	102½ 102	124½ 124¼	124¼ 124⅛	759
										164½		187 187½	45

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

T. AND N.O. RAILWAY.

Ontario Government Road Now Paying Its Way.

The Temiskaming and Northern Ontario Railway is now paying its way. Hon. A. J. Matheson, the Provincial Treasurer, announced recently that the net receipts from operation for the seven months ending July 31st were $379,698, while the proportionate share of the interest at four per cent. on the expenditure of construction and operating the entire system was $350,000. The announcement, while anticipated for some time, signalizes a new era for the people's railway. The minister's returns show that the gross earnings from operation in July were $148,111, with expenditures of $75,587, a net earning of $70,524, which, with $9,813 received in royalties, brings the total for the month to $80,337, as against $29,584 for the same month last year.

CAPE BRETON ELECTRIC COMPANY.

The following is a comparative statement of the earnings of the Cape Breton Electric Company for the months of July, 1908 and 1909, and for the seven months ending July of each year:—

	Gross.	Net.
July, 1908	$ 21,333.83	$ 9,455.03
July, 1909	21,872.40	8,862.38
7 months, 1908	136,859.56	54,419.81
7 months, 1909	126,383.78	43,492.14

ONTARIO ELECTRIC RAILWAYS.

ONTARIO RAILWAY AND MUNICIPAL BOARD.

The Ontario Railway and Municipal Board was created by Act of the Ontario Legislature in 1906 (see Chapter 31, 6 Edw. VII. Statutes of Ontario, 1906).

The present members of the Board are James Leitch (chairman), A. B. Ingram, vice-chairman, and H. N. Kittson.

CORNWALL STREET RAILWAY.

President, James Taske.
Manager, William Hodge.
Chief Engineer,
Purchasing Agent,
Kind of Road: Street Railway.
Length of Road:
Single track.
Total in single miles, six miles.
Character of Service:
Car equipment, General Electric, 800.
Number of motors, 2; power of motors, 20 h.p.
Method of controlling, K2.
Method of braking, hand.
Gauge of track, 4 feet 8½ inches; weight of rails, 60 lbs
Power:
Direct current, D.C.
Voltage of transmission, 550.
Trolley voltage, 500.

BRANTFORD AND HAMILTON RAILWAY.

President, J. W. Sutherland.
Manager, E. P. Coleman.
Chief Engineer, W. C. Hawkins.
Purchasing Agent, J. B. Guffeth.
Kind of Road: Interurban.
Length of Road:
Double track, 0 miles.
Single track, 22.91 miles.
Total single miles, 22.91.
Character of Service:
Car equipment, six 65 foot cars; type, Brill.
Number of motors, 4 each car; power of motors, 75 h.p.
Method of controlling, Westinghouse 4 controller.
Method of braking, straight air.
Gauge of track, 4 ft. 8½ in.; weight of rails, 80 lbs.
Power:
Direct current for power.
Alternating current for transmission.
Voltage of transmission, 40,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 66⅔.
Number of phases, 3.

CHATHAM, WALLACEBURG AND ERIE RAILWAY.

President, G. W. Kipp, Towanda, Pa.
Manager, R. G. Young, Chatham.
Chief Engineer, P. J. Shields, Chatham.
Purchasing Agent, R. G. Young, Chatham.
Secretary, J. G. Kerr.
Kind of Road: Interurban and Street Railway.
Length of Road:
Double track, 0 miles.
Single track, 38 miles.
Total in single miles, 38.
Character of Service:
Car equipment, 101 B.; type, Westinghouse.
Number of motors, 20; power of motors, 50 h.p.
Method of controlling, Westinghouse controller.
Method of braking, air-brake automatic Westinghouse.
Gauge of track, 4 ft. 8½ in.; weight of rails, 60 lbs.
Power:
Direct current, D.C.
Voltage of transmission, 550.
Trolley voltage, 550.

COMING MEETINGS.—Continued from previous Page.

Oklahoma Cement Users' and Contractors' Association.—September 29, October 8, 1909. Annual meeting, Oklahoma City, Okla. Secretary, D. C. Patterson, Scott-Thompson Building, Oklahoma City, Okla.

Railway Signal Association.—October 12-14, 1909. Annual convention at Louisville, Ky. Secretary, C. C. Rosenberg, Bethlehem, Pa.

American Public Health Association. — October 19-22. Annual convention at Richmond, Va. Secretary, Charles O. Probst, Columbus, Ohio.

Association of Car Lighting Engineers.—Annual meeting at the New La Salle Hotel, Chicago, Ill. Mr. E. W. Jansen, chairman, committee on publicity, Illinois Central Railway Company, Chicago.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

ADMINISTRATION OF HEALTH QUESTIONS BY CENTRAL AUTHORITIES.

As far as the questions of sewerage, sewage disposal, and water supply are concerned there can exist no doubt but, that, such questions must be settled and administrated by a central authority.

In Canada owing to the fact that the Dominion is divided into Provinces, the central authorities must necessarily be invested in the Provincial Governments.

Whether or not a supreme authority acting as a Court of Appeal should not be provided by the Dominion Government is a matter of policy which requires attention at Ottawa.

Dr. Hodgetts, the Secretary for the Provincial Board of Health of Ontario, is decidedly in favor of a supreme central authority at Ottawa, directed by able medical men and engineers, who can keep in touch with the work done in other countries as well as studying local conditions, so that it may be in a position to advise the several Provinces throughout the Dominion.

We must certainly agree with Dr. Hodgetts. In fact, his aim appears to be the establishment of an authority in Canada on the same lines (or improved) as that of the Local Government Board of Great Britain.

At the same time, owing to the great extent of territory in Canada, much must be done and left to the Provincial authorities.

What is being done at the present time by Provincial authorities is a mere flea bite compared with what ought to be done.

Provincial Boards of Health are all very well as at present constituted in Ontario and Quebec as a means of obtaining statistics of deaths from various diseases, and isolating diseases, which may, if left unattended, become epidemic. But what are these boards doing as central advising authorities to the various municipalities under their jurisdiction? Practically nothing! They have practically no data to hand out to the aspiring municipality, either as regards water supply or efficient sewerage or sewage disposal. They simply sit still and wait to see what each and every individual village, town, or city may do, and then after the event may criticize.

Now, what is really wanted, before we talk of a Dominion central authority dealing with these matters, is that every Provincial Government has an organized staff in its health department capable of giving just the exact advice required to its several municipalities upon questions of efficient and good water supply, general sanitation and purification of sewage, so that the present sources of water supply may be kept pure.

Mr. T. Aird Murray at Winnipeg, lecturing before the city council and others last week, made this point an issue. At present the city of Winnipeg discharges the whole of its sewage in a raw state into the Red River and Assiniboine. The local press have been raising a cry against this pollution. The point which Mr. Murray raised is simply this, that there is no provincial legislation on the subject, and even if Winnipeg purified its sewage, that these streams would still be polluted by Portage la Prairie and Brandon above Winnipeg.

The question is not a municipal one first, but a provincial one first and a municipal one second.

The Province of Saskatchewan have taken up this matter as a provincial question, and are about to frame laws and regulations dealing with the whole question on lines similar to those adopted by the State Boards of Health in the United States. Until Manitoba can see its way to adopt similar legislation little can be done, either at Winnipeg or any of the other large centres of population in the Province either to improve the quality of the water in the rivers or the general health of the people.

WATER STERILIZATION AT BOONTON, N.J.*

By George A. Johnson, Consulting Engineer, New York City.

The purpose of this paper is to describe the methods of operation followed during the first three months' operation of the sterilization plant of the Jersey City Water Supply Company at Boonton, N.J., the historical phases of the subject and a description of the process and the plant at Boonton have been given in papers of Dr. Leal and Mr. Fuller. In this paper, therefore, only the methods of operation will be described, together with a discussion of the results of analyses of the raw reservoir water and the treated water made in the laboratory of the water company at Boonton and in the laboratories of Dr. George E. McLaughlin, at Jersey City, and Dr. Wm. H. Park in New York City.

Force Employed.—From September 26th to December 31st, 1908, the operation of the sterilization plant at Boonton was under the direct charge of the writer. During that period Messrs. H. C. Stevens and Guy Britton were engineering assistants dividing the duties of the 24 hours of each day, and Mr. L. R. Whitcomb was analyst.

The duties of the engineering assistants were to superintend the preparation of chemical solutions and the application thereof to the water; to prepare accurate records of the rates of application of the sterilizing agent to the water; to collect and test at frequent intervals samples of the chemical solutions in order to ascertain the variation in strength of the same; and to prepare daily reports showing all necessary details of operation. Mr. Whitcomb's duties were to collect and analyze at least once a day samples of the raw reservoir water and of the water after treatment at a point on the aqueduct about one-mile below the point of application of the sterilization agent; and, also, to carry on incidental studies to show the effect of the treatment on particular forms of bacterial life.

In the beginning each of the tanks in which the chemical solutions were mixed and stored was carefully calibrated and tables prepared showing the content of each tank at different depths. The orifices whereby the flow of solution was regulated were also carefully calibrated and tables prepared showing the discharge through each orifice under a constant head with the orifice opened to a varying degree. With a knowledge of the amount of water which was being delivered into the aqueduct, it was possible by means of these tables

*Read before American Waterworks Association.

to adjust at the orifice the dose of chemical solution with a great degree of accuracy in a moment's time.

The bleaching powder was received at the plant in sheet-iron drums holding about 750 pounds, net. This powder was of a high degree of purity as ascertained by frequent analyses of it during the period of operation mentioned. Ordinarily the powder ran about 35 per cent. in "available chlorine," equivalent to 7.9 per cent. available oxygen. For the majority of the time solutions of 1 per cent. strength were used. For a part of the time, as is the case now, ½ per cent. solutions were used. By a ½ per cent. solution is meant the addition of 5 pounds of dry bleaching powder to each 1,000 pounds of water.

In making up a solution the amount of old solution remaining in the tank was first ascertained from the depth recorder and then it was decided to what height the tank was to be filled. By referring to the proper table showing the capacity of the tank between these two gauge readings it was then possible to figure the amount of dry bleaching powder necessary to add to make up a solution of the desired strength. This amount of dry powder was then dumped into the dissolving compartment of the mixing tank, raw water turned on, and the agitators started. The solution rising in the dissolving compartment overflowed into the main solution tank, which was filled to the required height through this overflow.

When it was desired to throw a tank into use the proper valves were opened, connecting the suction in this tank with the chemical feed pumps. The solution was tested by the Penot method for its strength in available oxygen by the so-called "available chlorine" method and the orifice on the orifice tank adjusted to give the required dose.

The chemical feed pumps were always operated so as to pump a quantity slightly in excess of that discharging through the orifice, and this excess escaped from the tank through an overflow pipe leading back into the main solution tank. In this manner it was possible to maintain at all times a constant head over the orifice and if, for any reason, the feed pumps stopped, the level of the solution in the orifice tank immediately began to fall, causing an alarm to be rung notifying the operator of the fact. Very little trouble was experienced from clogging at the orifice, and the variation in rate of application of the chemical solution was, therefore, exceedingly slight, but practically negligible.

In the beginning, not having a thoroughly definite idea of the smallest quantities which could be used with satisfactory results, the amount of chemical applied was 1.4 parts per million of "available chlorine," corresponding to 0.3 part per million of potential oxygen, or 36 pounds of dry bleaching powder per million gallons of water treated. Gradually the quantity of applied chemical has been decreased until at the present time about 0.2 part per million "availab'e chlorine" is being applied. This corresponds to 0.045 part per million of potential oxygen, or 5 pounds per million gallons of the bleaching powder.

There has been no striking evidence that the higher quantities were more efficacious in the destruction of bacterial life in the raw reservoir water than the small quantity last mentioned. The composition and temperature of the raw water apparently affected not at all the rapidity and completeness of the sterilizing action.

A long series of analyses were made with a view to establishing if possible a relationship between the amount of carbonaceous organic matter in the raw water and the amount of sterilizing agent necessary to effect the desired degree of sterilization. The quantities of the steriliz'ng agent used were so small, however, that there was found to be no such relationship existing. In other places, where the amount of organic matter is much higher than in the raw Boonton water, it is possible that such a relationship may be found to exist.

Records were tabulated showing the amount of water treated each day, the amount of chemical agent applied, expressed in parts per million of potential oxygen, the results of analyses of the raw and treated water, and of tests for B. coli communis carried on at Boonton and in the laboratories of Drs. Park and McLaughlin.

If there is an apparent disparity in the results of analyses of the treated water at the Romine gate house and at the point of delivery in Jersey City, 23 miles below, and if the numbers of bacteria at the latter point were higher than those at the Romine gate house, as they sometimes were, it shows either that bacteria were still being washed from the old deposits in the conduit, or that there was a slight multiplication among the harmless forms of bacteria which successfully resisted the treatment. The completeness of the sterilizing action, so far as the destruction of objectionable forms is concerned, is apparent from the results. From October 10th to December 31st, inclusive, the total number of bacteria in the treated water at the point of delivery in Jersey City averaged 15 per cubic centimeter, and only on one occasion out of 455 tests was B. coli positively isolated from the treated water at the point of delivery in Jersey City, namely, on November 1st, 1908, when it was isolated by Dr. Park in 5 cc. of treated water collected at the Summit Avenue gate house in Jersey City.

Some time after the sterilization plant was put into service studies were inaugurated to demonstrate the efficiency of electrolytically-prepared hypochlorite of sodium. An electrolyzer was obtained from the National Laundry Machinery Company, of Dayton, Ohio, and this machine was set up in the gate house at Boonton and studies began. This electrolytic cell is of porcelain-lined pottery clay containing carbon electrodes and glass and carbon baffles. A solution of common salt of about 4.5 per cent. strength and having an initial temperature of about 65 deg. Fahrenheit was run through this cell at a rate of about 2 cubic feet per hour in the presence of a direct electric current of 110 volts and 22 amperes. The yield of a single cell was about 0.6 pound of available chlorine per hour.

Between the dates of March 20th and 24th, 1909, a comparative test was made on the raw water to determine the relative efficiency of hypochlorite of lime in the form of bleaching powder and sodium hypochlorite electrolytically prepared. A considerable number of determinations of the bacterial quality of the raw and treated water before, during and after the use of the sodium hypochlorite solution showed that when equal quantities of the germicide in these two forms were added to the raw reservoir water the efficiency, so far as the destruction of bacterial life was concerned, was the same.

Under the existing circumstances the total cost which can be charged against the process when using bleaching powder was found to be $0.14 per million gallons of water treated, this figure being divided up substantially as follows, basing the figures on an average daily treatment of 40,000,000 gallons of water:—

One extra operator	$0.065
Bleaching powder	0.065
Coal for heating the plant, miscellaneous laboratory and other supplies	0.010
	$0.14

It may be well to point out that power costs nothing at this plant for the reason that it is obtained from a water wheel actuated by the water flowing through the pipes which deliver the water from the dam to the aqueduct leading to Jersey City.

With power costing nothing, the charge for electric current in this process is nil. It has been found that to produce a pound of available chlorine in the electrolytic cell requires about 8.5 pounds of common salt. This salt, delivered at the plant costs about one-third of a cent per pound; therefore, the cost for salt amounts to 4¼ cents per 1,000,000 gallons of water treated. The other figures previously given remain the same, making the total cost by the electrolytic process 11¾ cents per 1,000,000 gallons of water treated. In

neither case has interest on the investment been included nor charges for depreciation in the plant. If this were added the total cost of the process would be between 20 cents and 25 cents per 1,000,000 gallons of water treated.

As to depreciation in either process, it may be well to point out that, although the plant has now been in operation over seven months it has not been necessary to replace any of the piping, pumps or valves, and such repairs as have been made are not worthy of mention.

In general terms when hypochlorite of lime or soda is added to water the chemical and physical characteristics of the water are changed to some extent. Through the action of carbonic acid, either free or half bound, hypochlorous acid is released from the hypochlorite, and this acid, although very weak, is an active oxidizing agent. In the presence of organic matter its oxygen is released and this attacks the organic matter and oxidizes it. As hypochlorite of lime is a mixed compound, composed of calcium chloride and calcium hypochlorite, it follows that the former will add to the hardness of the water. In the electrolytic process where sodium hypochlorite is produced, the resultant solution contains in addition a slight amount of caustic soda and some sodium chloride, and the hardness of the water would, therefore, not be increased by its addition to it. In both cases the total solids in the water would be increased, and the color, if an organic stain, would be reduced. The carbonic acid in the water would be reduced, since it is essential for the liberation of hypochlorous acid from the hypochlorite.

In more concise terms it may be said that by adding hypochlorite of lime or soda to a water, the organic color thereof will be reduced; there will be an oxidation of organic matter; the carbonic acid will be reduced; the total solid matter in the water will be increased and, in the case of hypochlorite of lime, the total hardness of the water will be increased. With hypochlorite of soda this is not the case. All of the above changes were noted in a series of chemical analyses of the raw reservoir and treated waters. The amounts of chemical applied were so small, however, that the differences in the physical and chemical characteristics of the water before and after treatment were so slight as to be hardly noticeable and were well within the limits of accuracy of the methods of analysis.

The most important chemical change which is brought about in this process is the reduction of carbonic acid. This has considerable practical significance from a standpoint of the incrusting and corrosive action of water on iron and steel pipe brought about by the action of carbonic acid.

The claim has been made that free chlorine is liberated in this process, and that it may persist in water treated with hypochlorite of lime. This is in no sense true for the reason that free chlorine cannot be liberated from hypochlorite of lime or soda in a natural water. To do so it would first be necessary to decompose all the alkaline constituents in the water with an excess of strong mineral acid. Again, even if free chlorine could be liberated from hypochlorite of lime in a natural water, the chlorine would immediately combine with the hydrogen of the water and liberate atomic oxygen.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8053—Sept. 9—Authorizing the C. P. R. to construct, maintain and operate spur into the premises of the Brandon Gas & Coal Co.'s plant, Brandon, Man.

8054—Sept. 9—Authorizing the C.P.R. to construct, maintain and operate three industrial spurs for the Manitoba Rolling Mills, in the Town of St. Boniface, Man.

8055—September 13—Authorizing the Grand Trunk Railway to construct, maintain, and operate, branch line to and into the premises of Messrs. Davies & Doty, Oakville, Ont.

8056—July 13—Approving location of the C.N.O.R. Railway through Township of Gloucester, and the city of Ottawa,

8057—September 13—Extending for period of two weeks from date of order time within which the C.N.Q. Railway may operate its trains from Quebec City or Garneau Junction.

8058—September 13—Authorizing the C.P.R. to construct, maintain, and operate branch line in the city Saskatoon, Sask., to a point to be determined by the city engineer.

8059—September 10th—Authorizing the C.P.R. to operate branch line to the premises of George Vrooman, Lethbridge, Alta.

8060 and 8061—September 10th—Granting leave to the Corporation of the village of Stirling, Ont., to place its electric wires across the track of the G.T.R. at Bake Street, Stirling, Ont., and at Edward Street, Stirling, Ont.

8062—September 10th—Granting leave to the Laval Electric Company to place its electric wires across the C.P.R. near Therese, P.Q.

8063 to 8065 Inc.—September 13th—Granting leave to the Bel' Telephone Company to cross with its wires the tracks of the G.T.R. at Howick, P.Q., Stevensville Station, Ont., and Bridgeburg Station, Ont.

8066—September 14—Amending Order No. 7963, dated September 1st, 1909, authorizing the C.N.R. to alter its existing level crossing on Pembina Street, Winnipeg, Man., by substituting for the plans approved thereunder plans marked "A" on file with the Board.

8067—September 14—Authorizing the G.T.R. to construct, maintain, and operate spur into the premises of H. Corby Distillery Company, Limited, municipality of the Township of Thurlow, Ont.

8068—September 10th—Approving masonry work to be constructed at bridge No. 27.3, McLeod Section, C.P.R.

8069—September 10—Authorizing the C.P.R. to construct, maintain, and operate branch line in Blocks, 3, 7, 12 and 14, Plan Q, 10, town of Saskatoon, Sask.

8070—September 14—Approving and sanctioning location of the C.N.O.R. Company's Udney-Orillia line of railway through Township of Mara, County Ontario, Province Ontario.

8071—September 10—Granting leave to the Rural Municipality of Strathcona, to cross C.N.R. tracks one mile east of Belmont, Man.

8072—September 10—Granting leave to the Rural Municipality of Macdonald to cross with its wires the tracks of the C.N.R. at public crossing, two miles north-east of Brunkild, Man.

8073 and 8074—September 10—Granting leave to the Bell Telephone Company to cross the tracks of the M.C.R.R. near Bridgeburg, Ont., and near M.C.R.R. station at Welland, Ont.

8075 to 8078 Inc.—September 14—Authorizing the Volcanic Oil & Gas Company, Limited, to cross with its gas pipe under the track of the M.C.R.R. at four points in the Province of Ontario.

8079—September 14—Authorizing the G.T.R. to construct, maintain, and operate branch line in the town of Oakville, Ont.

8080—September 14—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway and two spurs in the town of Orillia, Ont., to planing mills of J. R. Eaton & Sons.

8081—September 14—Authorizing the C.P.R. to open for the carriage of traffic that portion of the Nomining Extension of its railway from Nomining, mile 0 to Rapide de l'Orignal, mile 34.6, a distance of 34.6 miles.

8082—September 14—Approving Standard of Tariff of Parlor Car Rates C.R.C., No. S. 2 of the Esquimalt and Nanaimo Railway Company.

8083—September 14—Authorizing the C.P.R. to construct extra track of its railway across road allowance lying between Sections 14 and 23, Tp. 11, Range 12, west principal meridian, Province Manitoba.

IRRIGATION IN WESTERN CANADA.

Splendid Work of C.P.R. in Alberta.

A development, which, owing to its magnitude, is absolutely unique in the engineering and agricultural annals of the continent, is that which is being so successfully brought to a completion in the Bow River Valley to the east of Calgary.

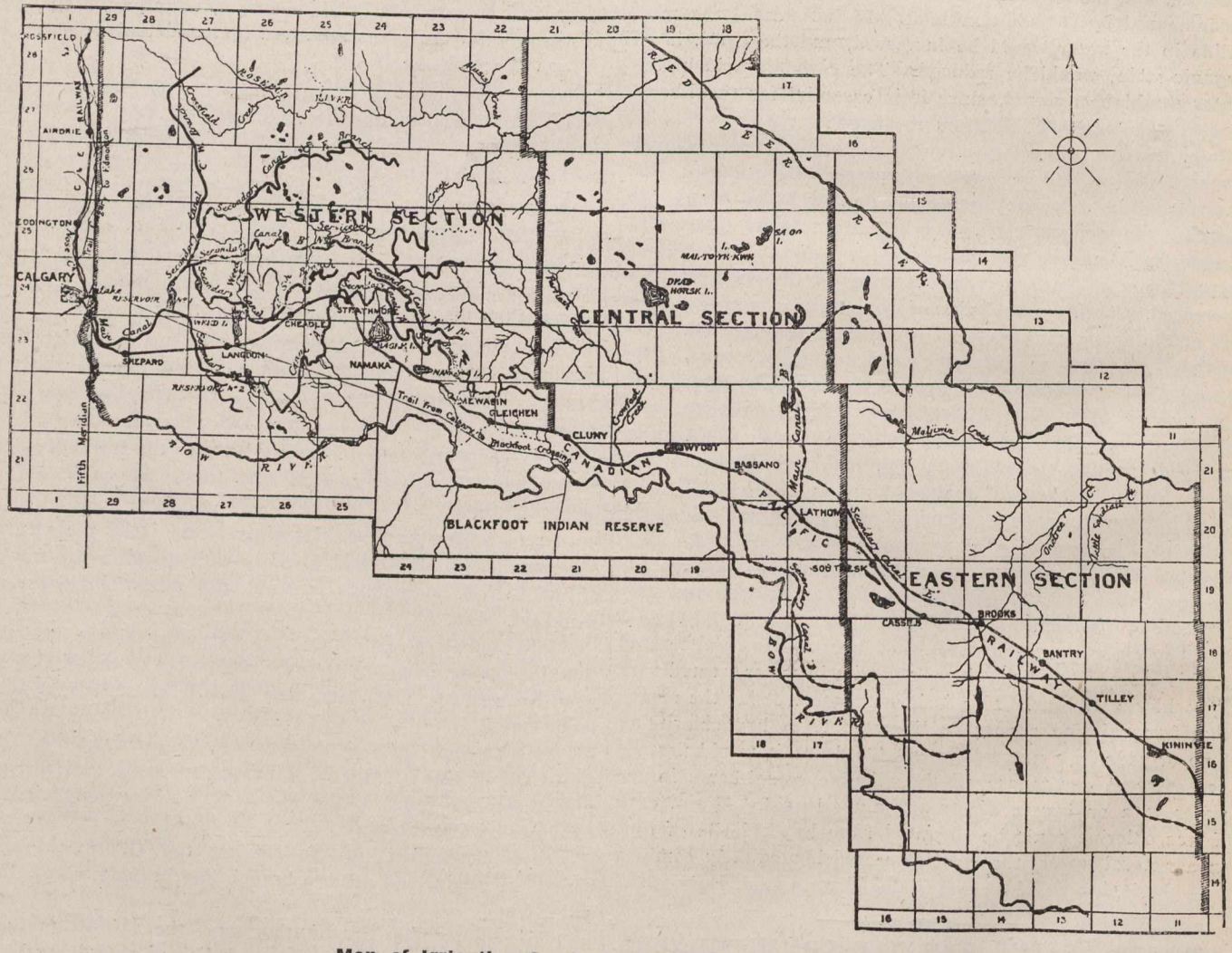
One requires but to realize the enormous value and possibilities of irrigation, to appreciate the inestimable wealth that will be acquired by those who till this fertile soil. The artificial application of water to the land not only increases crop production but also conserves the fertility of the soil to the greatest extent possible.

It is in the Bow River Valley that we find 3,000,000 acres of the choicest soil and ultimately 1,500,000 acres of this vast tract will be served by an irrigation system, which for its general utility and vastness will never be equalled on the continent.

The company developing this area by a wise consideration of that which constitutes a profit, refuses to place upon this land a price anywhere approaching its intrinsic worth, velop by irrigation the enormous block of land east of Calgary, Alberta.

The great project is 150 miles long by 40 miles in width and comprises an area of 3,000,000 acres of which at least 1,500,000 acres will be irrigated. In order to assist the engineers, the tract was divided into three sections, which were designated Western, Central and Eastern, each having an almost equal area. With a speed only made possible by a large and competent engineering staff these sections are being laid out in a system of ditches which when complete will comprise a length over 3,000 miles.

At Calgary is to be found the inlet of the main canal, the dimensions of the latter being at this point, bottom width 60 feet, width at water line 120; side slopes 3 to 1; depth of water 10 feet; sectional area 900 square feet. The grade is 0.528 feet per mile, and the completed discharge is over 2,000 cubic feet per second. This canal which is some seventeen miles in length terminates in a national reservoir three miles long, half a mile wide and 40 feet deep. From this basin the secondary canals A, B and C radiate, making the total length of main water channels 967 miles in the Western section. This is, of course, exclusive of the farmers laterals.



Map of Irrigation Sections of Alberta, on the C.P.R.

being content rather to make a nominal charge per acre, being assured that to the east of that city they will create a giant consuming and producing area, which ere long will be the most densely populated farming district in the world. The traffic produced will be their reward.

Settlers are arriving in ever increasing numbers, and this year will find a multitude of converts to the irrigation system of farming.

We have been told that "he who makes two blades of grass grow where one grew before" is a benefactor of mankind. Without a too liberal application of this proverb, there can be no doubt that the Canadian Pacific Railway amply earned this title when that company decided to de-

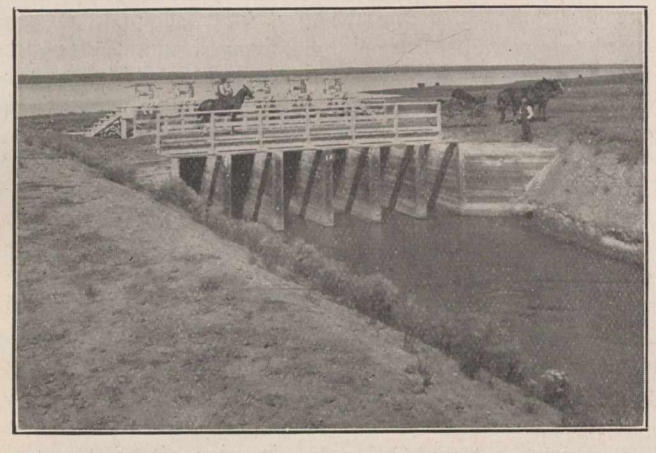
The construction of the canal in the Western section with its hundreds of miles of secondary canals and distributing ditches has been a large and expensive undertaking. The engineering surveys have been rigidly scientific and exhaustively performed, the contours of the entire Western section being located to five foot intervals.

An excavation of 2,500,000 cubic yards was necessary on the main canal while another 5,000,000 cubic yards were excavated in order to make the secondary canals A, B and C.

Many difficulties were experienced in the construction of the main canal and close to the headgates an unusual feature presented itself. It would have been necessary, if the canal line were to be kept on grade, to have thrown it on to

a bluff bordering the bottom. The incline of the bluff was much steeper, however, than the slope of the canal and it was decided that rather than make a cutting reaching entirely to the top, it would be much better to allow this bluff to form one side of the canal and form the other by means of an embankment.

The level of the old river bottom is that which was used in a portion of the work as the bottom for the canal and at the end immediately next to where excavation was again resumed the depth of water carried is twenty-six feet. Where the excavation commenced the grade line was again resumed.



Headgates Secondary Canal Leading from Reservoir.

In the building of this embankment, the greatest care was exercised. Stripping was resorted to in dealing with the surface soil and more of same was allowed to be used. In order that the embankment should be of a maximum strength, successive layers of selected material 10 inches in depth was all that was allowed to be dealt with at one time. This material was evenly distributed over the surface, given an application of water and thoroughly rolled with a three-ton roller.

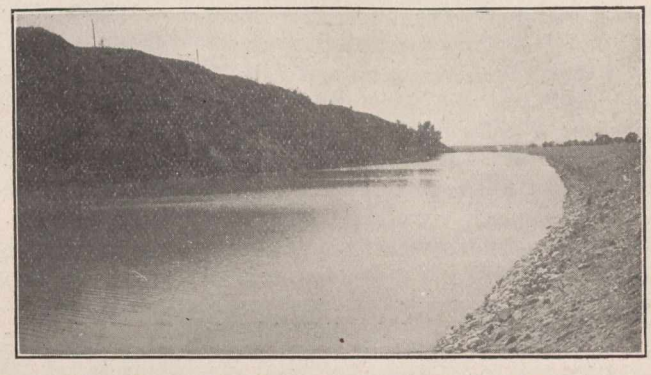
Owing to the natural slope of the country it was necessary to construct falls or "drops" which carry the water safely to the levels below, without erosion of sides or bed. Along the river's bank and in close proximity to the inlet, piles have been driven with a view to protecting the banks, and situated along the embankment is a spillway which allows only the required amount of water being retained.

Headgates of the Main Canal.

It will be seen by the above that every precaution has been taken in order that the canals and laterals may be protected to the greatest possible extent, no expense in the construction of same having been spared.

It is with pride that any country points to the work of their civil engineers, works which in the majority of cases are great constructive works of peace. Canada is no exception, her engineers are without peer, and it is to their indomitable pluck and perseverance that we owe our very existence. It would appear that the average individual does not appreciate what a factor the civil engineer is in the upbuilding of a country or community.

When the irrigation of the Bow River Valley was first proposed, a veritable storm of ridicule was directed at those who were courageous enough to conceive and advocate the scheme. That ridicule continued even after actual operations were commenced. Now, however, we find an appreciative feeling existing throughout the West and in Calgary especially there is an ever-increasing interest manifested by the prominent citizens who have at last awakened to the fact that with relentless and never-ceasing vigor, the Canadian Pacific is working out the destiny of Calgary, and that destiny is a metropolis of wondrous magnitude. Have the Canadian Pacific failed in any of their ventures? Have they not built cities where they wished them, and have they ever sanctioned any other expenditure for agricultural development, anywhere approaching that being expended on the Bow River project?



Two Miles Below Headgates Looking East.—Showing Pole Line and Rip Rap.

All this is due to the untiring perseverance of those who first considered the scheme possible.

This most successful engineering effort is unique in the fact that it is a great creative factor in the making of a demand for labor. As science advances, channels which were at one time open for individual effort are closed and the demand for labor decreased. By the opening of each fresh channel in the Bow River Valley, however, we find there an immediate demand for labor and an immediate possibility of happy, prosperous home.

RAILWAY ORDERS.

8084—September 14—Authorizing the City of Toronto to construct an additional bridge across the tracks of the G.T.R. and the C.P.R. where the same crosses Dundas Street, Toronto, Ontario.

8085—September 15—Granting leave to the Winnipeg Electric Company to operate their cars and trains over the track of the C.P.R. Company on Logan Avenue, Winnipeg, Man.

8086—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the tracks of the C.P.R. at Yonge Street, Fort William, Ont.

8087—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the tracks of the C.N.R., Fort William, Ont. (at Yonge Street).

8088—September 14th.—Dismissing application of the corporation of the town of Leamington, Ont., to open up and construct a street over the right of way of the Leamington and St. Clair branch of the M.C.R.R. in the said town.

8089—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the track of the G.T.P. Railway, at Yonge Street, Fort William, Ont.

8090—September 13—Granting leave to the corporation of the town of Listowel, Ont., to place certain wires across the track of the C.P.R. at Main Street in said town.

8091—September 14th—Granting leave to the village of Stirling, Ont., to place certain electric light wires across the track of the G.T.R. at William Street in said village.

8092 September 14—Granting leave to the corporation of the town of Listowel, to place certain electric power wires across the track of the C.P.R. at Inkerman Street in said town.

(Continued on page 383.)

DISCUSSION OF TRACK ELEVATION IN CHICAGO, ILLINOIS.*

M. K. Trumbull, Engineer of Track Elevation.

The City of Chicago has maintained a track elevation policy for almost one-fourth of its corporate existence. The annual growth of track elevation has been consistent. The cumulative result is remarkable. The railroads have executed mile after mile of this kind of construction with scarcely a word from public or press. Scarcely a train has been delayed. How few know even the names of the men who design and execute the work and in whose care the public safety is placed. How vigilant and resourceful they must be is little appreciated by the passengers who are almost lifted while they ride.

To elevate a stretch of railroad is no simple task. Wherein lies the factor that transforms what would seem an ordinary piece of construction to one that is difficult? Traffic. Every large merchant who completely remodels his store and takes care of his customers simultaneously can have some idea of what track elevation means to the railroad man. Every manufacturer who rebuilds his plant while continuing his operations; every restaurateur, or hotel keeper, who does likewise can gain some notion of the engineers' achievement; but none can conceive of the difficulties incident to the protection of life and comfort not only of passengers riding on the trains but of those making up the flow of travel at street intersections.

With a congested right of way to begin with the railroad must rebuild from below the ground up and handle its traffic without delay at the same time. The Commissioner of Public Works permits the blocking of but three or four consecutive streets at any one time. Two miles of track elevation, for instance, must be divided into from four to five separate sections in each of which the operations are separate and distinct. The object of this programme is to offer the minimum of obstruction to street travel; especially to surface cars and the city fire department. This restriction upon the railroads increases the cost of the work, complicates the handling of trains and lengthens the time to complete the work. Even this programme cannot wholly eliminate the damming up of the arteries of travel contiguous to the particular section in which the heavy operations are being carried on nor the temporary suspension of normal business on the part of a few tradesmen who happen to be located immediately adjacent to the railroad tracks that are being elevated.

The engineer must carefully map out his programme for the season and follow this schedule with a daily "line-up" which has in view the logical sequence of each distinct operation. The nature of the work requires that heavy operations and large forces of men must be handled within limited areas. The time interval between each two operations must be calculated to a nicety. Upon consideration of the many complications involved one wonders at the dispatch with which the work is accomplished.

Track elevation, properly speaking, began on May 23, 1892, when the Illinois Central Railroad Company secured from the City Council an ordinance for the elevation of its tracks from 51st street to 67th street. An urgent necessity confronted the Illinois Central officials to make some quick and radical moves in order to place themselves in a position to handle the heavy passenger traffic to accompany the opening of the World's Fair the following season. Thus a creature of neccessity, track elevation, had its birth. The population of Chicago at that time was 1,200,000. A crying need for a relief at a great number of grade crossings, where the railroads were annually killing and injuring many people, was felt. A few cases had been disposed of at important streets, by constructing viaducts over the tracks, to accommodate the street travel. The viaducts policy had, however, become unpopular. The height at which it was necessary to erect the viaducts, above the original grade of streets, required the construction of long approaches, not only in the streets provided with viaducts, but in those that intersected the site of the approaches as well. Then, as necesstiy arose, nearby streets were selected for viaducts. The logical result threatened that the zones of city property contiguous to the railroads was soon to be enmeshed in a network of approaches which would not only offer long and heavy grades to street traffic but would considerably depreciate the value of the property affected.

The track elevation idea was eagerly grasped by the city administration. Press and public alike demanded that all of the railroads within the city limits should forthwith proceed to elevate their tracks. Responsive to this demand, but with profound deliberation as to the feasibility of the programme, the City Council, within nine months after the passage of the Illnois Central ordinance, on February 23, 1893, passed a General Ordinance which provided for the elimination of all grade crossings in the city by track elevation. This ordinance was too comprehensive.

The railroads declined to enter into the wholesale scheme of construction expense. The administration thereupon made a survey of those zones in which the street crossing travel was most dense and decided to treat each zone separately, and where necessary, to further sub-divide each into elements of reasonable length.

Proceeding upon this theory the City Council, on July 9, 1894, passed an ordinance for the elevation of the tracks of the Chicago, Rock Island and Pacific Railway from Archer avenue to West 69th street and the tracks of the Lake Shore and Michigan Southern Railway from Archer avenue to State street. Less than seventeen months had elapsed after the passage of the General Ordinance. In this short period the Council found that it had started on the wrong track, took its bearings, and threw the helm to another course. Fair sailing was soon encountered and the good ship has not swerved since.

During the following four years seven separate pieces of track elevation were proivded for. This meant continuous labor on the part of the city administration and the railroads.

The first appropriation for the department was embodied in the budget for the year 1898.

Former Alderman Walter J. Raymer, was tendered the office as Mr. O'Neill's successor. This was a promotion from the Purchasing Department, in which he had served with distinction as its head.

Forty-two separate or original ordinances listed on pages 24 to 28, have been passed in the last seventeen years, or an average of about two and one-half per annum. With this period as a perspective, a glance at the first plat above referred to is of interest.

By the provisions of the General Ordinance the city was divided into three districts which are shown on Plates I and II. All tracks within District I. were to have been elevated by January 1, 1895; all tracks within District II. by January 1, 1897; and all tracks within District III. by January 1, 1899. Thus the railroads were required, by this ordinance, to elevate all their tracks within a period of six years. During the seventeen years that have elapsed since its passage the population of Chicago has been increased 85 per cent., until to-day the city numbers 2,200,000 inhabitants. Not much work has been done in District I. There has, in fact, been little necessity or demand for track elevation within this area. Nearly all the tracks in District II. have either been elevated or track elevation has been provided for. District III. offers much for a healthy growth of track elevation relief for the grade crossing evil.

Seventy-four per cent. of the work, for which ordinances have been passed, has been completed. The 148.72 miles of railroad roadbed, already covered by track elevation ordinances, is approximately 44 per cent. of the total mileage of roadbed within the city limits. Basing an estimate on this percentage and assuming:

*Abbreviated from a report to Walter J. Raymer, Commissioner of Track Elevation, Chicago, Ill.

First—That the city limits remain as they are at present;

Second—That the growth of population will require all tracks to be elevated within these limits;

Third—That the cost per mile of roadbed will be 80 per cent. of that already provided for, on the theory that there will be fewer tracks per mile of roadbed;

The ultimate cost of track elevation will approximate $150,000,000. This estimate, however, looks so far into the future that any one or more of these assumptions may be found to be without foundation.

The 720 subways, averaging seven subways to the mile of roadbed elevated, may be classified as follows: Roadway grade crossings abolished and subways provided for; viaducts removed and subways provided for; foot passageway subways; alley subways; railroad grade crossings separated; subways constructed by private contract, considering as a single subway each case where two or more roads have elevated their adjacent roadbeds and have participated in the expense of constructing the joint subway.

There is a mistaken impression in certain quarters, that it takes the railroads an unreasonable length of time, after the Track Elevation Department has opened negotiations for the elevation of any particular stretch of their tracks, to seriously discuss the question. On the contrary, the attitude of the railroads has been natural. In some cases, it is true, negotiations between the city and the railroad officers have consumed much time; but the average period has been short. The situation is parallel with negotiations preliminary to contracts of any character. As soon as the ordinances have been passed, approved and accepted, the railroads have executed their part of the agreements in good faith. In numerous cases they have even gone further and have performed work not called for in the ordinances, either upon their own initiative or upon the request of the city officials. This has brought about better feeling between the city and the railroads then existed a decade or two ago.

The officers of the railroads take personal interest in their work, with the result that the appearance and efficiency of their designs are steadily improving. Their efforts are inspired by the desire to produce permanent structures upon which the annual maintenance cost will be low. The city is beneficiary in that the more recent subways are more nearly watertight and noiseless than formerly. Seepage of moisture through abutments and retaining walls is prevented, greatly improving the appearance of the masonry. Shallow metal decked floor systems with their sounding board effect and lack of resistance to the dropping of water into subways below are a thing of the past. Be it said, however, that the railroads made their designs, ten or twelve years ago, in the light of what was then deemed best. To-day shows the result of study and a desire to improve. Track elevation has thus been an evolution.

The benefits from track elevation are so many that it is difficult to describe them briefly. First and foremost is the manifest reduction in grade crossing fatalities and injuries. Table I. speaks for itself, and no amount of comment on the writer's part can add any weight to it. No words can be more convincing when arguing in favor of track elevation.

This record takes no account of the accidents which occurred on the railroad rights of way between streets. It is a grade crossing record only. Prior to 1899 thirty-five miles of railroad roadbed had been elevated and one hundred and thirty-five subways had been constructed. This work, comprising about 30 per cent. of what has been completed to date, saved many lives and many accidents.

An estimate based on the data in Table I. would indicate that track elevation has prevented to date about 1,380 grade crossing fatalities and about 2,510 non-fatal accidents. How many more it has prevented between streets would be difficult to determine. There is now little temptation for boys to "hitch" and for other trespassers to climb upon the railroad tracks which are elevated.

On the basis of the $53,622,000 already spent, each grade crossing accident, prevented to date, has been effected at an expense of $13,800.

The outlay for track elevation, spread over a period of years in the future shows a material reduction for each estimated accident prevented, such that the $13,800 will become less than $3,000 within two generations on the basis of a total expenditure of $150,000,000.

Material results, however, should not be lost sight of Consider the time that would be lost annually in case no tracks had been elevated. During the year 1908 there were recorded 643,386,000 rides on the surface lines alone. Most of the railroads intersect street car tracks every half mile where the city is built up and where surface traffic is heaviest. It is fair to assume that 150,000,000 of these rides encountered railroad tracks or subways. If track elevation had not been accomplished passengers would have suffered many delays, due to crossings being blocked. Assuming that each passenger trip of the 150,000,000 would have been delayed an average of one minute and that 90,000,000 pedestrian trips would have been obstructed a like amount, 4,000,000 hours time would have been lost. The street cars themselves would show decreased operating revenue. When the delay to teams, carriages, and automobiles is considered a conservative estimate of the value of time lost would approximate $1,500,000 per annum.

If the above reasoning is correct, track elevation conserved this amount of wealth during 1908. Year by year the amount will be increased in direct ratio to the traffic affected. For illustration, and illustration only, if the population of Chicago could be taxed annually the amount thus conserved, the limit of bonded indebtedness of the city could be safely

TABLE NO. I.

ANALYSIS OF DECREASE IN GRADE CROSSING ACCIDENTS.

		Deaths All Causes		GRADE CROSSING ACCIDENTS. Fatal			Non-Fatal		Total	
Year	Population	Number	Rate Per 1,000	No.	Rate Per 1,000,000	Percentages of Death All Causes	Number	Rate Per 1,000,000	Number	Rate Per 1,000,000
1899	1,626,333	25,503	15.7	113	69	0.44	169	104	282	173
1900	1,698,575	24,941	14.7	97	57	0.39	105	62	202	119
1901	1,757,010	24,406	13.9	64	36	0.26	91	52	155	88
1902	1,815,445	26,455	14.6	61	34	0.23	122	67	183	101
1903	1,873,880	28,914	15.4	69	37	0.24	169	90	238	127
1904	1,932,315	26,311	13.6	55	29	0.21	172	89	227	118
1905	1,990,750	27,212	13.7	99	50	0.36	48	24	147	74
1906	2,049,185	29,048	14.2	68	33	0.23	65	32	133	65
1907	2,107,620	32,143	15.2	38	18	0.12	62	29	100	47
1908	2,166,055	30,548	14.1	20	9	0.07	27	12	47	21
	Average 10 Years		14.5		37	.026		56		93

more than doubled (from about $23,000,000 which it is at present).

The reduction in annual fire losses due to track elevation is difficult to compute. Be it said, however, that the delay to the fire department in reaching conflagrations is enormous when the railroad crossing gates are closed for passenger or freight trains. Every moment elapsing between the time a fire starts and the arrival of the fire department at the site is vital and is a matter of important consideration when viewing the delay due to a blockade at one or more railroad crossings.

Some additional benefits due to track elevation, obviously only a brief survey of the situation, are here enumerated:—

1. New districts are opened for settlement, thus reducing local congestion in population.

2. Accessibility to churches, markets and schools is improved.

3. Courts have fewer cases due to trespass, "hitching," or car thieving, etc.

4. Few streets are now crossed by railroad yards. Twenty-one yards have been elevated to date.

5. Better time is made by trains; fewer accidents occur for which the public has to suffer and for which the railroads have to pay; railroad rights of way are more clearly defined; freight trains do not have to be cut at street intersections.

6. Underground pipes and conduits are more accessible in subways than when lying directly under the tracks where the latter have not been elevated. Breakages of pipes and conduits due to the impact of heavy track loads are eliminated.

7. Improvements, such as new station buildings, new team yards, new freight houses, etc., are secured. In fact, within the limits of track elevation, the railroads are entirely rebuilt and reconstucted along strictly modern lines.

8. Future electrification of the railroads is made easier in that the third rail and return circuits can be more easily disposed of. This, however, is only one of the many difficulties attending the consideration of the question of electrification.

9. Nine unsightly viaducts have been removed. An additional viaduct will be removed this year. Only three away from the river will remain after this year.

10. Seven railroad grade crossings have been separated. One more has been temporarily separated. Three additional cases will be disposed of under existing ordinances with the probability that two more will be agreed upon by the railroads before all the ordinances now in effect have been executed.

Track elevation results have been tabulated above. The benefits have just been outlined. Let us see how much has been drawn from the City Treasury to help pay for this $72,622,000 improvement that the railroads have made.

The diversity of design as to retaining walls and abutments, both for foundation and masonry above foundations, is almost as great as in the superstructures. In the early years of track elevation the use of cut stone and rubble masonry was general, but to-doy concrete is used exclusively. During the last five years walls and abutments have been constructed of reinforced concrete by some of the roads.

The soil in and about Chicago is not the best for foundations. Few of the roads place the bottom of foundation more than one foot below the frost line. Two companies use caissons for column foundations. Of those companies constructing foundations only a trifle below frost line some drive piling under the toes of the retaining walls and abutments. Others extend the toe to add greater resistance to overturning. The soil is soft and some settlement results except in the case where caissons are sunk to bed rock. Concrete walls above foundation are constructed with "battered" or "stepped" back, according to preference of the engineers.

An earnest effort is being made to prevent the percolation of water through the walls and abutments. This improves the appearance and lengthens the life of the concrete. Some roads coat the back with asphalt or pitch. Some employ longitudinal drainage either four or five feet below the elevated track level or at the original grade of the tracks. Some use "weep" holes through the walls.

The writer will not attempt to go into discussion of the methods pursued by the different companies in elevating their tracks, unit costs, etc. Such a subject is interesting but would probably be out of place in this brief discussion. Suffice it to say, that, whereas, in the early years practically all work was done by hand, to-day nearly all classes of heavy work are performed by machinery. By the latter method smaller forces can be employed eliminating delays and uncertainty due to labor troubles. The rate of progress is thereby accelerated and a more uniform daily output assured. Even with the use of machinery track elevation gives employment to about five thousand men annually in Chicago.

Taken as a whole, Chicago track elevation as it appears to-day is a most satisfactory public improvement. There are a few places where reconstruction will be necessary in the

TABLE No. 2.

COST OF TRACK ELEVATION TO THE CITY OF CHICAGO.

Note—Percentages shown are on basis of cost to the Railroads ($72,662,000.)

Department Expenses to date	$	$ 66,084.29	$	0.09%
Damages paid to date:				
At 10 Streets where Viaducts were removed	256,151.01			
At 709 " " no " existed	105,107.75	361,258.76		0.50%
Total paid out of City Treasury to date		$ 427,343.05		0.59%
Paid into City Treasury Account Track Elevation		280,000.00		0.39%
Net Cost to City to date			147,343.05	0.20%
Estimated Damages yet to be paid on account Track Elevation Ordinances to date		350,000.00		0.48%
Plus above		361,258.76		
Total estimated to be paid out of City Treasury for damages account Track Elevation Ordinances to date		$ 711,258.76		0.98%
Plus above		66,084.29		
Total estimated to be paid out of City Treasury including Department Expenses Account Track Elevation Ordinances to date		$ 777,343.05		1.07%
Less above		280,000.00		
Net estimated cost to City Account Track Elevation Ordinances to date			497,343.05	0.68%

near future. There are subways which are poorly drained due to the inadequacy of the existing sewers. The latter, however, is a general evil which is not confined to the areas in which railroad tracks are located. It has been brought about by—

First—The flat and low grade of the city itself.

Second—The phenomenally rapid growth of the city.

Third—The hand-to-mouth scheme on which the city finances have been run due to the low limit of bonded indebtedness. This means that the design of sewage and water systems could not sufficiently anticipate the future demand.

A number of subways have been depressed so far below the original elevation of the streets that the roadway grade is down dangerously close to the sewer tops. That this condition is undesirable is obvious. A number of subways on the West and North sides, having surface cars, were provided with only twelve feet six inches of headroom in the original ordinances. The large type of cars provided for in the "Traction Ordinances" requires thirteen feet and six inches of headroom. How to secure the additional twelve inches without further depressing the floors of the subways or without necessitating a further elevation of the railroad tracks has been a problem. The railroads had completed their track elevation, under their contract ordinances, and were subject to no further demands. On the south side fortunately the City Railway Company looked sufficiently far into the future and demanded thirteen feet and six inches from the beginning of track elevation.

At subways under construction where sufficient headroom was not provided in the ordinance, the track elevation department has successfully urged the railroads to provide the additional amount. This correction of the old ordinances is progressing in such manner that as the rehabilitation of the surface lines is effected, and the through routes are inaugurated, no obstruction is met in carrying out the programme on account of insufficient headroom in subways.

The policy of the present administration has been, and is, to provide thirteen feet and six inches of headroom at all streets where surface lines exist, or are probable, and twelve feet at all others. A smaller amount of depression of the streets is being allowed the railroads. Subways are to be provided at least eight for each mile of elevation. A more careful consideration of all the many factors is being made than heretofore.

PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 103 Bay St., Toronto: Pollock Manufacturing Co., tone arm for talking mahines; R. H. Trumpour, clocks; Wm. S. Simpson, uniting, joining or welding of metals by fusion; Wm. S. Simpson, uniting or welding of metals; Pearce & Billington, typographical composing machines; Bevan & Morley, Nutlocks; J. C. Barker, automobile tires; F. W. Leever, stop and through way valves.

At Boat Harbour, Vancouver Island, between Nanaimo and Ladysmith, some thirty miles from Vancouver, the Pacific Coast Coal Mines, Limited, has recently opened up a new coaling port, capable of accommodating large ocean-going vessels. The bunkers are large, and the loading equipment has a capacity of 750 tons per hour. The collieries are distant seven miles from the harbor, and railway connection and modern rolling stock are already provided. The Company owns 200 acres, and has rights over 5,000 acres in addition. A large amount of tunnelling has been done and production has commenced. The seam at present worked is reported to be from 5 feet to 20 feet in thickness. Other underlying seams have been encountered in diamond drilling.

THE PHENOMENA OF RESONANCE IN ELECTRIC LINES.*

By J. Dalemont, E. E., M. Sc.

The phenomena of resonance may produce in electric circuits, as it is well known, some very serious accidents, such as the breaking of the cable insulation, sudden rise of tension or intensity, etc.

For example, the accident which happened in the underground light and power circuits of Berlin (Germany).

In this instance, the voltage of the busbars suddenly reached a value higher than the normal, the intensity of the current doubled, and the frequency was three times the normal; all this, without any higher admission of steam in the steam engines working the alternators.

This has often been attributed to the effect of resonance. We know that in a given circuit, the resonance proper depends on the self induction of the lines, on the machines, and also on the capacity of the lines.

But these values vary with the load of the circuit. In the present case, when the conditions for the resonance of the third harmonic were fulfilled, the amplitude of this harmonic increased rapidly.

To reduce the busbar tension to its normal value, the engineer of the power-house diminished the excitation current and thus, the amplitude of the third harmonic assumed a marked influence, and took the place of the fundamental wave.

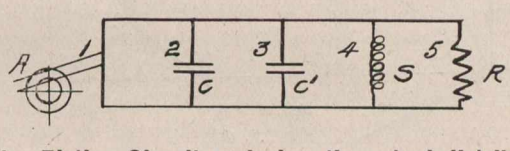


Fig. 1.—Fictive Circuit replacing the actual distributing Circuit.

In Berlin a recurrence of the accident was avoided by placing resistance coils in the circuits of the alternators. The impedance of these coils was sufficient to eliminate the currents of higher frequency. The foregoing shows the disadvantage arising from alternators having a low tension drop obtained through a low self-induction.

The tendency however, to-day, is to reduce the total reaction of the machines leaving a high value to the self-induction proper of the armature circuits. The self-induction of working alternators comes into the formula expressing the frequency proper of the circuits.

$O E_0$: elm. force at no load
V = tension at the terminals.
$E_0 e'$ = opposite reaction.
$e' e''$ = cross reaction.
$e'' e'''$ = elm. force of self-induction.
$e''' V$ = ohmic drop.

Let us consider an alternator A which supplies a circuit having self-induction and capacity. Let E be the constant e. m. f. at no load of the alternator;

V, the tension at the busbars;

l, the self-induction of the alternator;

C, the capacity of the receiving and cable circuit;

*In a technological and scientific dictionary, edited by G. F. Goodchild, B.Sc. (London) and C. F. Tweney, the following definition is given of the word Resonance: "If any body be acted upon by a succession of impulses or vibrations, which recur at intervals corresponding to its own natural period of vibration, it will itself be caused to vibrate. The phenomenon is very easily observed in the case of sound, e. g., a stretched string is readily set in vibration if a note of the same pitch (frequency) as its own fundamental tone be sounded in the vicinity."

Webster says: "By extension, the increase of vibration of any kind, as in electricity, by an intermittent force of the same period. In electricity, the principle is valuable in detecting and investigating electro-magnetic waves."

l', the self-induction of same;

r, the resistance of same;

p, the pulsation of the fundamental wave of tension and current.

We can use a fictive circuit (fig. 1) instead of the actual circuit, and assume: 1st: the capacity of the receiving circuit is divided in two capacities c' and c'', one of which, c'' gives the resonance with the self-induction l of the alternator, while the other, c^1 gives that of the self-induction S of the receiving circuit and of the lines.

2nd: the self-induction and ohmic resistance of the receiving circuit and of the lines, are separated in two circuits, R and S, one having the ohmic resistance R, the other the self-induction S. Then, if the resonance is reached between 1—2 and 3—4 the current I_1 supplied by the alternator A will be the resultant of the currents I_2 and I_5, making an angle of 90 degrees. The tension V at the terminals, of the alternator, will be in phase with I_5.

Fig. 2 shows the vector diagram of the currents and the tensions; O E_0 is the elm. force at no load; O e'' the the elm. force produced at the resonance load in the armature by the flux resulting from the normal excitation and the armature current; oi and oi' are the two components of the current I_1, one of which is in phase, the other in lag of 90 degrees with the elm. force at no load. These compon-

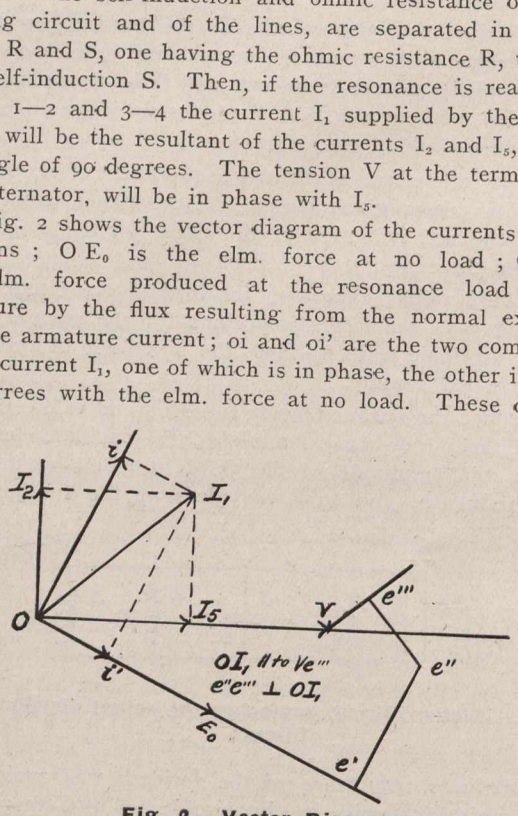


Fig. 2.—Vector Diagram.

ents produce in the armature the opposite and cross reaction. We can see that V is much greater than E_0. The resonance phenomena take place in the circuit 3 — 4 when

$$p\,l' = \frac{1}{p\,c'}$$

and likewise in circuit 1 — 2, when

$$p\,l = \frac{1}{p\,c''}$$

and since from $c' + c'' = c$, we obtain

$$p^2 c = \frac{l + l'}{l\,l'}$$

If we substitute $\frac{l\,l'}{l + l'} = L$ the condition of the resonance will be then:—

$$p^2\,c\,l = 1$$

As we said above, the dangerous effects of resonance are not to be feared for normal frequency, that is for the fundamental wave, but the higher harmonics may produce this resonance with harmful result.

In a circuit supplied with alternating current at 60 cycles, the frequency of the 5th harmonic is 5 x 6. 28 x 60 = 1885 and in this case in order that the 5th harmonic give the resonance, we must have

$$c\,l = .28210^6.$$

From $L = \frac{l\,l^1}{l + l^1}$ we can see that the influence on L of an increase of the alternator's self-induction is not very great, but it might be sufficient to eliminate the currents of higher frequency. The advantage of using compound alternators is also shown by fig. 1; the component of the current in lag of 90 degrees with E_0 is ahead of the no-load elm. force. The result is that it has a magnetizing effect on the armature circuits. If the armature reactions were compensated as happens in the compound generators, there need be no fear of the magnetizing effect of the armature current. On the other hand, it has been often shown that the construction of compound alternators with a higher self-induction and armature reaction would be more economical than that of the machines built at the present time for a low tension drop.*

It is difficult to see where improvements with regard to reducing the size and cost of alternator for a given output can be made, for although many attempts have been made to get a satisfactory compounding device, none of these have been very successful up to the present time. One of the reasons is that most of these devices have been fitted to the exciter with the result that to the field excitation lagged behind the change of load. It is therefore probable that compounding devices which are not directly applied to the alternator will never be entirely successful.

The higher harmonics of the tension may produce the breaking of cable insulation, and its effects are the more to be feared because the resonance of these harmonies, that is to say, the increase of its amplitude, is not generally shown at the voltmeters and other apparatus.

The engineers at the power-house could, therefore, not be warned of this increase of the tension, except by the breaking of the cable insulation in the circuit.

The importance of these facts is easy to see, especially if we consider that the resonance of the lower harmonics depends on the values of the self-induction and capacity of the circuits, increasing with the development of lines and underground cables.

From this point of view, the test of cables at a higher tension than the distributing tension is not sufficient, because a dielectrikum does not resist so well at high frequency as at low frequency.

Accidents of resonance may be avoided by the use of high self-induction alternators giving a sine curve elm. force. However, the use of such alternators may not be sufficient, because in many cases the generators are not connected directly with the distributing lines. The transformers placed in the circuits to increase or reduce the tension at the generating or receiving end, can, as shown long ago by Rowland, alter the wave by the variation of the permeability with the induction. The dangers of resonance may still continue, but we may add, that the low induction generally admitted by the transformer cores will not cause any great change in the wave of the elm. force.

To avoid accidents through resonance in underground circuits, it becomes necessary to take the tension curves at the power station with an oscillograph. In this way it may be easily ascertained whether the harmonics are present or if their amplitudes do not reach an excessive value.

It may, however, also be necessary to take tension scillograms of the motors supplied by the circuits because the resonance of their own harmonics may be produced by the self-induction and capacity of a local circuit in which currents of high intensity would be produced.

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*On this question we could mention an interesting work of McFarlane and Barge, recently published in the "Electrician" (11 and 18, of December, 1908.)

The statement was made in Wall street recently that Harriman pacific roads have now under construction 2,000 miles of extensions, with expenditures approximating $100,000,000.

According to the latest statistics the total peat-bogs of Sweden would be capable of producing 10,000 millions of tons of air-dried peat, suitable for fuel. This quantity, as compared with the present import of coal, would be sufficient for a period of 1,500 years. More exact examinations of the geological character of the peat-bogs will soon be started by the Swedish Geological Society.

TREES, FENCES AND HEDGEROWS.*

By Harold Parker, M. Am. Soc. C.E., Chairman Massachusetts Highway Commission.

In discussing the questions which are indicated in the title of this paper, it should be borne in mind that two causes for the results that have followed man's effort to beautify and improve what was first done from necessity alone must be taken into consideration, in order to bring before you the conclusion which I desire to make plain.

In the first place, before we can take into account the roadside trees, hedge rows and fences, we must consider that the road itself was the first development of the necessities of man. He had to have a road which led from one point to another, not only for his own passage, but for that of the vehicle which carried his produce, or later contributed to his pleasure; so that in the laying out of highways, as means of transportation alone, neither the comfort of those using them nor the beauty of their surroundings was considered, the aim of the road-builders being to secure the easiest means of getting from place to place.

It is not supposed to be a part of this discussion that I should consider the location, construction or maintenance of roadways, except in so far as the trees and roadside growths may be either a protection to the road itself or contribute to the comfort and happiness of those passing over it, which is, to be sure, a question of some economic advantage, and therefore has a value beyond the purely aesthetic.

Roads themselves have grown with the growth and wealth of population, and have usually kept pace with such growth, and, as the leisure and financial ability of communities increased, as well as the opportunities for improving their roadsides, the improvement of the roads and the beautification of the roadside surroundings became a sought-for consummation, and, as civilization increased, a practical interest.

In this way it may readily be seen that where population has concentrated for economic reasons, there has gradually grown up the desire for aesthetic effects, as is shown in the creation of parks and public reservations for the enjoyment of the people at large.

For the same reason the ornamentation of roadsides, extending gradually into the country from larger cities and towns, has developed and grown with the wealth of the people themselves; so that, as we look at it now in America, one of the considerations that are brought prominently to our attention, after building the best road that we know how, is the planting of roadside trees and other ornamental growths, and the erection of walls and fences that are no longer unsightly, but which will contribute to the beauty of the landscape and the unconscious advantage of those travelling over the road. This has now become so universally accepted that it cannot be ignored, even if those persons who are wholly practical consider it an unnecessary expenditure of money.

The development of this aspect has, of course, been different in Europe than in America, for there it has been so long and so gradual in its advance that it has attained in most of the civilized countries of Europe a finished result. There the roadside trees have been under intelligent care for generations, and produce on the mind of the traveller the most pleasing and salutary effect, even to those so ignorant that they cannot appreciate the reason therefor.

In France, and other parts of the continent of Europe, like the people themselves, the results have been largely of a formal or artificial character. In England, nature has been followed more closely, so that you get two methods of beautifying public reservations and the space between the travelled way and the fields of abutting land owners, which have grown by degrees from primitive conditions to the present artistic state.

In America, we have the advantage of both these methods worked out for our consideration, on which we can improve, but which do not give us immediately the results of trees of great size, or the finished appearance which comes through time alone.

To those of you who have driven horses or automobiles over the ancient highways of Europe, it must be painfully apparent that in comparison America suffers, notwithstanding the fact that in our older communities we have been striving for years to do in a shorter time what has there required many generations of careful work and study.

In almost all of the larger cities of the east in America very large sums of money have been spent in the acquisition of land and the planting of trees and shrubs which will thrive in their respective localities, and in the careful treatment of roadside conditions for many years, and the results of these intelligent efforts have been to make such cities more attractive to visitors and more livable to the inhabitants. It makes the conditions of life more healthful, and has a tendency to improve the people themselves.

The City of Boston in Massachusetts has expended over ten million dollars within the last twenty years in creating a park system for the use and at the expense of the metropolitan district, which, by the care that has been taken in its development, has become one of the most attractive and charming of any in the world; and this same theory has been adopted in many, if not all, of the larger cities, to a greater or less extent, paid for out of the public purse; so that, as I intimated in the first of this paper, so great has the insistence of the public become, that in the treating of public ways or reservations the question of beauty, as it is manifested through the efforts of trained and skilful men, has become a practical necessity, and the public is entirely willing to take upon itself the cost, however great, of such work.

What is true of the parks and other public reservations is true, to a greater or less extent, of the roadsides themselves. It is the custom almost everywhere to plant trees along the sides of roads, wherever practicable, and to save the natural growth on a new road. Wherever the road itself is improved it is noticeable that the land owners living along its borders instinctively improve the appearance of their possessions in proportion to the care that is expended upon the road and its immediate surroundings.

In Massachusetts, where the commonwealth builds and maintains its main lines of travel, and takes care of its roadsides, it is observed that farms and homes, previously deserted for years, are taken up, rebuilt and beautified everywhere along the borders of the road. No deserted farms can be found along State highways in Massachusetts. This, in itself, is an argument sufficient for the expenditure of such additional sums of money as may be necessary for improving the roadsides, as well as the roadways.

The Highway Commission of Massachusetts is required, under the law, to plant useful and ornamental trees along the borders of highways which have been made State roads. In order to do this intelligently and with the best results, the Highway Commission has employed a trained forester, and it has also established a nursery in which are cultivated trees and shrubs which are suited to all the climatic and physical conditions throughout the commonwealth. These trees are planted in locations suited to their character and kind, and are cared for under the direction of the forester, so as to attain their most complete and characteristic growth.

Where, in the course of the construction of State highways, it is necessary to make cuts through hills or embankments over low ground, it is the practice of the Commission to protect and beautify these cuts or fills by the planting of vines or shrubs which conceal their nakedness and prevent their disintegration. The work of the Commission along these lines has produced its effect upon the minds of those living along the roads, so that the ambition of the people to make their places more attractive, by the building of more or less ornamentl fences, the removal of unsightly accumulations, and the general well-being of their homes, has been aroused, and the result is encouraging and satisfactory.

* Paper presented at the First American Congress of Road Builders, Seattle, Wash.

It is also to be considered that trees and shrubs planted along the roadsides protect and prolong the life of the roads, and the planting or preseravtion of low-growing shrubs or bushes prevents the action of winds in drying up and removing the surface of the roadway, which otherwise would lead to destruction.

It is very plain that where roadways are shaded by trees horses will draw greater loads for greater distances, and that therefore more may be accomplished than under other circumstances.

You will, of course, appreciate that in a paper such as this is, it is impossible to enlarge upon the method of planting trees or other plans, how it should be done, or what kinds of trees should be used. Your conditions in Washington are so different from ours in the east that what would apply here would be wholly or largely inapplicable there.

It is usual with us, for example, to set out rock maples on the uplands which are exposed to severe winds or extreme climatic variations; white, red or pin oaks on less exposed hillsides or gravelly soils; white, red or pitch pines in sandy soils unprotected from the sun's rays; elms on fertile bottom lands; and white maples and willows in swampy reaches. Chestnuts have not been used to any extent for planting, though they become with care very large and handsome trees. They are, however, protected when found growing naturally by the roadside. Other trees such as poplar, ash, sycamore, locust etc., are suited to certain locations, but are not planted by us to any very great extent.

A great variety of native shrubs, such as cornus dogwood, lilac, etc., are used to give a picturesque effect or as wind breaks in exposed places. Such vines as blackberry, upland cranberry, low-growing sumach, etc., are planted on slopes and banks to protect them from disintegration, and to cover the raw appearance of new work. All these means can well be adopted to beautify and improve the sides of the roads, and, from my experience, are well worth the outlay from any point of view.

ASPHALT MACADAM ROADWAYS.*

By Clifford Richardson, M. Am. Soc. C. E.

It is somewhat surprising to one who has been a close observer of the development of the modern sheet asphalt pavement in the United States, during the last forty years, that so little application has been made of the experience gained in that industry to the problem of the construction of bituminous macadam highways, which shall meet the conditions which exist to-day.

There should not be any essential difference in principle in the construction of a sheet of asphalt pavement and a bituminous macadam roadway. Both consist of a mineral aggregate cemented together with a bituminous binding material, the aggregate in one case being fine, and the other, containing coarse particles. Experience has shown that, in either type of surface, the mineral aggregate being of a suitable character, the capacity of the resulting surface to resist travel will depend on the more or less satisfactory nature of the cementing material.

In the early days attempts were made to construct pavements in Washington and elsewhere with both fine and coarse aggregates, using coal tar as a cementing material. All these attempts with both fine and coarse aggregates were failures to a greater or less extent and its use was abandoned on the advent of the form of asphaltic construction developed by DeSmedt, although it was revived for a few years in the late '80's in mixture with asphalt with equally disastrous results. The surfaces having a coarse aggregate were somewhat more lasting than those made with sand and a small portion remained in place until the end of the century. They were known as Evans pavements, and were resurfaced with asphalt after a few years. One of these, protected by an asphalt surface, was found on repaving Connecticut Avenue, in Washington, in 1906. A piece of it was collected by the writer and examined. It appears that a coal tar bituminous macadam was constructed as long ago as 1873 and proved, in a short period of time, not to be a lasting form of construction. Notwithstanding this fact, experiment after experiment has been conducted along the same lines in recent years with similar results. Few, if any, highway engineers seem to have benefited by the experience of their predecessors, and most of them still have the coal tar lesson to learn on their own part, although it is evident that this form of construction cannot give satisfactory results for more than a few years.

On the other hand, referring again to the lessons of the paving industry, the modern sheet asphalt pavement, where constructed on rational lines on a rigid, well-drained foundation, has proved a complete success, as exemplified by the fact that a pavement of this type has satisfactorily resisted the heavy travel which is found on Fifth avenue, in New York City, 14,000 vehicles in the period between 6 a.m. and 7 p.m., for a period of twelve years. In the same way, an asphalt concrete surface constructed with a well graded but coarse mineral aggregate in 1902 in Muskegon, Mich., which has been used as a favorite drive since that time, has been in use with no repairs whatever where many similar surfaces in which coal tar has been the cementing material have deteriorated or required resurfacing under similar circumstances during the same period. The Muskegon work has not only demonstrated the superiority of asphalt as a cementing material, but this has been confirmed by other surfaces of the same form of construction in Owosso, Mich., in Paterson, N.J., Scranton, Pa., Staten Island, N.Y., and elsewhere.

The evident conclusion which may be drawn from past and present experiences is that success can be arrived at in the construction of any form of bituminous road surface only by the use of asphalt as a cementing material. The thing to be considered, however, is: how can asphalt be used in building the cheaper forms of country highways which are now in demand, to resist motor and concentrated traffic, where the aggregate is merely of the grading of the ordinary stone which is employed in surfacing macadam roads? The asphalt surface constructed in Muskegon in 1902, and elsewhere, was an asphaltic concrete. The mineral aggregate was well graded and, in itself, compact. This could only be combined with the cementing material in a hot condition, which required a plant to which the aggregate was hauled and from which it was again hauled to the point where it was put in place. The operation was, therefore, an expensive one, and makes the cost of this form of construction prohibitive for country roads. Recourse must, therefore, be had to some other method of combining a mineral aggregate and asphalt immediately on the spot where the surface is to be constructed.

For many years, tar macadam has been laid in England, France, and to a smaller extent, in this country in Rhode Island, New Jersey, and elsewhere. This form of roadway is arrived at by coating the No. 2 or surface stone of the macadam with coal tar in one way or another, either before or after rolling it, and afterwards filling the voids in the surface with more tar and grit, screenings or sand. Such a surface is desirable when first finished, but it soon begins to deteriorate and ravel, especially when exposed to horse-drawn travel, with the weathering and ageing of the cementing material. From past experience, it is not difficult to arrive at the conclusion that if an asphalt cement were substituted for the coal tar a result would be attained which would correspond to the improvement which was evident on the substitution of asphalt for tar in street pavements. The difficulty lies in the fact that an asphalt cement is much more viscous than tar. It must be used in a much better condition and does not mix with or adhere so readily to cold stone. Experiments have shown, however, that this can be accomplished by using a much softer asphalt than is customary in

*Address delivered at the First American Congress of Road Builders at Seattle, Wash.

street asphalt pavements, or even in surfaces of the type of the Muskegon pavement. To-day, we find ourselves, after some experiment, in the position of being able to coat stone, of the type used in macadam surfaces, with an asphalt cement which serves satisfactorily as a binder for such an aggregate, on a metal mixing board with hand labor and shovels, at the point on the road where the material is to be put in place, and with every reasonable economy. It produces a surface which, while not of the stability or having the wearing properties of the Muskegon type, is as far superior to the ordinary tar macadam as the sheet asphalt pavement is superior to one of the tar poultices of thirty-five years ago.

The base of the cementing material must, however, be an asphalt of the best quality, such as is used in the construction of sheet asphalt pavements; in fact, it must be an asphalt paving cement such as is called for under the strictest municipal specifications, but merely made softer by the use of a large percentage of flux. Dense oils and residuums to which no solid native bitumen has been added will not accomplish the same results to any greater or more satisfactory degree than they would if used in a street pavement. Further, the character of the flux in asphalt cements for use in macadam must be more carefully taken into consideration than that for use in street pavements, as the amount is so much larger, in consequence of which, it has a greater bearing on the character of the cement.

RAILWAY ORDERS.

8093—September 15th—Authorizing Clark Vanderburg, of Nelles Corners, Haldimand County, Ont., to lay gas pipe under the tracks of the G.T.R. where the same crosses at a point on Lot 47, in the Township of North Cayuga, Ont.

8094—September 15—Granting leave to the Mt. Albert Telephone Company to place its wires across the track of the G.T.R. at Lots 11 and 12 at the north end of the G.T.R., (first crossing north of Mt. Albert Station, Ont.)

8095 and 8096—September 15th—Granting leave to the New Brunswick Telephone Company, Limited, to place its wires across the track of the C.P.R. at two points in Carleton County, N.B.

8097—September 15th—Granting leave to the Manitoba Government Telephone System to place its wires across the track of the C.P.R. west of Stonewall Station, Man.

8098—September 15—Granting leave to the rural municipality of Macdonald, to place its wires across the track of the C.P.R. at public crossing 200 feet south of La Salle Station, Man.

8099 to 8101—Inc.—September 15th—Granting leave to the Government of the Province of Alberta to cross with its telephone wires the track of the C.N.R. between mile posts 816 and 817, Alberta, and the Canadian Pacific Railway ¼ mile south of Parkdale, Alta., and at 11th Avenue, Calgary, Alta.

8102 to 8106 Inc.—September 15th—Granting leave to the Bell Telephone Company to cross the tracks of the G.T.R. at three points, and the M.C.R.R. at two points in the Province of Ontario.

8107—September 15th—Granting leave to the Saskatchewan Government Telephone System to cross with its wires the track of the C.P.R. immediately east of the town of Glen Ewen, Sask.

8108—September 15th—Authorizing the Volcanic Oil and Gas Company, Limited, to lay gas main under the track of the C.P.R. where the same crosses McDougall Avenue, between Lot 84 and 85, Township Sandwich West, County Essex, Ontario.

8109—September 15th—Authorizing the C.P.R. to construct bridge No. 84.7 at Six Mile Creek, Mountain Section of the Pacific Division of its line of railway.

8110—September 14—Authorizing the Vancouver Power Company to cross with its tracks the tracks of the New Westminster and Southern Railway Company at Cloverdale, B.C.

8111—September 15th—Directing the Brandon, Saskatchewan & Hudson Bay Railway to employ two men and a foreman on each of the sections known as the "Boissevain and Minto Sections," and if that number be not sufficient that the railway company is to employ such additional men as may be necessary for the purpose.

8112—September 16th—Granting leave to the Volcanic Oil and Gas Company to place its wires across the track of the P.M.R.R. at the itersection of the railway of the said company with town line between Townships Tilbury East and Romney, County Kent, Ont.

8113—September 16—Granting leave to the Saskatchewan Government to place its wires across the track of the C.N.R., between Sections 21 and 28, Tp. ¾ 33, R. 4, west 3rd. Meridian, Saskatchewan.

8114—September 16th—Granting leave to the Rural Telephone Company, Limited, to place its wires across the track of the C.P.R. at Valley Street, Govan, Sask.

8115—September 15th—Authorizing the C.P.R. to construct, maintain, and operate industrial spur near "McLeods," Township of Hampden, County of Crompton, P.Q., for the Lake Megantic Pulp Wood Company.

8116—September 21st—Authorizing the C.P.R. to construct, maintain, and operate, branch line on Alley West of Caron Avenue, Windsor, Ont.

8117—September 21st—Authorizing the C.P.R. to construct bridge No. 69.8 on its Moose Jaw Section.

8118—September 17th—Authorizing the C.P.R. to construct bridge No. 42.15 on the Schreiber Section, Lake Superior Division of its line of railway.

8119—September 21st—Approving location and detail plans of stations of the C.N.R. on its Ottawa-Hawkesbury and Garneau-Quebec Divisions.

8120—September 14th—Dismissing application of the G.T.R. for permission to construct spur into the premises of the Noxon Company, Limited, near Ingersoll, Ont.

8121—September 21st—Approving location of the C.N.R. from mileage 10 to mileage 15, up the Fraser River from Yale, B.C.

8122—September 21st—Granting leave to the Ontario Power Company to place its transmission line across the track of the N. St. C. & T. Railway between Lots 17 and 30, Township of Thorold, Ont.

8123—September 21st—Approving revised location of the G.T.P. Railway from S.E. ¼ Sec. 14 to the S.W. ¼ Sec. 23, Tp. 14, Range 27, west 1st Meridian, District of Shoal Lake, Man.

8124 to 8127 Inc.—September 21st.—Granting leave to the Saskatchewan Government Telephone System to cross with its wires the track of the C.P.R. at four different points in the Province of Saskatchewan.

8128—September 21st—Authorizing the corporation of the town of Weyburn, Sask., to lay water main under the tracks of the C.P.R. at Third Street, Weyburn, Sask.

8129 to 8131 Inc.—September 21st—Granting leave to the B.C. Telephone Company to place its wires across the track of the Vancouver, Victoria & Eastern Railway at three points in the Province of British Columbia.

8132 and 8133—September 21st—Granting leave to the Bell Telephone Company to cross with its wires the track of the C.P.R. at West Brome, P.Q., and the G.T.R. at Clinton, Ont.

8134—September 21st—Granting leave to the Canadian Machine Telephone Company to cross the track of the G.T.R. at Mount Pleasant Flag Station, Ont.

8135—September 21st—Granting leave to the Volcanic Oil and Gas Company to place its wires across the track of the M.C.R.R. at public crossing at Lot 9 North Middle Road, and Lot 9 South Middle Road, Ontario.

8136—September 17th—Granting leave to the corporation of the town of Milton, Ont., to lay water main under the track of the C.P.R. at Court Street in the said town.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING — CONTRACTORS.—President, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, E. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. B. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 1 Victoria Rd., Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont. Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 701 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que. Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

COMING MEETINGS.

American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

American Society of Municipal Improvements.—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

Royal Architectural Institute of Canada.—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

National Gas and Gasoline Engine Trades Association. Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30,

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

Quebec.

MONTREAL.—Tenders will shortly be invited for rebuilding the St. Catherine St. bridge. Mr. John R. Barlow is the city surveyor.

MONTREAL.—Tenders will be received until October 6 for alterations to the examining warehouse, Montreal. Mr. guori, Montcalm County, Que.; J. L. Michaud, Resident Engineer, Merchants Bank Building, Montreal; Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

QUEBEC.—Tenders will be received until Friday, October 22nd, for the construction of an Ice Breaker at St. Liguori, Montcalm County, Que. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

Ontario.

BERLIN.—Tenders will be received until Thursday, October 28th, for paving King Street. A. H. Millar, town clerk; Wm. Mahlon Davis, C. E., town engineer. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will shortly be invited for two new steam fire engines for the city of Toronto.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, October 11th, for the construction of sewers in the township of York. Barber & Young, York Township Engineers, Toronto. (Advertisement in the Canadian Engineer.)

WELLAND.—Tenders for Postoffice, Customs and Inland Revenue Fittings, will be received until Monday, October 11. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

Manitoba.

SHELLMOUTH.—Tenders will be received up to the 27th October for building a bridge across the Assiniboine river. Plans and specifications can be seen at the office of the department of public works, Winnipeg. F. G. Richardson, Clerk.

Saskatchewan.

MAPLE CREEK.—Tenders will be received until October 15th for sewage pumping equipment. H. A. Greeley, secretary-treasurer; C. M. Arnold, consulting engineer, Lethbridge. (Advertisement in the Canadian Engineer.)

MELVILLE.—Tenders will be received until October 7th for a drainage system. H. D. Wilson, secretary-treasurer, Melville; L. B. Merriam, consulting engineer, 609 Builders' Exchange, Winnipeg. (Full particulars advertised in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received until Monday, October 11th, for 50 water meters and connections. J. Darlington Whitmore, city engineer. (Advertisement in the Canadian Engineer.)

British Columbia.

VANCOUVER.—Tenders will be received until October 25th for building a large bridge over False Creek, this city. W. A. Clement, city engineer; Waddell & Harrington, consulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

CONTRACTS AWARDED.

Quebec.

MONTREAL.—Messrs. Quinlan and Robertson, of Montreal, secured the contract for widening and deepening the aqueduct for $815,690. A complete list of the other tenders appears on page 314 of our issue for September 17th.

MONTREAL.—Mr. Justice Davidson has rendered judgment dismissing the action in a case of Nicholson vs. the Town of St. Pierre. This was a petition to set aside a resolution of the municipal council granting a $31,000 contract to Messrs. Henault & Heffernon for the construction of sewers. The proceedings were taken on the ground that the contract had been previously awarded to another party, but the court maintained the town's plea that it was justified in reconsidering the first award.

Ontario.

TORONTO.—A contract for steel by the ton for use in the rebuilding of the Parliament buildings, has been awarded the Dominion Bridge Co., Ltd. of Montreal. T. V. Gearing was awarded the contract for carpenter work. Tenders for stone and brick to be delivered immediately will be asked for.

TORONTO.—The Board of Control recently awarded contracts as follows: McKnight Construction Co., sewers; Godson Contracting Co., sewers, asphalt pavements; Maguire Co., sewers and pavements; Excelsior Co., pavements; Barber Asphalt Co., pavements; Contracting and Paving Co., pavements; Warren Bituminous Co., pavements; Queen City Co., concrete pavements.

ST. CATHARINES.—Messrs. J. & T. Riley have been given the contract for sewers at $830. Messrs. Newman Bros. bid $880.

Manitoba.

WINNIPEG.—The contract for the new telephone exchange building near the corner of Portage avenue and Sherbrooke street, was let to Messrs. J. J. and J. M. Kelly, contractors of this city, the price being in the neighborhood of $43,000. Work on the building will be commenced immediately, so that the structure may be roofed in before winter and ready for occupation in the spring. The contract for the switch board, which will cost in the neighborhood of $150,000 has been let to the Northern Electric company, and operations for its installation are already under way.

WINNIPEG. — The principal contract for the interior equipment of the McArthur building, Winnipeg's new skyscraper has been let at a price of about $47,500. The contract calls for plumbing, heating and ventilation and the successful tenderers are Green & Lister. The plant to be installed will be, it is said, the most modern in the city. Every office in the building will be supplied with fresh air, and in the winter this will be brought over tempering coils and through an air washer, and then forced into the various rooms. The Otis Fensom Elevator company will put in the three high speed elevators. The contract price for these is $25,000. The contracts were let by J. H. G. Russell, architect.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—Work on the enlargement of the Turcot freight yards so as nearly to double their capacity, has just been started by the Grand Trunk Company. At present the yards have a capacity for 4,000 freight cars, but the company has a large enough site to increase the capacity to 15,000 cars when necessary. In view of the present extension, the Lachine line of the Park and Island Railway will be moved over six hundred feet towards the Canada Car Company's works. It is probable that the G. T. R. will also start on the enlargement of the terminals at St. Lambert in the spring. Over two hundred acres of land in the vicinity of the station have been purchased with this object.

Ontario

MORRISBURG.—The town of Morrisburg, on September 25th, voted to give the Canadian Sheet Steel Corporation a sixty-year franchise of its hydro-electric power plant and right of way through the principal streets for an electric railway. There were only ten votes recorded against the by-law.

OTTAWA.—A hundred and fifty men are busy in the vicinity of Hurdman's Bridge, rushing work on the Canadian Northern Railway, which is being built into the city. Work has just started on the west side of the Rideau on a steel bridge that is to be laid across the river, so as to afford an entrance into the city. Men have started laying the piers, and the work will be rushed just as rapidly as possible. There will be nine piers made of concrete, and the superstructure will be of steel, somewhat similar to the Ottawa & New York railway bridge, that is south of the one over the main road. On the other side of the river (the east) the work of track-laying is going on. A gang of men are busy and the tracks are daily getting nearer to the east shore. The bridge referred to will be run from the west side to the east and will join the tracks there.

OTTAWA.—An application will be made to parliament at the next session to incorporate the Nelson River Railway company. The company proposes to construct a railway from a point on Lake Winnipeg, near the Nelson river or the Saskatchewan river, to a point of junction with the proposed Hudson Bay railway.

TORONTO.—It was announced on Tuesday, that Mr. Angus Sinclair, of Toronto, had been the successful tenderer for the construction of the Toronto-Trenton division of the Canadian Northern line to Ottawa. Six tenders were received by Messrs. Mackenzie & Mann. Mr. Sinclair's contract calls for the completion of this 104 miles of road within a year. He will start work at once at different points along the line. Mr. Sinclair has had charge of a good deal of railway construction work. He built a considerable portion of the C.N.O. line between Toronto and Sellwood, and also constructed a portion of the Inverness & Richmond Railroad in eastern Canada, another Mackenzie-Mann enterprise.

Alberta.

EDMONTON.—Mr. W. E. Mann, divisional engineer for the G. T. P. returned recently from a trip of inspection over the new line as far west as the Macleod river. He says the Pembina bridge will be completed in two months and that the line will be ready for operation to Macleod by that time.

LETHBRIDGE.—A company is being organized to build and operate a street railway in Lethbridge and connect it with Royal View and other towns in the near vicinity.

Saskatchewan.

PRINCE ALBERT.—A party of Grand Trunk Pacific engineers is in the district of Duck Lake, locating a line from Watrous to Prince Albert.

British Columbia.

VANCOUVER.—The Canadian Northern Railway has purchased Anacis island, which lies at the mouth of the Fraser river, twenty miles from Vancouver. It contains 900 acres and will be the site of the shops, elevators, etc., for freight shipping. The probability is that the Canadian Northern will use the Hill line across the Fraser and into the city for passenger business.

PRINCE RUPERT.—The contract for extending the railway right-of-way along the front of the townsite to Seal's Cove has been let. Messrs. Foley, Welch & Stewart have signed the documents, and Mr. Stewart let the sub-contracts. The work is probably the heaviest along the road and will involve an expenditure of over half a million dollars. The length of the extension is three and one half miles, and if it is double-tracked it will cost from $800,000 to $1,000,000. The work is to start immediately and continue through the winter. It will take probably a year to complete the job. The contract is sub-divided into two sections, of about equal proportions. Angus Stewart gets the first half, and V. W. Smith & Co., get the outer section.

VANCOUVER.—Contracts for the last section of the C.P.R. Alberni branch will probably be let this week or next. The tenders are now being considered.

VICTORIA.—Speaking of the Alberni extension of the C.P.R. to north end of Island, Mr. R. M. Marpole, general executive assistant of the C.P.R., recently said that the surveys between French Creek and Union Bay were still going on. The first rough survey was now being followed by the final locating of the line which would have to be finished before the railway could be built. Two parties had been working, one from Union Bay north to Black Creek, a distance of over 20 miles, and the section south of that between Union Bay and French Creek. The northern section south had been already completed, and the surveyors were now all working on the southern section.

SEWERAGE AND WATERWORKS.

Quebec.

MONTREAL.—The roads committee is asking for $50,000 for another section of the Sherbrooke sewer.

Ontario.

COBALT.—Work has been started on the permanent water and sewage system at the Lake Sasaginaga end and Mr. French, representing Newman & Co., of Winnipeg, assures Town Engineer Sutcliffe that he will have water on the Square in a month's time. It is expected that tenders for the proposed new septic tank and filter for the disposal plant will be called for shortly, though work on these will not start until next spring.

OSHAWA.—The town council have of late been compelled through legal proceedings to pay large sums to farmers owing to the pollution of the Oshawa Creek by sewage, Several cattle have been affected by enteritis. The council have decided to call in Mr. T. Aird Murray, C. E., of Toronto, to prepare a scheme and estimate of the cost for the purification of the town sewage before discharging it into the creek in accordance with the modern method of biological method of purification.

OTTAWA.—In the Exchequer Court last Wednesday, hearing was begun in the case of E. A. Wallberg of Montreal, who claims from the Government $105,000 for drainage and waterworks extras in connection with the Moncton Car Shops of the I. C. R.

Manitoba.

SELKIRK.—On Monday tenders closed for the supply and installation of gasoline engines, pumps and elevated water tanks. Mr. C. A. Millican, C. E., of Winnipeg, has charge of the works.

LIGHT, HEAT, AND POWER

Ontario.

PORT ARTHUR.—The city has commenced laying underground telephone conduits on Arthur street. The plan is to have all wires under ground in the business section.

TORONTO.—The conduits for the cable for the civic electric power plant have been constructed on John street, from Adelaide street Wellington street, in the course of the conduits being laid to the city waterworks, at the foot of John street.

LADYSMITH.—Work has commenced on the new power house and the council are considering the question of using meters.

VANCOUVER.—The Burrard Power Company has received from the Dominion Government a grant of 25,000 miners' inches of water on Lillooet river. Under the terms of the grant the harnessing of the waters of the Lillooet will be commenced at no distant date, and as the power plant will be only 23 miles from Vancouver, it is declared that it will not be long before some sections of industrial Vancouver will be drawing power from this source.

CEMENT—CONCRETE.

British Columbia.

NELSON.—A number of cement sidewalks will be constructed by this city.

VANCOUVER.—Concrete piers, which are to be sunk by the pneumatic process, and concrete pedestals, will be used in a bridge 3,375 feet long, to be erected over False Creek, Vancouver, by Waddell & Harrington, consulting engineers, Kansas City, Mo., for the city council, who will receive tenders for the work of erection until October 25th. Mr. W. A. Clement is city engineer, and further particulars appear in our advertising columns.

TELEPHONY.

Quebec.

MONTREAL.—Extensions to the lines of the Bell Telephone Company have been approved of as follows:—Exchange-Aerial.—Tilbury, Ont.; Levis, Que. Rural lines.—St. Thomas, Port Stanley, Wellandport, Winslow, Ormstown, English River. Underground.—Sault Ste. Marie, conduit and cable; Montreal (St. Louis), conduit; Montreal, (Westmount), conduit. Long distance lines.—Sherbrooke, Black Lake, Ridgeville, Marshville.

CURRENT NEWS.

New Brunswick.

FREDERICTON.—Dr. H. Ries, of Cornell University, and Mr. J. Keele, of the Dominion Government Survey, have been in New Brunswick for some time inspecting the clays and shales. The object of this inspection is for the purpose of finding out if crockery, fire-brick, sewer pipe, etc., can be manufactured there. Large samples of the clays and shales from different localities will be sent to Ithaca, N.Y., to be tested during the coming winter, and a report will be made as to their suitability for the above purposes. Owing to the opening up of large iron mines and other industries in the Maritime Provinces it is most important that a good quality of fire-brick be manufactured here. Large quantities of shale have to be mined along with the coal of Grand Lake, and up to the present the mine owners have not utilized this enormous by-product. If, as Mr. J. J. Winslow, the Fredericton, N. B., Board of Trade Secretary, tells us, Dr. Ries reports favorably upon these shales, a large industry for New Brunswick will be the result.

Ontario.

TORONTO.—Canadian Contracts, Limited, is the name of a new engineering and contracting organization to which a charter has been granted. The headquarters of the company will be in Toronto and the capital is $100,000. The officers are: President, W. A. Lamport; vice-president, William de Leigh Wilson; managing director and secretary-treasurer, C. H. Mortimer. The new company is well equipped for the carrying out of contracts for engineering works of all kinds, including the construction of power transmission and telephone lines.

British Columbia.

VICTORIA.—The Jordan-Wells Railway Supply Company, Limited, has been incorporated with capital of $150,000 to carry on the business of manufacturing supplies for railway and tramcars, rolling stock, bridge work in metal, steamship appliances, machinery, etc.

FINANCING PUBLIC WORKS.

Nova Scotia.

SYDNEY.—A firm operating a shipbuilding plant here intend to ask the city for a bonus of $400,000.

Quebec.

MONTREAL.—The city of Montreal is authorized by the legislature, to borrow $24,100,000, for the construction of a high pressure system, underground conduits, elevating the G. T. R. tracks and for the purchase of the Montreal Water & Power Company.

Manitoba.

BIRTLE.—Telephone debentures amounting to $5,000, are offered for sale by Mr. J. C. Dudley, town clerk here.

PORTAGE LA PRAIRIE.—The ratepayers will shortly vote on a by-law to raise $17,500 for waterworks.

ST. BONIFACE.—This municipality has sold debentures amounting to $100,000 to Messrs W. A. Mackenzie and Co., of Toronto.

Saskatchewan.

SASKATOON.—Local improvement by-laws which call for the expenditure of $130,000 have been sanctioned by the ratepayers of Saskatoon. The most important was a by-law to provide $70,000 for the construction of a subway under the C. N. R. tracks.

Alberta.

NANTON.—The ratepayers vote to-day on a by-law to raise $16,000 for an electric light plant.

British Columbia.

NELSON.—The city council have passed the street railway by-law and it will be submitted to the ratepayers on October 7th for ratification.

NEW WESTMINSTER.—Until October 15th, Mr. H. P. Latham, city treasurer of New Westminster, will receive tenders for debentures which include $234,000 for waterworks, $104,000 for street improvements and $20,000 for an incinerator.

VANCOUVER.—On Saturday, October 23rd, the ratepayers of Vancouver, will vote on by-laws to borrow $675,000 for bridge across False Creek, and $400,000 for waterworks requirements.

MISCELLANEOUS.

Quebec.

MONTREAL.—Plans for the Montreal harbor improvements, which are to be carried out by the Harbor Commissioners, when a loan is negotiated from the Government, are nearly ready. The board of engineers is considering the two sets of plans submitted by Mr. F. W. Cowie, Montreal, harbor engineer, and by Mr. Davidson, the English engineer, and have practically finished their deliberations after many months' work. The details will be submitted shortly to the Harbor Commission. If they are then approved they will be laid before the House of Commons with the request for a loan to carry out the scheme.

Ontario.

TORONTO.—A branch factory of the Steel Shoe Company, of Racine, Wis., will be established here shortly.

PERSONAL.

MR. NATHANIEL BEAM has been appointed waterworks engineer by the town of Waterloo.

DR. EUGENE HAANEL, Director of Mines, Ottawa, has been chosen president of the American Peat Society, now in session at the Massachusetts Institute of Technology, Boston. This honor is in recognition of his systematic investigation of peat bog in Canada.

MR. F. H. BANBURY, engineer of the Acheson Oildag Company, of Niagara Falls, sailed for Europe on the steamer

"St. Louis," Saturday, September 25th. Mr. Banbury is an Englishman by birth. He came to America about five years ago and won degrees as a Mining, Mechanical, and Electrical Engineer. A little over a year ago he became connected with the Oildag Company. Dr. Edward G. Acheson is president of the Oildag Company, and it was he who gave the world Deflocculated Graphite as a lubricant.

ONTARIO'S HYDRO-ELECTRIC PROBLEM.

A meeting was held in Toronto, September 29th, for the purpose of renewing the interest of the municipalities in the Hydro-Electric power scheme. The commission was represented by Hon. Mr. Beck, Mr. W. K. McNaught, M.P.P., and Engineers P. W. Sothman and E. Richards, while the visitors included Ald. Wm. Trott, P. Meehan, and G. Roche, St. Thomas; Councilman L. E. Weaver, Hespeler; Mayor A. Weidenhammer, Waterloo; Engineer K. L. Aitken, Toronto; Mayor C. C. Hahn, Berlin; Engineer E. J. Philip, Berlin; Engineer E. J. Sifton, London; Engineer J. J. Heeg, Guelph; Ald. L. H. Reesor, Chairman of Light and Water Committee, St. Mary's; Engineer W. R. Reynolds, St. Mary's; Engineer Geo. L. Oill, St. Thomas; Mayor Dingman, Ald. J. Davis Barnett, Chairman of Water Commission, and Chief Myers, fire department, Stratford; Engineer James Abell, City Solicitor W. B. Doherty, and Mayor Geo. Geddes, St. Thomas; Ald. R. N. Price and S. Chance, St. Thomas, and others.

Following an informal discussion the engineers and mechanical superintendents organized. Mr. R. A. Ross, Montreal, consulting engineer of the commission, was chosen Chairman, and Mr. E. Clarence Settell, Secretary of the commission, Secretary. Municipalities who have not at present civic lighting and power service were represented at their request by Mr. P. B. Yates of the commission's engineering staff. Much technical conference work was gone over in detail.

MARKET CONDITIONS.

Montreal, September 29th, 1909.

Antimony.—The market is steady at 8 to 8¼c.

Bar Iron and Steel.—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

Copper.—Prices are strong at 14½ to 14¾c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—**The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.**

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.50 to $3.60.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

Tin.—Prices are unchanged, at 33¾ to 34c.

Zinc.—The tone is steady, at 5¾ to 6c.

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Toronto, September 30th, 1909.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—Demand inactive, market unchanged at $9 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Shipments are fairly heavy, mainly on existing contracts, and not much new business is offering. An indication of a disposition towards greater stiffness in the market is afforded by the following quotation made to-day by a large producing company:—"Our price to-day for Portland cement, f.o.b. Toronto, is $1.70 net cash including cotton bags, for acceptance within 10 days from date of quotation, and for shipment within 30 days from date of acceptance." According to stories in the newspapers, the cement merger is assuming shape. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

Coal.—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is laregly used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.