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The Canadian Engineer

ESTABLISHED 1893.

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Index of this issue will be found on page 455.

GUY ANCHORS.

Pole lines on city and town streets are at best unsightly. When it is necessary to cross from one side of the street to the other or turn sharp corners, anchoring devices are necessary. At best the most improved device and its necessary wiring is unsightly, and frequently a matter of great annoyance to the property-owner.

The best known device is a "dead man." To place it in the ground frequently necessitates the cutting up of lawns, with the attendant mud and annoyances. More recently there has come upon the market patent guy anchors, and many of these are just as efficient as the old-fashioned "dead man."

The patent anchors on the market to-day are of various types, but the construction man has them pretty well reduced to the few efficient and cheaply-installed systems. Usually it is not necessary to dig or in any way cut the sod when using these approved patterns. The cost of installation is cheaper than with the old style of anchor, and the property-owner is saved the annoyance to which he was formerly subjected.

In suitable soil the patent anchors will have sufficient holding power to do the work required. There are, however, conditions under which they are not as efficient as might be desired. A construction gang, from the conditions and from their knowledge of these anchors, will not make any mistake in the selection of the proper system.

The many advantages of the patent anchor are so apparent that it would be well for the city and town engineers to insist upon their use in lines placed upon the streets of the municipality.

GRADE SEPARATION.

The question of grade separation has been for some time in Canada a much-debated subject. A year ago the Canadian Parliament set aside a large sum of money to be used for this work, and passed a number of regulations, making it much easier for municipalities to require from the railways the elimination of grade crossings.

Last week at the Engineers' Club, Toronto, Mr. W. H. Breithaupt, M. Inst. of C.E., of the firm of Keating & Breithaupt, Toronto, read a very interesting paper on this subject. The paper will be found published in part elsewhere in this issue.

One of the difficulties in securing the elimination of grade crossings in the past has been the great cost of constructing subways or overhead bridges with the present requirements. Railway regulations for a long time have insisted upon brakesmen standing upon top of box cars. Some very experienced railway men insist that this is necessary for the proper handling of long freight trains. When the air-brakes and the signal systems on freight trains are perfect enough to allow of their handling in the same manner as passenger trains, the

clearance distance can then be lowered some four or five feet. This will lessen considerably the cost of overhead crossings, and make possible the construction of a great many that, because of location, have in the past, been impossible.

* * * *

GOVERNMENT-CONTROLLED HIGHWAYS.

Canadians have been giving much time to the question of the control of freight rates, the control of private corporations, the control of our lakes and rivers, but we have neglected Government control of highways.

In every Province of Canada new interest is being taken in the good roads movement. Highways engineers are being appointed, good roads literature is being distributed, but as yet no very far-reaching and definite public policy has been announced.

The Province of Ontario perhaps is leading in this movement. The divisional campaign inaugurated by Mr. A. W. Campbell years ago is bearing fruit. Even yet that Ontario's good road policy is left too much to local endeavor and local planning. Ontario pays one-third of the cost of good roads under certain conditions. Here and there throughout the Province we have patches and sections of suitable roadway, but it does seem unfortunate that the Province has not assumed control of leading highways and constructed them as Government roadways.

In New York, the State, county and township pay in the ratio of 50, 35 and 15 per cent., respectively. This makes it possible for the working out of comprehensive road schemes.

Canada will not have much success with her good road problem until a great deal of the local option features of her present method of improvement are eliminated.

STANDARDIZE THE CATALOGUES.

The "Mining World" has published a series of articles on the question of standard size for books and trade catalogues. A uniform size in books, catalogues and magazines would be a matter of considerable saving to the purchaser, and in the case of catalogues to the publisher.

If one looks over a stack of catalogues he will be forced to notice the ununiform appearance of the stack. Instead of carefully arranging them for reference and future use he throws them away in disgust because of the great difficulty he would have in properly shelving and arranging, believing it easier and cheaper to write for new catalogues than to arrange shelves for so many sizes.

Some years ago the American technical societies, through committees, agreed on a suitable and convenient size for publications of this class. It would be well if our large manufacturing concerns, which produce so many valuable catalogues, would adopt these sizes, and in that way encourage the engineer, the architect and the contractor to file their publications, and thus reduce large printing bills.

PERSONAL GUARANTEE.

With the passing of the new insurance bill at Ottawa a number of companies doing business in Canada as accident and guarantee companies will be permitted to write contractors' guarantees.

In the past many contractors have asked their personal friends to sign their bonds, apparently because the number of companies doing this business was very limited, also because it was cheaper, and frequently because the contractor did not know where it was possible to secure guarantee.

Many men dislike asking their friends to go bond for them. Many more men dislike going bonds for their friends. The change in the situation in Canada, brought about by the new Insurance Act, will so widen the field, so increase the number of companies doing business that the contractor will have little excuse for calling upon his friends to bond him.

With the most of us the liquidating of our own liabilities is sufficient work; when we add to this the burden of our friends, we, indeed, place a heavy handicap upon our efforts.

The man who refuses to go bond for an acquaintance saves himself a lot of worry, and the contractor who makes use of the industrial company for his surety will retain his many friends.

EDITORIAL NOTES.

The Canadian Electrical Association will hold their annual convention at the Royal Muskoka Hotel, Muskoka Lakes, on July 6th, 7th and 8th. A very interesting programme has been arranged, and some of the leaders in the electrical industry and the most prominent men (electrical engineers) in the United States and Canada will be present. In addition to the papers and discussions, the attendants at this convention will have an opportunity for a most pleasant holiday.

* * * *

The Forestry Committee of the Conservation Commission have recommended that the Railway Act be amended so that the railway companies shall be liable to a fine of $1,000 when it is proven before two justices of the peace that from their engines forest fires have started. They also recommend that the Government railway retains a staff of forests and transport from the provincial forest rangers.

* * * *

The Dominion Minister of Railways in bringing down the railway subsidies did not add any new grants, his motion only including re-votes. The total mileage subsidized by the resolutions was 3,277 miles. These subsidies run out in two years unless construction is started within that time. The most important line affected is the two hundred mile line to the N.T.R. from Montreal, Que.

EXTENSIVE CONTRACTS GO TO WIRE AND CABLE COMPANY.

Large orders for lead-covered, paper-insulated telephone cable have recently been placed with The Wire & Cable Company of Montreal, P.Q., by the Saskatchewan Government and the City of Edmonton, The Manitoba and Alberta Governments and the City of Fort William have also placed similar contracts.

THE ADVISORY CHEMICAL ENGINEER.

Several years ago the president of the Massachusetts Institute of Technology said to his students: "The day is not far distant when the engineering profession will find its service as much in demand and in an analogous advisory capacity to an established clientele as those of the legal profession."

The day has come. Manufacturers do not now ask for advice only when new work is contemplated, but realize the

worth and value of a permanent adviser. This is perhaps most marked in the matter of purchasing coal, for large buyers who give attention to the reduction in their fuel bills are beginning to realize that coal can no longer be profitably bought by the ton only. They recognize the importance of quality as well as weight, and now insist that their coal be bought with the same care that is exercised in the selection and purchase of such commodities as wheat, wool, lumber, ores, fertilizer, etc.

The up-to-date buyer now seeks to obtain the most power or heat for a dollar, and in order to do this buys strictly on a heat unit basis. This method is perfectly fair to seller and buyer and protects the latter in that if poor coal is delivered to him it forms the basis for settlement or allows him to reject it. Further, he does not pay a good price for moisture, ash, etc.

The purchase of coal on a B.t.u. basis calls for sampling and chemical analyses, processes which require both scientific training and a laboratory with modern equipment. The coal buyer has neither; he therefore turns to the commercial laboratory of engineering chemistry which, when properly organized and equipped by trained fuel engineers will save him many times the cost of the service.

T. S. SCOTT.

Mr. Thomas S. Scott, B.A. Sc., who recently resigned the position as Principal Assistant of the City Engineer of Toronto, received his university training at Queen's University, Kingston. Mr. Scott was a member of the Class of '94 in Arts, graduating with honors in mathematics, physics and English. Completing his course in Arts he took up the course in civil engineering, then being established in the Kingston School of Mines and in 1897 received a degree of B.Sc., being the first student of Queen's to receive that honor.

The year of his graduation, Mr. Scott went to southern British Columbia to report on a hydraulic mining scheme, and it was when returning from this work that he came in touch with one of the most difficult problems he ever had to solve.

Major Walsh of the Northwest Mounted Police required the transportation of a large quantity of supplies through the Chilkoot Pass. This was a year before the White Pass Railway was built and the difficulty of transporting men and supplies by this route may well be imagined when it is known that for a space of 12 miles the goods had to be carried on men's backs and that the transportation of freight through this pass cost $1,000.00 a ton. The prestige of the N.W.M.P. of Canada was involved and Mr. Scott handled the work with such dispatch that this feat is still looked upon as one of the most successful transportation expeditions of the West

In the winter of 1898 Mr. Scott joined the G.T.R. as foreman on the construction of a new yard: that spring he was transferred to the general road-master's office, as chief clerk, and from there went out on the road in charge of a switch gang and was shortly promoted to the position of road-master. In 1901 he resigned from the G.T.R. Maintenance Department, and went to Niagara Falls as Instrument man for the Canadian Niagara Power Company on the wheel pit.

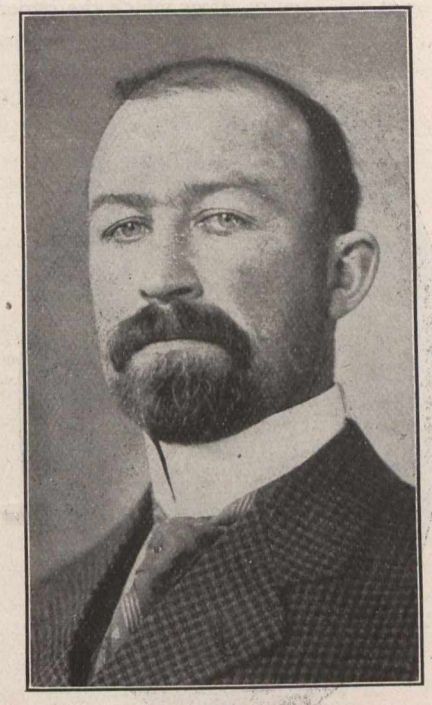
In 1902 he joined the Ontario Power Company as Field Engineer on accurate surveys, and was later placed in charge of a section of their construction work. In 1904 he was engaged by one of the contractors on the rock excavation work in connection with the same power development work at Niagara. In 1905 he was chosen as the mutual representative of the contractors and the company to complete the wheel pit extension at the Canada Niagara Power Company's plant.

During 1905 and 1906 he was engaged by the contractors on the high tension transmission line from Rochester to Syracuse, N.Y. From this work he went in charge of construction work on the Shawenegan Falls Tunnel and in 1908 he was representing the contractors who had charge of macadam road construction in New York State. In the latter part of this year and 1909 he returned to railroad work and completed forty-five miles of the T. & N. O. Railway, acting as the representative of the contractors and the Commission.

At the completion of this work Mr. Scott was appointed principal assistant to City Engineer Rust in Toronto, and resigned in March of this year.

Mr. Scott goes to Vancouver as president and general manager of the British Columbia organization of the Bitulithic Paving Company.

Mr. Scott's experience has been varied and each change of work has meant a promotion. Experience and promotion are two things that the engineer appreciates, but it is interesting to know that in connection with Mr. Scott's career he can look back with great pleasure upon three particularly difficult tasks which he carried through successfully and to the great satisfaction of his employers.



Mr. T. S. Scott, B.Sc.

Major Walsh congratulated him and complimented him upon the resourcefulness and dispatch exhibited in the transporting of supplies and men across the Chilkoot Pass before winter set in.

General Superintendent McGuigan of the G.T.R., telegraphed his compliments to him for his management in changing steel on 9½ miles of track in ten hours with one gang of men working in one direction, this being the record for North America.

Chairman J. Englehart, of the T. & N. O. Railway Commission, specially thanked Mr. Scott for his completion in one season of forty-five miles of railway.

These commendations coming from leaders in different lines of activity must have been particularly gratifying as too frequently we find that the engineer does not receive the credit due him.

APPLIED SCIENCE AND ITS RETIRING EDITOR.

With the April issue of Applied Science, No. 6, Volume 3, Mr. Kenneth Alexander Mackenzie, B.A. Sc., who, since the inception of that journal three years ago, has been its managing editor, severs his official connection therewith. Although Applied Science was issued primarily for the graduates and undergraduates in the Faculty of Applied Science and Engineering of Toronto University, yet engineers in Canada and beyond are interested in the achievements of Mr. Mackenzie and the journal which he has so ably edited. While an undergraduate of the University of Toronto, Mr. Mackenzie conceived the idea of the Faculty of Applied Science, publishing a technical journal. The University of Toronto has had, and will have many college journals covering the field of literature and art, but it is safe to say that it has not seen and may not witness for many years the successful transference in such a short period of a college journal into the class of technical publications.

Such a journal as Applied Science, published monthly and containing some of the best and most original work of the graduates of the Faculty, after which the paper is named,

K. A. Mackenzie, B.A.Sc.

must necessarily have a great influence upon the men in the engineering profession and upon the community. The graduates of the old School of Science, and more recently of the Faculty of Applied Science have been the best advertisement that this department of university life has had. Their success has brought credit to themselves and to their Alma Mater.

In addition to personal touch between the University and the business world, there has been welded, during the past three years, the additional connecting link in the shape of a monthly magazine. Mr. Mackenzie has made a name for himself as a writer, as a managing editor and as an organizer. The growth and influence of the journal from issue to issue and volume to volume is the best evidence. Besides these incidents in the day's work, he has done splendidly for the University and for the Faculty of which he is an honored graduate.

In the thirty-three years during which the study of engineering has been a separate course of university work, we do not know of any movement or organization which, in a period of three years, has meant so much to the engineering profession as has the publication of Applied Science.

Mr. Mackenzie is city born, receiving his education in Toronto as a Gladstone Avenue Old Boy, one of Parkdale's Collegiate students. He took the first steps to Canadian fame by being principal for a few years of a rural Public school. From Public school teaching he graduated to High school teaching and then into commercial life, and for three years represented a couple of the best manufacturing concerns in western Ontario territory, and in Western Canada.

In the autumn of 1903, Mr. Mackenzie registered in the Department of Mining, Faculty of Applied Science of Toronto University. During his college course, he took an active interest in many departments of university activity, and in the spring of 1906 was elected president of the Engineering Society. As president of the Engineering Society he developed the sectional idea for the different branches of engineering within the society and gradually led up to the publication of Applied Science, instead of the annual volume of transactions which had been published for twenty-one years.

In May, 1907, Mr. Mackenzie was appointed managing editor of a new journal afterwards named Applied Science, and in October of 1907, Volume I., No. I., which was looked for with great interest by those who had at heart the welfare of the Engineering Department, appeared.

It was a new venture entered upon along broad and daring lines. It took some courage to face the issues raised and much diplomacy and hard work to avoid friction with other organizations interested in university publications and with advertisers already disgusted with results obtained from college journals. Doubts were dispelled, the outlook brightened and after three years of careful work, Mr. Mackenzie has the pleasure of handing over to his successor a monthly magazine not in the class of the ordinary college journal, but a publication that may well be placed side by side with the technical journals of Canada, the United States and of the lands beyond the sea.

Whether Mr. Mackenzie enters the engineering profession or commercial life, he will take with him his splendid organizing ability; his faculty for hard work; his wide knowledge of men and affairs; and the good wishes of a host of friends.

SUMMER COURSES FOR ENGINEERS AND ARTISANS AT THE UNIVERSITY OF WISCONSIN.

The tenth annual session of the Summer Schools for Engineers and Artisans, under direction of the College of Engineering of the University of Wisconsin, opens June 27th, continuing for six weeks.

Advanced courses are offered in Direct and Alternating Currents Hydraulics, Machine Design, Descriptive Geometry, Applied Mechanics, Shopwork, Steam and Gas Engineering and Surveying. Elementary courses for artisans, and those not having preparation for the advanced work, are offered in Applied Electricity, Engines and Boilers, Fuels and Lubricants, Mechanical Drawing, Machine Design, Materials of Construction, Shopwork and Surveying.

The teaching staff is taken from the regular instructional force, and all laboratory equipment of the engineering college is available for students. For bulletin or further information, address F. E. Turnoaure, Dean, College of Engineering, Madison, Wisconsin.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

CONSERVATION OF QUANTITY AND PURITY OF WATER IN THE PROVINCE OF SASKATCHEWAN.

"To the West, to the West, to the land!" (of scarcity of water?)

Is there a scarcity of water in the Province of Saskatchewan?

From the lips of the pessimist one hears the remark: "Saskatchewan may be producing twice the quantity of wheat over any other two Western Provinces combined, but the water problem is the great difficulty."

It is true—everlastingly true—that a population can only grow to the extent of its available pure water supply in the proportion of about one person to each available 11,000 gallons per annum, viz., a daily consumption rate of about 30 gallons per head.

Grain elevators, railway facilities and wheat-producing land will never maintain a city population of 10,000 people unless there is an accompanying water supply of 300,000 gallons per day.

The scarcity of water in Saskatchewan is more apparent than real.

There is an abundance of water throughout the whole Province; it is only a question of conservation of quantity and purity.

Let us examine the question, and provide a few facts which the pessimist may digest at his leisure.

The Province is endowed with two large rivers, the North and South Saskatchewans, which find their source in the Rocky Mountains, and drain the plains of Alberta. The rivers respectively each have a normal flow of about 26,000,000 cubic feet per minute.

Apart from these great rivers, however, we have the rainfall over the Province itself.

Allowing an annual rainfall of 12 inches, all that part of the Province south of Prince Albert receives annually 1,238,360,000,000 gallons of water.

About half is evaporated directly back to the atmosphere, leaving 7,119,180,000,000 gallons.

Two-thirds of the latter quantity is absorbed by plant life, leaving 2,373,060,000,000 gallons, which either enters underground channels or visibly finds its way on the surface by creek or river.

Owing to the porous soil and flat character of the plains, about 75 per cent. disappears from view, while 25 per cent. remains visible, viz., 1,778,395,000,000 gallons in the earth and strata and 594,665,000,000 gallons in rivers and creeks.

At thirty gallons per head per day, rivers and creeks depending only upon the rainfall of the Province will maintain a population of about 54,000,000, while the underground water, if collected, will maintain a further population of 160,000,000.

Moose Jaw and south of Moose Jaw towards Milestone and Weyburn have been and are still considered dry districts.

The watershed drained by the Moose Jaw Creek and its tributaries includes about 8,400 square miles, and, with an annual rainfall of twelve inches, will provide 162,624,000,000 gallons of water.

Again, allowing a direct loss of about half the rainfall due to evaporation, there remains 81,312,000,000 gallons to account for.

Allowing two-thirds for plant life absorption, viz., 54,208,000,000, we have 27,114,000,000 gallons, which either finds its way underground or into the creek.

Assuming 75 per cent. to pass underground, the respective quantities are 20,335,000,000 and 6,778,500,000 gallons.

At thirty gallons per head per day the creek water, if conserved, will maintain a population of about 616,228; and the underground water, if collected, a population of 1,839,591.

The unfortunate part of the Western rainfall is that it is not spread evenly over the whole year. For months the creeks are dry, or almost dry; for occasional weeks they are in flood. The consequence is that great quantities of valuable water are wasted.

The whole solution of the water supply question is summed up in the word **"Conservation."**

Huge dams must be built and large collecting areas formed, so that the freshet waters can be held back, providing supplies for dry periods.

The preservation of the purity of natural waters is another question, which the West is taking up seriously and practically.

The thirty gallons per head per day, or whatever the particular amount may be, is returned as sewage, mixed with all the waste and dirt of the community.

Communities are finding that it is necessary to remove the waste and dirt from the returned water before discharging it. Hence, we find cities like Regina, Saskatoon, Prince Albert, Moose Jaw and many of the towns contemplating up-to-date sewage purification works.

Plans for the purification of the Regina sewage have just been passed by the Provincial Bureau of Health. The scheme will include all the most up-to-date features. The system to be adopted includes:—

(a) Pumping the total sewage to a sufficient height above creek flood level.

(b) Removal of sewage solids by slow sedimentation tanks.

(c) Circular bacteriological filter beds, with revolving sprinklers, protected from frost and provided with artificial heat in winter.

(d) Final disinfection of the non-putrescible effluent by use of calcium hypochlorite in contact tanks.

(e) Stand-by tanks for storage of excess storm water.

(f) Ample area of land for digestion of sludge from the sedimentation tanks.

They will form the most up-to-date sewage scheme in the whole of Canada, and will include all the most important modern features. The scheme has been formulated by Canadian engineers, without advice from the States or elsewhere. The engineers employed by the corporation are Mr. Darlington Whitmore, of Regina, and Mr. Macpherson, of the Provincial Works Department, while Mr. T. Aird Murray, engineer to the Bureau of Health, has acted as consulting engineer from time to time.

Although Regina is leading the way, other cities and towns are falling into line, and it is safe to predict that in the course of two or three years the Province of Saskatchewan will have done more than any other Canadian Province to maintain and conserve the purity of its natural water supply sources.

TORONTO'S SEWAGE CONTAMINATED ZONE AND ITS WATER SUPPLY.

Continually we hear discussed by the Board of Control, by the Medical Officer of Health, by the daily newspapers:—

How far does Toronto's sewage contaminated zone extend into Lake Ontario?

Just how far should the intake pipe be extended?

How long will it take for any extension to come within the danger zone?

Never are the following questions discussed either by the Board of Control, the Medical Officer of Health or the daily newspapers:—

What measures should be taken to prevent the contamination of Lake Ontario by sewage?

Why should raw sewage be permitted to enter Lake Ontario?

Why allow the sewage contaminated zone to increase?

Why provide for an increased length of intake pipe, anticipating further and increased contamination of the lake?

The policy of the Board of Control, of the Medical Officer of Health, of the daily newspapers is: Let us flee further and further from the increasing sewage contaminated zone. We are confessedly not strong enough, not manly enough, to tackle the enemy at home.

The policy of this Review in all sanitary matters is: "Prevention is better than cure." If the sewage effluents from Toronto were sterilized, viz., the enemy strangled before he does the damage, then the problem of having to face a further and yet further extension of the intake pipe would not exist.

The policies of Cleveland, Buffalo, etc., of constantly fleeing from an increasing danger is but the policy of a moment.

The policy of absolutely preventing either the occurrence or extension of any zone of sewage contamination is a final one.

WATER FILTRATION IN THEORY AND PRACTICE.

(An address given before the Undergraduate Society of Applied Science at McGill University, Montreal, on February 23, 1910.)

George C. Whipple.

Consulting Engineer, New York City

I have chosen the subject of filtration of water for two reasons, first, because it is a typical, and perhaps the best, example of what modern sanitary science is doing for the health and comfort of mankind; and second, because it is a practical problem that is becoming pressing in many a Canadian city, and, therefore, is of vital interest to you, not only as scientists, but as citizens.

Requirements of a Public Water Supply.

A public water supply, in order to be generally satisfactory, must conform to certain standard requirements. It must be safe and wholesome, that is, free of poisonous substances and disease germs; clear and without perceptible color, taste or odor; reasonably soft, and nearly free of iron and other mineral salts. If the water is hard, too much money must be spent for soap needlessly wasted; if it is saline, plumbing fixtures and steam boilers will be corroded; if it contains too much iron the clothes in the laundry may become stained. If the water is highly colored or muddy, it is unattractive for drinking and even for bathing; if it contains algæ, the taste and odor of the water may be intensely disagreeable, and, what is of paramount importance, if there are present the germs of typhoid fever or dysentery or other water-borne diseases it may be positively dangerous.

Typhoid Fever and Water Supplies.

It is, perhaps, hardly necessary to enlarge upon the relation that exists between typhoid fever and water, because of the numerous epidemics that are constantly occurring. If proof were necessary it is abundantly found in the vital statistics of all countries, which show that cities that have water supplies taken from pure mountain springs or waters that have been filtered have low typhoid fever death rates, while water supplies taken from polluted streams cause high death rates. The great epidemics have been an important influence in hastening the installation of filters. The spectacular occurrence of many typhoid fever deaths at one time always makes a deeper impression on the public thought than the same number of deaths scattered over a long period. It may be fairly said, therefore, that in the long run such epidemics have saved more lives than they have cost, because they have attracted attention to dangerous conditions that otherwise would have been overlooked. Epidemics have been influential in another way. They have shown that water supplies apparently but little polluted are liable to sudden infection. Some of the worst outbreaks of typhoid fever have occurred as the result of sudden and unexpected infection of a water supply hitherto regarded as safe. The damage that can be done by a single case of typhoid fever on a sparsely settled watershed testifies to the soundness of the position taken by Germany in compelling all surface waters to be filtered and prescribing certain standards of efficiency.

But a still more potent force at the present time is the public opinion that is rolling up in tremendous volumes in favor of better sanitation and greater cleanliness all along the line. Nothing is more conspicuous in magazine literature at the present time than the prominence given to public hygiene, and from cleanliness demanded for the sake of

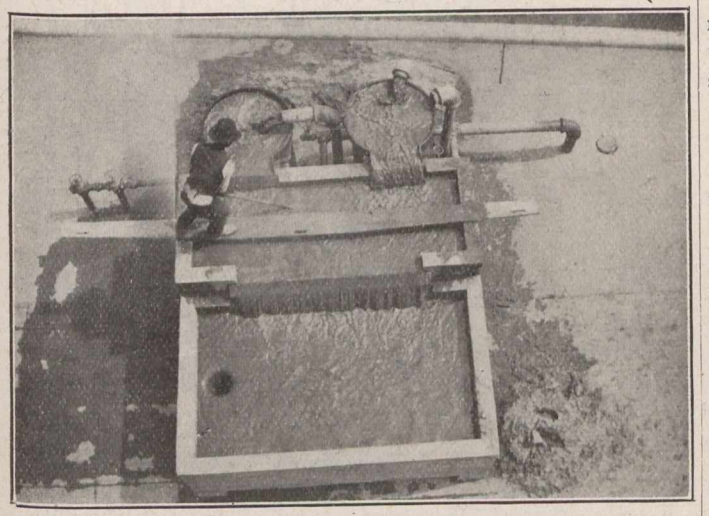
safety to cleanliness for its own sake is but a stepping-stone. And so it is that filters are being built to get water that is clean, free from dirt, free from color, free from bad-smelling algæ, free from iron, as well as free from bacteria.

Methods of Water Purification.

In considering the principles of water purification we shall find it convenient to divide the subject into six somewhat distinct topics. These are sedimentation, filtration, coagulation, æration, disinfection, and distillation. It is interesting to observe that all these processes occur in nature. The raindrop stands for water that is distilled. The cataracts and the mountain streams stand for water that is ærated. The blue color of the water in the Great Lakes shows the effect of sedimentation. The artesian well and the boiling spring illustrate nature's filtration through the soil, while in limestone caves, in running brooks and stagnant ponds we have illustrations of chemical and biological processes.

Natural Purification.

It used to be said that "running water purifies itself," and so it does, to a certain extent. A polluted stream tends



Sand Washer.

to become clearer through sedimentation in quiet coves and behind rocks and dams. The water of swamps generally loses its color in reservoirs through the bleaching action of sunlight. An algæ-laden water rippling down a stony channel may lose much of its odor through æration. Biologically, also, the water may improve. Organisms may disintegrate and bacteria die through lack of food or through unfavorable environment. These natural purifying processes may all occur, and yet the water of a stream may remain unfit to drink because the processes have not been completed—because the time element has not been long enough. So while, as chemists and biologists, we recognize these natural agencies of purification in running water, and to a still greater extent in standing water, yet, as sanitarians, we must admit their imperfections, their incompleteness, their fallibility and their unreliability. It is because we cannot depend upon the natural processes of purification that we resort to artificial methods.

Filtration.

By filtration is meant the passage of a liquid through a porous medium for the purpose of removing suspended matter. So far as our subject is concerned it means the passage of water through a bed of sand. Water filtration is not mere straining. A strainer removes only those particles too large to pass through its pores. A water filter does this, but it does more than this: it removes particles many times smaller than the pore spaces between the sand grains. Sometimes this filtering process alone is sufficient, but frequently the quality of the raw water is such as to require one or more of the other processes referred to, namely, sedimentation, chemical coagulation, æration, or disinfection. These are all to be considered, however, as supplementary to the passage of the water through sand. The main process will be the first to receive our attention, namely, the removal of suspended matter by means of sand filtration, or, as it is sometimes called, slow sand filtration.

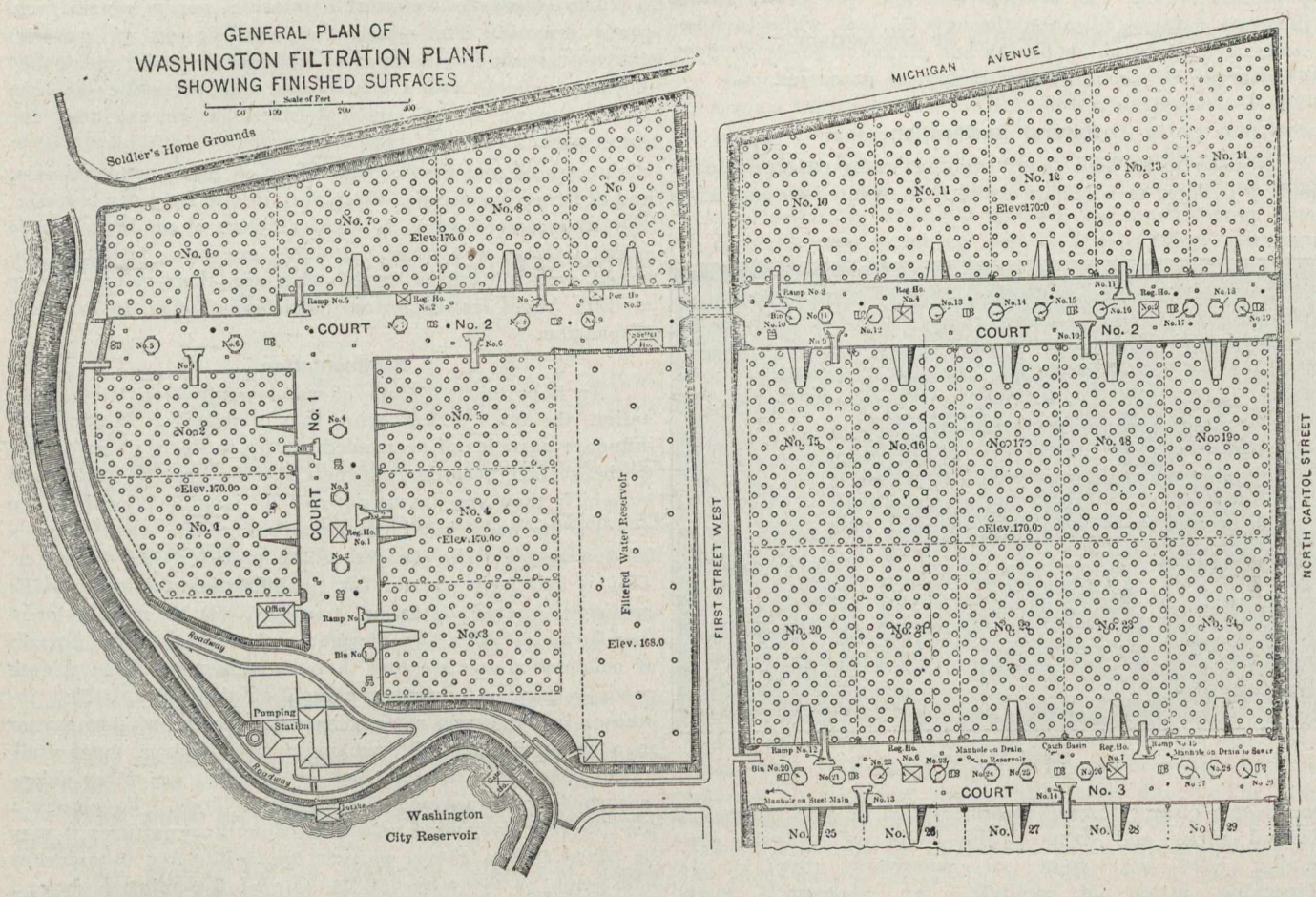
The suspended matter in water is partly mineral and partly organic. The mineral matter consists of particles varying greatly in size down to and past the point where they become invisible with a microscope, and where they exist in what is known as the colloidal state, as, for example, the finest particles of clay. The organic matter consists in part of disintegrated and lifeless fragments of plants and animals, and of living organisms, which vary in size from the bacteria the diameter of which is only 1/25,000 of an inch, up to algæ, Cyclops and water mites that are easily visible to the naked eye. Minute as the bacteria are, their volume is ten to fifty times as large as particles of clay in colloidal suspension.

Sedimentation.

An important principle of water purification is sedimentation, the force acting being that of gravity. Under this influence particles of suspended matter settle in water or rise to the surface according to their specific gravity. The force by which they are drawn downwards is proportional to the mass of the body, but in settling through the water there is friction between the surface of the particles and the water. This is relatively greater for small particles than for large particles; hence, smaller particles settle more slowly than large particles. Furthermore, when we enter the domain of colloidal matter we find that the almost infinitely minute particles have a vibratory motion of their own, which increases in amplitude as they become smaller, so that matter in a colloidal state will remain in water almost indefinitely unless coagulated through heat or chemical action, or unless absorbed by the surface of some larger body. To illustrate the different downward velocities of settling particles it may be noted that a gravel particle one millimeter in diameter will settle in the water at the rate of five miles a day; a particle of sand 0.1 millimeter in diameter will settle at the rate of 2,000 feet a day; a particle of silt 0.01 millimeter in diameter will settle at the rate of 40 feet a day; a bacterium 0.001 millimeter in diameter will settle at the rate of only a few inches a day, its specific gravity being not much greater than unity; a particle of clay 0.0001 millimeter in diameter will settle at the rate of one-twentieth of an inch a day, while colloidal particles will remain in suspension for weeks and months. Various other factors besides gravity influence sedimentation. For instance, the viscosity of water changes with temperature. Everyone has heard the expression, "As slow as cold molasses." Water also is more viscous when it is cold. In summer, at 74°, a particle will settle in water twice as fast as in the winter when the temperature is near the freezing point. This is one reason why water purification in the winter is somewhat more difficult than in the summer.

The larger particles of matter are most cheaply removed from water by means of settling basins. Even with filtration

it is common to utilize sedimentation as a preliminary process in order not to put too heavy a load on the filter bed. In the Mississippi valley, and in general in the southern part of the United States below the glacial drift, the streams are normally muddy, and in many cities sedimentation plays a most important part in the purification of the public water supplies. Thus, in St Louis, Kansas City, Omaha, and many other places large settling basins have been in use for many years. For a time plain sedimentation was depended upon, but lately they have come to use alum or lime and iron as coagulants to assist the process. In St. Louis, in the old days before chemicals were used, about 70 or 80 per cent. of the suspended matter was removed by the process of sedimentation, but enough finely divided matter remained to make the effluent decidedly turbid, and visitors to the city were usually shocked by the amount of mud that would settle in a bath tub. Now the efficiency of the process is enhanced by the regular use of chemicals, although the result falls short of what would be accomplished by filtration.

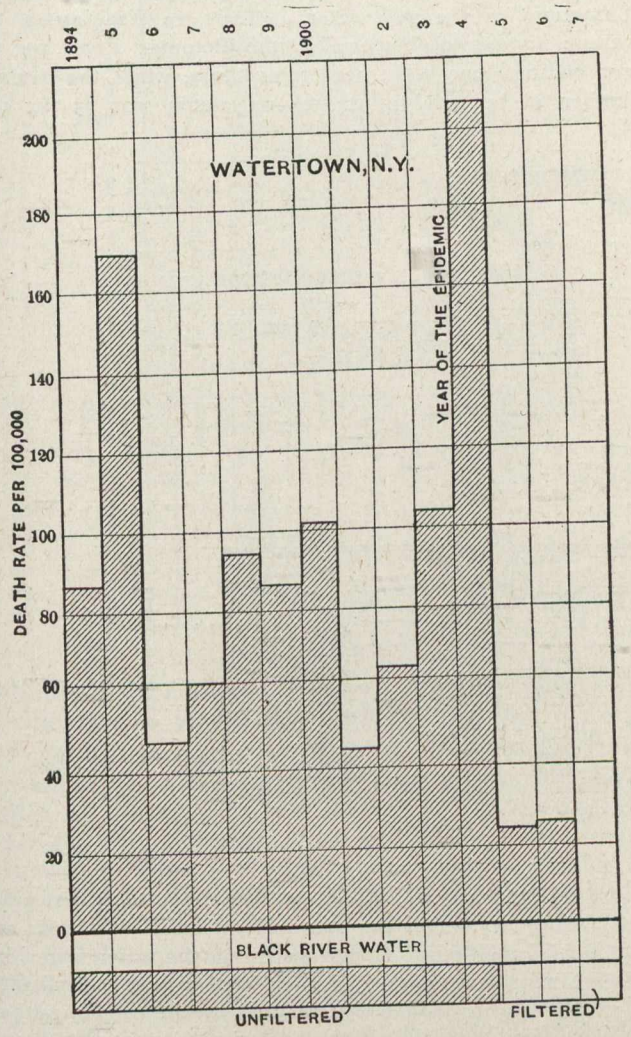


At Cincinnati, where experiments were made on the sedimentation of the water of the Ohio River, it was found that after twenty-four hours' subsidence 62 per cent. of the suspended matter was removed; after forty-eight hours, 68 per cent.; after seventy-two hours, 72 per cent., and after ninety-six hours, 76 per cent. It will be seen from these figures that there is a limit to economical subsidence, which limit, of course, varies according to the nature of the suspended matter in the water.

To take another illustration: The water supply of Washington, D.C., is taken from the Potomac River at Great Falls, and passes through a series of three reservoirs before it reaches the filters. These reservoirs act as sedimentation basins. Thus, during the year ending June 30th, 1908, the average turbidity of the water in the Potomac River is 117, at the outlet of the Dalecarlia Reservoir it had fallen to 53, at the outlet of the Georgetown Reservoir to 45, and at the outlet of McMillian Park Reservoir, which represents the water supplied to the filters, 31. Sedimentation results not only in making water clearer, but it also improves the hygienic quality, for bacteria are removed as well as clay. Thus, in the three reservoirs at Washington the numbers of bacteria in the Potomac River were reduced from 6,300 to 1,200 per c.c. The action in removing bacteria by sedimentation is largely a mechanical one, the bacteria, with their sticky, gelatinous coatings, become attached to the heavier particles of suspended matter and settle to the bottom with them.

Recently attempts have been made to establish certain mathematical principles of sedimentation based on the theory of settling particles. Heretofore settling basins have been designed on the hit-or-miss principle. Sometimes they have been built shallow, sometimes deep, sometimes arranged in series, sometimes in tandem, sometimes with no baffles, and sometimes very elaborately baffled, both vertically and horizontally. The ratio of length to depth has varied all the way from 3 to 1 to 500 to 1. Logically, the length of the horizontal course of a particle passing through a basin should be equal to or not very much greater, in point of time, than the period required for the particle to settle from the top to the bottom, but the difficulty is that the particles are not uniform in size. Theoretically, the efficiency of a sedimentation basin is independent of depth except as this involves the velocity of the water at the bottom, and the deposit of suspended matter depends principally upon the area of the upturned surface exposed for the collection of the sediment.

By increasing the area of the exposed horizontal collecting surface the efficiency of a basin is increased. This is actually done in some cases of sewage sedimentation by building up layers of slate supported on stones. An extension of the idea of increasing the surface exposed for the collection of sediment brings us to a class of structures called "scrubbers," which are basins filled with coarse material, such as gravel, coke, wood shavings, or sponge. These are sometimes used in place of sedimentation basins for partially clarifying water preparatory to filtration. Doubtless they have their place, but it must be remembered that they remove chiefly the coarser particles, and that only to a much less extent



do they remove the very minute particles of colloidal clay that sand filters find it difficult to handle.

Theory of Filtration.

I said a few moments ago that a filter was more than a strainer, and that it removed particles smaller than the pores between the sand grains. This is explained partly by the conception of a filter bed as a sedimentation basin, with the surface exposed for the collection of sediment increased to an enormous extent. If time permitted it would be possible to show by calculation the size of the smallest particle that could be removed by a filter having certain sized sand grains and a certain rate of filtration, and it would be found that such calculation agreed very closely with actual experience. But there is another factor involved, namely, the removal of particles by absorption. The passages between the sand grains twist and turn and the channels expand and contract. The bacteria in the water have a sorry time in trying to thread their way through such passages. At every turn they come in contact with the sand grains, and their sticky, gelatinous coats cause them to adhere to the surface of the sand so that, as a result of what is sometimes termed "a multiplicity of contact" the water becomes free of the bacteria originally present. As they adhere to the sand grains the surfaces of the latter become sticky and slimy and more ready to entangle other bacteria and other particles of suspended matter. Thus it happens that in a sand filter three feet deep relatively few bacteria succeed in passing more than a few inches into the sand. Some, perhaps, may reach the outlet through the chance continuity of passages larger than the average, but as a rule less than one per cent. get through. Bacteriological studies have shown that after a filter has been for some time in operation the upper quarter inch of sand may contain many millions of bacteria per gram; the second quarter inch several hundred thousand; the third quarter inch less; the fourth quarter inch still less, and so on down. In the early days of bacteriology the Germans worked up the theory of "schmutzdecke," or slime layer, claiming that the effective action of a filter was due to the presence of a rather dense and fibrous film upon the surface of the sand, this being due to the accumulation of bacteria and suspended matter of various kinds, organic matter being essential. In some waters this slime layer is a conspicuous phenomenon, and in the open filters so common in Europe growths of diatoms and algæ of various kinds add materially to the surface mat. But it is not necessary to resort to this schmutzdecke to explain bacterial removal in a filter, and in some cases no well-defined schmutzdecke forms.

The question is often asked, "What becomes of the bacteria in a filter?" The answer is that some of them remain alive attached to the upper sand grains and are removed when the filter is scraped, but most of them die. They die because of unfavorable environment, oxidation and starvation in their struggle for existence, one with another. The bulk of protoplasm represented by their dead bodies would be infinitesimal compared to the rest of the organic matter in the water.

In some cases the oxidation of organic matter is an important element in the purification, as in the intermittent filtration of polluted water or water containing algæ.

In practice, a slow sand filter consists of beds of sand about 3 feet deep, supported on layers of graded gravel and broken stone, resting on a water-tight floor. The size and number of beds depend upon the capacity of the plant. In large plants each bed may have an area of an acre or more. In warm climates or when the filter is to be operated intermittently the beds are open, but most of the filters recently built in this country have been covered with a roof. In northern climates a roof is essential. The structures of a sand filter consist of rectangular basins with inverted groined arch floor, vertical side walls and groined arch roof supported on piers a dozen feet or so apart, the whole being built of concrete. The interior height of the filter chamber is about 12 feet. Each filter is provided with an entrance and there are manholes in the roof at frequent intervals. The roof is overlaid with soil and turf sufficient in depth to keep out frost. There are one or more regulator houses from which the operation of the filter is controlled. In addition to these principal structures there are commonly a sedimentation basin, a covered clear water basin, a court or series of sand bins for storing sand, sand washers, and generally a building containing an office and laboratory.

The filter sand has to be selected with great care and its effective size and uniformity co-efficient kept within certain well-defined limits. Recent improvements in the art of sand washing have greatly reduced the cost of securing a suitable sand for this purpose.

Sand Filters.

The raw water stands several feet over the sand and passes downward through it at a vertical rate of ten to twenty feet a day, collects in a system of underdrains laid in the gravel drainage, and is conveyed by a central outlet pipe to a pure water reservoir, also covered. In passing through the sand there is a certain amount of friction, increasing as the bed becomes clogged, which has to be overcome by the pressure of the water. Consequently, the level of the water at the outlet is lower than that of the water on the filter, and this difference of level is termed the "loss of head." Filters are provided with devices for measuring the loss of head and the rate of filtration, which are the guides that the attendant follows in determining when a filter bed needs to be cleaned.

The rate of filtration varies according to the character of the raw water. Comparatively clear waters can be filtered at a higher rate than muddy waters. In Europe the rates are seldom much above two or two and a half million gallons per acre daily, but in this country especially of late, there has been a tendency to use higher rates of filtration, and with clear water rates as high as six million gallons per acre daily have been established, as, for example, in the case of Toronto, where the water supply is taken from Lake Ontario. In other places rates of ten million gallons per acre daily have been recommended. Even in the case of muddy waters there is a tendency to use high rates of filtration, and to more thoroughly prepare a water for these high rates by some appropriate preliminary process, such as the use of scrubbers or chemical coagulants.

After a filter has been in use for some time its surface becomes clogged and the sand has to be removed and washed. The filter may be thus pared down several times, but finally it is necessary to restore the washed sand. Filters are usually scraped by hand, using shovels, the men wearing wood sandals in order to prevent the sand from becoming compacted under the feet. The dirty sand is thrown into a portable ejector, from whence it is carried by water through a line of hose to a sand-washer placed outside the filter. There it is agitated and washed with water, the dirt flowing away with the water and the sand being carried through a hose to storage bins, where it is kept until needed for use.

The chief purpose of sand filtration is to clarify the water, remove the bacteria, and the success of the process is attested by long years of experience in many cities. Ordinarily, the efficiency of a sand filter is upwards of 99 per cent.; that is, the filtered water contains less than 1 per cent. of the number of bacteria in the raw water. Thus, in Washington the average number of bacteria in the Potomac River for the year ending June 30th, 1908, was 6,299, while the average number of bacteria in the filtered water was 55 per c.c.

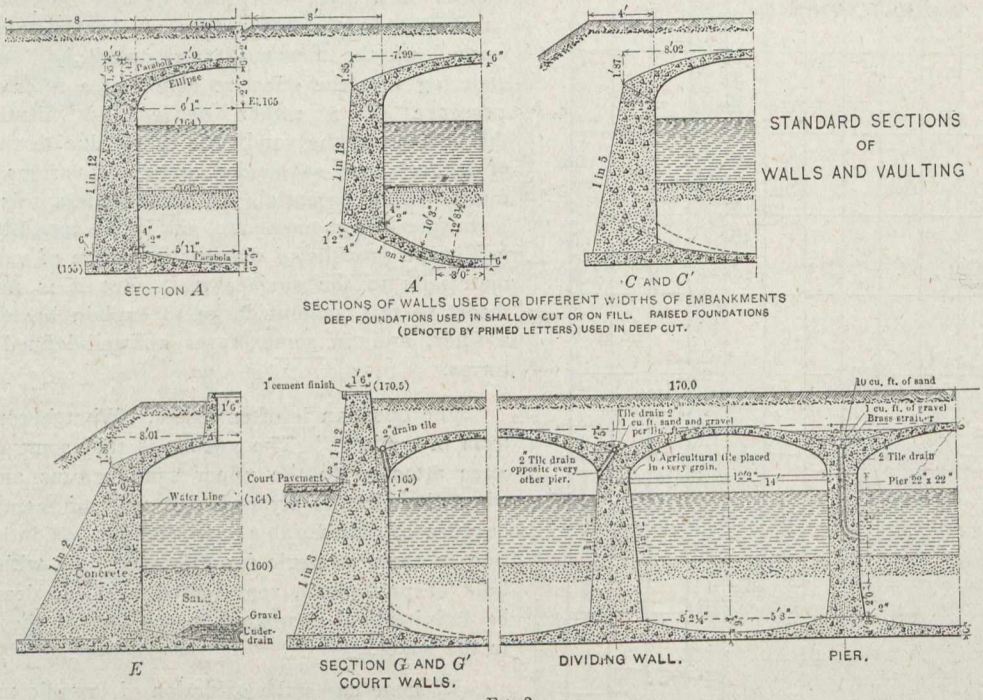


FIG. 2.

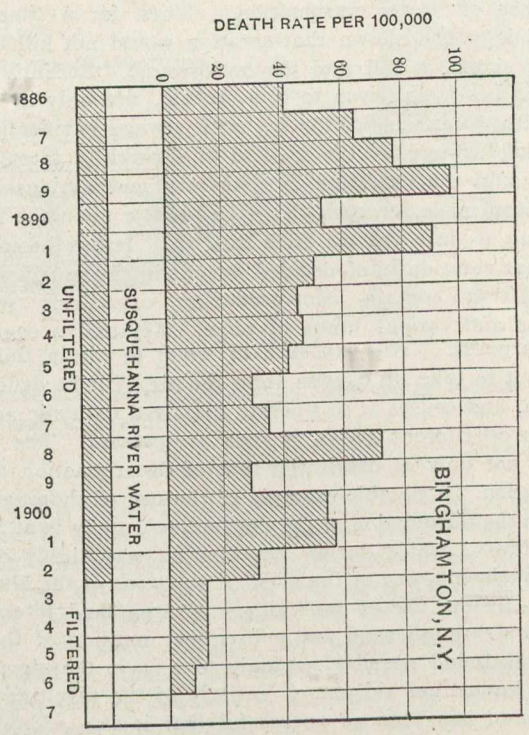
Tests for the colon bacillus showed that this intestinal germ was reduced to about the same extent, and inference, any typhoid fever or other disease germs in the water were likewise reduced in number. The real efficiency of a sand filter is usually higher than is represented by the calculated bacterial removal, for not all the bacteria found in the filtered water pass through the filter. Some of them represent growths in the drainage system below the sand bed.

A sand filter not only makes a water clearer and safer, it removes a part of the color and organic matter. There are many cases, however, where a sand filter cannot be economically used and some where it may utterly fail. For example, no sand filter by itself could be made to economically purify the muddy waters of the Middle West or the deeply stained waters coming from swamps. In these cases where one is dealing with large amounts of matter in colloidal suspension and organic matter in chemical solution, it is necessary to resort to chemical treatment. This brings us to the next division of our subject, i.e., coagulation.

Coagulation.

By the coagulation of water is meant the use of chemicals to produce an artificial flocculation of the colloidal matter and fine particles in suspension so as to neutralize

their electric charges and produce aggregates of such large size that their hydraulic subsiding value is increased and their removal by sedimentation and filtration made possible. The most common coagulant used is sulphate of alumina, popularly known as alum. When this is put into water containing calcium carbonate, for example, it is decomposed by this "alkalinity," the products being calcium sulphate, which remains in solution, carbonic acid gas, which also remains for a time in solution, and aluminum hydrate, which



precipitates as a sticky, gelatinous mass, and which is the active agent in producing the desired flocculation.

At one time there was a good deal of unreasonable popular opposition to the use of alum, but this has largely subsided. In the early days it was sometimes used in excess, but chemists have shown that if the natural carbonate hardnesss of the water is sufficient all the alum is decomposed and none of it reaches the consumers, while, if the natural alkalinity of the water is insufficient, it can easily be increased by the use of lime or soda. What has done more than anything else, however, to overcome the popular prejudice against alum is the continued use of this substance in many cities with no ill effect on the health and with noticeable benefits in the reduction of water-borne diseases.

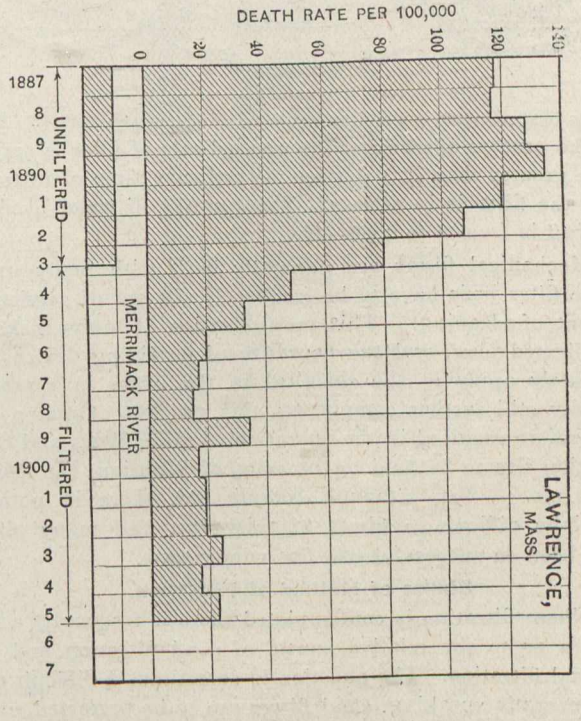
I have just said that there is a slight alteration in the character of the hardness of the water, the calcium carbonate being changed to calcium sulphate; that is, the water would be more likely to form a hard scale in boilers than a soft scale. This is a fair objection, but experience has shown that the actual effect of this change is slight. The total hardness of the water is not altered, yet people have found that where alum is used filtered waters require more soap than formerly. This is because soap is ordinarily used with hot water, and the permanent hardness due to sulphates is, therefore, somewhat more objectionable than the temporary hardness due to carbonates. It has also been observed that when alum is used for the coagulation of soft colored waters there is a tendency at times for the water from the hot water faucets to be rusty, a phenomenon that is coming to be known as the "red-water plague." These objections are trifling, however, when compared with the benefits derived, although it is fair to consider them in comparing different projects.

Another form of coagulation that is being used to some extent, especially in the Western States, where the amount of sediment is large, is a combination of ferrous sulphate, or copperas, and lime. It is usually known as the lime and iron process. In this case the coagulant, instead of being aluminum hydrate, is the hydrate of iron, which acts in a similar way. With certain waters the process is somewhat cheaper than the use of alum, but it is more troublesome to handle, and there is left in the water certain compounds of lime that are objectionable, as they tend to form incrustations on the filter sand and in the meters and distribution pipes in the city. In the case of hard waters it is possible, by increasing the dose of lime, to use this process to obtain a somewhat softer water.

The colored waters of the Northern States and of some places in the South may be decolorized by the use of alum, which throws down not only the colloidal suspended organic matter, but also, probably, some colored organic matter in solution. By this means it is possible to take a water that has a color as dark as that of an ordinary cup of tea and render it almost as white as distilled water.

Certain waters of the Middle West are excessively hard, containing large amounts of calcium and magnesium salts. Thus, the well water supply of Winnipeg, Manitoba, contains 0.1 per cent. of solid matter in solution. Such waters need to be softened. This can be done by using lime and soda, the lime acting on the carbonates and the soda acting on the sulphates. If the water contains a considerable amount of dissolved magnesia, as well as lime, the resulting precipitate will settle down as a flocculant precipitate, and will serve the purpose of a coagulant, making it unnecessary to use alum.

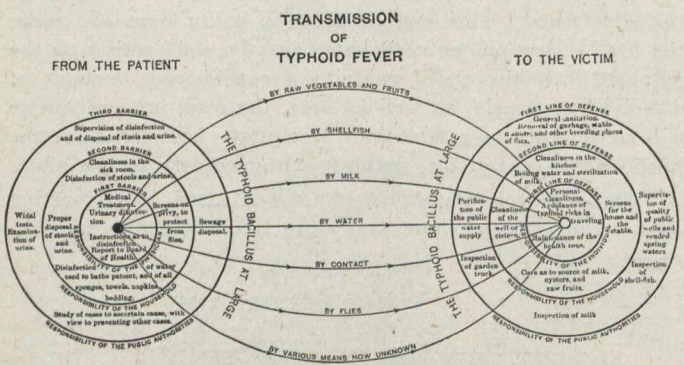
Chemical coagulation is sometimes used in connection with sedimentation alone, but more frequently it is used in



connection with what is called mechanical filtration. It may be used also with sand filtration when the raw water is turbid for only a part of the time, and under some conditions this is a very satisfactory combination.

Mechanical Filtration

Mechanical filters, as they are now built, consist of comparatively small, water-tight concrete basins containing a layer of sand, coarser than is used for sand filters, underlaid with a thin bed of gravel in which is imbedded a gridiron system of pipes known as the strainer system. The water to be filtered passes downward through the sand into the strainer system to the outlet pipes. The rate of filtration is many times larger than that of sand filters, often being as high as 125 million gallons per acre per day, this high rate being made possible by the large size of the flakes resulting from the preliminary chemical coagulation of the water. With this high rate it is evident that such a filter must clog rapidly. Instead of having to be cleaned at long intervals it is necessary to clean the filter almost daily and even two or three times a day. To do this by scraping would be impossible. Arrangements are therefore provided for washing the sand in place without removing it from the bed. This is done by reversing the flow of water so that it passes upward through the filter, dislodging the accumulated dirt from the sand and carrying it off through gutters into the sewer. In the early types of these filters mechanical devices were used for stirring the sand while it was being washed, and this gave rise to the name "mechanical filter." These mechanical devices have been generally abandoned, compressed air being substituted. In some cases not even compressed air is used, dependence



being placed upon a greater velocity of the wash water. During the process of washing the upward rate of filter is several times greater than it is during the ordinary time of filtration when the filter is in service. The quantity of water used for washing is from 2 to 4 per cent.

Mechanical filters are generally built with many units, as the filter beds have to be frequently put out of service on account of cleaning. This multiplication of units makes a complicated plan, and the necessity of providing devices for accurately applying the chemical to the water in a precise quantity still further complicates this process. Greater care is therefore required in the operation of these filters and close attention has to be paid to the rates of filtration, the loss of head, etc. Yet, although complicated, there is nothing especially difficult in filters of this type, and many plants have been in successful use for a long time.

Choice of Method of Filtration.

Where filtration is contemplated there is frequently a discussion as to the relative merits of sand filtration and mechanical filtration. The question is sometimes a difficult one, but generally speaking, sand filters are to be preferred where they can be used, namely, with waters that, though polluted, are comparatively clear and colorless, as they are simpler to operate and suffer less by possible neglect. If the color and turbidity are considerable, or if questions of water softening are involved, mechanical filters may be advisable. Sand filters usually cost more to install but less to operate. Mechanical filters can be often put in cheaper, as the structures are smaller, but the annual charges for chemicals and for labor are larger. Local conditions as to site, etc., always figure very largely in a choice between the two methods and the matter is one best left to the expert in such matters.

Aeration.

Many years ago aeration was looked upon as a very important part of water purification, especially in the natural processes of water purification. Then for a time, after bacteriology had shown that aeration would not kill bacteria to any extent, it fell into the background. Recently a new impetus has been given to this process, not only in connection with water purification but with sewage purification. In purifying sewage by the method of sprinkling filters it has been found that aeration is necessary and various devices have been made for sprinkling the sewage upon the beds or spraying it into the air from nozzles. It has been found also that aeration is of decided benefit in the purification of waters that contain odor-producing organisms such as diatoms and various kinds of algæ. Aeration accomplishes two purposes. The exposure of water to air in thin films causes it to take up oxygen from the air, if it be deficient in oxygen, and causes it to liberate dissolved carbonic acid and various odoriferous gases, if such are present. The process is one not only of oxidization but of decarbonation and deodorization. A notable example of the use of thorough aeration in the purification of the old Ludlow supply is at Springfield, Mass., which during hot weather was highly charged with **Anabaena,** one of the most troublesome of the bluegreen algæ. By the use of preliminary aeration and intermittent filtration through sand and subsequent aeration of the effluent, was found possible not only to remove the algæ themselves but to get rid almost entirely of the resulting odors. This plan has been so successful that it was adopted in a much more extensive form in the design of some recent filters for Brisbane, Australia. The process of aeration, therefore, bids fair to be a most important one in many future water purification plants.

Disinfection.

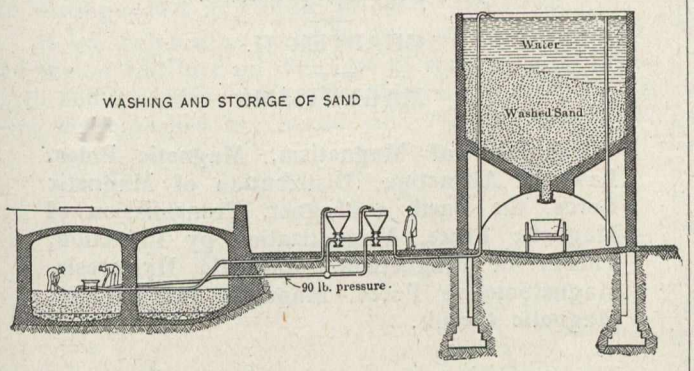
Many attempts have been made by chemists to provide a means for suitably disinfecting a water supply, that is, of poisoning or destroying by chemical means the bacteria in the water. Copper sulphate has been found effective in destroying growths in water, even when used in very minute quantities, such as a few pounds of blue vitriol in a million gallons of water, but it has not proved successful in destroying bacteria without using very large quantities of the chemical.

Ozone has been suggested and is used abroad, to a slight extent, for this purpose. It is reasonably effective but thus far has proved unreliable and very expensive, much more expensive, in fact, than the purification of water by the ordinary methods of filtration. It does not remove the suspended matter in water nor does it decolorize to any great extent.

Recently the use of chloride of lime has been advocated in many cities for disinfecting public water supplied. When put into water nascent oxygen is liberated and this reaction has a destructive effect on bacteria. Comparatively small quantities are needed, say 25 pounds per million gallons, sometimes even as low as 10 or 15 pounds. It often enables a sand filter to be operated at higher rates and a mechanical filter to be run with smaller quantities of coagulant. It has even been used in some cases without filtration, but this should be regarded only as an emergency measure.

Storage of Pure Water.

After water has been filtered or otherwise purified it is necessary to store it in the dark to prevent accidental contamination and to prevent growths of algæ. These "clear water basins" are concrete masonry structures with arched roofs supported on piers, very much resembling the filter plants themselves, except that there is no filtering material.



They have a capacity sufficient to compensate for the hourly fluctuations in consumption.

Benefits of Filtration.

It would be interesting, if there were time, to take up the benefits to be derived by filtration and to show how a community is benefited not only in the supreme matter of saving lives but in many ways that affect the purse strings of every household. It could be shown, for example, that at Lawrence, Mass., the introduction of filtered water saved an amount equivalent to $9.50 per capita each year; and that in Albany, N. Y., where the typhoid fever death rate was reduced from 105 to 26 per 100,000, the annual saving of life value was $7.80 per capita. At the ordinary life insurance rates the introduction of this filter was therefore equivalent to handing to each head of a family a paid-up life insurance policy of $2,300. The vital statistics of Pittsburgh and Philadelphia have shown that in these cities which until recently have been hot-beds of typhoid fever, the death rate from that disease has fallen to a nominal figure since the introduction of filtered water.* It must not be thought, however, that typhoid fever is caused only by drinking water. There are many other ways in which it is transmitted, a fact which should not be lost sight of in considering the subject of water purification.

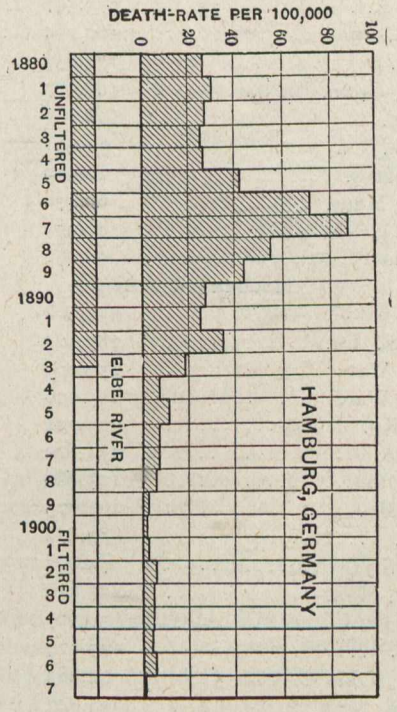
From reading the literature relating to the purification of water it would be easy for one to obtain the idea that the principal object of filtration is to reduce the typhoid fever death rate. This is not so. The object of filtration is to purify the water supply and the use of pure water means a great deal more than a lowering of the typhoid fever death-rate. Statistics have shown that where an impure water supply has been filtered many other diseases than typhoid fever have been reduced and that the general death rate has fallen by an amount many times greater than that due to the reduction in typhoid fever alone. Prominent in this has been the reduction in the infant mortality, especially as relating to diseases of a diarrhoeal character. Sanitarians believe, also, that the use of pure water tends to improve the general health tone in a community, thereby preventing other diseases from being acquired even though they may not be strictly of a water-borne character. For instance, in some places it has been found that the introduction of filtered water has decreased the death-rate from pneumonia. These are matters that are just coming to be known but they are believed to be of great importance.

Filtered water is desirable, also, from the standpoint of general cleanliness and common decency, and to-day filters are being built in cities supplied with water from an almost uninhabitated watershed, as at Springfield, Mass., thus forestalling the possibility of an epidemic from accidental causes.

We might also approach the subject from an economic point of view and show that when a hard water is softened, when a colored water is made white and when a turbid water is made clear, there are corresponding financial benefits to the entire community that more than offset the cost of the process.†

Filtration vs. Sewage Disposal.

Finally, I would like to say a word in regard to using water without filtration. There are still some who believe that it is better to prevent the pollution of lakes and streams with sewage than to allow the streams and lakes to become foul and then spend money to purify them. The answer to this is that for ideal conditions both ought to be done, and in the future both will be done. To allow our naturally pure streams to become as foul and unsanitary as many of them are is indeed a disgrace. Nevertheless, sanitary improvements, like all other improvements, cost money and it is wisest to spend our money where it will go farthest. Now the filtration of water is very much cheaper than the purification of sewage and from the sanitary standpoint is more efficient. It is therefore logical, scientific and



hygienically proper to devote our attention first to the filtration of our water supplies, leaving questions of sewage disposal to be treated locally and principally from the standpoint of nuisance. Where pollution threatens, the essential thing is to have somewhere between all possible sources of

*Detailed data as to the effect of water supplied on typhoid fever death rates are to be found in "Typhoid Fever," by Geo. C. Whipple, published by John Wiley & Sons, New York, in 1908.

†See the "Value of Pure Water," by G. C. Whipple.

pollution and the water consumers a reliable safeguarding mechanism constantly in operation.

It is true that self-purification by nature's agencies counts for much; it is true that pollution can be avoided for a time by changing the outfall of a sewer, as at Chicago, or by extending a water-works intake a few miles into a lake, as at Cleveland; it is true that pollution can be reduced in amount by depopulating a watershed or by building sewage purification works; and it is true that sedimentation and chemical coagulation, aeration and disinfection will improve the sanitary condition of a water; but it is only by filtration, with or without the use of these supplementary processes, as they may or may not be necessary, that a public water supply can be secured from surface waters that conform to modern standards of hygiene and decency. Our American cities are doing well in following the time-honored example of Germany and England in their almost universal practice of filtering all surface waters.

Increase in Filtration

During the last ten years many new filter plants have been constructed in America and it is certain that during the next ten years the increase will be even greater. The following is a partial list of places in the United States where filters are in use, taken from a recent book on "Clean Water and How to Get it," by Allen Hazen.

Sand Filters

Place.	Population 1900.	Capacity of Filters, in U.S. Gals. per Day.
Philadelphia, Pa.	1,293,697	420,000,000
Pittsburg, Pa.	321,616	100,000,000
Washington, D.C.	278,718	87,000,000
Toronto, Ont. (Under construction)	208,040	60,000,000
Providence, R.I.	175,597	24,000,000
Indianapolis, Ind.	169,164	24,000,000
Denver, Col.	133,859	30,000,000
New Haven, Conn. (in part)	108,027	15,000,000
Albany, N.Y.	94,151	17,000,000
Reading, Pa. (in part)	78,961	5,750,000
Lawrence, Mass.	62,559	5,000,000
Springfield, Mass.	62,059	15,000,000
Yonkers, N.Y. (in part)	47,931	7,500,000
Superior, Wis	31,091	5,000,000
Mechanical Filters		
Cincinnati, Ohio	325,902	112,000,000
New Orleans, La.	287,104	44,000,000
East Jersey Water Co.	250,000	32,000,000
Hackensack Water Co.	225,000	24,000,000
Louisville, Ky.	204,731	37,500,000
Toledo, Ohio	131,822	20,000,000
Columbus, Ohio	125,560	30,000,000
St. Joseph, Mo.	102,979	11,000,000
Atlanta, Ga.	89,872	6,000,000
Charleston, S. C.	55,807	5,000,000
Kansas City, Kan.	51,418	6,500,000
Harrisburg, Pa.	50,167	12,000,000
Norfolk, Va.	46,624	8,000,000
Youngstown, Ohio	44,885	10,000,000
Binghampton, N. Y.	39,647	8,000,000
Augusta, Ga.	39,441	5,000,000
Little Rock, Ark.	38,307	5,500,000
Terre Haute, Ind.	36,673	9,000,000
Davenport, Iowa	35,254	7,000,000
Elmira, N.Y.	35,672	7,000,000
Chattanooga, Tenn.	30,154	9,000,000
East St. Louis, Ill.	29,655	11,000,000
Watertown, N. Y.	21,696	6,000,000

ELEMENTARY ELECTRICAL ENGINEERING.

L. W. Gill, M.Sc.

This series of articles will be continued for some months. They will be of particular interest to the student of electrical work and the civil engineer anxious to secure some knowledge of the simpler electrical problems.

CHAPTER II.

MAGNETISM.

Definition of Magnetism, Magnetic Poles, Laws of Attraction, Distribution of Magnetic Force, the Earth a Magnet, Transmission of Magnetic Force, Magnetization by Induction, Theory of Magnetism, Magnetic Hysteresis, Magnetomotive Force, Magnetic Permeability, Magnetic Circuit.

The magnetic effect produced by an electric current is the most important of its effects, because it is dynamic in character; i.e., mechanical power can be developed through the medium of this effect. Since electricity is used principally for power purposes, it follows that a

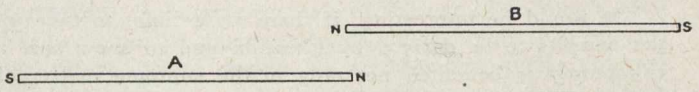


FIG. 10

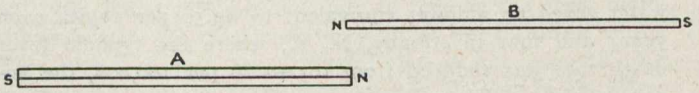


FIG. 11

knowledge of the fundamental laws of magnetism is essential to the student of electrical engineering. In this connection it may be noted that the magnetic effect produced by an electric current is identical in character to that property which is possessed by a number of the chemical elements. This chapter is, therefore, devoted to a discussion of magnetism in general.

Definition of Magnetism.—Magnetism is that property of a substance which causes it to attract or repel another substance when neither is charged with electricity. A body possessing this property is said to be magnetized, and is called a "magnet." A substance which is capable of possessing this property is said to be "magnetic." There are three elements which are magnetic in a marked degree, viz., iron, cobalt and nickel. Compounds and alloys of these elements are also magnetic. Some other substances are very slightly magnetic, but for practical purposes only the three elements above mentioned may be considered as magnetic.

A magnetic substance often shows no evidence of magnetism. A piece of iron, newly cast, or forged, for instance, will not attract or repel anything. On the other hand, the power of a magnet to attract or repel may be easily reduced to nil and increased again to any value up to a certain maximum, as will be seen later.

Magnetic Poles.—If a small piece of iron is placed at different points near a magnet, it will be observed that the attraction is always toward more or less definite points. In other words, the attracting force appears to be exerted from definite points within the magnet. These

points are called the "poles," and may be in any position. While there may be a number of these poles, there are usually only two, **but never less than two,** and if the magnet is in the form of a bar these two will usually be very near the ends of the bar.

If a two-pole magnet is brought near a pole of a second magnet, it will be observed that this pole attracts one pole of the magnet and repels the other, which indicates that the poles are not alike. The different poles are distinguished as "positive" and "negative."

If we balance a two-pole magnet on a pivot, we find that it will turn on the pivot so that one pole points north and the other south. For this reason the poles are often distinguished as "north" and "south" poles. The

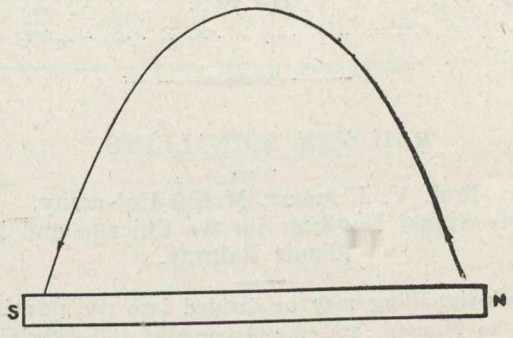


FIG. 12

north pole of a magnet may be easily distinguished from the south pole in this way. (A small magnet suspended in this way is known as a "mariner's compass," or a "compass needle.")

Laws of Attraction and Repulsion.—A few simple experiments will suffice to indicate the laws which govern the force exerted by a magnet.

If the north poles of two magnets, A and B, are brought together as in Fig. 10 they will repel each other, while if a south pole and a north pole are brought together, they will attract. This proves the first law, that **like poles repel and unlike poles attract.**

If these two magnets are made of long pieces of steel wire, and placed as in Fig. 10, the effect of the south pole of magnet A on the north pole of magnet B will be very small compared to the effect of the north pole of A, because the former is relatively far away. For the same reason the effect of the south pole of magnet B will be very small. The force exerted between the two magnets will, therefore, represent very closely the influence of one north pole on another.

To deal with this force quantitatively it is necessary to first adopt some unit to express the strength of the poles, since all poles do not exert the same force. Such a unit may be selected arbitrarily, but the selection might not lead to simple mathematical expressions. For the present, however, it will serve the purpose to express the pole strength by a symbol. It may also be decided to adopt the C.G.S. system of fundamental units.

Let m be the symbol for pole strength.

Let m_1 = pole strength of magnet A.

Let m_2 = pole strength of magnet B.

Let d = distance between the two north poles.

Let F = force exerted between the poles, in dynes.

If the force F is measured for different values of d, it is found that **this force varies inversely as the square of the distance d**; i.e., if the distance is doubled, the force is reduced to one-quarter, and if the distance is trebled, the force is reduced to one-ninth, etc.

The variation of this force with variation of pole strength may be determined by placing beside the magnet A (Fig. 2) another magnet exactly the same, so that together the two magnets form one magnet whose pole strength is double that of A. By varying the strength of m_1 of the poles of A in this way, and measuring the corresponding change in the force, we find that the force varies directly as the pole strength m_1. A similar experiment will show that the force varies directly as the pole strength m_2 of the magnet B. It thus follows that

$$F \propto 1/d^2;\ F \propto m_1;\ F \propto m_2.$$

Combining these into an equation we have—

$$F = Km_1m_2/d^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

K being a constant.

Having obtained a mathematical expression for the force exerted between two poles, a unit of pole strength may now be selected, which will make this expression as simple as possible. This is done by making K unity. In this case, if $m_1 = m_2$, these must each be unity when F and d are each unity. In other words, if F is one dyne and d is one cm., m_1 and m_2 must each be unity. This gives a simple unit of pole strength, and the one which has been adopted by international agreement. It may be defined as follows: **A unit pole is one such that, if placed one centimeter from another unit pole, the mutual force exerted is one dyne.**

Equation (7) now becomes—

$$F = m_1m_2/d^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7a)$$

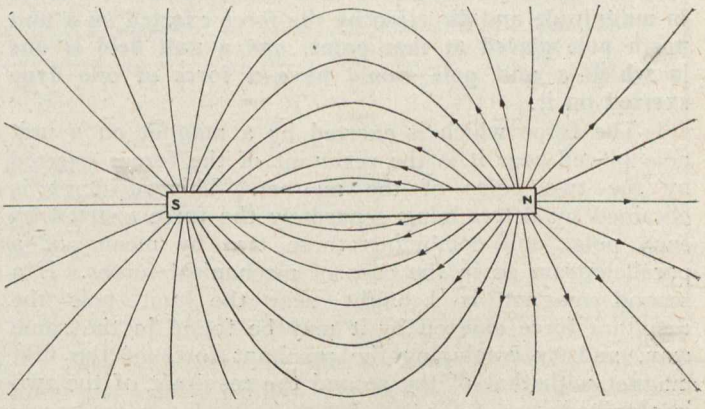


FIG. 13

Problem 4.—A north pole of strength 10 is placed 4 cms. from another north pole of strength 5 to determine the mutual force exerted.

$$F = m_1m_2/d^2 = 10 \times 5/4^2 = 3.12 \text{ dynes.}$$

Distribution of Magnetic Force.—The influence of a magnet pervades the whole space surrounding it, for it exerts a force on a magnetic substance placed at any point near it. This space is known as the "field" of the magnet, and is often referred to as a "field of force." The magnitude of the force exerted is greatest near the poles, and becomes less as the distance from the poles increases, as shown by equation (7). If a very small magnet is balanced on a pivot so that it is free to turn about a vertical axis, and then placed near a large magnet so that both are in the same horizontal plane,

the small magnet will at once assume a definite position. The resultant force of the large magnet acts in one direction on the north pole of the little magnet and in the opposite direction on the south pole.

The small magnet will, therefore, point in the direction of the magnetic force at that point. (It is here assumed that this magnet is so small that the space it occupies may be regarded as a point.) If this little magnet is moved in the direction in which its north pole points, its centre will follow a curved path as indicated in Fig. 12. This path will begin at the north pole and end at the south pole, and its location will depend on the starting point. Since we may start at any number of points, it follows that there are any number of paths. Fig. 13 shows a number of these paths in one plane. From Fig. 12 it is obvious that the force at any point of one of these paths or curves is in the direction of the tangent to the curve at this point. In other words, the force acts along this path so that a **free** north pole would be driven along one of these paths from the north pole to the south pole of the magnet. These paths or lines along which a **free** pole would move under the influence of the magnet are known as "lines of force." It must be remembered, however, that these lines are imaginary, being only a symbolic representation of the condition of the medium through which the magnetic force is transmitted.

The resultant force which is exerted on a unit pole placed at any point in a magnetic field is known as the "magnetic force," or the "strength of the field" at that point. Since the direction of the force must be considered, it is usual to take the direction of the force exerted on unit north pole as positive. It follows, then, that **the magnetic force or magnetic field at any point is defined in magnitude and direction by the force exerted on a unit north pole placed at that point, and a unit field is one in which a unit pole would have a force of one dyne exerted on it.**

The force which is exerted by a magnet on a unit pole placed near it is the resultant of the forces exerted by the two poles of the magnet. This resultant is obtained by determining separately the force exerted by each pole, and combining these two by means of a parallelogram as in the case of mechanical forces. If a second magnet is brought near the unit pole the resultant force exerted by it may be found in the same way, and by combining the resultant force of the first magnet with that of the second the resultant of the two is obtained.

Problem 5.—The distance between a free north pole of strength 5 and the north pole of a magnet of strength 20 is 10 cms., measured on a line passing through the north pole of the magnet at right angles to its axis. If the distance between the poles of the magnet is 17.3 cms., to determine the resultant force exerted by the magnet on the free pole.

From equation (7a) the north pole of the magnet repels the free north pole with a force $F = m_1m_2/d^2 = 5 \times 20/10^2 = 1$.

The distance between the south pole of the magnet and the free pole is $d = \sqrt{(10^2 + 17.3^2)} = 20$, and the attracting force is $F = m_1m_2/d^2 = 5 + 20/20^2 = 1/4$.

The angle between these two forces is 120°, and from the parallelogram of forces the resultant is found to be 0.9 dyne.

Problem 6.—To determine the strength of the magnetic field at a point 5 cms. from the north pole and 10 cms. from the south pole of a magnet of which the pole strength is 6 and the length is 12 cms.

The north pole of the magnet will repel a unit north pole placed at this point with a force $F_1 = m_1m_2/d^2 = 1 \times 6/5^2 = .24$ dyne.

The south pole will attract a unit north pole placed at this point with a force

$$F_2m_1m_2/d^2 = 1 \times 6/10^2 = .06 \text{ dyne.}$$

The angle between these two forces is 79° (very nearly).

The resultant force exerted on the unit pole (which by definition is the strength of the field at this point) is the resultant of these two forces, or

$$F = \sqrt{(F_1^2 + F_2^2 + 2F_1F_2 \cos 79°)}.$$
$$= \sqrt{(.24^2 + .06^2 + 2 \times .24 \times .06 \times .98)} = .299 \text{ dyne.}$$

RAILWAY SIGNALLING.*

Prof. V. J. Smart, McGill University.
Formerly Signal Engineer for the Chicago and Eastern Illinois Railway.

Block-signalling may be divided into two principal methods—the Manual, and the Automatic. The definition of the Automatic Block System as given by the Standard Code is as follows: "a block system in which the signals are operated by electric, pneumatic or other agency actuated by a train, or certain conditions affecting the use of a block." The means used to actuate these is through the use of a track circuit, this is the foundation of every automatic block system. It is its main element of strength and also one of the elements of weakness. The installation of a section of track circuit is very simple. The track is cut into sections of varying length, by means of insulating joints, the intermediate rails being bonded together by means of No. 8 galvanized iron wire, plugged into each rail, the wires running around the angle bars. A battery is connected across the rails at one end of the section, and an electro-magnet across the rails at the other end. In the diagram, Fig 9, it can be seen that this would form a closed circuit, the rails forming the connection from the battery to the electro-magnet. This electro-magnet is called a relay. It has a pivoted armature weighted so that it will fall away from the coils by gravity, and the magnet must be energized to raise it. The moving armature carries contacts for controlling auxiliary electric circuits, and by these contacts the operating circuit of the signal is controlled. The wheels of the train when on the track circuit offer so little resistance to the current that the relay does not get enough current to hold the armature up. It then falls, opening the signal operating circuit. The voltage on the track is from one to two volts, usually supplied from a gravity battery, although storage battery is being used to some extent. There is no insulation between the rails except the ties and ballast, and during wet weather the leakage between rails is considerable. The resistance of the relay is ordinarily four ohms; if it is much above nine ohms in wet weather it will not work, and if it is much below four ohms the train will not cause it to open. The relays have to be protected against weather, and the careless adjusting of maintainers, as the instrument is comparatively delicate, that is, the range between the conditions that produce safe operation and those that would produce unsafe operation is very small. All automatic signals are actuated by this track circuit. The circuits which operate the signals themselves being controlled through one or more of the contacts of the track relay. In the use of the Automatic method

the necessity for the train order rules has not been done away with, no complex thing like a railway can be operated automatically, there must be some means having intelligence which can distinguish between trains of superior class, and which can confer right on one train and restrict the right of others, therefore the automatic does not eliminate the order system.

The Standard Code rule 502 reads as follows: "Block signals control the use of blocks, but unless otherwise provided, do not affect the movement of trains under the time table or train rules nor dispense with the use or observance of other signals whenever and wherever they may be required." With the automatic it cannot be "otherwise provided," therefore the train rules and train orders remain. The automatic is essentially a permissive signal as if a signal is out of order and assumes the stop position, traffic would have to be suspended, to overcome this necessity the rule is used that if a signal is found at stop, the train must be brought to a stop, and then may proceed under caution. Moreover, the automatic can fail in such a way as to give a clear indication when it should have indicated stop. Accident Bulletin 32, and Bulletin 33, have accounts of two collisions which occurred on account of a false clear indication of an automatic; the number of failures of this kind that do not cause accidents would be hard to arrive at, as failures of this sort are not for publication. The great weakness of the automatic is the track circuit, it is an extremely delicate thread to hang the safety of the trains on. In the first place, the material used to insulate the joints is paper fibre, and the safety of the whole scheme depends on the integrity of this insulation, should it break down, a clear signal with a train in the block is the result. Automatic signals require very careful and high-class men for their maintenance, and even with the very best maintenance numerous failures will occur.

There is probably no better organized maintenance force on any railroad, than that of the Harriman Lines, yet the average daily failures for the month of December last year was 11 per day, these were failures to the stop position, but they, as every other road has had and will have, failures to the clear position. Breakages in the mechanisms, lightening, and break down of insulation, all have produced false, clear failures, and once the possibility of such failures is admitted the reliability of the system is lost. One of the most distressing things in connection with these failures is, that everyone connected with the maintenance and operation of the signals feels that it is part of his duty to hide the false clear failures, not only from the public, but even from the railroad officials themselves. For every false clear failure that is reported, I think I am safe in saying that there are ten others that never get into the records. The attitude of the signalling fraternity toward these false clear failures seems to be that of the ostrich with regard to its enemies.

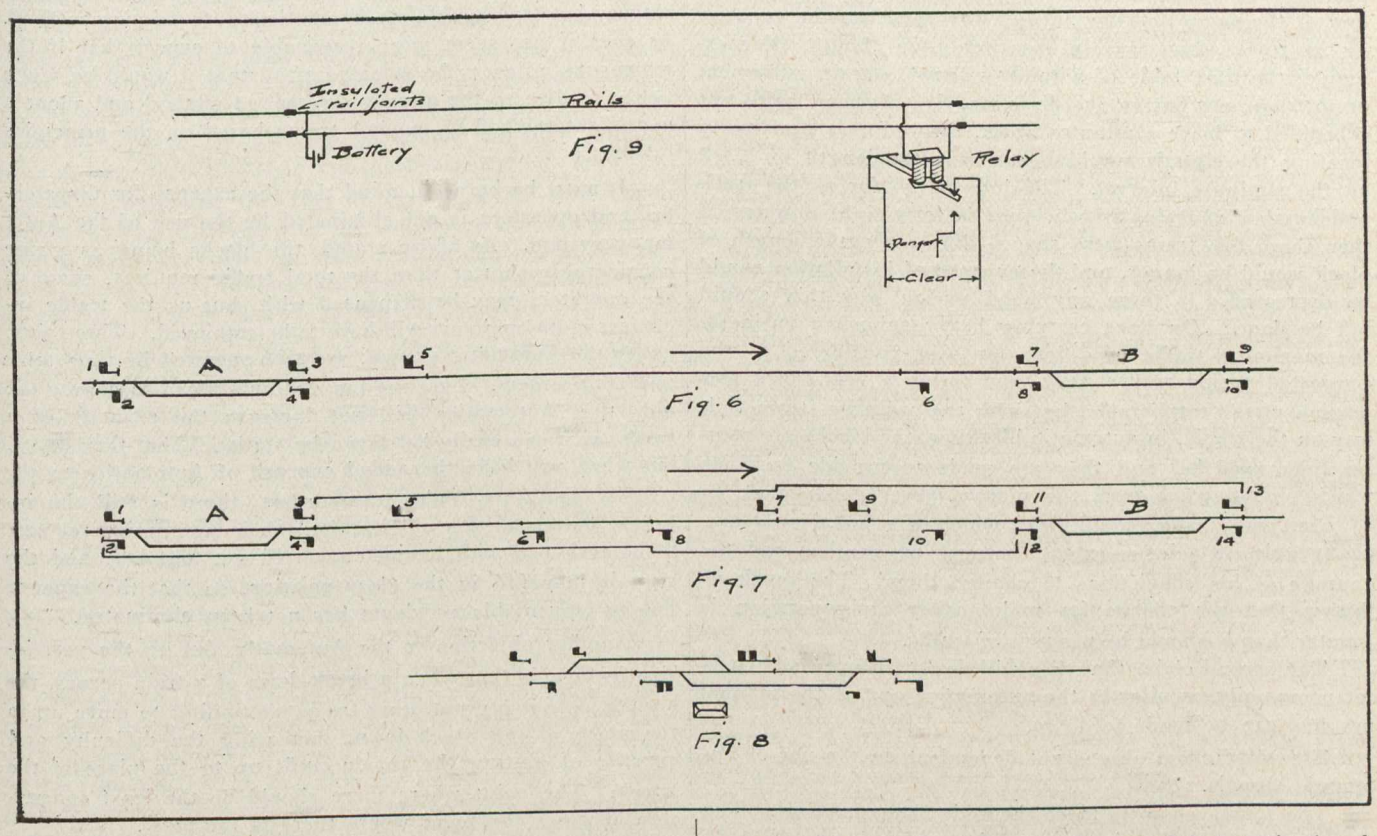


Fig. 9

Fig. 6

Fig. 7

Fig. 8

The claims made in favor of the use of Automatic signals over the manual control signals are; 1st, they are cheaper to operate; 2nd, they will detect an open switch; 3rd, they will detect a car left within fouling distance of the main track; 4th, they will detect a broken rail.

The first claim that they are cheaper to operate is partly true, as the chief charge is for battery renewal, there is no claim, however, that they are cheaper to maintain. In locating automatics, maximum traffic conditions are assumed as a basis for the lengths of the blocks, and once the signals are located, the charge for maintenance and operation forms a fixed charge per mile, even though the maximum traffic conditions only exist for a few weeks during the twelve months, the charge does not vary with the traffic.

On page 63 of the Railway Age Gazette of this year, is a summary of the expense due to maintenance and operation of 27 miles of automatic signals just installed on the Baltimore & Ohio R. R. outside of Washington, D.C. "Cost per mile, per annum, double track, operation and maintenance, $233.79," this is made up of labor and material and superintendence. Nothing is included for depreciation or

interest, if we add these, the maintenance and operation will be as follows:

7 per cent. depreciation on $2,014.00 (cost per mile)	$140.98
Interest at 4 per cent. on $2,014.00	80.56
Cost maintenance and operation as given	233.79
Total cost per mile, per annum	455.33

The length of blocks on this territory (found by dividing the number of signals into the distance) is about eight-tenths of a mile. This charge has become a fixed charge per mile irrespective of the volume of traffic.

With few exceptions automatic signals are located from maximum conditions as shown on an existing time table, consequently the blocks are shorter than they need be, if the train schedules were slightly changed length of blocks could be increased, thus reducing considerably the first cost, and at the same time not in any way reducing the capacity of the tracks for trains in the twenty-four hours. For example, the time table of a railway shows a train movement of 30 trains per day in one direction, five of these trains are scheduled to leave 3 minutes apart, the ordinary practice in locating the signals would be to base the length of block on the 3-minute interval. The interval so far as the track and number of trains is concerned is forty-eight minutes, if then these five trains were spaced differently, the length of block would be longer, and the expense of installation would be decreased. Is there any good reason why this should not be done? On lines carrying heavy suburban business, the maximum traffic conditions must be considered as the congested period recurs daily, and forms a very large proportion of the total traffic, but with the ordinary steam railway on the whole, in automatic blocking, the blocks are shorter than need be, and they are made to provide facilities which should come from the motive power department, or to overcome traffic conditions, which are considered unchangeable, to a large extent, because no one has had the courage of his convictions to change them. The result of this is that the charge for maintenance and operation is greater than it should be per unit of traffic.

The second claim that they will detect an open switch is not necessarily peculiar to the automatic; any of the manual systems can be made to do so.

The third claim also is not dependent on the use of automatic signals.

The fourth claim is more theoretic than practical. The only broken rail that is certain of causing interruption to the track circuit, and thereby causing a signal to indicate stop, is one which has a clean break through the rail somewhere away from the joint, and where the two broken ends have actually drawn apart. A break at the joint will not be detected on account of the fact that it is bonded, and the track circuit is not in any way interfered with, piped rail, broken head, broken base, and other breaks which would be dangerous to a train would in no way affect the signal.

The record of rail failures on a certain road for six months gives a summary of breakages as follows:—

Split	95	16%
Piped	197	33%
Crushed	111	19%
Breaks at joints	94	16%
Breaks outside the joints	94	16%

What proportion of these rails which were removed from the track as unsafe would have been detected by automatic signals is impossible of determining; it would only be some unknown percentage of the 16% of the whole shown as breaks outside the joints. I doubt very much that, if this was the only element in favor of the automatic, there would be very many installed.

The chief objection to the automatic, in my estimation, is the fact that in its very nature it must be a permissive signal thereby violating one of the very fundamental principles of safe block operation. From this feature of the automatic, that is, its permissive nature, has arisen the complicated system of indications advocated in the Railway Signal Association. The necessity of distinguishing to the engineer a permissive signal from an absolute stop signal naturally gives rise to inconsistencies, and a multiplication of the number of aspects with which the runner must familiarize himself, this multiplicity of indications is certainly not tending to simplicity. Again, the automatic system is not all sufficient in itself for the operation of trains, but must only be an addition to some other system of moving trains. The question then arises, if the method of controlling train movement has been found unsafe and uneconomical, is the railway bettered by adding automatics to its existing method, or does it not seem more reasonable to expect that if the expense is going to be incurred at all that it would be much better to discard the already discredited method and adopt a consistent method of moving trains based on the principles involved?

It must be borne in mind that the expense for dispatchers and operators is not eliminated by the use of the Automatic system. As above stated, the blocks being as a rule considerably shorter than the total traffic requires, some of the operators may be dispensed with, but as the traffic increases more operators will have to be employed. The trains, under the Automatic system, are still operated by time table and train orders. I do not for a minute mean to convey the idea that Automatics will not increase the capacity of a track, as it can easily be shown by statistics that they do so, but when you have the added expense of Automatics to the cost of operating under train orders, there is still the inherent defect of this system, i.e., their permissive feature to be reckoned with, trains may still get together, and the signals may fail in the clear position, so that the expense due to preventable accidents has not been eliminated.

Another objection to the Automatic, due to the permissive feature, is that when a break-down of a train occurs, the signals do not prevent other trains continuing to move up to the place of the break-down, increasing the difficulty and expense of getting the repair outfit up to the place of the wreck. The point where there should be the least congestion becomes the point where there is the most.

The Manual Control system is divided into two methods the Lock and Block, and the Staff methods. The Standard Code of the American Railway Association divides the Manual system into two classes: The Telegraph Block system—"A block system in which the signals are operated manually, upon information by telegraph, and the Controlled Manual Block system—a block system in which the signals are operated manually, and so constructed as to require the co-operation of the signalmen at both ends of the block to display a clear signal." The first of these is another make-shift, and is used in America, at least, in conjunction with the train order system, we can pass over this without further remark. The Controlled Manual system is based on the principle of preventing more than one train being in the block on the same line at the same time, and the failure of any part of the apparatus, including the human element in this case, will not be able to show a clear signal if the conditions are not right.

The Lock and Block, as this system is called in England, is operated as follows: The line is divided into blocks of a length varying with the volume of traffic, the entrance to, and the departure from, each block being controlled by a

signal operated by a signalman. The levers operating the signals at each end of a block section are so interlocked electrically, as to make it impossible for any single signalman to clear his signal without first communicating with the block operator in advance, who has to release the locking before a signal can be cleared. As this system is operated in Europe, all trains are moved absolutely by it, no schedule of trains is used except for the convenience of the traffic department, and the public. Trains only get the right to run from block to block by means of the signals. There is but one authority for the movement of trains and that is given by the signalman, at the time and place where it is required, thereby making it possible of getting the maximum capacity for traffic out of the track.

The first cost of the apparatus, and the future maintenance is considerably less than that of the Automatic. The cost for operation is principally the wages of the operators, which is undoubtedly more than the cost for the operation of the Automatics, if you leave out of consideration the fact that by the introduction of Automatics, you have not eliminated the charge for operators to handle the train orders, but still have the dispatcher and the operators, but fewer in numbers. Moreover, the cost of operating the controlled manual system will vary with the volume of traffic, whereas the Automatic does not. A block station can be cut out or added, to take care of the variations in the traffic, making the blocks longer or shorter as the case may be.

Viewed from the point of view of the engineman, there is an element of safety in the method of operation under the Manual Control system which is not given by the addition of Automatics. Even when these are used, when an engineer leaves his terminal he has the right given him by the time table to run his train to the end of his division; if his movement is in any way to be restricted it is up to the dispatcher to catch him, it is not particularly to his interest to be caught, his attention is herefore not necessarily on the "qui vive" to notice the position of train order boards at each station, he has the feeling all the time that he has a right to continue running until he is caught, and that nothing can be done in the way of conferring right on some other train until he has been caught. On the other hand by the block method, divorced absolutely from the order system, the engineer knows that he has only the right to run from one block station to the next, and that, if he is to get over the road he must get permission to enter the next succeeding block at the entrance to that block. His attitude is entirely changed, he is directly responsible for getting his train over the road, and he is ever on the watch to see that he has got the necessary authority to do so.

In running trains on double track, the only danger is of getting two trains, running in the same direction, together. The problem on single track becomes more complicated, as head-on movements must also be provided for. In England, on single track lines the staff system is in use. This differs from the double track operation under the Lock and Block, in that a staff or piece of metal is given to the engineer as his authority to occupy a block, it being possible to give but one staff for any one block section at any one time. These staffs are contained in a machine at each end of the block, and are taken out by the signalman and delivered to the engineer, where high speed trains are being run these staffs are caught and delivered by a catching device located at the side of the track. In England, on some of the single track lines these staffs are being caught and delivered by trains running at fifty and sixty miles per hour.

This series of articles will be continued next week.

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Chairman, J. E. Schwitzer; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

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

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ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

10163—April 13—Authorizing the G.T.R. to construct a spur to the premises of the Bryan Manufacturing Company, Collingwood, Ontario.

10164—April 5—Authorizing the C.P.R. to take certain lands on the line of the Columbia and Western Railway Company at station 3968-80.3,—initial point of chainage being at Castlegar Junction, B.C.

10165—April 5—Dismissing application of H. Grant Hannan, of Kipp, Alberta, for an Order directing the C.P.R. to provide, construct and maintain a suitable station and railway sidings on the south-west quarter of Section 29, Tp. 9, R. 22, west 4th Meridian, Province of Alberta.

10166—April 5—Adding the city of Hull, Quebec, as a party in the matter of the complaint of R. Ouain against the dangerous condition of the level crossing by the C.P.R. near Matthews' Pork Factory, Hull, Quebec.

10167—April 5—Rescinding Order No. 7931, dated September 1st, 1909, which approves of a change of location from a point on the Crow's Nest Pass Branch of the C.P.R.

10168—April 18—Authorizing the C.P.R. to carry its tracks across the public road between Lots 6 and 7, Con. 4, at station 1457.90, Township of Darlington, Ontario.

10169—December 8, 1909—Directing that general plans and specifications of the work called for by Plan known as "Part 1" of the Toronto Grade Separation, shall within two months be filed by the G.T.R. with the Board for approval, and copies at the same time furnished by the G.T.R. to the city and the Townships of Etobicoke and York; that the subway at Queen Street, in the city of Toronto, commonly known as "Sunnyside Crossing," shall be of the width of sixty-six feet; that the G.T.R. shall commence the work before the 1st of May, 1910, and shall within two years from the date of this Order complete the separation of grades at the several crossings.

10170—April 18—Approving of Standard Passenger Tariff of the Nipissing and Central Railway.

10171—April 18—Directing that the C.P.R. make the approaches to the crossing at mileage 47.31, between Concessions 8 and 9, County Wellington, Township of Puslinch, Ontario, twenty feet wide, and refence the approaches to conform to the requirements of the Board under its General Regulations affecting Highway Crossing of January 26th, 1909.

10172—April 18—Authorizing the city of Edmonton to construct a highway across the railway of the Edmonton, Yukon, and Pacific Railway Company, within the limits of the city of Edmonton, for the purpose of extending Athabasca Avenue east of the said railway to connect with the extension of the said avenue west of the said railway.

10173—April 18—Approving Standard Freight Tariffs Supplement No. 3 to C.R.C. No. W. 2, Supplement No. 3 to C.R.C. No. W. 3, and Supplement No. 2 to C.R.C. No. 7, adding certain stations on new lines of the C.P.R to the said Standard Freight Tariffs.

10174—April 19—Authorizing the C.P.R. to construct and operate an industrial spur at Okanagan Landing, British Columbia, for the Okanagan Lumber Company.

10175—April 18—Authorizing the C.N.O.R. to construct its railway across a travelled road on Lot 24, Con. 3, Tp. of Pickering, Ontario, at station 2761, by means of an overhead structure.

10176—April 18—Authorizing the C.N.O.R. to cross by means of an overhead structure the public road known as Dawes' Road, on Lot 2, Con. 2, Tp. of York, at station 139, Ontario.

10177—April 15—Authorizing the Manitoba Government Telephones to erect its telephone wires across the C.N.R. at public crossing 400 feet south-east of Oakburn station, Manitoba.

10178—April 15—Authorizing George E. Higginson, of Calumet, Quebec, to erect wires of 1,000 volts across the track of the C.P.R. about three-quarters of a mile west of Calumet station, Quebec.

10179—April 15—Authorizing the Waterloo Water & Light Commission to erect its electric wires across the track of the G.T.R. on Queen Street, Waterloo.

10180—April 19—Authorizing the Western Counties Electric Company, Limited, to erect its power and light wires across the track of the Toronto, Hamilton & Buffalo Railway at Mohawk Street, in Brantford, Ontario.

10181—April 19—Authorizing the Dominion Light, Heat and Power Company to erect light and power lines across the track of the C.P.R. at its Hochelaga Yards.

10182—April 18—Authorizing the Seymour Power and Electric Company, Limited, to erect an electric transmission line across the wires of Bell Telephone Company at Campbellford, Ont.

10183—April 18—Authorizing the Uxbridge & Scott Telephone Company to erect its telephone wires across the track of the G.T.R. on Brock Street, in the town of Uxbridge, Ont.

10184-85—April 18—Authorizing the Ottawa Electric Company to erect electric wires across the track of the C.P.R. at two different points in Ontario.

10186 to 10189 Inc.—April 18—Authorizing the Wahnapitae Power Company, the Dominion Nickel-Copper Company, Limited, and Moose Mountain, Limited, to erect transmission and telephone wires across the tracks of the C.N.R. and C.P.R. at four different points in Ontario.

10190 to 10197 Inc.—April 19—Authorizing the Hydro-Electric Power Commission of Ontario to erect its telephone and relay wires across the tracks of various railway companies at eight different points in Ontario.

10198 to 10201 Inc.—April 19—Authorizing the Bell Telephone Company of Canada to erect and maintain its aerial wires across the tracks of various railway companies at four different points in Ontario.

10202 to 10212 Inc.—April 19—Authorizing the Saskatchewan Government Telephones to erect and maintain telephone wires across the tracks of the C.P.R. at eleven different points.

10213—April 14—Authorizing the Water & Light Commission of Waterloo, Ontario, to relay the present gas main across the tracks of the G.T.R. on Queen Street, Waterloo, Ont.

10214 to 10217 Inc.—April 18—Authorizing the C.P.R. to open for carriage traffic portions of its line known as the Weyburn-Lethbridge Branch from mile 0.0 to mile 26.0; Kipp-Aldersyde Branch from mile 0 to mile 28.2; Wynyard Section from mile 88.3, to mile 125.3, between Wynyard and Lanigan, and Pheasant Hills Branch from mile 430.39 to mile 561.63, between Wilkie, Saskatchewan and Hardisty, Alberta.

10218—April 18—Authorizing the C.N.O.R. to construct its line of railway across Division Street, in the village of Colborne, Township of Cramahe, Ontario.

10219—April 18—Approving plan of "Standard Masonry Abutments" for highway crossings, on C.N.R.

10220—April 19—Authorizing the C.N.O.R. to construct its line of railway across the public road between Lot 32, Con. 1, and Lot 33, Con. 2, Tp. of Cramahe, Ont.

10221—April 18—Approving location of the C.N.R. through Townships 10-13, Ranegs 21-23, west Second Meridian, Province Saskatchewan, mileage 28.54 to 58.27.

10222—April 19—Approving location of the C.N.R. through Townships 6-10, Ranges 18-20, west Second Meridian, Province of Saskatchewan, mileage 0.00 to 28.54.

10223—April 18—Approving plan showing bridge at Cataract Street, Niagara Falls, Ontario, of M.C.R.R.

10224—April 12—Authorizing the C.P.R. to construct and operate an industrial spur across Tweed Street, and across Lot 37 in D. G. S. 65 and 66, St. Boniface, in the city of Winnipeg.

10225—April 19—Authorizing the C.P.R. to use and operate bridges Nos. 83.0, 85.2, 99.88, 114.1, and 119.7 on its Smith's Falls Section.

10226—April 19—Approving plan of the G.T.R. showing the proposed additions to the masonry at each end of the company's bridge, No. 21, at mile-post 76.02, 20th District, over the track of the Brantford & Tillsonburg Branch.

10227—April 19—Ordering the Railway Company concerned in the crossing at the following points be relieved for the present from providing further protection at the crossings named, it appearing from an inspection made by the Board's Engineer and Operating Department and from plans furnished, that the view at the crossing is excellent from both directions; that the crossing signboard is properly placed, and that there are whistling posts on the railway:—G.T.R. crossing of the first public road south of the station at Drew.

10228—April 19—Directing that within sixty days from the date of this Order the G.T.R. shall install an electric bell at the crossing just west of the station at Ridgeway, Ontario.

10229—April 19—Directing that within sixty days from the date of this Order the C.N.R. shall install an electric bell at the crossing of Gore Street, Fort William, Ontario.

10230—April 20—Authorizing the C.N.O.R. to construct its lines and tracks across the public road between Lots 24 and 25, Con. 1, at station 409, Township of Scarboro, Ont.

10231—April 19—Ordering the Railway Company concerned in the crossing at the following point be relieved for the present from providing further protection at the crossing named, it appearing from an inspection made by the Board's Engineer and Operating Department, and from plans furnished, that the view at the crossing is excellent from both directions; that the crossing signboard is properly placed, and that there are whistling-posts on the railway:—G.T.R. crossing of Haggerty Street, in the village of Newbury, mile 153.68, Con. 2, Tp. Mose, Ontario.

10232—April 20—Approving location and arrangement of the G.T.R. Company's proposed new station to be erected at Waterloo, Ontario.

10233—April 12—Authorizing the G.T.R. to construct a branch line to the premises of the Stratford Manufacturing Company, Stratford, Ontario.

10234—April 19—Authorizing the Galt, Preston, and Hespeler Railway Company to put interlocking plant into operation at Hespeler, Ont.

10235—April 18—Authorizing the Pere Marquette to reconstruct the bridge over the Canard River, in the Township of Colchester North, near the station called New Canaan, Ontario.

10236—April 20—Authorizing the P.M.R. to reconstruct bridge over Whitebread Drain, Township Sombra, Ontario.

10237—April 19—Approving plans of proposed station at Tecumseh Road, Township of Sandwich West, Ontario, M.C.R.R.

10238—April 19—Approving plan of M.C.R. showing proposed changes to be made in bridge at Park Street, Niagara Falls, Ontario.

10239—April 19—Authorizing the M.C.R. to reconstruct the overhead bridge at Murray Street, Niagara Falls, Ont.

10240—April 20—Approving plan of M.C.R. showing proposed changes to be made in bridge at Clifton Avenue, Niagara Falls, Ontario.

10241—April 19—Approving proposed changes in Canadian Classification, No. 14, viz.:—1. The elimination of item 23 on page 57 of Canadian Classification No. 14, covering ratings on evaporated potatoes. 2. The elimination of item 8 on page 65 of the Classification, covering ratings on evaporated vegetables. 3. The addition of an item in the Classification, under the heading of "Groceries," reading; Vegetables, desiccated or evaporated: In bags, boxes, or barrels, L.C.L., 3, C. L. 5.

10242—April 19—Approving location of proposed new station of C.P.R. at Carlstadt, Alberta.

10243—April 19—Authorizing the village of Abernethy, Sask., to erect telephone wires across the track of the C.P.R., and to install a telephone in the station at Abernethy, Sask.

10244—April 20—Authorizing the Manitoba Government Telephones to erect its wires across the track of the C.P.R. at Tar Plant, Archibald St., St. Boniface, Man.

10245 to 10255 Inc.—April 19—Authorizing the Saskatchewan Government Telephones to erect wires across the tracks of various railways at eleven different points.

10256 to 10260 Inc.—April 19—Authorizing the Hydro-Electric Power Commission of Ontario to erect its telephone and relay lines across the tracks of various railways at five different points in Ontario.

10261-10262—April 18—Authorizing the city of Winnipeg to lay and thereafter maintain water mains under the track of the West Selkirk Branch of the C.P.R. where said branch line intersects Manitoba Avenue and Selkirk Avenue, Winnipeg.

10263—April 18—Authorizing the town of Dunnville, to place and thereafter maintain a sewer under the track of the G.T.R. at Tamarac Street, Dunnville.

10264 to 10268 Inc.—April 18—Authorizing the village of Weston, Ontario, to lay and thereafter maintain a water pipe across the Grand Trunk and Canadian Pacific Railways at five different points in Weston, Ontario.

10269—April 19—Authorizing the Saskatchewan Government Telephones to erect telephone wires across the track of the C.P.R. between Sections 27 and 22, Tp. 17, R. 7, west 3rd Meridian, at Ernfold, Sask.

10270—April 18—Authorizing the city of Winnipeg to lay and thereafter maintain a water pipe under the track of the West Selkirk Branch of the C.P.R. where the said branch line intersects Pritchard Avenue, Winnipeg.

10271—April 19—Rescinding Order of the Board No. 3979, dated November 19th, 1907, which authorized a crossing at the point marked "A" shown on the plan on file with the Board; authorizing a crossing at the point marked "C" on said plan, and directing that the C.P.R. fence off the crossing at the point marked "B" shown on said plan.

10272—April 19—Directing that within sixty days from the date of this Order an electric bell shall be installed by the G.T.R. at Beverley Street, Galt.

10273—April 21—Directing the C.P.R. to install within sixty days from the date of this Order an electric bell at crossing of Martin Street, Milton, Ontario.

10274 to 10299 Inc.—April—Ordering the Railway Companies concerned in the crossings at the following points be relieved for the present from providing further protection at the crossings named, it appearing from an inspection made by the Board's Engineer and Operating Department, and from plans furnished, that the view at the crossing is excellent from both directions; that the crossings signboards are properly placed, and that there are whistling-posts on the railways:—

74-75-76—April 21—1. G.T.R. crossing Murray Street, Pembroke. 2. G.T.R. crossing second public highway west of Moose Creek, Ontario. 3. G.T.R. crossing highway known as Hunter's Crossing, town of Galt, Ontario.

78-79-77—April 20—4. G.T.R. crossing public highway known as Talbot Road, mile 89.88, Tp. of Middleton, Ont. 5. G.T.R. crossing highway known as the Barley Side Road, Tp. of Middleton, Ontario. 6. G.T.R. crossing of the highway about 2½ miles west of St. Mary's Junction, Ontario.

80—April 19—7. Crossing of G.T.R. at Thomas Street, Arnprior.

81—April 20—8. G.T.R. crossing highway known as St. Liboire Road, Quebec.

82—April 19—9. G.T.R. crossing public road about three miles north of Port Dover, Ontario.

83 to 99—April 21—10. C.P.R. crossing Turgeon St., village of St. Therese, Quebec. 11. C.P.R. crossing highway at Bridge St., Three Rivers, Que. 12. C.P.R. crossing highway at Cote des Perrons, (Chemin de Base), Parish of St. Rose, Que. 13 C.P.R. crossing highway known as Cassidy's Crossing, Tp. Wakefield, Quebec. 14. G.T.R. crossing second highway east of St. Mary's Junction, County Perth, Ontario. 15. G.T.R. crossing first public road ½ mile south of Wingham Junction, Tp. Morris, Ontario. 16. G.T.R. crossing public road, 1½ miles south of Dunkfield, Township Brant, Ontario. 17. G.T.R. crossing of Waterloo Road, 3½ miles north of Hespeler, Tp. Guelph, Ontario. 18. G.T.R. crossing highway ½ mile south of Paisley, Township of Elderslie, Ontario.

10292—April 19—19. G.T.R. crossing 1½ miles north of Mildmay, Ont.

10293—April 21—20. G.T.R. crossing three miles west of Fort Erie, Township of Bertie, Ontario. 21. C.P.R. crossing Canillon Street, Sauveur, (Cralton and Carlton Street, St. Malo), Quebec, P.Q. 22. G.T.R. crossing side road ¾ mile west of Stoney Point, Tp. Tilbury, Ontario. 23. C.P.R. crossing highway one mile south of Claresholm, Alberta. 24. G.T.R. crossing highway known as St. John's Crossings, two miles east of Clinton, Ont.

10298—April 20—25. C.P.R. crossing highway known as Government Road, mile 99.71, Tp. of Pembroke, Ontario.

10299—April 19—26. G.T.R. crossing highway known as Ferguson's Crossing, two miles east of Admaston, Ontario.

10300—April 5—Directing that the Guelph & Goderich Railway (C.P.R.) cut down and remove the small hill or mound on the south side of the highway at the crossing of highway between Concessions 9 and 10, Tp. of Morris, Ontario.

10301—April 19—Extending for thirty days of date of Order the time within which the interlocking plant required under Order No. 8110, dated September 14th, 1909, be installed,—made upon the application of the Vancouver Power Company, Limited, and authorizing that company to cross with its track the track of the New Westminster & Southern Railway Company at Cloverdale, B.C.

10302—April 21—Authorizing the C.P.R. to construct two additional tracks across Centre Avenue in town of Claresholm, Alberta.

10303—April 21—Authorizing Esquimalt & Nanaimo Railway to construct its tracks across the highway at mileage 6.40 of the Comox Extension, from mileage 0 at Parksville, on the Wellington to Alberni Branch, to mileage 34.79 at Union Bay, Vancouver Island, B.C.

10304—April 18—Authorizing the C.P.R. to construct spur in the city of Winnipeg, across Lot 1, and across the lane in Block 31, Parish Lot 35, St. Johns.

10305—April 20—Authorizing the C.P.R. to construct spur for the Saskatchewan Flour Mills Company, Limited, and the Rat Portage Lumber Company, Limited, in the city of Moose Jaw, Saskatchewan.

10306—March 19—Authorizing the C.P.R. to construct spur through Blocks 10 and 7 and across 18th Street, Saskatoon, Sask.

10307—April 21—Authorizing G.T.R. to substitute plan in lieu of plan approved by Order No. 6980, dated May 10th, 1909, which authorized the construction of certain branch lines for the Consumers' Gas Company, of Toronto.

10308—April 14—Authorizing G.T.R. to construct spurs to the premises of Messrs. Gibson, McCormack, Irvin Company, in the village of Weston, Ont.

10309—April 19—Authorizing G.T.R. to construct certain branch lines with sidings to premises of the Laprairie Brick Company, Limited, Laprairie, Quebec.

10310—April 20—Rescinding Order No. 9648, dated February 17th, 1910, and directing that the Niagara, St. Catharines, and Toronto Railway Company install, maintain, and operate a full interlocking plant at the crossing of the G.T.R. between Clifton Junction and Stamford, Ontario.

10311—April 21—Extending for three months from date of this Order time within which the G.T.R. shall construct branch line in the Township of Humberstone, County of Welland, Ontario, as provided in Order No. 9398, dated January 29th, 1910.

10312—April 20—Approving Standard Freight Tariff of the Chatham, Wallaceburg & Lake Erie Railway Company, C.R.C. No. 116.

10313—April 19—Authorizing C.N.O.R. to divert and cross with its line of railway the public road between Lot 13, Con. 3, and Lot 13, Con. 4, in the Township of Clarke, County of Durham, Ont.

10314—April 19—Authorizing the Qu'Appelle, Long Lake, and Saskatchewan Railway and Steamboat Company to construct a branch line on Lauriston Street, in the city of Saskatoon, Saskatchewan.

10315—April 21—Directing the C.N.O.R. to construct a subway across the public road through Lot 3, Concession 2, Township of Hope, County of Durham, Ont., and pay all costs of closing Cavan Road by the Township of Hope, except the land damages.

10316—April 21—Directing the G.T.R. to clean out the approaches at the crossing of the public road which forms the boundary between the Township of Ops and Lindsay, Ont.

10317—April 21—Refusing application of the C.N.O.R. for approval of site and side elevation of bridge over Port Hope Creek, and the G.T.R., Lot 3, Con. 2, Township of Hope, and directing that the opening in the embankment of the Port Hope Creek be at the other side.

10318—April 22—Approving plans of bridge proposed to be constructed by the C.N.R. over the Assiniboine River at Winnipeg, Man.

10319—April 21—Authorizing the C.N.O.R. to carry its tracks across the public road between Con. 1, and Con. "A," Township of Hamilton, County of Northumberland, Ont.

10320—April 21—Authorizing the C.N.O.R. to construct its tracks across the public road between Lots 10 and 11, Con. 3, Township of Hope, County of Durham, Ont.

10321—April 12—Directing that within sixty days from date of Order the C.P.R. install an electric bell with a suitable light attached at crossing at mileage 81.28, Toronto Section, Township of Markham, County of York, Ont.

10322—April 22—Approving strain sheet for proposed 39-foot girder span to be provided by the Lincoln Mills Paper Company for intake at Lybster Mills, Merritton.—(C.N.R.).

10323—April 23—Approving revised location of Tillsonburg, Lake Erie & Pacific Railway Company between Ingersoll and Code Junction, Ont., also highway crossings shown on plan of such revised location.

10324—April 22—Approving plans of C.N.O.R. strain sheets for bridge over Dixie Creek, Ontario.

10325—April 23—Declaring that C.P.R. crossing at Maitland Street, London, Ont., is protected to the satisfaction of the Board.

10326 to 10337 Inc.—April 22—Ordering the Railway Companies concerned in the crossings at the following points be relieved, for the present, from providing further protection at the crossings named, it appearing from an inspection made by the Board's Engineer and Operating Department, and from plans furnished, that the views at the crossings are excellent in both directions; that the crossing signboards are properly placed, and there are whistling-posts on the railway:—G.T.R. crossing at Garnet, in the 10th Concession of Walpole, Township of Haldimand, Ont. G.T.R. second road west of Wainfleet, Township of Wainfleet, County of Welland, Ont. G.T.R. third road west of Dunnville, County of Haldimand, Ont. G.T.R. 1½ miles

(Continued on next Page, 2nd Column).

TORONTO, CANADA, MAY 6, 1910.

CONTENTS OF THIS ISSUE.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	RAILWAY EARNINGS. Date from	Date to	1910	1909	STOCK QUOTATIONS TORONTO Price April 22 '09	Price April 14 '10	Price April 21 '10	Sales Week ended Apr. 21
Canadian Pacific Railway...	10,048	$150,000	$100	Jan. 1	April 21	$25,098.000	$21,418 000	177 175¾	....	1 8	46
Canadian Northern Rail'y.	3,180	.....	.....	"	April 21	3,104 600	2,416.100	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	"	April 21	12.755 955	10,528.845	*1st. pref. 110, 3rd pref 64¾, ord'y 28.			
T. & N. O.....	264.74	(Gov. Road)	.....	"	April 21	347.857	263,706	.....	.....	.....	.....
†Montreal Street Railway...	141.79	18,000	100	"	April 23	1,270,935	1,086,336	209¼ 209	246¾ 246¼	246⅝ 246¾	1917
Toronto Street Railway,...	114	8.000	100	"	March 31	975 806	804.631	123 124	123	123	50
Halifax Electric	13.3	1,400	100	"	April 21	56 612	49.875	.....	.....	.....	.....
London Street Railway					March 31	55.237	51 446				

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

WEEKLY EARNINGS

NAME OF COMPANY	TRAFFIC RETURNS Week Ending	1910	Previous Week	1909
Canadian Pacific Railway.	April 30	*$2,265.000	$1,789.093	*$1,814.000
Canadian Northern Rail'y.	April 30	*397.600	252,.00	*19.,600
Grand Trunk Railway	April 21	823,325	824.840	724,631
T. & N. O.....	April 30	*3,.871	25,740	40,006
Montreal Street Railway ...	April 23	78,796	77,732	67,714
Halifax Electric.....	April 21	3,8.4	3,804	3,315

*April 22nd to 30th (inclusive).

CANADIAN PACIFIC

Net Earnings in March, $2,711,173, Against $1,803,708 in 1909—Increase for Nine Months, $8,587,834.

The report of the Canadian Pacific Railroad Company for the month of March and nine months ended March 31st, compares as follows:

	1910	1909	1908	1907
Mar. gross ..	$7,796,337	$6,518,763	$5,424,931	$6,132,910
Expenses	5,005,104	4,715,055	4,123,901	3,007,174
Mar. net ...	$2,711,173	$1,803,708	$1,301,030	$2,245,736
9 mo. gross..	$69,818,325	$56,958,485	$54,938,029	$52,071,118
Expenses ..	44.233,662	39,961,700	38,224,888	34,069,200
9 mo. net..	$25,584,663	$16,996,779	$16,713,141	$18,001,918

CANADIAN NORTHERN

March, Net $272,300, Against $204,500 Year Ago—Nine Months' Gain About $478,000.

The report of the Canadian Northern Railroad Company for the month of March and nine months ended March 31st, compares as follows:

	1910	1909	1908	1907
Mileage op. ...	$ 3,180	$ 3,094	.....	.....
Mch. gross	934,100	738,700	$625,300	$488,800
Expenses	661,800	534,200	453,400	394,800
Mch. net....	$272,300	$204.500	$171,900	$94,000
9 mos. gross....	9,214,600	7,402,600	6,997,000	5,089.500
Expenses	6,580,300	5,246,500	5,017,300	3,767.200
9 mos. net....	$2,634,300	$2,156.100	$1,979,700	$1,322.300

ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously given:—

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London Street Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston.
Toronto and York Radial Railway.
Windsor, Essex and Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.
Niagara, St. Catharines and Toronto Railway.
Peterborough Radial Railway.
Berlin and Waterloo.
Sarnia St. Ry. Co.
Toronto Suburban St. Ry. Co.

HAMILTON STREET RAILWAY.

President,
Secretary and General Manager, Mr. W. C. Hawkins.
Purchasing Agent, Mr. J. B. Griffith.
Chief Engineer,

Kind of Road: Street Railway.

Length of Road: Double Track, 22 miles.
Total in single miles.

Character of Service:
Number of cars, 55.
Type, 40 closed, 15 open.
Number of motors, 125.
Power of motors, 40 h.p.
Method of controlling,
Method of braking, hand.
Gauge of track, 4 ft. 8½ in.
Weight of rails, 62 lbs. and 93 lbs.

Power:
Direct current, 575 volts.
Alternating current, 40.000 volts.
Voltage of transmission, 40,000.
Trolley voltage, 575.
Frequency of transmission for A. C., 66 2-3.
Number of phases, 3.

RAILWAY ORDERS.

east of Tillsonburg, being the Town Line between Bayham and Dereham Townships, Counties of Oxford and Elgin, Ont. C.P.R. crossing of highway known as Chemin Frederick, at mileage 21.86, county road between Lots 466 and 504, Parish of St. Felis de Valois, Que. M.C.R. crossing first highway west of Appin Junction (G.T.R. crossing), County of Middlesex, Ont. C.P.R. crossing of public road at mileage 40.66 east of town of Harrison, Township Minto, Ont. Canadian Pacific Railway crossing of highway, known as Le Rang de Lacadie, Parish of Pointe der Lac, Que. C.P.R. crossing of highway 2½ miles east of St. Basile Station, Parish of Ste. Keanne De Neuville, Que. G.T.R. crossing of highway, 1 mile south of Palmerston, Ont. G.T.R. crossing public road 1½ miles east of Walsh, Township of Charlotteville, Ont. G.T.R. crossing of public road, 2 miles north of Rymal, in Salt Fleet Township, Ont.

10338—April 21—Directing the form of protection to be provided by the G.T.R. at the crossing of Darcy Street, Cobourg, Ont.

10339—April 22—Authorizing the Canadian Niagara Power Company to carry its transmission line across the Michigan Central at Gilmore Street, Bridgeburg, Ont.

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 PENDING.

In addition to those in this issue.

Place of Work.	Tenders Close.	Issue of.	Page.
Ottawa, Ont., steel steamer	May 31.	Apr. 15	367
Vancouver, B.C., garbage destructor plant	May 31.	Apr. 22.	50
Winnipeg, Man., electrical distribution	May 16.	Apr. 22.	50
Grimsby, Ont., high school	May 30.	Apr. 22.	398
Beith, Que., macadamized road	May 10.	Apr. 22.	398
Toronto, Ont., centrifugal pumps and electric motors	May 17.	Apr. 29.	52
Sault Ste. Marie, Ont., Railway Construction	May 16.	Apr. 29.	52
Brockville, Ont., Bridge Construction	May 11.	Apr. 29.	52
Rouleau, Sask., Reconstruction of telephone system	May 14.	Apr. 29.	428
Ottawa, Ont., Construction of wharf	May 13.	Apr. 29.	427
Ottawa, Ont., Extensions and repairs to wharf	May 20.	Apr. 29.	427

TENDERS.

Montreal, Que.—Tenders will be received until May 6th, for building a public bath. L. O. David, City Clerk.

Montreal, Que.—Tenders will shortly be invited by City Surveyor Barlow for street paving and sidewalk construction to cost over a million dollars.

Westmount, Que.—Tenders will be received until May 5th, for street paving in asphalt scoria block, bitulithic or other permanent material. A. D. Shibley, City Clerk.

Brantford, Ont.—Tenders will be received until May 26th, for the construction of concrete abutments for a steel bridge. S. J. McKelvey, Tuscarora P.O.

Bridgeburg, Ont.—Tenders will be received until May 16th, for about ten thousand lineal feet of vitrified pipe sewers from 8 to 24 inches in diameter, also septic tanks of fifteen thousand cubic feet capacity. George Ross, Ross & McCaw, Consulting Engineers, Welland, Ont.

Lindsay, Ont.—Tenders will be received until May 16th for a Ten or Six-room School. Ellis & Connery, Manning Chambers, Toronto, Architects. Robert Spier, Secretary Board of Education.

Niagara Falls, Ont.—Tenders will be received until May 17th, for the construction of a macadam roadway, with the necessary drainage and culverts. John H. Jackson, C.E., Superintendent, Queen Victoria Park Commissioners.

North Bay, Ont.—Tenders will be received until May 11th, for a number of sectionmen's houses on the T. & N.O. Railway. A. J. McGee, Secretary-Treasurer, 25 Toronto St. Toronto.

Orillia, Ont.—Tenders will be received until 8 p.m., Monday, May 16th, for sewage sedimentation tanks. Plans, etc., may be seen at the Town Hall, Orillia, or at the office of the Chief Engineers, 204 Mail Building, Toronto. W. C. Goffatt, Mayor; Chipman & Powers, Chief Engineers.

Ottawa, Ont.—Tenders will be received until May 10th, for the construction of a line of railway between Nelson and Chatham, N.B. Plans may be seen at the Station Master's Office, Chatham, N.B., or at the Chief Engineer's Office, Moncton, N.B., and at the office of the Secretary of the Department of Railways and Canals, Ottawa. A. W. Campbell, Chairman, Government Railways Managing Board.

Ottawa, Ont.—Tenders will be received until May 25th, for the equipment necessary for a power house in connection with the shops east of Winnipeg, including water tube boilers, mechanical stokers, feed water heaters, engines, generators, air compressors and pumps. Plans may be seen at the office of the Chief Engineer of the Commissioners, Gordon Grant, Ottawa, also at the office of the District Engineer at St. Boniface, Man. P. E. Ryan, Secretary, Transcontinental Railway Commissioners.

Port Arthur, Ont.—Tenders will be received until May 15th, for the erection of a Roman Catholic Church. Rev. Father J. A. Grenier, Parish Priest. G. Emile Tanguay, Architect, 20½ d'Aiguillon St., Quebec.

Toronto, Ont.—Tenders will be received until May 14th, for the erection of an addition to Osgoode Hall. H. F. McNaughten, Secretary, Public Works Department.

Toronto, Ont.—Tenders will be received up to Tuesday, May 17th, for the supply of soft coal screenings (or for run of mine) for the Waterworks (about 15,000 tons of bituminous slack coal).

Also tenders will be received for 2,500 tons of coarse lump coal (or for run of mine) for East Toronto, and the dredges. G. R. Geary, (Mayor), Chairman, Board of Control.

Toronto, Ont.—Tenders will be received until Tuesday, May 17th, for a year's supply of lumber required by the Property Department. G. R. Geary (Mayor), Chairman Board of Control.

Toronto, Ont.—Tenders will be received until May 14th for the erection of a Brick School House at Mimico, Ont. E. J. Lennox, Architect.

Woodstock, Ont.—Tenders will be received until May 7th, for the erection of a 125 foot steel bridge with concrete abutments and also for a 30 foot reinforced concrete arch. F. I. Ure, County Engineer.

Winnipeg, Man.—Tenders will be received until May 11th for the erection of two fire stations and drill tower. A. & W. Milville, Architects, 813 Union Bank Building.

Winnipeg, Man.—Tenders will be received until May 5th, for labor and materials necessary to erect addition to the upper floor of the crematory building. M. Peterson, Secretary, Board of Control.

Winnipeg, Man.—Tenders will be received until June 28th, for construction of concrete piers and erection of steel superstructure and floors with two lines of street railway tracks, re overhead bridge at Brant St. M. Peterson, Secretary, Board of Control.

Moose Jaw, Sask.—Tenders will be received until May 7th, for the erection of a Land Titles Building. F. J. Robinson, Deputy Minister of Public Works.

Regina, Sask.—Tenders will be received until May 9th, for the construction of a sewer from the Legislative Buildings. F. J. Robinson, Deputy Minister of Public Works.

Vancouver, B.C.—Tenders will be received until May 7th for ornamental cluster lamp standards, electrical work and electrical apparatus, concrete work and erection of standards, in connection with the proposed system of ornamental street lighting. E. A. Earle, 532 Pender St. W.

Vancouver, B.C.—Tenders will be received until May 7th, for the supply, laying and joining of about 72 miles of wire-wound stave pipes; 2½ miles of lap-welded 12-inch steel water pipe; and a supply of sluice, air and scour valves. C. L. Blight, C.M.C., Richmond Municipality, Lulu Island. Cleveland & Cameron, Consulting Engineers, 506 Winch Buildings, Vancouver.

Victoria, B.C.—Tenders will be received until May 9th, for the construction of a motor yacht. F. C. Gamble, Public Works Engineer.

Victoria, B.C.—Tenders will be received until May 9th, for supply and erection of Volute sewerage pump, electric motor, and an automatic starter. Wm. W. Northcott, Purchasing Agent, City Hall.

CONTRACTS AWARDED.

Annapolis Royal, N.S.—J. Avord Beele,, of Bridgetown, was given the contract for the construction of a wood stove pipe flume, 49 inches in diameter and 600 feet long, at $2,200. The Pedlar People offered to instal a 14 gauge galvanized iron 48-inch flume for $3,000.

Halifax, N.S.—On page 428 last week we gave a list of tenders for supplies at Halifax. Here are some additional figures:—

LUMBER—Rhodes, Curry & Co., $1,370.96; J. McInnes & Son, $1,361.43; Brookfield Bros., $1,342.17. Brookfield Brothers was recommended by the Board for acceptance.

SPECIAL CASTINGS—Hillis & Sons, $1,722.25; Douglas & Co., $1,794.24; Dartmouth Iron Foundry, $1,908.58; Hillis & Sons recommended.

HARDWARE—A. M. Bell & Co., $2,076.62; Lawrence Hardware Co., $2,084.50; W. Robertson & Son, $2,039.20. Roberston & Sons recommended.

GRANITE—A. W. Yeadon's tender recommended.

The Engineer will report on explosives before the contract is awarded.

Montreal, Que.—The Atlantic Quebec & Western Railway have given to the Dominion Bridge Company a contract for all the steel superstructures on the line. The sub-structures on 27 bridges below Port Daniel, have been finished, and most of the roadbed has also been completed.

Chatham, Ont.—E. M. Graves, of Cleveland, Ohio, was given a contract by Chatham Township for the construction of a large outlet drainage work. The tenders were as follows:—

E. M. Graves, Cleveland, Ohio	$25,457
Gilmour Bros., Toledo, Ohio	28,989
Chatham Dredging Co., Chatham	30,200
Windsor Dredging Co., Windsor	31,350

Connelly & McDonell, Stratford, 25 cents a cubic yard.

Fort William, Ont.—Stewart & Hewitson were awarded a contract for rock and screenings at $1.35 a cubic yard, by the Fort William Street Railway Company.

Mimico, Ont.—Six tenders were received for the construction of the purification works for the New Toronto sewerage system. The prices ranged from $3,200 to $6,194. The tender of O. L. Hicks, of Humber Bay, was accepted, being for $3,535. A. L. McAllister is the engineer in charge.

Ottawa, Ont.—Contracts for dredging in Quebec Province totalling $200,000 have been awarded. The biggest job is at Quebec, amounting to $60,000. The successful bidders are:

For Quebec Harbor. Dominion Dredging Company, 24½ cents per cubic yard; St. Maurice River at St. Pierre, 15 cents; Beauharnois, H. M. Conley, 20 cents; Berthierville, L. Cohen and Son, 16 cents; Batiscan, Dufresne and Marchildon, 20 cents; Riviere du Loup, W. J. Poupore, 20 cents; Yamaska River, W. J. Poupore, 18 cents; Valley-field, General Construction Company, 21½ cents.

Toronto, Ont.—The American Sewer Pipe Company were given the contract for supplying conduit required by the city in connection with the hydro-electric system at the following prices per duct foot:—Butt joint, round bore, .0590 cents; square bore, .0635 cents.

The National Iron Works, Toronto, as mentioned in a previous issue, succeeded in securing the order for the annual supply of 3, 4 and 6-inch cast iron pipe at the following prices per length:—3-inch, $4.35; 4-inch, $4.88; 6-inch, $6.97; 8-inch, $10.62; 10-inch, $14.96; 12-inch, $19.99. The Canada Foundry who will supply the 8, 10 and 12-inch pipe submitted the following prices:—3-in., $4.41; 4-in., $4.92; 6-in., $7.05; 8-in., $10.50; 10-in., $14.80; 12-in., $19.85.

Toronto, Ont.—The Board of Control awarded to John Wagner, of Cleveland, the contract for the high-level intercepting sewer east of the Don, despite the objections registered by the next lowest tenders, Ryan & Reilly, of Philadelphia, who claimed that the former's tender was irregular, as it did not contain their sureties. The city solicitor held that the board could legally award the contract to Wagner, regardless of the oversight. Wagner's price was $107,000, and Ryan & Reilly's $120,000.

Weston, Ont—Contracts for pumps and filters were awarded as follows:—Pump house to Geo. B. Moogk, Waterloo, $4,500.00; mechanical water filters to American Water Softener Company, Philadelphia, $2,742.00; electrically operated pumping machinery to Smart-Turner Manufacturing Company, Hamilton, for $6,758.00.

Winnipeg, Man. — Public Parks Board awarded to the Great West Wire Fence Company a contract for 1,200 feet of wire fencing at 35 cents a lineal foot.

Winnipeg, Man.—The city of St. Boniface have awarded the contract for street paving for the present year to the Bitulithic and Contracting, Limited. It is estimated that between 50,000 and 75,000 square yards of pavement will be laid.

Winnipeg, Man.—The C.P.R. has let contracts for the erection of two new steel bridges, one at Headingly, and the other at Souris. Contracts were let to the Dominion Bridge Company, who have now in hand the building of the more important Lombard Street bridge across the Red. The new structures will be of most modern type. Their completion will mark another step in the betterment of the Souris line which is conceded to be one of the best in the province.

Winnipeg, Man.—The W. A. Harper Construction Company of this city has secured contracts for the erection of seventeen elevators in Saskatchewan for the Maple Leaf Milling Company. The elevators will be along the Pheasant Hills, Sheho-Lanigan and Arcola branches of the C.P.R. Each will hold 30,000 bushels and the contract price for the seventeen is $102,000. The Maple Leaf company contemplates the expenditure of a million dollars in Ontario and the west this season. In this expenditure will be included a 6,000 barrel and a million bushel elevator at Port Colborne, Ont.

Calgary, Alta.—The following tenders were received for **Cement:**—Canada Cement Company, $2.63½ per barrel, f.o.b., Calgary, not including sacks; Western Canada Cement & Coal Company, $2.63½; Rocky Mountains Cement Company, $2.65.

For **Concrete Curbs,** prices per lineal foot were as follows:—Batchelor, Marshall & Skarin, 42 cents; Calgary Paving Company, 46 cents; Hewson & Boney, 47 cents.

Subway excavation, per cubic yard; prices were as follows:—

Tenderer.	Excavation.	Free haul.	Overhaul of 100 feet.	Free haul of one-half mile.
John Breckenridge	$0.67	500 feet	1¼c.	$0.93¾
Rooney & McGrath	$0.94	2,640 feet	1c.	$0.94
	$2.00 for abutments	2,640 feet	1c.	$2.00
Davidson & Mestaway, Edmonton	$0.77	2,640 feet		$0.77
A. C. Stewart, Winnipeg	$1.00	2,640 feet		$1.00

TENDERS FOR SEWER PIPE were as follows:—

	2′ Long.			Standard,		2′ 6″ Long.				
	4″	6″	8″	9″	10″	12″	15″	18″	20″	24″
Blackmer & Post	11¾c.	18½	30	33	39 2-10	51 7-10	76 7-10	$1.10¾	$1.45½	$2.02½
Pipe Company	19c.	30	43	48	56	72	$1.10	$1.50	$2.12	$2.05
Canadian Equipment	10¼c.	.16 9-10	.26 1-19	$ .32	$ .38¾	.48½	.71	.93	$1.20	$1.77
Calgary	31½c.	.49¼	.91	$1.10	$1.30	$1.85	$2.50	$3.27	$4.20	$6.20
	16½c.	.17	.26½	$ .32¾	$ .38¾	.49¼	.71½	$0.94	$1.22	$1.81
	32c.	.50	.92¾	$1.13	$1.35½	$1.02	$2.52	$3.30	$4.23	$6.25
Stanley Brock,	11c.	.17	.27	$ .34	$ .30¼	.53	.73½	.96½	$1.25	$1.80
Winnipeg	35c.	.51	.81	$1.15	$1.24	$1.60	$2.30	$3.00	$3.80	$5.25
						All pipes 2′ Long.				
Hamilton & Toronto Sewer	11¼c.	.16 19-20	.27	.....	$ .39⅜	.53	.75	....	$1.30½	$2.08
Pipe Co.	45c.	.67½	$1.12½	.....	$1.20	$2.25	$3.05	....	$5.57 3-20	$8.77 4-5
Dominion Sewer	10⅝c.	.15 7-10	.29 1-5	$ .34 1-5	$ .38 1-5	.54 1-5	.75 1-5	....	....	....
Pipe Co.	32c.	.48	$1.01½	$1.18½	$1.37	$1.90½	$2.63	....	....	....
German, Clancey &	11½c.	.17½	.25½	$ .30	$ .35½	.45	....	....	....	....
Grindley	37c.	.62	.95	$1.06	$1.25	.53½	.82½	$1.20¼	$1.32¾	$2.00
Evans & Howard	12c.	.21	.30 6-10	.36 6-10	.39½	$1.55	....	....	....	....
Fire Brick Co.	35c.	.62 8-10	.92½	$1.12	$1.20	$1.72½	$2.51 6-10	$3.73½	$4.33½	$6.67¾

Tenders for iron castings were submitted by:—
1.—Union Iron Works.
2.—Alberta Iron Works.
3.—Calgary Iron Works.

	1.	2.	3.
Manhole Frame and Cover ..	$20.54	$14.45	$13.95
Extra Manhole Covers	6.85	4.50	4.95
Catch Basin, Open Grate, Gutter pattern	7.55	6.95	8.00
Extra Gutter Gates	2.37	2.15	2.40
Catch Basin, Side Entrance ..	8.70	7.90	8.33
Extra Covers for Side Entrance	1.85	1.95	1.75
Side Entrance Castings	1.44	1.35	1.75
Street Railway, Track Drips ..	10.17	8.90	10.70

Davidson, Sask.—For a solid brick town hall, Isaac J. Roseborough of Davidson, was given a contract at $13,700. Other bids were:—E. Senior Estlin, Winnipeg, $14,757.55; V. Desautel, Davidson, $15,250; G. N. Hughes, Saskatoon, $14,289; E. J. Rud & Company, Saskatoon, $18,459.95.

Prince Albert, Sask.—Day labor will be used in the construction of 10,500 lineal feet of concrete sidewalk, for which tenders were recently invited with the following result:—John Craig, Prince Albert, 18 cents; Western Pavers, Ltd, Winnipeg, 18⅛ cents; City Engineer, 17 cents.

Saskatoon Sask.—The Western Pavers, Ltd., of Winnipeg, were awarded the contract for concrete sidewalks, at $56,395. Other tenders were:—Forest City Paving Company, Regina, $56,512; Saskatoon Concrete Company, Saskatoon, $69,360; Batchelor, Marshall & Skarin, Calgary, $76,332.50.

Of much interest to engineering contractors is the following list of contracts let by the City of Saskatoon for works to be completed during 1910:

Works	Contractor	Amount
Pedestals for Footbridge	Saskatoon Const. & Eng. Co., Saskatoon	$1,500
Superstructure for Footbridge	Algoma Steel Bridge Co., Winnipeg	14,500
Foundation for Stand Pipe	Saskatoon Const. & Eng. Co., Saskatoon	2,477
Stand Pipe Superstructure	Western Bridge & Equipment Co., Chatham	6,478
Labor on Sewer and Water Extensions	Saskatoon Const. & Eng. Co., Saskatoon	64,485
Labor on Sewer and Water Extensions	William Cooke, Saskatoon	27,330
Valves and Hydrants	Kerr Engine Company, Walkerville	7,700
Cast Iron Pipe	Canada Iron Corporation, Fort William	43,816
Sewer Pipe	American Sewer Pipe Co., Akron, O.	18,371
Water Meters	Neptune Meter Company, New York	8,160
Concrete Sidewalks	Western Pavers, Limited, Winnipeg	56,395
House Sewer and Waterworks services	Day Labor, estimated cost	27,000
Total		$278,212

Vancouver, B.C. — The following tender for four auto hose waggons and auto chemical engines was accepted: W. H. Seagrave, $25,983.

The following also were received: Northern Electric, 20 miles copper wire at $21.50 per 1,000 feet; 1,000 feet of covered wire, $13.00 per 5.000 feet; half-inch conduits, $5.75 per 100 feet; 1,000 insulators at $45 per 1,000 feet.

F. Darling tendered for the same as follows: $21.50, $13.50, $5.85, $24.60.

Cope & Son's tender was $1.407 for the lot, and the Canadian General Electric, $1.374 for the lot. These were referred to the city electrician.

The following tenders were for the erection of two fire halls: James Layfield, No. 4 firehall, $16,620 and No. 11, $10,675; C. S. Phalen No. 11, $9,589; R. D. Cowan and F. F. Bennett, No. 4, $15,854; N. G. Patterson, N. 11, $8,500. The lowest tenders, those of Cowan & Bennett, for No. 4, $15,854; and U. G. Patterson, for No. 11, $8,500, were accepted.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, Que.—Montreal Street Railway subway bill recently passed, without opposition, its second reading in the provincial Upper House. The underground railway company's measure is still being discussed in the Lower House.

Montreal, Que.—The Grand Trunk viaduct scheme was recently outlined before the Railway Commission. It is the intention of the company to construct a four-track viaduct extending from the Bonaventure Station to a point at St. Henri station, where the line diverges to the south, then to a point east of Wellington Street subway and back to the point of diversion, carrying the line westerly to a point west of Cote Street. Paul Road, and coming down to grade level in the company's yards at Turcot. This would eliminate an grade crossings in the city of Montreal controlled by the Grand Trunk, except where grade crossings would be absolutely necessary for switching purposes. The viaduct would be approximately four miles in length, and the cost has been estimated at upwards of eight million dollars.

Montreal, Que.—The C. P. R. has decided to proceed at once with the reconstruction and enlargement of the Place Viger Station and hotel, and among the building schemes of the year in Montreal this will be second only in magnitude to the work the same company is carrying out at Windsor Street Station. All the property necessary for the huge terminal scheme of the company at the Place Viger has been bought, the necessary permission obtained to close various streets and the plans completed and approved. Tenders for the foundation work have been invited, and it is expected the contracts will be well in hand before the close of the present month.

Sherbrooke, Que.—A two-million dollar monorail company has been organized here. Shops will be built at Montreal and Levis. Toronto or Ottawa and Medicine Hat. Five cars have already been built.

Winnipeg, Man.—A contract for the Greenway and Wakopa branch of the Canadian Northern, which will be extended to Deloraine, has been given to Nat Boyd. The Goose Isle branch will be pushed on twenty-five miles north paralleling the C.P.R. line to Teulon. It will be eventually built to Fisher River, affording an outlet for the country lying along the Washow and Fisher rivers, which is now being rapidly taken up. Engineers are out locating the line. It is hoped to be able to carry the Ochre river line some seventy miles farther up the west shore of Lake Manitoba. Work is being pushed with all possible speed on the line from Melfort to Humboldt and along the Rossburn extension. The Mayfield extension is being pushed into the Willow Bunch country and a track-laying gang will leave Winnipeg for work upon it this week.

Winnipeg, Man.—The prospects now are that the Hudson's Bay Railway will make considerable progress this year and that by fall it will have taken definite outline. At the present time there is available the sum of $680,000 for engineering and construction if the half million included in the supplementary estimates is passed. Of the total sums available it will need approximately $80,000 for the engineering and location work, which is now being carried on. A couple of parties are in the field and another will be sent out next week. Other parties will be put out as soon as navigation opens to the upper end of Lake Manitoba. Probably the first contract let will be for the construction of the bridge across the Saskatchewan at The Pas, and this will take about $250,000 of the total available, leaving $350,000 for grading.

Camrose, Alta. — The laying of steel on the Canadian Northern has just been completed to this point, making full connection with Vegreville and the east. Sidings have been made and telegraph poles set also.. Camrose now has her second road ready for business eastward. The G.T.P. is fully graded far beyond here and steel will be laid soon.

Edmonton, Alta.—Jean Revillon, of Revillon Bros., will make application to the next Alberta Legislature for a charter to build a railway from Edmonton to Grande Prairie, on Peace River, via Sturgeon Lake, a distance of 250 miles. The guarantee asked will not be as high as that given the Alberta & Great Waterways Railway.

LIGHT, HEAT, AND POWER

Montreal, Que.—The Montreal Light, Heat and Power Company will expend during the present year $750,000 in normal extensions to its gas and electric departments, and in extending its system of gas distributing mains throughout the city and district. Extensive arrangements are being made for enlarging the capacity of the plants in every department.

SEWERS, SEWAGE AND WATERWORKS.

North Vancouver, B.C.—District Engineer Cameron is preparing plans for the installation of waterworks at North Lonsdale.

BY-LAWS AND FINANCE.

Montreal, Que.—The town of Outremont is seeking permission to borrow $190,000 for local improvements.

Cobalt, Ont.—Until May 17th, R. L. O'Gorman, town clerk, offers for sale waterworks and sewerage debentures amounting to $25,000.

Clinton, Ont.—A by-law to spend ten thousand dollars on good roads and another to give the Electric Light Company a new contract were both carried.

Fort William, Ont.—This city has just sold debentures issued for the following purposes: — Waterworks, $59,000; electric light, $28,000; telephone, $27,000; street railway, $152,000; roads and sidewalks, $151,000; sewers, $200,348; Grand Trunk Pacific, $100,000; hospital, $6,000; bridges, $10,000.

North Toronto, Ont.—A by-law authorizing the issue of debentures to the amount of $25,000 will be submitted to the electors on June 4th, to extend the waterworks system.

Owen Sound, Ont.—A by-law to loan the Imperial Cement Company $20,000, carried.

Woodstock, Ont.—N. E. Birtch, clerk of Oxford County, offers for sale $50,000 road improvement debentures.

Carlyle, Sask.—Ratepayers will probably carry a $20,000 waterworks by-law.

New Westminster. B.C.—Ratepayers will shortly vote on school by-laws amounting to $97,500.

MISCELLANEOUS.

Sydney, N.S.—The output of the Dominion Coal Company for April, is 243,000 tons. The output for the Dominion Iron & Steel Company for April is officially declared to be as follows:—Pig iron, 21,194 tons; steel ingots, 25,263 tons Shipments totalled 21,900 tons.

Montreal, Que.—Dominion Railway Commission ordered the construction of bridges at Rockfield and Lachine. The greatest portion of the cost will be borne by the G.T.R.

Montreal, Que.—Council decided to spend $1,387,950 on the construction of street pavements and permanent sidewalks.

Kingston, Ont.—The foundation stone of "Gordon Hall," the new chemistry building at Queen's University, was laid on April 27th by Sir James Whitney.

Niagara Falls, Ont.—The Queen Victoria Niagara Falls Park Commissioners invite proposals for the construction of nine miles of macadamized roadway along the Niagara River. This is the largest connecting link of the roadway that will unite Fort Erie with the Queen Victoria Niagara Falls Park at the Falls, and it is hoped to have most of the work finished this year. The construction will be supervised by the Superintendent of the Park System, John H. Jackson.

Winnipeg, Man.—The works and property committee is recommending to the council that local improvements aggregating $146,178 be done this year. These include four asphalt pavements, fifteen granolithic walks, eleven plank walks, ten sewers, seventeen plank crossings, and that nine streets be graded.

Winnipeg, Man.—In another column appears an invitation for tenders for the construction of a viaduct over the C.P.R. yards at Brown and Brant Streets. The total cost has been estimated at $235,000, the contract calling for something like 5,000 yards of concrete and 30,000 lineal feet of piling in addition to the superstructure which involves about 2,000 tons of steel. The tenders are to be in by the 28th June, the base work to be completed on November 15th of this year, and the superstructure to be done by June 1st, 1911. The bridge will extend from Logan Avenue to Dufferin Avenue and will carry one 340 ft. clear span. The deck will carry a 26-ft. roadway, with accommodation for double track electric railway system. Reinforced concrete and wooden blocks will be used in the floor construction.

Victoria, B.C.—An automobile will be purchased for the use of the city engineer, Mr. Angus Smith.

Victoria, B.C.—City engineer is preparing a report relative to the proposed trunk road improvements which would involve an expenditure of $500,000.

PERSONAL.

Dr. Charles A. Hodgetts, Secretary of the Provincial Board of Health of Ontario, who was recently appointed a Fellow of the Society of Medical Officers of Health of Great Britain, being the first gentleman in the overseas dominions to have that honor conferred upon him, was elected president of the Association of Executive Officers of State and Provincial Boards of Health on April 29th at the Washington, D.C., convention.

Messrs. Chapman & Walker, Limited, engineers and contractors, of Toronto, who are the sole Canadian agents of Crossley Bros., Limited. Dick, Kerr and Company, Limited, and several other well-known British firms, have opened a branch office at 429 Coristine Building Montreal.

Mr. Alex. R. Dufresne, A. M. Can. Soc. C. E., district engineer of public works at Winnipeg, has been appointed to the position of assistant chief engineer with headquarters in Ottawa, and it is understood that he will have charge of all dredging work.

Mr. Wm. Zobiski Earl, M. Can. Soc. C. E., who succeeds Mr. Dufresne, was formerly in private practice in St. John, N.B.

Mr. Albert Eastman of Syracuse, succeeds Mr. Walter Pigott as manager of the Windsor, Essex and Lake Shore Railway.

Mr. W. A. Reilly, D.L.S., with whom is associated Mr. Harold Dawson, has just been given a contract to resurvey a portion of the city of Regina. The firm of Reilly, Dawson & Reilly, just established, recently opened offices in the capital of Saskatchewan in the Willoughby & Duncan Block, for the practice of architecture, surveying and civil engineering. They will make a specialty of engineering works for municipalities, road construction, water supply and sewage disposal.

Mr. J. B. Comstock, for six years with the Westinghouse Electric & Manufacturing Company at its East Pittsburgh works, and for four years manager of its publication department and printing plant, severed his connections with that company in April, to accept a similar position with the P. & F. Corbin Company of New Britain, Conn. Prior to Mr. Comstock's connection with the Westinghouse Company, he filled the same position with the Corbin Company that he has recently been recalled to assume.

Mr. J. J. Antonisen, city engineer of Port Arthur, Ontario, has also been appointed by the city council, commissioner in charge of the public utilities. He will have full executive power over lights, telephones, waterworks, street railway construction, maintenance, power, etc. His position is similar to that of general manager of a railway company. He hands over all executive work and will act only in a legislative capacity in future. It is the first appointment of a general manager of a city in Canada and was made on authority given the city in a special Act of the Ontario Legislature last session.

Mr. John Feeney will probably be appointed city engineer of Fredericton, N.B.

Mr. A. K. Grimmer, formerly city engineer of Fredericton, N.B., and latterly as Professor in the Engineering Department of Manitoba University, has accepted the appointment of city engineer of Medicine Hat, Alta., and has already taken up his residence there.

Dr. George A. B. Hall has been selected as the new medical health officer for the city of Victoria, B.C. Dr. Hall is a brother to Lewis Hall, ex-mayor of the city. He formerly sat in the local legislature as M.P.P. for Nelson. For over a year past he has been residing and practising in Victoria.

OBITUARY.

Mr. C. B. Reeve, former vice-president and general manager of the Grand Trunk, died May 1st, at his Lamirada home, aged 71.

SOCIETY NOTES.

Canadian Railway Club, Montreal:—The annual meeting of the Canadian Railway Club was held on Tuesday night, when A. A. Maver, master mechanic of the Grand Trunk, was elected president and A. A. Goodchild, auditor of stoves of the C.P.R., vice-president.

Toronto Architects' Annual Meeting:—The annual meeting of the Toronto Society of Architects was held on Tuesday, May 3rd. Reports from the various committees indicate that the past year was a very successful one for the society, a great deal of good work having been accomplished, particularly on educational lines and pertaining to the general welfare of architecture. After the secretary's report and the president's address, the following officers were elected for the coming year:—President, Mr. C. H. Acton Bond; vice-president, Mr. J. C. B. Horwood; secretary, Mr. P. B. McGiffin; treasurer, Mr. A. H. Cassels; committee, Mr. J. P. Hynes and Mr. S. G. Beckett.

Royal Architectural Institute:—Alcide Chaussé, honorary secretary of the Royal Architectural Institute of Canada writes that the third general annual assembly of that institute will be held in Winnipeg on August 24, 25, 26 and 27 next. Every Canadian architect is invited, whether a member of the society or not. The programme will be distributed early in July.

Canadian Institute Elects Officers:—At the latest meeting of the Canadian Institute, Toronto, the nomination of officers took place, and, as there was no opposition, the following were declared elected:—President, Mr. J. B. Tyrrell; first vice-president, Prof. J. P. McMurrich; second vice-president, T. Arnold; secretary, J. Bertram; treasurer, Wm Scott; Librarian, Prof. A. B. Macallum; editor, Dr. Geo. Kennedy; curator, F. Williams. Those nominated for the Council were: Dr. J. H. Faull, Dr. Coleman, R. F. Stupart, Prof. Keys, Prof. Millar, W. B. Tyndall, W. Brown, T. Blizzard, Prof. Bell, Prof. Brodie, A. B. Spotton and D. Ellison.

EXPLORING THE ANTARCTIC.

To the members of the Canadian Institute, the citizens of Toronto and Canadians generally owe much. Under the auspices of that society many lectures of inestimable value have been given during the winter, but the one most appreciated was undoubtedly that delivered on Wednesday evening, April 27th, by Sir Earnest Shackleton, who told to some four thousand people the story of his dash for the South Pole.

In view of the fact that data of a scientific character will be published in book form, beyond the remark that observations were made every two hours during the whole expedition, few technical details were given. The lecture, which was a literary treat, was illustrated with pictures and cinematograph views that added a vividness to an account of Antarctic exploration that will not soon be forgotten.

One of the important discoveries of the expedition was coal, the presence of which proved that sometime within 180 miles of the South Pole the climate had once been warm. It will be remembered that the party was reluctantly compelled to turn back when within 97½ geographical miles of the goal, on account of a food scarcity. They could have reached the Pole, but, as Sir Earnest humourously put it, to find the Pole and starve to death would have been of no use to them. The ascent of Mount Erebus while in volcanic action, the first ascent ever made by man; the climbing of the largest glacier in the world, the discovery of ranges of mountains never known before, were all described in characteristically modest fashion.

Professor J. J. Mackenzie, president of the Canadian Institute, presided.

SCIENCE DEPARTMENT, QUEEN'S UNIVERSITY

The results of the Department of Engineering, Mining and Applied Science of Queen's University indicate a large increase in the number of graduates in the Science Department. The examination results for the various degrees in the different departments were as follows:—

Master of Science—B. E. Norrish, B.Sc., Walkerton.

Bachelor of Science in Mining Engineering—A. M. Bateman, Kingston; W. F. Battersby, Brantford; E. H. Birkett, Kingston; O. G. Gallaher, Ottawa; O. Gillette, Hamilton; A. A. Holland, Ottawa; D. E. Keeley, Railton; T. J. Mateer, Kingston; A. G. Morrison, Woodstock; W. M. Morrison, Maxville; A. A. MacKay, Scotstown, Que.; E. H. Orser, Kingston; J. H. Rose, Winchester (with honors); C. Spearman, Stittsville; A. C. Young, Renfrew.

B.Sc. in Chemistry Engineering—K. S. Clarke, Woodstock.

B.Sc. in Civil Engineering—F. A. Bell, St. Thomas; R. Callander, Scotland; D. S. Ellis, M.A., Kingston (with honors); McL. Ewart, Medicine Hat, Alta.; W. J. Fletcher, Valetta; F. B. Goedike, Toronto; P. K. Johnston, Cleveland, O.; J. J. MacEachern, Gravenhurst; L. R. Neilson, Stella; N. A. Newlands, Kingston; O. Stanley, Port Colborne (with honors).

B.Sc. in Mechanical Engineering—H. G. Bertram, Dundas (with honors); J. L. Stanley, Port Colborne.

B.Sc. in Electrical Engineering—A. T. Arthur, Carleton Place; S. N. H. Butler, Loreburn, Sask.; V. W. Crawford, B.A., Kingston; J. V. Dobson, Picton; G. F. Drewry, Stirling (with honors); E. S. Frost, Pembroke; M. S. Madden, Napanee; E. S. Malloch, Hamilton; R. F. Ockley, Kingston; K. F. A. Williams, B.A., Kingston; J. H. Young, Almonte.

B.Sc. in Sanitary Engineering—W. R. Hambly, Napanee; G. A. Simmons, Simmons, Que.

Diploma in Mining Engineering—J. C. R. McPherson, Woodstock.

Diploma in Civil Engineering—W. S. Earle, Picton; J. C. Moyer, St. Catharines.

COMING MEETINGS.

APPALACHIAN ENGINEERING ASSOCIATION.—May 6-7. Annual meeting at Winston-Salem, N. C. Secretary, Henry M. Payne, Morgantown, W. Va.

AIR BRAKE ASSOCIATION.—May 10. Annual meeting at Indianapolis, Ind. Secretary, F. M. Nellis, 53 State St., Boston, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—May 16-20. Annual meeting at Los Angeles, Cal. Secretary, P. W. Drew, Room 306, 135 Adams St., Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION.—May 17-19. Annual meeting at Chicago, Ill. Secretary, Franklin H. Wentworth, 87 Milk St., Boston, Mass.

AMERICAN RAILWAY ASSOCIATION.—May 18. Annual meeting at New York City. Secretary, W. F. Allen, 24 Park Pl., New York City.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—May 19-20. Semi-annual meeting at Cincinnati, Ohio. Secretary, F. E. Sanborn, Ohio State University, Columbus, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—May 23-26. Annual meeting at Chicago, Ill. Secretary, D. B. Sebastian, 327 La Salle Station, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—May 23-28. Annual meeting at St. Louis, Mo. Secretary, T. C. Martin, 29 West 39th St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—May 31-June 3. Spring meeting at Atlantic City, N.J. Secretary, Calvin W. Rice, 29 West 39th St., New York City.

ENGINEERS' SOCIETY OF PENNSYLVANIA.—June 1-3. Annual convention at Harrisburg, Pa. Secretary, E. R. Dasher, Gilbert Bldg., Harrisburg, Pa.

MASTER CAR BUILDERS' ASSOCIATION.—June 15-17. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

AMERICAN FOUNDRYMEN'S ASSOCIATION.—June 7-9. Annual convention at Detroit, Mich. Secretary, Richard Moldenke, Watchung, N.J.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—June 20-22. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—June 21-24. Annual convention at Chicago, Ill. Secretary, Chas. W. Hunt, 220 West 57th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—June 22-24. Semi-annual meeting at Niagara Falls, N.Y. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

MARKET CONDITIONS.

Following the quotations of the various articles listed in the markets will be found in brackets numbers, thus (10). These numbers refer to the list number of advertisers on page 3 of this issue and will assist the reader to quickly find the name and address of a firm handling any particular article. Buyers not able to secure articles from these firms at the prices mentioned will confer a favor by letting us know.

Montreal, May 4th.

Prices are as follows:—

Antimony.—The market is steady at 8¼ to 8½c. (111).

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.90; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $2.00 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $1.95; imported, $2.20 (111, 119).

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 year will be the largest in the history of the country. Prices on foreign fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch). (164).

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. (26, 164).

Chain.—Prices have advanced considerably of late, being now as follows per 100 lbs.:—¼-inch, $5.10; 5-16-inch, $4.50; ⅜-inch, $3.70; 7-10-inch $3.45; ½-inch, $3.35; 9-16-inch, $3.25; ⅝-inch, $3.20; ¾, ⅞ ,and 1-inch, $3.15.

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 14¼ to 14½c.

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.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. 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. (111).

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

Iron.—First boats are now arriving at Montreal, and importers are quoting prices, ex-wharf, about $1 per ton under prices ex-store. Following are the prices, on cars, ex-wharf, Montreal:—No. 1 Summerlee, $20.50 to $20.75 per ton; selected Summerlee, $20 to $20.25; soft Summerlee, $19.50 to $19.75; Carron, special, $20 to $20.50; soft, $19.50 to $20; Clarence, $17.25 to $17.50; Cleveland, $17.25 to $17.50 per ton.

Laths.—See Lumber, etc.

Lead.—Prices are about steady at $3.55 to $3.65.

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. (112)

Nails.—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 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 shows a steady tone although demand is on the dull side. Prices are firm, and approximately as follows:—$32 for 6 and 8-inch pipe and larger; $33 for 3-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above. (74, 188).

Pipe.—Wrought and Galvanized.—Demand is about the same, 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 71½ per cent. off for black, and 61½ 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. (111).

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. (73).

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). (164).

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. (132).

Spikes.—Railway spikes are firmer at $2.45 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. (132).

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 firm, at $34.50 to $35.

Zinc.—The tone is easy, at 5¾ to 6c.

CAMP SUPPLIES.

Beans.—Prime pea beans, $2 to $2.25 per bushel. (74).

Butter.—September and October creamery, 28 to 32c.; dairy, 23 to 24c.

Canned Goods.—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 85c.; tomatoes, 85 to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65. (74).

Cheese.—Finest, colored, 12¾c.; white, 13 to 13¼c. (74).

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c. (74).

Dried Fruits.—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6¼c.; California, seeded, 7½ to 9c.; Evaporated apples, prime, 8 to 8½c. (74).

Eggs.—New laid, 21 to 23c. (74).

Flour.—Manitoba, 1st patents, $5.80 per barrel; 2nd patents, $5.30; strong bakers, $5.10. (74).

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 45c.; Porto Rico, 40 to 43c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case. (74).

Potatoes.—Per 90 lbs., good quality, 45 to 60c. (74).

Rice and Tapioca.—Rice, grade B., in 100-lb. bags, $2.75 to $2.80; C.C., $2.65. Tapioca, medium pearl, 5½ to 6c. (74).

Rolled Oats.—Oatmeal, $2.20 per bag; rolled oats, $2, bags. (74).

Sugar.—Granulated, bags, $5.05; yellow, $4.65 to $5. Barrels 5c. above bag prices.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, green, 20 to 50c.; low-grades, down to 15c. (74).

Fish.—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to 81.25. (74).

13½c. per lb. for compound. (74).

Provisions.—Salt Pork.—$30 to $34 per bbl.; beef, $18 per bbl.; smoked hams, 16 to 20c. per lb.; lard, 17 to 18c. for pure, and 11¾ to 13½c. per lb. for compound. (74).

TORONTO HORSE MARKET.

Horses are decidedly scarce in the country. Shippers who formerly brought in eighteen or twenty in a lot from the country, now have difficulty in picking up seven to ten. With this scarcity prices are very high, choice drafters are going up to $230 and $235. Serviceably sound horses, if in pretty good shape, are going at $140 to $160, while really good farm workers are bringing $260.

AMERICAN HORSE MARKET.

Competition among buyers for horses weighing 1,500 and better is more active in Chicago than at any previous time this season. Good pairs of chunks weighing 1,400 and over have sold from $500 to $580 for the pair, some very good express horses going at $550. A large city teaming concern has disposed of a number of aged horses fairly well worn out, at $175, to go to the country. Farm workers are going at $140 to $185.

* * * *

Toronto, May 5th.

According to Old Country advices the feeling in iron and steel is firm, especially among the Scotch mills, which have plenty of orders. The United States market is somewhat less firm, although the output of structural material continues large, the building activity being great.

Business here in these goods is active, and such heavy goods as boiler plates and tubes are moving fairly well; steel sheets are higher. More pig-iron will presently be available, lake boats having begun to move. Ingot metals are all weak.

Slaters are busy, brick and stone masons, too, though there is uneasiness and strikes in other directions, a clear case of putting "pressure" on house-builders. Brick makers are very well employed, and cement mills feeling better. Lumber is steady, and in fair demand.

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

Antimony.—Market almost lifeless; price 9c. per 100 lbs. (332).

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9. (217, 377).

Bar Iron.—$2.00 to $2.10, base, per 100 lbs., from stock to wholesale dealer. Market supply limited (332).

Bar Mild Steel.—Per 100 lbs., $2.10 to $2.20. (372).

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds. (241, 362, 456).

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10 foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $11 to $11.50; 3½-inch, $18 to $18.50; 4-inch, $19 to $20 per 100 feet. (514).

Building Paper.—Plain, 27c. per roll; tarred, 35c. per roll. Demand is moderate. (518).

Bricks.—In active movement, with very firm tone. Price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick are in request. Red and buff pressed are worth $18 delivered and $17 at works per 1,000. (518).

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 75c. until further notice, per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa. (518).

Cement.—Car lots, $1.75 per barrel, without bags. In 1,000 barrel lots $1.60. In smaller parcels $1.90 is asked by city dealers. Bags, 40c. extra. Demand good; in another week or two the movement by water will be active. (61, 518).

Coal.—The price of anthracite has dropped for the spring season, and opens at $6.75; pea, $5.75. From these prices a cash discount of 25c. per ton is given on any quantities purchased. 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, $3.75 to $3.80; mine run, $3.65 to $3.70; slack, $2.75 to $2.85; lump coal from other districts, $3.55 to $3.70; mine run 10c. less; slack, $2.60 to $2.70; cannel coal plentiful at $7.50 per ton; cook, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.10; Connellsville, 72-hour coke, $5.25. Soft coal and slack are slowly growing more plentiful, and now that labor troubles have been settled a more healthy tone has been established in the market.

Copper Ingot.—We do not change quotation from 13¾ to 14c.. A great deal is selling in the States, but stocks are heavy and production still great.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1. (212).

Dynamite, per pound, 21 to 25c., as to quantity. (212).

Felt Roofing.—The spring trade has opened very well at an unchanged price, which is $1.80 per 100 lbs. (518).

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. Fire clay, $8 to $12 per ton. (518).

Fuses.—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet. (212, 217, 377).

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs. (217, 377).

Iron Pipe.—A steady request at former prices:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, 27.08; 4-inch, $30.78; 4½-inch, $35.75; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet. (185).

Pig Iron.—We quote Clarence at $20.50, for No. 3; Cleveland, $20.50; Summerlee, $22; Hamilton quotes a little irregular, between $19 and $20. Though much is beginning to move, it is on winter contracts. (332, 372).

Lead.—Small movement at $3.75 to $3.85.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is moderate. (518).

Lumber.—Dimension stuff is in brisk demand, for present or later delivery. Prices are generally firm, especially in pine. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $17 to $17.50; spruce flooring, car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.10, lath growing scarce and stiffening, No. 1, $4.40, white pine, 48-inch; No 2, $3.75; for 32-inch, $1.70. (333).

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs. (217, 377).

Pitch and Tar.—Pitch, unchanged at 70c. per 100 lbs. Coal tar dull at $3.50 per barrel. (518).

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $1.95; retail, $2.15 per barrel of 300 lbs. (518).

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.10. Plasterer's, $2.15 per barrel of three bushels. (518).

Ready Roofing.—An active demand; prices are as per catalogue. (453).

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7, with a prospect of advance. Dealers are beginning to be busy. (518).

Rope.—Sisal, 9½c. per lb.; pure Manila, 10½c. per lb., Base. (217, 377).

Sand.—Sharp, for cement or brick work, 90c. per ton f.o.b., cars, Toronto siding. (518).

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.65	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

Business moderate; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. (96, 211, 421).

Steel Beams and Channels.—Active.—We quote:—$2.75 per 100 lbs., according to size and quantity; if cut, $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees. (65, 77, 94, 241, 362, 363, 372, 454, 551).

Steel Rails.—Current price for rails at the Soo, $32 to $34 for weights 60 to 100 lbs.

Sheet Steel.—The market has advanced 10c.; American Bessemer, 10-gauge, $2.60; 12-gauge, $2.65; 14-gauge, $2.45; 17, 18, and 20-gauge, $2.55; 22 and 24-gauge, $2.60; 26-gauge, $2.75; 28-gauge, $2.95. (65, 77, 94, 241, 362, 363, 372, 454, 551).

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 lbs. Fleur de Lis—28-gauge, $4.10; 26, $3.80 per 100 lbs. A very large tonnage of all sorts has been booked. An advance of 10c. is declared. (332).

Tank Plate.—3-16-inch, $2.40 per 100 lbs. (241, 362).

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c. (3, 372).

Tin.—Irregular outside, but firmly held locally. At present we continue to quote 34½ to 35c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each. (217, 377).

Zinc Spelter.—The market can no longer be described as lively; a steady but limited movement goes on at $5.65 to $5.90 per 100 lbs.

CAMP SUPPLIES.

Butter.—Dairy prints, 26 to 28c.; creamery prints, 31 to 32c.; the creamery output is now increasing every week, and prices must come down.

Canned Goods.—Peas, $1.10 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 80 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.50 to $1.85; raspberries, 2s, $1.50 to $1.95. (74).

Cheese.—Moderately firm; large, 13c.; twins, 13¼c. (74).

Coffee.—Rio, green, 11 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c. (74).

Dried Fruits.—Raisins, Valencia, 5¾ to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 15 to 16c. per lb.; prunes, 60s to 70s, 7½ to 8c.; 90s to 100s, 6c.; evaporated apples, 8c. (74).

Eggs.—New laid, coming in freely, are now quoted 20 to 21c. per dozen, case lots. (74).

Flour.—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.60; second patents, $5.10; strong bakers', $4.90; 90 per cents., Glasgow freights, 28s. 6d. Ontario Flour.—Winter wheat patents, for export, $4.20 to $4.25, in buyers' sacks outside. (74).

Lard.—Tierces, 16¾c.; tubs, 17c.; pails, 17¼c.; market steady. (74).

Molasses.—Barbadoes, barrels, 37 to 45c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c. for medium. (74).

Pork.—Market very firm, short cut, $29 to $30 per barrel; mess, $27 to $28. (74).

Rice.—B. grade, 3½c. per lb.; Patna, 5 to 5¾c.; Japan, 5 to 6c. (74).

Salmon.—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75. (74).

Smoked and Dry Salt Meats.—Long clear bacon, 15 to 15½c. per lb., tons and cases; hams, large, 17 to 17½c.; small, 17½ to 18c.; rolls, 15 to 15¼c.; breakfast bacon, 19 to 20c.; backs (plain), 20 to 21c., backs (peameal), 21 to 22c.; shoulder hams, 13½c.; green meats out of pickle, 1c. less than smoked. A steady but small trade doing, people buying mostly from hand to mouth. (74).

Spices.—Allspice, 18 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c. (74).

Sugar.—Granulated, $5.20 per 100 lbs., in barrels; Acadia, $5.10; yellow, $4.80; bags, 5c. lower. (74).

Syrup.—Corn syrup, special bright, 3½c. per lb. (74).

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c. (74).

Vegetables.—Beans, hand-picked, $2.35; prime, $2.25; stocks light, market firm; beets, 85c. a bag; carrots, 60 and 65c. a bag; onions, $1.25 a bag; potatoes, best, 65 and 70c. a bag; turnips, 45c. a bag. (38).

* * * *

Winnipeg, May 4th, 1910.

There is no slackening off in the activity which has developed in all lines of business throughout the West; on the contrary each week furnishes additional evidence of an exceptionally busy season. All over Western Canada, the amount of construction and building work in progress surpasses the best of previous years. Contractors have their hands full, and those engaged in the building trade have enough to do to keep pace with the amount of work undertaken. Numbers of jobs which were started three weeks ago are still at the excavation stage through brick shortage, and in others by a scarcity of labor, but new sources of brick supply have been requisitioned, and the railways are busy bringing in supplies to alleviate the shortage.

Wholesalers are experiencing a steady and brisk flow of trade, and dealers in builders' supplies and construction material report that a large volume of business is being done. Generally speaking, wholesale prices do not show any change, but remain firm at last week's figures, and the situation is very satisfactory all round.

Quotations are as follows:—

Anvils.—Per pound, to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50 (111, 132).

Axes.—Chopping axes, per dozen, $6 to $9; double bits $12.10 per dozen.

Barbed Wire.—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

Bar Iron.—$2.50 to $2.60.

Bars.—Crow, $4 per 100 pounds. (119.)

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch. (4, 30, 41, 50, 118, 119, 127, 132, 145, 176.)

Boards.—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24.50; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

Bricks.—$10, $11, $12 per M, three grades.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $5 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

Copper Wire.—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

Tenders Called For

NOTICE TO CONTRACTORS

Tenders for Power House Equipment.

Sealed tenders addressed to the undersigned, and marked on the envelope "Tender for Power House Equipment," will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, Ont., until 12 o'clock noon of the 25th day of May, 1910, for the equipment necessary for power house in connection with the shops east of Winnipeg, including water tube boilers, mechanical stokers, feed water heaters, engines, generators, air compressors, pumps.

Plans and specifications may be seen in the office of the Chief Engineer of the Commissioners, Mr. Gordon Grant, at Ottawa, and in the office of the District Engineer of the Commissioners at St. Boniface, Manitoba.

Persons tendering are notified that tenders will not be considered unless made on the printed form supplied by the Commissioners, which may be had on application to the Chief Engineer at Ottawa, or to the District Engineer at St. Boniface, Man.

Each tender must be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted check on a chartered bank of the Dominion of Canada, payable to the order of the Commissioners of the Transcontinental Railway, for a sum equal to ten per cent. (10 p.c.) of the amount of the tender.

Any person whose tender is accepted, shall, within ten days after the acceptance thereof, sign the contract, specifications, and other documents required to be signed, and in any case of refusal or failure on the part of the party whose tender is accepted to complete and execute the contract with the Commissioners the said check shall be forfeited to the Commissioners as liquidated damages for such refusal or failure, and all contract rights acquired by the acceptance of the tender shall be forfeited.

The checks deposited by parties whose tenders are accepted will be deposited to the credit of the Receiver-General of Canada, as security for the due and faithful performance of the contract according to its terms.

The check deposited by parties whose tenders are rejected will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By order,

P. E. RYAN, Secretary.

The Commissioners of the Transcontinental Railway.

Dated at Ottawa, April 27th, 1910.

Newspapers inserting this advertisement without authority from the Commissioners will not be paid for it.

TWO REINFORCED CONCRETE FOOT BRIDGES OVER CHIPPEWA AVENUE, CENTRE ISLAND

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, May 17th, 1910, for the construction of two reinforced concrete foot bridges, thirty-four foot clear span, crossing over Chippewa Avenue, Centre Island.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

The usual conditions relating to tendering, as prescribed by the City By-law, must be strictly complied with, or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.
G. G. POWELL,
Principal Assistant Engineer.

City Hall, Toronto, May 2nd, 1910.

TENDERS FOR

Improvement of Big Marsh Drainage System, Pelee Island.

Sealed tenders addressed to the undersigned marked "Pelee Island Big Marsh Drainage Improvement" will be received up to eight o'clock p.m. of Saturday, the 28th day of May, 1910. For the Dredge and team work, also highway bridges required in connection with the Improvement of this Drainage System.

Plans, specifications and form of tender can be seen at the office of the undersigned.

Tenders may be for the whole or any of the above mentioned parts of the work.

An accepted bank cheque payable to the treasurer of Pelee Township, for five per cent. of amount of tender must accompany each tender.

The lowest or any tender not necessarily accepted.

ALEX. BAIRD, O.L.S. & C.E.
Engineer in charge.

Leamington P.O., Ontario, May 3, 1910.

Additional Tenders on pages 52--64

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-ineh $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Copper.—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite.—$11 to $13 per case.

Hair.—Plasterers', 80 to 90c. per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c

Galvanized Iron.—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

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. (119).

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

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, except 10 feet, $27; 2 x 20 to 2 x 40, up to 32 feet, $40.

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Picks.—Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb. (132.)

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.25; 1½-inch, $13.60; 2-inch, $18.10 Lead, 6½c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Rope.—Cotton, ¼ to ½-in., and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¾c.; British Manila, 11¾c.; sisal, 10½c. (132.)

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. (119.)

Spikes.—Basis as follows:—1¼ 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 abse; cast tool steel, lb., 9 to 12½c.

Staples.—Fence, $3.40 per 190 lbs. (119).

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $36; 6 x 20, 8 x 20 up to 32 feet, $40.

Tool Steel.—8½ to 15c. per pound.