PAGES

MISSING

The Canadian Engineer

An Engineering Weekly

THE HIGH TENSION TRANSMISSION SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

THIRD ARTICLE.

Telephone System.

A private telephone system connects and provides a means of instant communication between the transforming stations of the system. The Niagara, Dundas, Toronto and London stations are what might be termed "terminal stations," since the telephone lines terminate on the individual drops in these exchanges, while Port Credit, Guelph, Preston, Berlin, Stratford, St. Marys, Woodstock and St. Thomas are through stations with exchanges bridged across the the main line and operated as party-line stations. All exchanges are located on a loop circuit and can be sectionalized without interfering with other exchanges by means of specially installed switches in case of trouble.

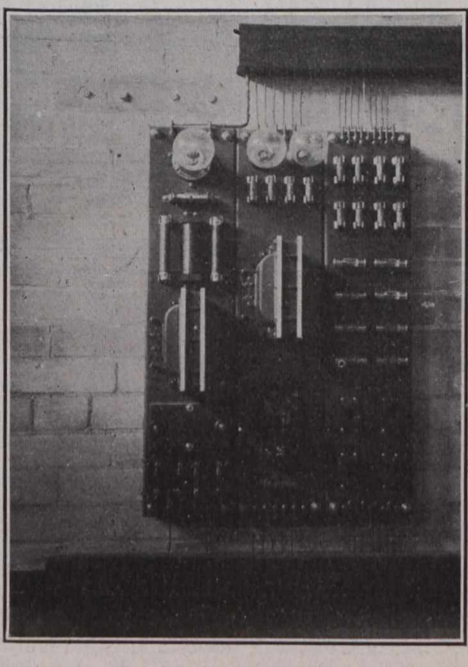


Fig. 21.—Telephone Protective Equipment Panel.

The telephone circuits are erected on separate poles paralleling the high-tension system. Considerable inconvenience was at first experienced from induced potential on the telephone circuits, which was found to be sufficiently high to strain the insulation of the standard potential equipment beyond safe limits. Various types of protective equipment were at first employed, but were unsatisfactory. After careful consideration and study of the conditions and requirements, an entirely original equipment, designed by the engineers of the commission, was installed and the operation of the telephone system since then has been entirely satisfactory. The equipments (Fig. 21) are mounted on special slate panels and consist of indicating fuses, vacuum type lightning arresters, auxiliary gap arresters, specially wound open-core choke coils, accurately balanced bleeding inductances and condensers.

Description of Stations.

Niagara Falls Station.—Power is received at the Niagara Falls station (Fig. 22) from the Ontario Power Company's distributing station at a potential of 12,000 volts over three conductor, 300,000 cm., paper-insulated, lead-sheathed cables 2,200 feet in length, placed in tile conduits. Each cable has a carrying capacity of 4,500 kw., and since the individual

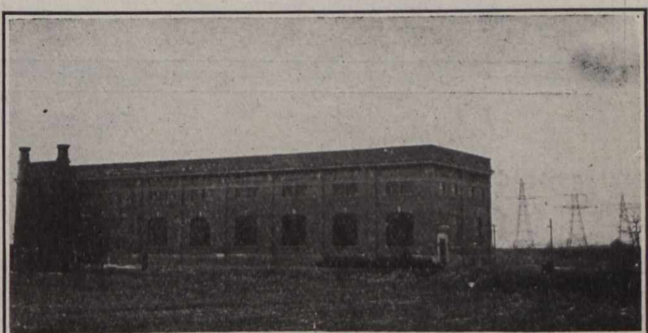


Fig. 22.—Niagara Falls Step-up Transformer Station.

transformer banks have a rating of 9,000 kw., the incoming power cables feeding these banks are connected in parallel. The ends of each pair of cables are protected by automatic oil circuit breakers connected to auxiliary buses, which in turn, are connected by similar breakers to the main buses, or directly to banks of transformers as desired.

At present there are nine 3,000 kv-a. single-phase transformers installed, although the building has been made sufficiently large to contain an additional bank of three.

From the high-tension side of the transformers the current is carried through disconnecting switches, and high-tension oil switches to the high-tension busbars, here it passes again through disconnecting switches and oil circuit breakers to the line outlets of the two 110,000 outgoing lines, and thence through choke coils and electrolytic arresters, provided with horn gaps placed outside, on to the line. (Fig. 23).

The 12,000-volt switches, busbars and accessories are located in the basement, and incoming feeder cables are laid in ducts beneath the basement floor, the necessary number terminating at the terminal compartment opposite each feeder switch. The heating boilers, oil tanks, storage battery, pumps and air compressor are situated in other parts of the basement. The cables feeding the switches terminate in terminal rooms with standards and bells, above which the feeders are tied together in pairs. The leads from the transformer oil switches pass up through the floor to the transformers, where the potential is stepped-up to 63,500 volts single-phase. Each feeder is equipped with three oil circuit breakers, the first connecting the power source to an auxiliary bus, the second, the auxiliary bus to the main bus, and the third, the auxiliary bus to a bank of transformers. By this arrangement a feeder, with a capacity equal to that of a transformer bank may be connected directly to a transformer bank or to the main bus. Through the medium of the auxiliary bus a transformer bank may also be connected to the main bus. This arrangement, while not complicated, offers sufficient flexibility to the circuit, since there are always two oil circuit breakers in series. The feeder switches are equipped with inverse time limit relays. The feeder switches are equipped with inverse time limit relays. Only the bus switches are non-automatic. Disconnecting switches are also supplied on both sides of the oil switches, which are electrically controlled from a switchboard located in the control room; colored lights being employed to indicate the position of the switches.

A service oil switch for controlling the transformers employed for the lighting, mechanical and other station equipment is connected to the main 12,000-volt bus.

All 12,000-volt connections, busbars and switches are enclosed in concrete cells.

The transformers and high-tension switches are located on the main floor. Transformer banks are separated from each other by a brick wall 25 feet high, and from the high-tension switches by a brick wall 15 feet in height. A track runway is provided to facilitate the removal of the transformers to the erection room for inspection or repairs. The piping subway is beneath the transformer compartments, and the oil, water and air pipes pass through the floor immediately in the rear of the transformers to the piping mains. The transformers are connected in delta on the low tension, in star on the high tension sides, and have grounded neutrals through a water resistance. The nine 3,000-kv-a. transformers are shell type, oil-insulated, water-cooled, and designed for operation at a potential of 12,000 volts low-tension, and 110,000 volts high-tension. They are equipped with the Westinghouse condenser type of bushing. (Fig. 24).

The transformers and high-tension lines are connected to the buses by automatic three-pole oil circuit breakers, operated from the control gallery in a manner similar to the 12,000-volt oil switches. In general the oil switches are isolated by means of disconnecting switches with blades normally vertical, mounted on post insulators, supported on the walls. All 110,000-volt connections and buses consist of bare one inch seamless copper tubing installed near the roof and supported on porcelain petticoat insulators, of the built-up post type, with an over-all height of 39 inches, in turn secured to special steel structures. These buses extend the entire length of the high-tension switch room, and have a minimum clearance of 6 feet between phases and 3 feet 6 inches between a conductor and ground. The five 110,000-volt three-pole circuit breakers are electrically operated, and equipped with Westinghouse condenser type bushings. Due to the design of these switches, no concrete barriers or brick work are required, and the switches proper will automatically open by gravity, should accidents occur to their mechanism.

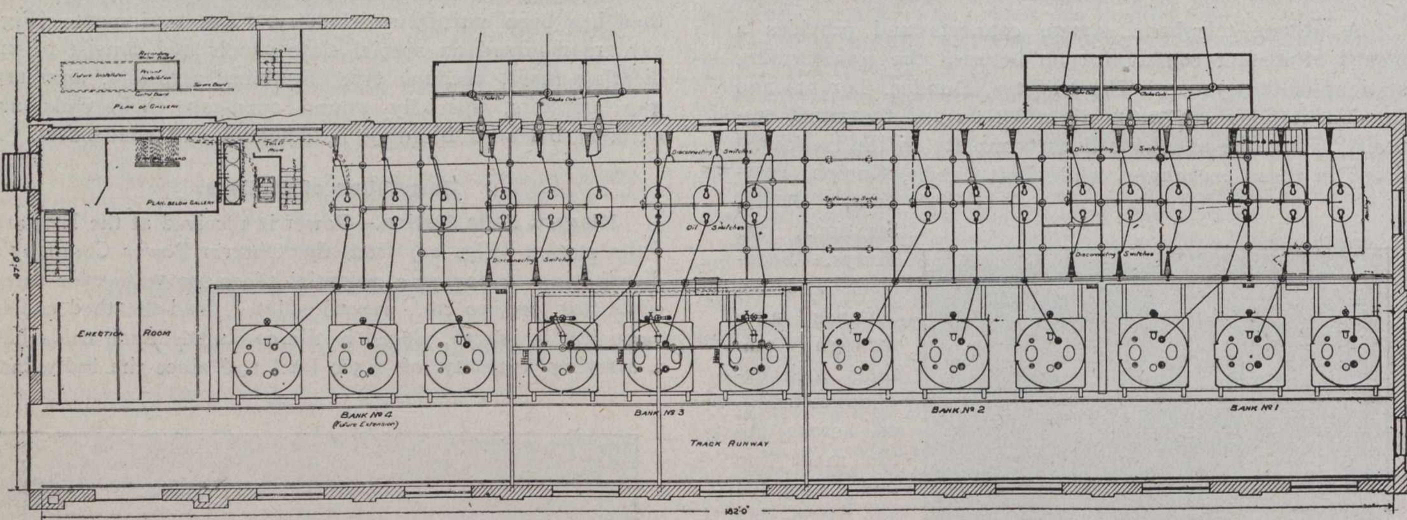


Fig. 23.—Plan View, Niagara Station.

The line outlets consist of corrugated porcelain tubes 40 inches long, supported in a horizontal position by four porcelain posts mounted to the plane of the wall in a treated wooden frame five feet square, and having the intervening space filled with plate glass.

The hoods protecting the outlet bushings from the weather are 8 feet wide and extend three feet below the level of the bushing. On leaving the porcelain the leads drop vertically to a post insulator beneath the hood from the top of which the cable is carried directly to the insulator on the arrester structure. Beneath the wall outlet and this insulator is placed a choke coil constructed of aluminum wire in the shape of a helix with porcelain separators between the adjacent turns.

Lightning protection is secured by two sets of electrolytic lightning arresters, one for each outgoing line, equipped with horn gaps and placed on special steel structures outside the building. The aluminum plates are immersed in boiler iron tanks filled with oil.

Two switchboards are installed in the control room. The main board consists of three 28-inch slate panels, each panel controlling one incoming feeder, the two connected 12,000-volt switches and one transformer bank. Two of the panels, in addition, control the outgoing high-tension lines. Mimic bus connections, and the indicating lamps on the board assist the operator. The recording meters are placed on panels in the rear of the main board. The second switchboard is used only for station service, and controls the main lighting, the motor generator, the battery charging, the crane, the battery, and pump circuits. Illumination is secured by means of incandescent lamps connected to three phases of the 110-volt station circuit. Every third light is wired in such a manner that by means of a no voltage release switch on the service switchboard, these lamps may be quickly thrown over to the battery circuit in case alternating current energy is off.

The water used for cooling the transformers is obtained from wells with auxiliary connections to the city of Niagara Falls and Ontario Power Company's systems. The water, after passing through the transformer coils, is carried to a sprinkling cooling tank, which is an open concrete basin, 6 feet in depth, in two sections, each 30 by 60 feet, with the top just above the ground level. The water is delivered to the basin through sprinklers designed to reduce the temperature of the water, and located some distance above the surface. Duplicate motor-driven pumps are installed for operating this system. The duplicate oil tanks are also installed in the basement, the capacity of each is slightly greater than the oil capacity of one transformer. The transformers are provided at their tops with oil blow-offs piped to a main, running into the "bad" oil tank, which is provided with an oil sealed blow-off and a valve at the bottom for draining purposes. Oil filters and dryers are installed between the tanks, and the oil, after being filtered, is pumped back into the "good" oil tank. An oil pump is also provided for pumping pure treated oil to an "intermediate" oil tank placed on the main floor at an elevation that permits the oil to be drawn into any of the transformers by exhausting the air from the cases by a specially installed motor-driven air compressor and vacuum pump which is pumped to the different transformer cases. This equipment may be operated as a vacuum pump for drawing oil into the case, or as a compressor for pumping in air to assist gravity in emptying it. The high-tension oil switch tanks are connected by pipes to a switch oil tank in the basement, also connected to the oil filter.

All stations in the system are equipped with similar oil and air circulating systems. The water system is varied in the different stations to suit local conditions, but in such case duplicate pumps are provided unless the station is connected to the local mains. The construction room is located near the end of the building, and contains a 45-ton traveling crane, with electric hoist, hand bridge and trolley travels. The control room is situated near the erection room in an enclosed gallery overlooking high-tension switch and erection rooms. From this gallery the operator has an unobstructed view of the erection and high-tension switch rooms. Eventually, the erection and control rooms will be located in the centre of the building, and 344 feet long by 50 feet wide.

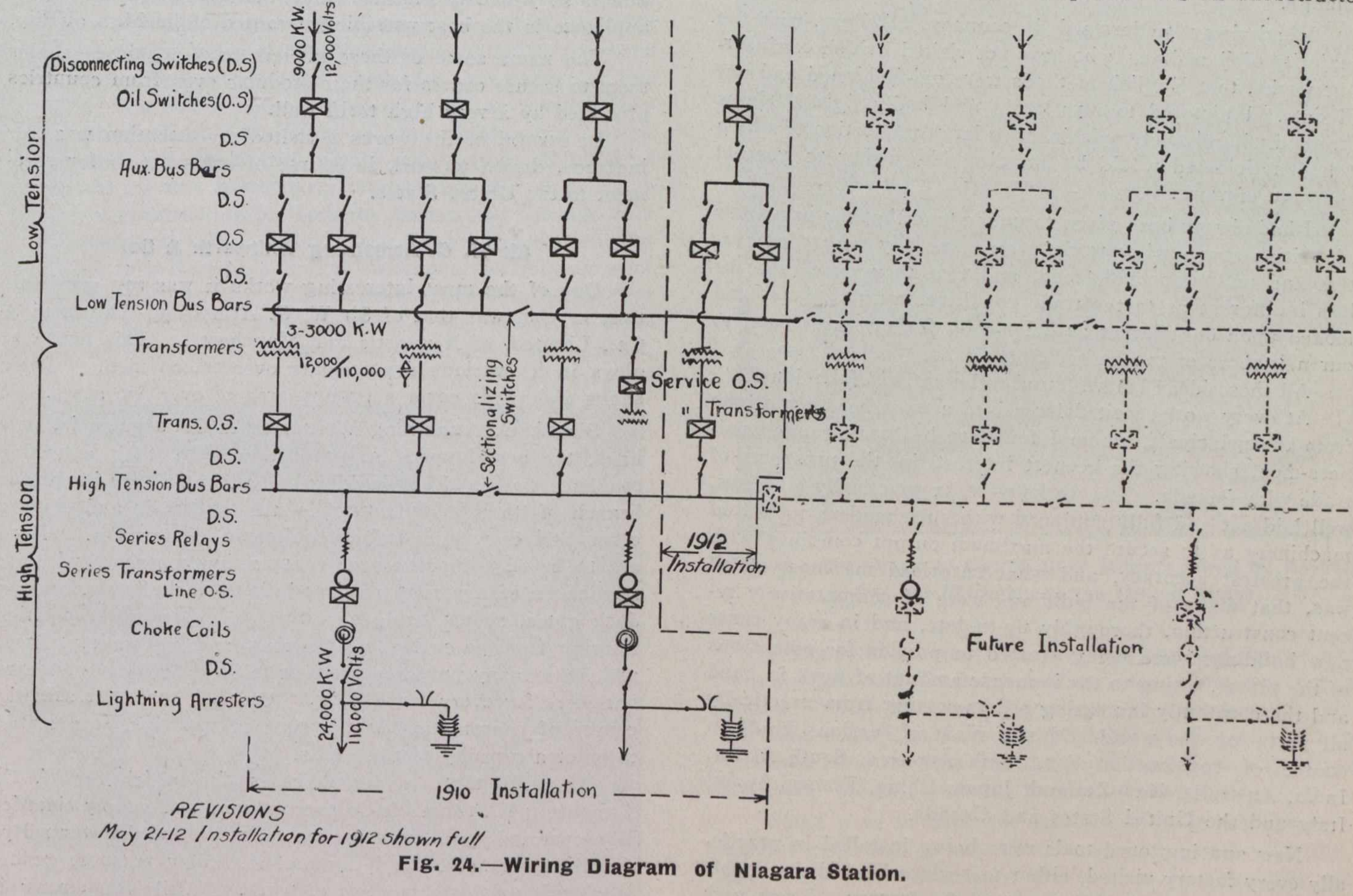


Fig. 24.—Wiring Diagram of Niagara Station.

The high-tension switch room extends along one side of the building, contains all the high-tension transformer lines, disconnecting switches and high-tension busbars.

A wrecking expedition is now at work over the hulk of the old ship Pewabic which sank in Thunder Bay nearly fifty years ago. The vessel is one hundred and sixty feet below the surface and in order to allow the diver to work at this depth a device known as the iron man is being used. It is known that the Pewabic carried over four hundred tons of copper and it is planned to bring this to the surface, a couple of hundred pounds at a time on days when the lake is calm. The use of the iron man is expected to work a revolution in deep water work. The divers are connected by telephone to the surface.

SOME FALLACIES AND FACTS CONCERNING ENGINEERING WORKS IN GREAT BRITAIN.

By W. A. MARTIN,
Late Assistant General Manager of the Toronto Electric Light Company.

During the past winter I paid a visit of some three months to England looking into the question of the sale of British-made engineering appliances and raw materials in this country, and while there was afforded an opportunity of going over a number of engineering works in the United Kingdom. As a result, my ideas of the methods and general practice adopted in these works have undergone a complete change.

I had always understood, in common, I believe, with the majority of Canadians who have not visited British engineering works, that English methods were old-fashioned and out of date. I pictured to myself old and badly lighted shops crowded with obsolete machinery, a large proportion of which I had anticipated would be standing idle owing to general shortage of work.

I had always been given to understand that the principals of British engineering works were generally very conservative and unapproachable men, and that they were more or less indifferent as to the trade conditions with Canada, and looked upon our market as belonging, for the most part, to our neighbors of the United States.

All these ideas I have found to be entirely fallacious.

At every works visited I received a most hearty welcome from the principals, whom I found to be broad-gauge business-men, showing the keenest interest in the prospects of trade with Canada. The works were, in practically all cases, well laid out and fully equipped with such modern tools and machinery as to secure the maximum output combined with the greatest accuracy, and what surprised me most of all was, that many of the buildings were of comparatively recent construction, thoroughly up-to-date, and in many cases new buildings were being erected to provide for extensions of the plants, owing to the immense amount of work in hand and the constantly increasing orders coming from practically all parts of the world. I saw plant of various kinds in course of construction for South America, South Africa, India, Australia, New Zealand, Japan, China, France, Spain, Italy and the United States and Canada.

New and improved tools were being installed in practically every factory visited, either to replace less efficient tools or otherwise increase the output of the factory. I saw very few tools standing idle, and in many factories day and night shifts were being run, in order to keep pace with the work in hand.

Standardizing of all parts is carried to the highest pitch and a most rigid system of inspection of individual parts is the invariable rule, with the result that the various parts of machines of similar sizes are absolutely interchangeable.

This inspection of parts is rather a fetish with the British engineer, and almost appears to be carried to excess in some cases. There is no doubt, however, that it is this care and accuracy which has established for the British manufacturer the high reputation for quality he has the world over.

The system of cost-keeping appears to be very complete in all cases, and the general system of keeping track of labor and stores to be very thorough and up-to-date.

The most striking feature of British practice is the extent to which practically all engineering firms concentrate their entire energies and attention upon the perfecting of one of a few specialties. The very large market to which manufacturers in the United Kingdom cater, permits of such specializing in a manner that would obviously not be possible in countries where manufacturers cater almost exclusively for home consumption.

Factories operating with from 300 to 600 employees are usually engaged in the manufacture of only one line of machinery, and although the larger works employing many thousands of hands, may specialize in, perhaps, half a dozen different lines, the manufacture of each specialty is confined to a distinct branch or department of the works, under the direct management and control of experts in that particular line of manufacture.

One direct result of this specializing has been that certain manufacturers have been able to establish the highest possible reputation as makers of the particular line of apparatus for which they have become noted, and this reputation is so jealously guarded that the makers' name on an appliance is the best possible guarantee of its high quality.

The name some of these makers have acquired enables them to secure orders for their products even from countries protected by a very high tariff wall.

In several of the works I visited my attention was, for instance, drawn to work in course of construction for shipment to the United States.

Sir W. G. Armstrong Whitworth & Co.

One of the most interesting works it was my good fortune to visit was that of Sir W. G. Armstrong-Whitworth & Co., Limited, of Newcastle and Manchester. This firm employs in its various departments over 20,000 men. Their shops and yards cover a ground area of over 270 acres.

Sir W. G. Armstrong Whitworth & Co.'s name is, perhaps, the best known in connection with their extensive ordnance work and shipbuilding yards, but a very important branch of their manufacture is the hydraulic and electric crane and dock and harbor equipment department. Here are to be seen in course of construction massive hydraulic appliances of a variety of descriptions, including enormous dock gates, swing bridges, cranes of carrying capacities ranging from 30 cwt. up to 250 tons, and hydraulic presses, which for many purposes are now taking the place of steam hammers for every large work. One of these presses in course of construction at the time of my visit, was stated to be of a capacity of 1,000 tons.

Although there are some cases for which Sir W. G. Armstrong Whitworth & Co., recommend and supply electrically operated appliances, as being more suitable than Hydraulic appliances, the latter are, for many reasons, generally preferred for this class of work. While Armstrong & Whitworth make a specialty of traveling cranes for shop and other uses—both electrically and hydraulically operated—they have devoted special attention to the construction of hydraulic cranes for the rapid loading and unloading of vessels. At their Elswick works at Newcastle-on-Tyne, they have an enormous crane erected on the river bank alongside of the building where they carry on the manufacture of ordnance, etc. This crane is capable of handling 150-ton lifts, and is so arranged that is can be swung over the building in question and through openings in the roof; can pick up huge cannon gun mountings and other equipment for the war vessels they build, and lift them bodily on to the vessel, which is brought alongside for that purpose.

Whilst fully realizing the advantages of hydraulic power for heavy work such as the above, it struck me that the severe winter conditions in Canada would make it impracticable to use such power here, and I brought this question up. I was met with the statement that Sir W. G. Armstrong-

Whitworth & Co. had supplied a number of hydraulic cranes for use in parts of Russia, where the cold is even more severe than in Canada, and that they were operating with entire satisfaction, the danger of freezing being overcome by drawing off the water from the machines when not in use or where this is not practicable by using petroleum or by treating the water with glycerine. I was told that this latter mixture is supplied as part of the equipment in the first place, and that the wastage in operation is so little as to make the cost of future supplies of glycerine negligible.

Messrs. Reyrolle & Co.

Another works visited in the Newcastle district was that of Messrs. Reyrolle & Co., makers of electric switchgear. This business was started in London 26 years ago by Mr. Reyrolle, the present proprietor, assisted by about ten employees. Here, again, we see the effect of specializing in one line of manufacture. By concentrating their attention upon the perfecting of electric switchgear, this firm has been able to establish a reputation which, for that particular line of work, is probably second to no other in the world. They now employ about 500 hands making nothing but electric switchgear, for which they obtain orders from all parts of the world. I was particularly interested to see switches in course of construction for both the Boston and Chicago Edison Companies. Messrs. Reyrolle & Co. have paid particular attention to perfecting a line of switchgear for mining work and sub-station control. This gear appears to be as near fool-proof as it is possible to make it. All the gear is made up of individual units, which are absolutely standardized,

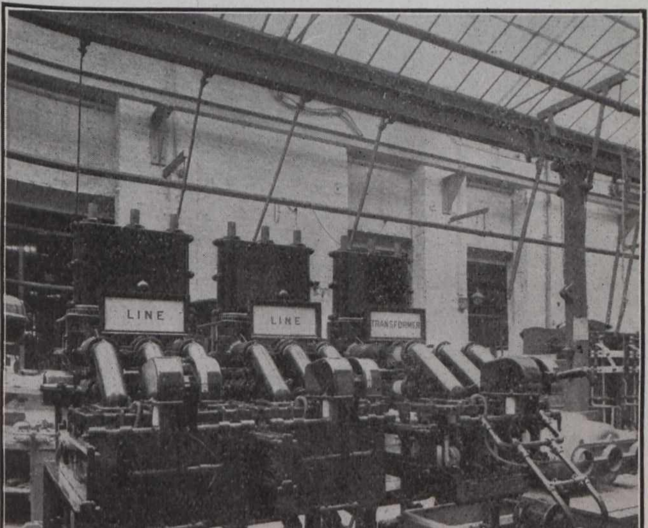


Fig. 1.—Front View of Switch Manufactured by Reyrolle & Co., for Shipment to the United States.

and can, therefore, be replaced by, or interchanged with, other units of a similar size.

Another switchgear shown on the accompanying photographs was awaiting despatch to another large American power company. The first photograph shows the front view of this switchgear with the switch controlling the transformer circuit isolated and the oil tank lowered on a truck to be supplied for this purpose. The second photograph shows the back view of the same gear.

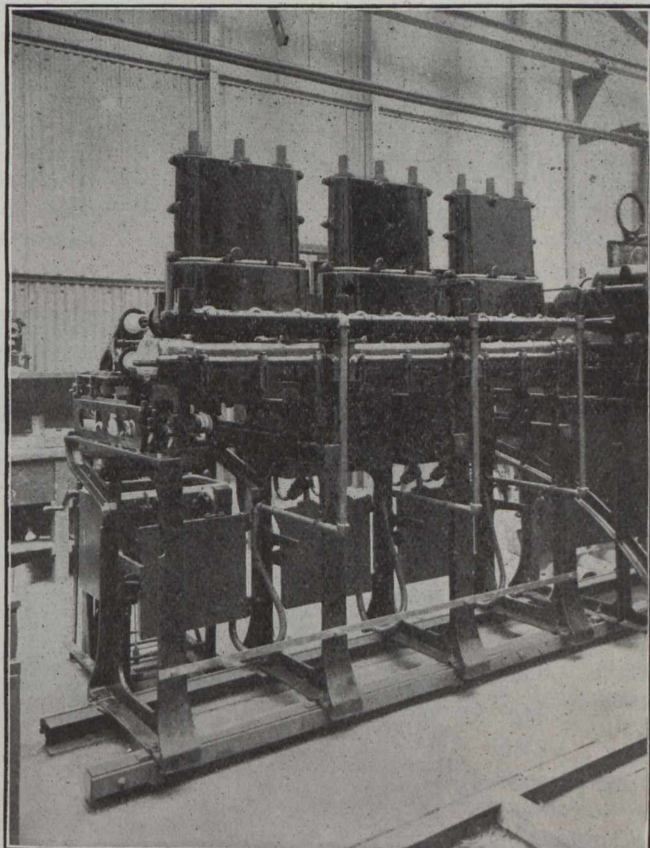


Fig. 2.—Rear View of Switch Gear Manufactured by Reyrolle & Co., for Shipment to the United States.

I was informed that this firm had installed in the Northumberland and Durham district alone about 750 similar panels. These were included in 120 sub-stations in that district and some idea as to the reliability of this gear will be gathered from the fact that the generating plant capacity of the power stations amounts to over 100,000 k.w.

Plans were in hand for power station switch panels to control generator circuits of sizes up to 12,000 k.v.a., and I have heard since that they are making the power and substation gear for Sheffield corporation power station at Neepsend, where 40,000 k.w. generating plant is to be installed.

Messrs. Cammel, Laird & Co.

While in Sheffield I was afforded an opportunity of going through the Cyclop Works of Messrs. Cammel, Laird & Co.

Sheffield steel is synonymous with best quality steel the world over, and of all the many steel workers in that city the name of "Cammel-Laird" ranks at the top as specialists in the manufacture of high-grade steel.

The fact that they employ in their combined works at Sheffield and Birkenhead and Penistone over 16,000 workpeople, is, in itself, some indication of the enormous output from these works. The total area covered by the combined works is over 160 acres. The management are justly proud of the immense business that has been built up and is now under their charge, and I was furnished with very full information as to the history of the company and its progress since its first organization in 1837.

The original firm of Johnson Cammel & Co. has twice been changed, in 1852 having been changed to Charles Cammel & Co., and in 1903, when, in order to share in the advantage of being in a position to build a battleship complete, the well-known shipbuilding business of Laird Brothers, Limited, Birkenhead, was acquired, the style of the firm was again changed to that of Cammel-Laird, Limited. In furtherance of this policy large ordnance works were started at Coventry for the manufacture of armour and guns.

The Cyclops Works have been visited from time to time by many members of the Royal family (including King George V. and Queen Mary when Duke and Duchess of York) and the reigning houses on the continent, as well as by distinguished statesmen and noted military, literary and scientific people from all parts of the world, but it is a unique record to be able to crown the list by the visit of her late Majesty Queen Victoria, who, on the 21st May, 1897, in the 60th year of her glorious reign, witnessed at her own request, the rolling of an armour plate destined for H.M.S. "Ocean." The event is especially interesting, forming as it did the only visit to a works undertaken by her late Majesty during the whole of her reign.

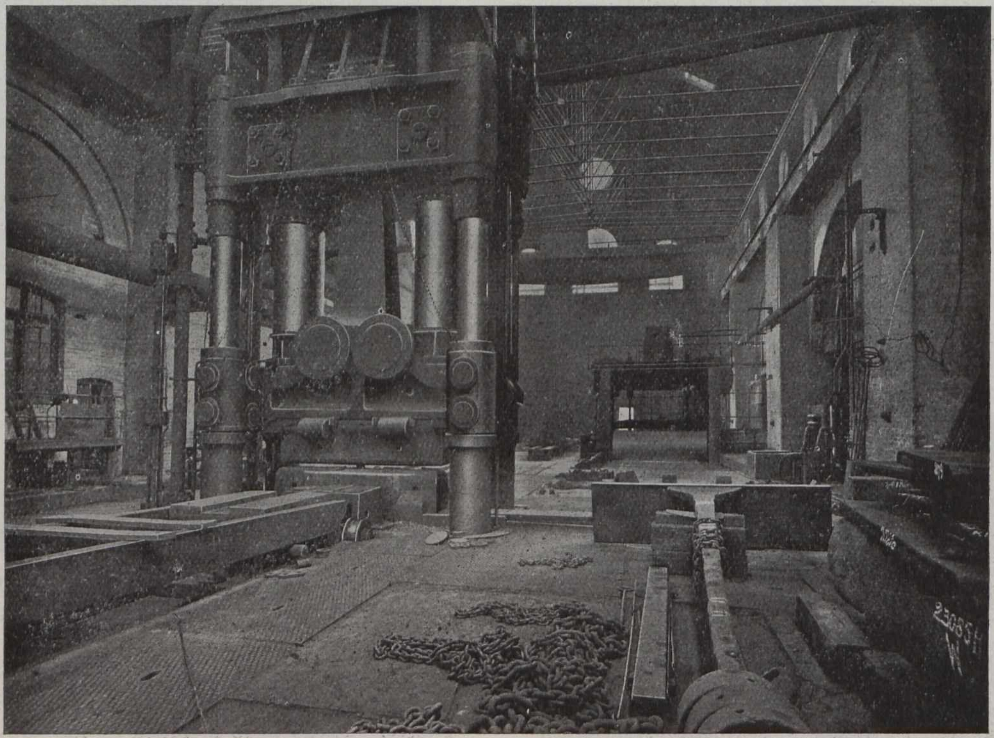


Fig. 3.—View of the Armour and Press Shop of Cammel, Laird & Company, Limited, Sheffield.

The manufacturers of the firm now include armour plates, guns, projectiles; steel tyres, axles, springs and buffers for locomotives, carriages and wagons; locomotive crank axles, steel rails, fish plate, sole plates, billets, blooms and bars by the "acid" process; steel castings and steel forgings of all kinds for shipbuilders, engineers and mining machinery; high-speed tool steel; nickel steel for motor cars and wagons, etc.; best crucible cast steel for engineers' and blacksmiths' tools, mining drills, etc.; files, hammers, picks, saws, etc., etc.

Space will not permit of my detailing the capacity of the company's various works, but I may say that the annual capacity of the works where steel and manufactures of steel are turned out was stated to be 450,000 tons.

The illustration is reproduced from a photograph of the armour and press shop. The dimensions of this building are 310 feet long by 64 feet wide. It is served by three heavy electric traveling cranes, the most powerful being of 150 tons capacity.

The hydraulic press in the foreground has a capacity of 4,000 tons, and is used for the slabbing of armour ingots previous to rolling.

The armour mill in the background, one of the largest in existence, has rolls 14 feet long by 4 feet diameter, and is driven by three cylinder h.p. engines, of 12,000 horsepower.

The process of steel making and treating in all its branches is most fascinating. From the large gas-fired furnaces, where it is seen boiling and bubbling like water until it is run off into ingots, and then whilst still red hot carried by goliath cranes to one of the large hydraulic presses, there to be squeezed into a forged block from which later a large gun is to be turned. Or it may be that its fate is to be rolled into railway tyres or carriage springs, or possibly to be hammered into rods of different sections for high speed tool steel, to be eventually made into tools which will retain their cutting edge when red hot. Or again, it may be forged into armour plate 12 inches or more in thickness for the protection of battle ships. The ingredients of the mixture are in some cases varied according to the purpose for which the steel is to be used, and the mixture has to be of different characteristics in different sections of the mass. For instance, in the armour plates referred to the face to a depth of a few inches must be hard and brittle to resist penetration, whereas the back of the plate must be tough and tenacious to avoid risk of fracture.

Messrs. Cammel Laird have established a branch in British Columbia, through which they are doing a considerable business in their special tool steel for mining purposes, including rock drills, stamps and dies, etc.

Messrs. Ashmore, Benson, Pease & Co., Limited, and Messrs. The Power Gas Corporation, Limited.

Messrs. Ashmore, Benson and Pease, of Stockton-on-Tees, specialize in the manufacture of structural iron work, including large gas holders, large rivetted pipes for hydroelectric plants, etc. At the time of my visit this firm were just completing a contract for 450 tons of pipes twelve feet in diameter, to be shipped to British Columbia for the hydroelectric plant of the Ocean Falls Company. They have also recently executed a contract for the supply and erection of a large gas holder for the city of Vancouver, having a capacity of 2¼ million cubic feet.

Messrs. Ashmore, Benson and Pease also manufacture all the gas producers, gas cleaning plants, Mond sulphate of ammonia recovery plants, etc., supplied by the Power-Gas

Corporation. Amongst the many interesting installations recently carried out by this latter firm is a plant for the recovery of sulphate of ammonia from peat. This installation

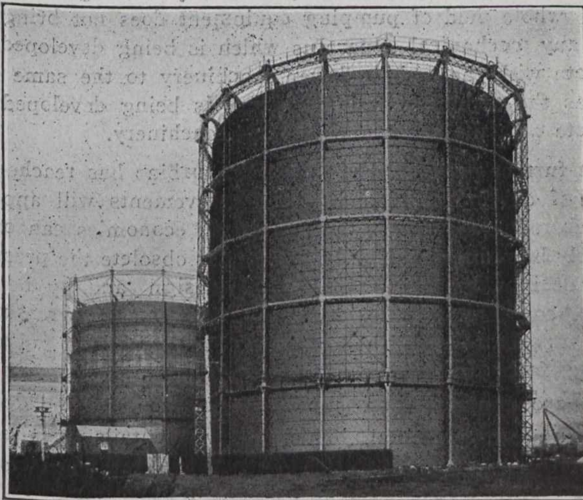


Fig. 4.—Large Gas Holder Manufactured by Ashmore, Benson and Pease for use in the City of Vancouver, B.C.

is stated to be an entire commercial success. In the process of recovering this very valuable fertilizer from the peat, large quantities of gas are given off, which may be used for generating power in large gas engines. In a similar installa-

Fig. 5.—A Section of 12-ft. Pipe Line Manufactured by Ashmore, Benson and Pease for the Ocean Falls Power Company, British Columbia.

tion in Germany the waste gas is already being successfully utilized in this way.

(To be continued.)

CANADIAN BOUNTY PAYMENTS.

The total amount paid in bounties by the Canadian Government for the year ending March 31 last, was only $538,529, compared with $1,591,663 for the preceding year. The bounties paid were as follows: Wire rods, $160,750; crude petroleum, $141,935; lead, $179,288; manila fibre, used in the manufacture of binder twine, $50,556. Since 1896, when the bounty system was introduced, the total payments have been a little over $21,000,000, of which $7,000,000 went for pig-iron, over $4,000,000 for puddled iron bars, and $6,000,000 in steel bounties.

TURBINE-DRIVEN CENTRIFUGAL PUMPS FOR WATERWORKS SERVICE.*

By W. O. Beyer.

It is only recently that centrifugal pumps have received the serious consideration of waterworks engineers, although their economy and efficiency have long since been demonstrated for supplying water in large quantities to industrial plants. It is our purpose here to show that the combined fixed charges and operating costs of the rotatory unit compare favorably with those of the high-duty vertical triple-expansion unit or other type, where the price of coal is not excessive.

The high duty shown by reciprocating engines in waterworks service, involving the pumping of large quantities of water against a constant head, without any great variation in rate, has long and justly been regarded as a supreme achievement. Due to the direct connection of the pump and engine cylinders and to the high efficiency realized in the unit when the proper attention is paid to its valves and packings, the triple-expansion reciprocating pumping engine has been able to develop duties that are unapproachable by rotatory units consisting of turbines and centrifugal pumps. However, a careful comparison of the total costs of pumping will show that the balance may be entirely reversed when fuel costs do not exceed a certain price per ton. That is, the high first cost of the reciprocating unit, together with the cost of the foundation required, introduce annual charges for interest, upkeep and depreciation, which more than offset the lower duty of the turbine unit.

Of the several types of pumping engines, the following are chiefly used for waterworks service: The low-duty compound condensing engines, costing, with foundations, piping and appurtenances, about $2,300 per million gallons capacity per 24 hours; low-duty triple-expansion condensing horizontal engines, costing about $2,800 per million gallons capacity; cross-compound condensing horizontal fly-wheel engines, costing about $3,300 per million gallons capacity, and high-duty triple expansion vertical condensing engines, costing about $4,800 per million gallons capacity. The figures given are from a paper presented before the American Society of Civil Engineers, May 17, 1911, by the late Charles A. Hague. Since this paper selected the high-duty triple-expansion vertical engine as the only one to be considered in most cases, it is with this type of engine that we shall make our comparison.

The prices for pumping units given below are, to the best of our knowledge, accurate and include condensers, piping and foundations complete.

No account has been taken of the greater volume required in the buildings for reciprocating units, as a unit volume cost must be assumed which would agree with only one architectural design; similarly, no account has been taken of the greater volume required for the larger boiler installation of the turbine units, for the majority of existing plants usually have their building proportions determined, and a saving could not be made in either room without special complications of no account in this discussion. However, the difference in cost of foundations has been taken into account, because this is an addition in existing buildings and can be computed easily.

* Paper read before the American Waterworks Association.

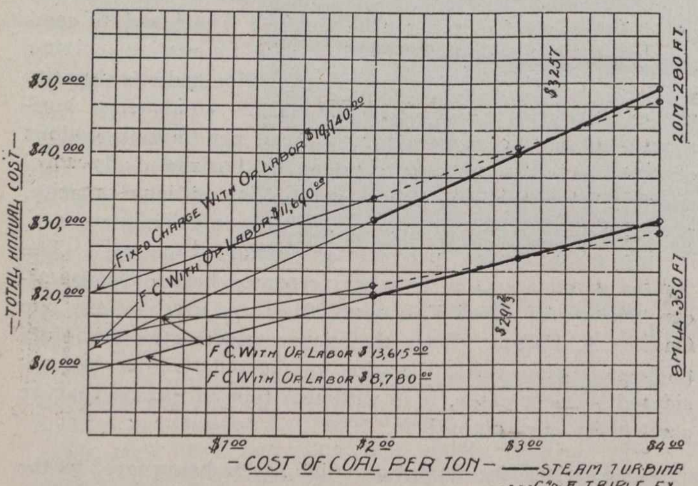
In a new station the turbine should be credited with any saving in floor space, buildings, etc., which it may effect, as compared with the reciprocating engine, and the reciprocating engine credited with the saving effected in the boiler rooms.

In a comparison of this kind certain assumptions must necessarily be made. We have tried to eliminate as far as possible arbitrary assumptions, and all figures of first cost of apparatus have been taken from, or estimated from, recent bids on the two types of machinery under consideration. The first cost per boiler horse-power we have taken to be $30, complete with piping, chimney, stokers, etc. (The use of a lower figure would favor the turbine-driven pump as compared with the high-duty engine, but we believe, with everything taken into consideration, this will prove to be an average figure.) We have assumed the following annual charges against pumping machinery:

Interest	5%
Depreciation	3%
Repairs and supplies	2%
Total	10%

We have also assumed the following annual charges against the boiler equipment.

Interest	5%
Depreciation	5%
Repairs and supplies	5%
Labor on maintenance	2%
Total	17%



Comparisons of Operation Cost of Steam Turbine and Triple Expansion Engines, Small Plants.

It will be noted in the above that an annual depreciation of 3 per cent. has been taken on the first cost of both the crank and flywheel and turbine-driven unit, equivalent to a life of 33⅓ years. We have chosen this method rather than one in which the capital charges are figured on a constantly decreasing book value for the pumping machinery and boilers, in order to avoid a complicated method of accounting.

For the reason that less data are available on the life of turbine-driven units than on crank and flywheel units, it is possible more objection may be made to this assumption of a life of 33⅓ years for each machine. However, as in neither case the question of obsolescence has been taken into account, we believe the assumption a fair one. Viewed in the light of possible future development, it would seem that a longer life should be accorded to the turbine-driven unit than to the crank and flywheel unit, as a very thorough canvass of the whole field of pumping equipment does not bring to light any mechanical apparatus which is being developed to compete with the turbine-driven machinery to the same extent as the turbine-driven machinery is being developed to compete with the crank and flywheel machinery.

It further appears that the steam turbine has reached a stage of development, such that improvements will appear only as refinements of type; and steam economies can only possibly be reduced sufficiently to render obsolete the present good designs by better theoretical design and by better steam conditions. The use of high steam pressures and superheat may be expected to gradually obtain further favor in this country as in European practice, where 250 degrees Fahr. superheat and 200 pounds steam pressure are not unusual. This, however, entails practically no change in turbines as constructed for present steam conditions.

Fuel costs are based on a boiler efficiency of 65 per cent., heat content of 13,000 B.t.u. per pound of coal and 24-hour per day operation.

The duties given are on a basis of 150 pounds steam pressure, with no superheat.

Three examples are taken, based on coal at $2, $3 and $4 per ton. Where coal can be obtained cheaper than $2 per ton, the advantages of the turbine-driven pump are more clearly marked.

It will be noted that the point at which the total annual costs are equal for the eight-million-gallon crank and flywheel vertical unit and the eight-million-gallon turbine centrifugal unit is when coal costs $2.91 per ton. Also for the twenty-million-gallon vertical crank and flywheel unit and the twenty-million-gallon turbine centrifugal unit, the total annual costs will be equal when coal costs $3.25 per ton. Above these points the reciprocating unit has the advantage, and below these points the rotatory unit has the advantage, on the basis of these calculations.

Tabulation "A."

8,000,000 Gallons per Day, 350-ft. Head, 491 w.h.p.

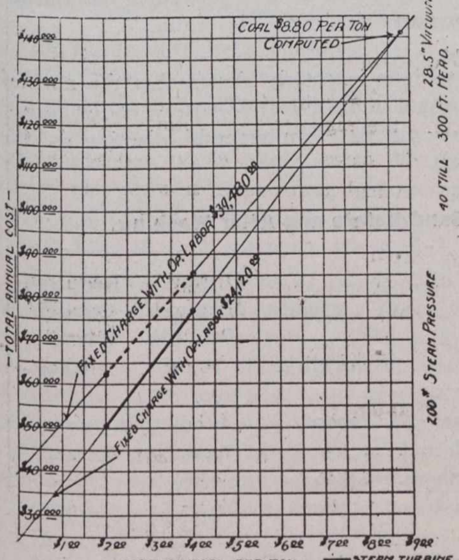
Item.	Vertical C. & F. W. Triple Expansion, 150,000,000 Duty, 3 125-h.p. Boilers.	Steam Turbine Centrifugal, 105,000,000 Duty, 3 175-h.p. Boilers.
Cost, pumping unit	$72,000	$16,000
Interest, depreciation, etc., 10%	7,200	1,600
Cost, boilers	11,250	15,750
Interest, depreciation, etc., 17%	1,915	2,680
Labor, three shifts—		
Engines	2,700	2,700
Boilers	1,800	1,800
Total int., depreciation, etc., and labor	13,615	8,780
Fuel cost, $2 per ton	7,467	10,700
Fuel cost, $3 per ton	11,129	16,100
Fuel cost, $4 per ton	14,934	21,400
Total annual cost, $2 coal	21,082	19,480
Total annual cost, $3 coal	24,744	24,880
Total annual cost, $4 coal	28,549	30,180

Tabulation "B."

20,000,000 Gallons per Day, 280-ft. Head, 981 w.h.p

Item.	Vertical C. & F. W. Triple Expansion, 165,000,000 Duty, 3 225-h.p. Boilers.	Steam Turbine Centrifugal, 120,000,000 Duty, 3 300-h.p. Boilers.
Cost, pumping unit	$120,000	$26,000
Interest, depreciation, etc., 10%	12,000	2.600
Cost, boilers	20,250	27,000
Interest, depreciation; etc., 17%	3,700	4,590
Labor, three shifts—		
Engines	2,700	2,700
Boilers	1,800	1,800
Total int., depreciation, etc., and labor	19,940	11,690
Fuel cost, $2 coal	13,570	18,630
Fuel cost, $3 coal	20,335	27,945
Fuel cost, $4 coal	27,140	37,260
Total annual cost, $2 coal	33,510	30,320
Total annual cost, $3 coal	40,275	39,635
Total annual cost, $4 coal	47,080	48,950

We believe it can be assumed safely that the development of pumping machinery in the future will be along somewhat the same lines as the development of power-producing machinery. At the present time one of the most noticeable features in the development of power machinery is the increasing favor witb which larger units are being adopted. In large central station work five years ago, the ordinary size of unit was from 10,000 to 15,000 k.w. Now, not only in European practice, but also in American practice, 25,000 k.w. units are being installed in the larger stations. There are two reasons for this development, the first being the continual endeavor to obtain better economy, not only in actual steam consumption, but in capital charges, including first cost, buildings, real estate, etc. The second reason for the development along this line comes from the fact that engineers of to-day seem to have more initiative than formerly, and where before the development of a 15,000 k.w. turbine would have seemed an impossible task, now the installation of 25,000 k.w. turbines is becoming a matter of course.



Comparisons of Cost of Steam Turbine and Triple Expansion Engines, Large Plants.

We have assumed that there will be progress along this line in waterworks pumping machinery, and that installations of very large units will be made in the future. We have evolved a comparison between two units of the types under consideration, each having a capacity of 40,000,000 gallons per 24 hours, against a total head of 300 feet. This comparison is based on utilizing the greatest range of steam temperature which the best modern practice has established as commercially practicable, and which at the same time is not too intensely theoretical. We refer here to European practice, in which steam pressures of 200 pounds, 275 degrees superheat and 28.5 inches vacuum are successfully and commercially utilized. Especially important in this connection is the item of high vacuum, since in the case of waterworks large quantities of water are always available for condensing purposes.

Extremely large capacities and high heads present no difficulties nor disproportionate costs in the construction of steam turbine-driven centrifugal pumping units, since it is an inherent characteristic of the centrifugal pump that the larger the capacity, the greater the efficiency for a given head.

There is practically no development necessary on the turbine to take advantage of these conditions, as the turbine of almost exactly the same characteristics that would be necessary for this installation is now in successful operation in hundreds of power-producing plants to-day. We have had to assume no steam consumption, as this is a matter of test, and practically have had to assume no pump efficiencies, as we have taken the minimum which we know can be obtained on this size pump.

Further, the turbine is well adapted to take advantage of the improvement in steam conditions as mentioned above, and reciprocating engines can also be designed as to take advantage of the initial and terminal conditions favoring high economy.

The results of this comparison are shown in Table "C." It is apparent from these tables that the point at which the two curves of overall economy of the two units cross is at a cost of approximately $8.80 per ton for coal.

It would appear, therefore, that the field of these large capacities at high heads for ordinary coal costs belongs to the turbine-driven centrifugal pump exclusively.

Tabulation "C."

40,000,000 gallons per day, 300-ft. head, 2120 w.h.p., 200 lbs. steam pressure. 275 deg. F. superheat. 28.5 in. vacuum.

Item	Vertical C. & F. W. Triple Expansion, 223 000,000 Duty, 3 350 h. p. Boilers	Steam Turbine Centrifugal, 193,000,000 Duty 3 400 h. p. Boilers.
Cost, pump	$210,000	$55,000
Interest, depreciation, etc., 10%	21,000	5,500
Cost, boilers	31,500	36,000
Interest, depreciation, etc., 17%	5,360	6,100
Labor, three shifts—		
Engines	7,200	7,200
Boilers	5,320	5,320
Total int., depreciation, etc., and labor	39,480	24,120
Fuel cost, $2 coal	23,265	26,800
Fuel cost, $3 coal	34,897	40,200
Fuel cost, $4 coal	46,330	53,600
Total annual cost, $2 coal	62,475	50,920
Total annual cost, $3 coal	74,377	64,320
Total annual cost, $4 coal	85,810	77,720

In conclusion, if the above data are correct—and it has been our sincere endeavor to present only such figures as are fair for both types of machines—it would seem that the steam turbine centrifugal pumping unit must be conceded a place of primary importance in the field of waterworks engineering.

RESULT OF FILTRATION AT ALBANY.

The filtration plant at Albany, N.Y., which receives its supply from the Hudson River and comprises a sedimentation basin, 16 roughing filters and 8 slow sand filters, each having an area of 0.7 acres, purified during the year ending September 30, 1911, an average daily quantity of 21,506,490 gal. at a cost of $5.32 per million gallons, including a charge of $2.64 per million gallons for pumping. The latest annual report of Mr. H. J. Deutschbein, superintendent of the Bureau of Water, to Mr. Wallace Greenlach, commissioner of Public Works, contains the following data on the operating results during the year.

The raw water was remarkably uniform in its character during the year. The turbidity average 22 parts per million, the color 35 parts and the bacteria 37,166 per cubic centimeter. There were no especially heavy freshets; each reaching its maximum height gradually and subsiding slowly. The sharpest flood stage occurred from December 31 to January 21, when the water rose to El. 105 in 24 hours. The largest freshet extended from February 27 to May 23, the highest stage being reached on April 17 at El. 106.8. The turbidity was highest at this time, being 400 parts per million. Table 1 shows the efficiency of the system under extreme conditions:

Table 1.—Operating Results During Largest Freshet, March 29.

	Suspended matter.	Turbidity.	Turbidity coefficient.	Suspended matter efficiency, per cent.	Turbidity efficiency, per cent.
River	170	400	0.43	....	....
Basin	63	320	0.19	62.9	20.0
Primary Eff. .	19	80	0.24	69.8	75.0
Secondary Eff.	0	0	....	100.0	100.0

From table 1, it is seen that most of the matter in suspension was of a coarse nature, nearly 70 per cent. being taken out by the basin. The primary filters easily removed the remainder. The plant as a whole experienced no difficulty in handling this flood.

Owing to the uniform conditions the water was of a weaker nature than of past years. The average bacterial content per cubic centimeter being 37,000 against 44,000 of last year. The organic matter likewise was below normal. During the latter part of July and the early part of August, a heavy growth of sponge developed, which seeded up the basin and primary filters to such an extent that the spores were carried over onto the secondary filters and materially lessened their lengths of runs. The life cycle of this organism was short, however, and did not necessitate any remedial measures.

The basin was out of commission from November 1 through November 11 for cleaning. Since the last cleaning 16,514,600,000 gal. of water passed through the basin. This amount of water caused the deposition of 1,770 tons of silt, or approximately 0.11 ton per million gallons. Most of this silt subsided immediately upon entrance, the remainder settling out uniformly over the basin to an average depth of 3 inches.

Outside the overgrowth of sponge no trouble was experienced from aquatic organisms.

The bacteria efficiency was 23.3 per cent. against 17.0 per cent. of last year, while the turbidity efficiency was 34.6 per cent. against 37.5 per cent. last year.

Primary Filters.—The prevailing conditions of these filters throughout the year were about normal. The approximate average length of run was 35 hours. The amount of wash water used was 4.1 per cent. The average vertical rise was 1 foot, and the average duration of wash 10 minutes. Owing to the enormous amount of silt and organic matter passing onto these beds and owing to their high efficiency of 71.9 per cent., it was necessary to employ two supplemental washes during the year. At these times the entire sand layer down to the gravel was ejected and replaced by means of the Nichols separator. Before these beds were washed in this manner, the average initial loss of head at a 70,000,000-gallon rate was 2 feet. After washing, the initial loss of head was reduced to 0.8 feet.

Primary filter No. 9 is supplied with a uniform quartz sand whose effective size is 0.65 mm. All the other beds have a uniform sand of effective size of 0.45 mm. Table shows a comparison between primary No. 9, with a coarse sand, and primary No. 12, with a fine sand, before and after the supplemental wash:

Table 2.—Washing Coarse and Fine Sands.

Primary Filter No. 12 (Fine Sand).

	Before Wash.			After Wash.		
Section.	Turb.	Org-N.	Ox-con.	Turb.	Org-N.	Ox-con.
0-10 in.	4000	2.04	43.8	1200	0.97	25.5
10-30 in.	3500	2.44	35.6	1500	1.45	26.4

Primary Filter No. 9 (Coarse Sand).

	Before Wash.			After Wash.		
Section.	Turb.	Org-N.	Ox-con.	Turb.	Org-N.	Ox-con.
0-10 in.	3200	1.45	40.0	950	0.13	11.6
10-30 in.	2000	1.20	21.6	1000	0.18	12.5

Note.—Organic nitrogen and oxygen consumed determinations are expressed in parts per 10,000 dry sand.

From the above table it is clearly shown that the normal upward flow wash is much more effective with a coarse sand, and that the efficiency of the supplemental ejection is far greater.

Table 3.—Sand Before and After Washing.

	Turbidity.	Organic Nitrogen Pts. per 10,000	Required Oxygen Pts. per 10,000
Secondary No. 7.			
Top 10 in. before wash	2000	2.00	17.5
Top 10 in. after wash	 650	0.15	4.2
10 in.-20 in. after wash	 850	0.20	5.0
20 in.-30 in. after wash	 900	0.22	6.2
Secondary No. 1.			
Top 10 in. before wash	1800	2.15	15.4
Top 10 in. after wash	 525	0.20	3.8
10 in.-20 in. after wash	 700	0.22	4.3
20 in.-30 in. after wash	1000	0.48	8.1
Secondary No. 6.			
Top 10 in. before wash	2200	0.35	15.0
Top 10 in. after wash	 700	0.17	3.2
10 in.-20 in. after wash	 750	0.21	4.7
20 in.-30 in. after wash	 900	0.38	5.1
Secondary No. 4.			
Top 10 in. before wash	2500	3.10	20.0
Top 10 in. after wash	 600	0.20	5.0
10 in.-20 in. after wash	 650	0.25	5.8
20 in.-30 in. after wash	 900	0.25	6.0
Secondary No. 8.			
Top 10 in. before wash	1950	2.20	18.0
Top 10 in. after wash	 650	0.28	5.5
10 in.-20 in. after wash	 800	0.32	5.6
20 in.-30 in. after wash	 950	0.40	6.4

Secondary Filters.—When the entire sand in all the secondary filters was washed and replaced down to the gravel, by ejection in the fall of 1909, the sand was of the following degree of cleanliness: Turbidity, 800; average of organic nitrogen, 0.25 part per 10,000 gm. sand and oxygen consumed equivalent of 3.5 parts per 10,000 gm. dry sand. One month following the cleaning of this sand the top 2 in. of the beds were in the following condition: Turbidity, 1,300; organic nitrogen, 1.40; oxygen consumed, 11.3. Five inches below the surface was in the following condition: Turbidity, 900; organic nitrogen, 0.38; oxygen consumed, 7.2. It is thus seen that there is a decided penetration of silt and organic matter into the top 4 in. of the bed, the degree of penetration depending upon the conditions in the river. As a consequence of this penetration the bed becomes hard and compact in time, so that remedial measures must be adopted.

In the spring of 1911 so much sand had been removed from the tops of the beds in the consecutive scrapings, and the top 10 in. had become so silted up and compacted, that it was decided to eject and replace. Five secondary filters had 10 in. of their top sand washed and replaced, and 10 in. of fresh sand added. Table 3 shows the condition of the sand before and after washing and replacing.

The total quantity of water filtered during the year was 7,849,869,000 gallons, making an average of 21,506,490 gallons day. The average rate of filtration was 4,018,000 gallons per acre per day for the secondary and 80,500,000 gallons per acre per day for the primary filters. The average quantity of water filtered per unit of 0.7 acre, between scrapings, was 85,338,000 gallons, or 121,911,000 gallons per acre. The maximum rate at which any secondary filter was operated was 6,000,000 gallons.

All filters have been operated at a 5,500,000-gallon rate when necessary, and have given good results. Cleanings were made on the eight filters 93 times, and two units were raked and put in service. The average scrapings for the eight units was 11.66 times each. During the past year 316,386 sq. yd. of filter surface was scraped in 2,663 man-hours, making an average of 2,865 man-hours per scraping of each filter or each 3,402 sq. yd.

During the year 5,100 cu. yd. of sand have been washed and replaced in 2,897 man-hours. There were 2,666 cu. yds. replaced from the storage pile in 1,666 man-hours. During the year 5,572 cu. yds. of sand have been ejected to the rear of the filters in 4,126 man-hours, an average of 48.54 per cleaning, and an average of 65.5 cu. yds. per cleaning; there were 85 cleanings ejected. The sand to a depth of 10 in. has been washed and replaced, and sand from the rear filters replaced in filters Nos. 1, 6, 7, and 8, leaving them with a uniform depth of 3 ft.

All pre-filters have had the sand removed, washed and replaced twice during the year, as it was found necessary to do so. The sedimentation basin has been thoroughly cleaned and 1,770 tons of silt removed. The hypochlorite machine has been in operation all year and has proved satisfactory in the results obtained.

During the year there was cut and housed 125 tons of ice, the full capacity of the ice house.

The average removal of the preliminary filters was 81 per cent. of the bacteria, incubated on gelatin at 68° Fahr., 74 per cent. of the acid colonies incubated on litmus lactose bile agar, 72 per cent. of the turbidity and 10 per cent. of the color. The efficiency of the filters was lowest during the winter months; the average removal of the bacteria incubated on gelatin from Nov. 1 to April 1 was 70 per cent., and for the remainder of the year 88.3 per cent. Twice during the year the entire sand layers in these filters was ejected, washed and replaced.

The average effective size of the sand in the preliminary filters is 0.45 mm. In December, 1909, a sand of an effective size of 0.65 mm. was placed in Filter No. 9. This sand has proven more advantageous, giving as great efficiency as the finer sand, and materially lengthening the runs and reducing the required wash-water. The average length of run for the past year of preliminary Filter No. 9 was 55 hours, the average rate 79,300,000 gallons per acre per day, and the wash-water percentage of the gross yield 2.6. It is proposed to equip one preliminary filter with sand of an effective size of 1.2 mm., with a view of determining that size of sand which will operate most economically and maintain the standard of efficiency desired.

Commencing on Nov. 19, 1910, and continuing throughout the year, hypochlorite of lime has been applied to the effluent of the slow sand filters. The average application has been 0.35 part per million of available chlorine. This treatment was used as a safety factor during the cold months, and was continued during the summer, in order to determine whether by such treatment the number of cases of typhoid fever and diarrhoeal diseases could be diminished. Owing to the large number of factors entering into the causation of these diseases, it is impossible to determine from one season's record whether such effect has been produced. Before a definite conclusion can be reached, the application of bleach will have to be continued for a period of two or three years.

With the help of sterilization the average removal of bacteria, gelatin count, between the influent of the slow sand filters and the pure well has been 99 per cent.

The average number of bacteria sent to the city for the year was 39 per cubic centimeter, with a maximum average for November, when hypochlorite was used but half the month, of 183 per cubic centimeter, and a minimum average in the month of August of 4 per cubic centimeter.

The cost per million gallons of delivering filtered water to the consumers of Albany is subdivided among the following items: Pumping station expenses, $2.64; sedimentation basin, 3 cents; preliminary filters, 53 cents; slow sand filters, $1.04; laboratory, 53 cents; hypochlorite plant, 26 cents; superintendence, 29 cents; total, $5.32 per million gallons of water filtered.

ACCIDENTS IN BUILDING WITH REINFORCED CONCRETE.

By Dr. F. von Emperger, Vienna.

(Translated by C. Salter.)

Experiments in which accidents in the course of building are brought about by design are known to be capable of affording valuable information on the properties of materials; and thus an accident during building also forms a material test, carried to the point of rupture and furnishing particulars of a defective property of the material. It is naturally to the general interest that these tests should be confined to the laboratory and we believe therefore that these experiments and the increased knowledge gained thereby on the building materials and their coaction form the means whereby accidents in practice may be prevented. In order, however, to ascertain what are the points on which our knowledge is capable of improvement, and where experimental investigation should begin in order to attack the

* Paper delivered to International Association for Testing Materials.

problem effectually, we must endeavor to trace the main origin of these building accidents and find in what their causes consist. The same dual task had to be faced in drawing up the report on building accidents, presented to the Brussels Congress in 1904. The inadequacy of private means for an exhaustive representation was expatiated upon in that report, and the desire was expressed that a clearer insight into the circumstances of the case might be afforded by the aid of unimpugnable official statistics.

This endeavor, the primary aim of which is the prevention of accidents, has, in the meantime, been able to record an important success, inasmuch as two countries have given effect to the aforesaid wish of the Congress by introducing a system of official reports, thereby creating an unimpeachable basis for further work of the kind. This was affected in a particularly thorough manner in Germany by an ordinance issued by the Minister of Public Works on 18 September, 1911, which, at the outset, was applicable only to Prussia (see "Beton und Eisen," 1911 p. 361).

This ordinance not only prescribed the procedure to be adopted in all kinds of building accidents (and therefore including also such accidents as, not being attended with any injury to life or limb, were not previously subjected to any jurisdiction), but also ensured competent judgment, by providing a list of experts, whereas the pre-existing reports on building accidents were not only very imperfect, but had also been drawn up, as a rule, by persons more or less unqualified for the work.

A similar, though less detailed ordinance was issued by the Austrian Ministry of Public Works at a somewhat earlier date, viz., on May 8th, 1911, (see "Beton und Eisen," 1911, p. 449). These two important ordinances fulfilled a principal wish expressed in the report of the Brussels Congress in 1906, in this connection, and at the same time created an influential example. At all events they have restricted the system of private reports to the other countries exclusively.

Since the date of the last report, only a few accidents, of little importance, have occurred to excite general attention. In view of the circumstance that these have all been reported in due course in the columns of "Beton und Eisen," the author considers it unnecessary to recapitulate them here, more especially since the published reports lay no claim to completeness, and in many instances are derived from sources that are not always reliable.

One of the chief causes of such accidents has always resided in imperfect knowledge of the material at the same of removing the false work of the concrete, since, in view of the divergent influences to which the material is exposed in building operations, the quality of the material can only be imperfectly judged in the laboratory; or also because, in the absence of any connection between the laboratory and the building site, the material has actually escaped any checking. It has happened, for instance, that the false work has been taken down from concrete which has been spoiled by frost or checked in its development, although the regulations laid down for ordinary average conditions have been strictly complied with; and that this premature dismantling of the false work has led to extensive accidents. Moreover, it has also happened that some contractors have had accidents when working on proved lines, through using materials to which they were not accustomed, without having ascertained whether the same were equal to those with which they were acquainted.

Even the most careful precaution cannot, perhaps, always prevent accident; but builders do not always possess the warning consciousness of danger at the time when the latter is most imminent. For such contingencies, the present writer has found a trustworthy and proved auxiliary* in the form of check — or test beams, which enable one to ascertain, in a simple and reliable manner and on the spot, whether the concrete of a structure is quite ready for the falsework to be taken down, or whether that operation should be delayed. The use of this auxiliary is strongly recommended when building operations are being carried on under unusual conditions, especially in autumn and winter; also in excessively hot weather and when unknown material is being used; and a warning must be uttered against the assumption, so frequently expressed, that an experienced concrete layer can judge concrete by touch. For instance, I have, on several occasions on which specimens of sand and gravel have been rejected, or declared, from their appearance, as bad, by experienced men in the trade, obtained fundamentally different results by means of the test beam. How much less is it possible to determine the influence of cold on the concrete from its external appearance only. For the purpose of affording a thorough check on concrete, I have applied and tested this method (for a description of which, see "Beton und Eisen," 1903) during several building operations in Vienna in 1910; see more especially, Kromus: "Die Betonkontrolle beim Neubau des k. k. Kriegsministeriums in Wien" ("Benton und Eisen," 1911-12) and also an exhaustive description by G. Neumann: "Eine Güterprobe für Beton, System Dr. F. von Emperger," ("Forscherheft" XLI.).

Taking all these circumstances into consideration, the further continuance of the system of making private reports does not seem advisable; and it is recommended that the German and Austrian official representatives should be approached, in order that a report from official sources may be available for the next Congress. The wish might also be expressed that the other States would follow the example, and by means of these facts, afford a comprehensive review of the measures to be adopted for the prevention of building accidents. The matter would become more complicated and important by the inclusion of the Latin countries, such as France, in which there is no stringent building-police supervision, at least of the kind customary in the Germanic countries. It would furnish an opportunity for comparing which of the methods gives the best results, or in which respect they have an improving influence on the contractor, if the statistics were compiled in an approximately uniform manner. The question at issue is whether a high condition of independence and the consequent feeling of responsibility are able to replace the present extensive but always insufficient supervision, or not. The matter of uniformity of the reports demands an international pronouncement, which, however, is only possible on the occasion of our congresses; and it would be desirable if this could be brought about by the time of the next congress.

As one of the most important measures in connection with the widening of our knowledge on the matter in question, the fostering and extension of experiments in building-mechanics in general and in their simplest, and therefore so important form, namely, the test beam, are warmly recommended to all interested in the matter. It would also, in the first place, be desirable that reports on the use of the test beam in practice should be presented to the next congress.

---

* "II. Bericht der Tagung der höheren deutschen Baupolizeibeamten," Berlin, 1911, published by W. Ernst & Sohn.

SOME NOTES ON BAND CONVEYORS.

By F. Tissington.

(FOURTH ARTICLE.)

One of the most recent developments in the details of these conveyors consists of a special type of carrier, or roller sets. The idea consists in making each individual roller complete in itself with supports, spindle and bearings, and these are then arranged in twos, threes, fours, etc., to make up a complete carrier for any width of band.

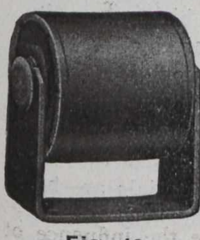


Fig. 18.

Fig. 21 shows a section of a conveyor as made by the Jeffrey Manufacturing Company. This indicates the general appearance of the rollers, and it will be noticed that the three rollers forming the troughing set are each supported in their own bearings.

Fig. 22 is of a similar character, but includes a set of guide rollers such as were referred to in a previous article. This figure is also by the above firm.

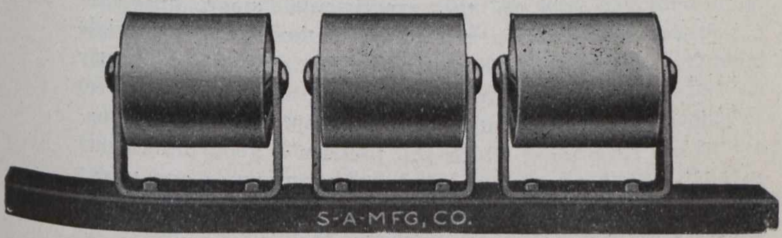


Fig. 19.

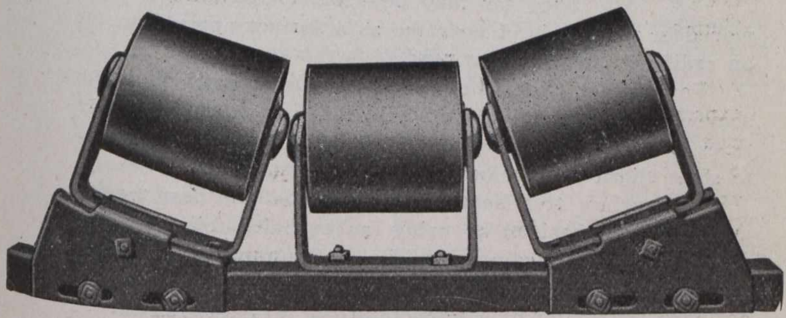


Fig. 20.

Figs. 18, 19 and 20 show carriers as made by the Stephens-Adamson Manufacturing Company.

The first illustration depicts one of their new unit sections which are arranged to suit both the carrying and return

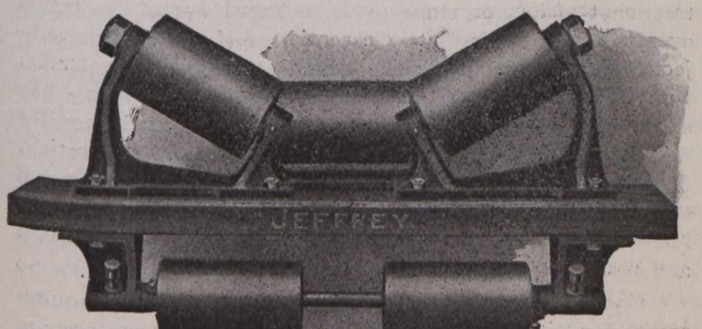


Fig. 21.

sides of the band, and may be with equal facility used for either flat or troughed bands without any alteration in the unit of any kind. The manner in which this is accomplished is seen in the last two figures, viz., 19 and 20.

If a wider belt is required it is only necessary to add more units to make up for the increased width.

The advantages to be gained with the use of this style of carrier are fairly obvious.

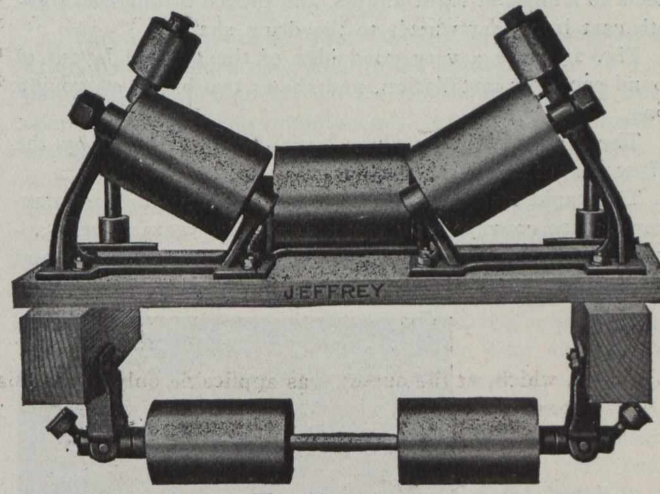


Fig. 22.

(1) Similarity of design for all belts, both flat or troughed, enables a few spares to be kept in stock which will suit any number of conveyors.

(2) If it is found necessary to alter the width of a band, the old style of rollers would be useless, but with these unit rollers all that need be done is probably a little resetting and increase of the number, and the belt will be quite as perfect as it was in its original state.

(3) Probable lessening of the cost of manufacture due to all the parts being alike, but on this point the author has no figures available.

In addition to these points Messrs. The Stephens-Adamson Manufacturing Company state that their rollers are practically dust-proof and indestructible, and further, owing to the method of construction the rollers are much lighter than the other type.

Another advantage claimed is a saving in power, and the makers state that for a flat level conveyor using this type of carrier 40 per cent. of the power required for a conveyor of the old type would be saved.

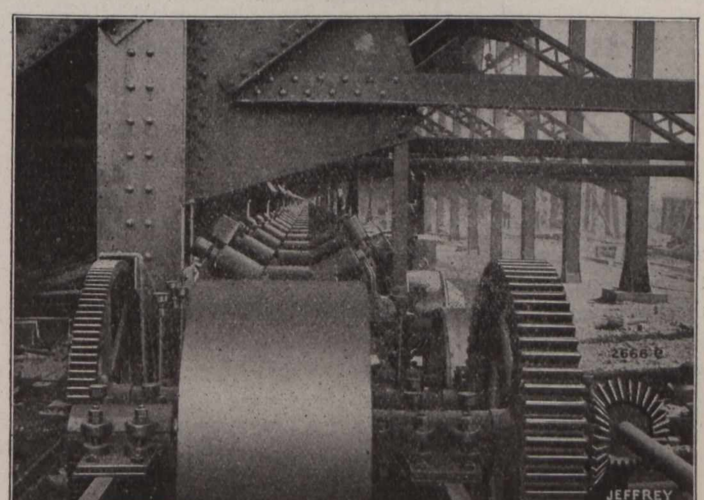


Fig. 23.

This appears to the writer to be rather a big amount and he assumes their figures are based on a conveyor running light, so that the actual percentage of saving on a conveyor fully loaded would be something less than this.

Fig. 23 shows a typical arrangement of the driving gear of a modern conveyor. It will be seen that the motive power is supplied by a shaft running parallel with the length of the conveyor, and this is transmitted by a pair of mitre wheels to a shaft at right angles, and thence through straight teeth cast iron gear wheels to the drum shaft.

Fig. 24 gives a very good idea of the general layout of a band conveyor installation, and shows two bands conveying stone.

The last two illustrations have been supplied by the Jeffrey Manufacturing Company.

The rapid strides that have been made in the manufacture of these conveyors during the last few years is very apparent to all those in any way connected with their use and with the improvements made and decrease in the cost of manufacture their field of usefulness has been extended into practically every branch of manufacture.

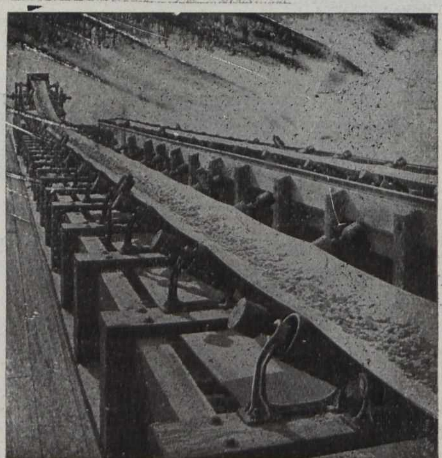


Fig. 24.

In conclusion, the writer would like to impress upon purchasers of this type of machinery that the great point to aim at is simplicity in general outline and details. Then, after buying a good conveyor, spend a reasonable amount on same for attention, such as oiling, overhauling and cleaning. If this is faithfully carried out the best results will be obtained, both as to efficiency and maintenance.

EXTENSION TO WINDSOR STATION, MONTREAL.

Improvements in train departure and in handling crowds have been under way for some time in the Canadian Pacific Railway depot in this city. Two of the new tracks are now in use and a third track is rapidly nearing completion. The work on the new building is being pushed ahead with all speed and the workmen engaged in demolishing the wall of the old building to prepare for cementing the old with the new are now getting towards the foundation.

GREAT BRITAIN'S CONTRACTORS SUCCESSFULLY COMPETE AGAINST FOREIGNERS.

A firm of British engineers, in competition with Belgian, German and structural firms in the United States has secured the contract for the steel work for a new bridge of the Eastern Bengal state railway over the lower Ganges. The bridge will consist of fifteen main spans weighing thirteen hundred tons each, and will involve the expenditure of one million, one hundred and twenty-five thousand pounds.

BITUMINOUS ROAD SURFACES.

In a paper before the American Society of Civil Engineers, Mr. A. W. Dean takes up the question of superficial coats of bituminous material with or without stone for road surfaces.

Bituminous pavements of various types have been in use for many years, whereas bituminous surfaces are of recent adoption. The early superficial applications of oil were made largely for the purpose of dust prevention on dirt roads, a crude light oil being used, having very little binding quality. The advent of motor-vehicle traffic, however, has led to a very extensive use of bituminous surfaces, not only for the purpose of dust laying, but for the preservation of the roads. As a natural consequence, many experiments have been tried by road authorities to determine what methods and materials are best adapted to overcome the difficulties encountered, and by producers to determine what quality of bituminous material can be manufactured at a minimum cost to meet the requirements of the road authorities. Being still in the experimental stage, final conclusions regarding methods and materials are obviously impossible. It has been clearly demonstrated, however, that no uniform specification can be adopted defining a material which will produce a good bituminous surface on roads of every type and under every condition of traffic. Experience has shown, for instance, that while a heavy refined tar may be used to advantage on a macadam road, it is of no value as a surface application on an ordinary gravel or dirt road.

For surface treatment of dirt roads, a light oil helps somewhat to preserve the road, in that it prevents the particles composing the surface from blowing away, and assists, to some slight degree, in hardening the surface.

For surface treatment of gravel roads, the best results appear to be obtained by using an asphaltic oil of what might be termed medium viscosity, or by approximating the maximum viscosity that will permit application through an ordinary distributor at a temperature of 50 degrees Fahrenheit.

For surface treatment of broken stone roads, a light or medium oil acts mainly as a dust layer, yet if frequently applied it preserves the road to a very appreciable extent. In determining what bituminous material would be the most economical and advantageous for the preservation by surface treatment of broken stone roads, a knowledge of the traffic over the road is absolutely essential. If the road is subjected to light motor-vehicle traffic and light team traffic, with the motor vehicles predominating, experience has shown that an asphaltic oil, of such viscosity that it requires heating to at least 250 degrees Fahrenheit before application, forms a bituminous surface which withstands the traffic and thoroughly preserves the road for a period of time depending partly on the quality of the material and workmanship and partly on the quantity of traffic.

Chemists do not agree unanimously on definite requirements for bituminous materials to be used for surface applications, and, as this method of treatment of roads is of such recent practice, it is probable that at least two years more must elapse before positive specifications can be drawn. Producers claim that the best oils for the purpose contain 90 per cent. asphalt. Residuum oils placed on roads in Massachusetts early in the season of 1909, still show life, and an indication of durability for a considerable time to come, and this fact would show that, while natural asphalts may possibly be superior, the residuum asphalts are, nevertheless, suitable for the purpose.

Fully as important as the quality of the bituminous material is the quality of the workmanship in applying it. In the preparation of the broken stone surface, extreme care should be taken to sweep and remove every particle of dust and dirt, so that the stones will be absolutely bare. Many failures of bituminous surfaces can be traced directly to the improper preparation of the broken stone surface, the heavy oils being distributed on dusty and dirty sections, and, consequently, peeling up through lack of adhesion. In order to get the best adhesion of asphaltic oils, it appears that the stone surface should also be somewhat moist ratner than extremely dry. In distributing the oil, if the stone surface is comparatively new and smooth, the best results appear to be obtained by applying the oil under pressure in two applications, each of ¼ gallon per square yard, covering the first application with grit or pea stone before putting on the second, and covering the second application with the same material as soon as possible after it has been made. The effect of applying the material in this manner is to make the distribution more uniform and prevent surplus oil from flowing on the sloping crown of the road, thereby causing ridges and bunches to appear after the work has been done. If the stone surface is full of slight depressions, however, a single application of ½ gallon per square yard, applied with or without pressure, has proved satisfactory. The oil tends to run to the depressions, causing a slight surplus of oil in them, so that when the grit is applied on top of the oil, the portions over the depressions absorb more grit, consequently rendering the road smoother.

The character of the grit or other material used for covering the oil is of great importance. Where the traffic is confined exclusively to motor vehicles, sand appears to be as effective as any material for covering, but if there is some steel-tyred horse-drawn traffic, a coarse material like pea stone or fine gravel is necessary.

The cost of a bituminous surface as just described will vary, of course, with the availability of the material to be used for covering, and the length of haul of all materials. In Massachusetts, during the last four years, several hundred miles of macadam road have been improved or preserved by a bituminous surface of this kind. The average cost during 1910 was a little less than $0.08 per square yard, and, during 1911, a little more than that price, with labor costing from $1.75 to $2.00 per 8-hour day, and asphaltic oil costing $0.06 per gallon delivered in cars.

In maintaining these bituminous surfaces a re-treatment of about ¼ gallon of bituminous material per square yard is only made on those places from which the bituminous material has disappeared. The present condition of these roads indicates that the expense for patching and sanding in 1912 will not exceed $0.01 per square yard, in which case the total expense of maintenance for four years will have been $0.1076, making the average cost $0.0269 per square yard, or approximately $236.72 per mile per year for a 15-foot road. Whether such a surface on a macadam road will withstand the traffic of heavily loaded motor trucks cannot now be determined, as such trucks have not been in service sufficiently long to permit of determinations.

On roads where the prevailing traffic consists of steel-tyred horse-drawn vehicles, this application of bituminous surface, consisting of heavy asphaltic oil and grit, has proved unsuccessful, in most instances, the surface being cut and dented to such a degree that it soon disappears. On such a road, it is possible that a heavy, refined tar surface may be economical, or it may be economical to use oil of a lighter grade, applying it with sufficient frequency to keep the surface of the stone covered with oil at all times.

EXPERIMENTS ON CONCRETE WATER BARRELS AS APPLIED TO FIRE PROTECTION OF RAILWAY BRIDGES.*

By Hunter M'Donald.

The maintenance of water barrels for fire protection on bridges and trestles may seem to the uninitiated to be a comparatively small matter. To the person upon whom the responsibility for their maintenance and efficiency rests the matter presents an entirely different aspect. To be efficient, water barrels must be kept full of water and be easily accessible, which essentials entail the following requirements:

The water must not freeze; the barrels must not leak; the water must not evaporate or be drunk by cattle; frequent inspections must be made; the barrels must be filled when installed and frequently refilled; the barrels must be placed at proper intervals for effective use in case of fire; they should be provided with small cans or vessels, in which the water can be carried to the point where it is needed.

The principal damage other than fire risk, caused by freezing, is that it makes the barrels leak. This can be prevented to some extent by fastening in the barrel a stick running in a slanting direction from near the top to the bottom. The addition of salt will, of course, lower the freezing point, but will not prevent freezing. The only consolation to be derived from frozen water barrels is the fact that fires in bridges are not likely to occur in freezing weather.

Where water barrels are completely buried in the earth at the ends of the trestles, they seldom leak until the wooden staves become rotten, which occurs in about four years. If wooden barrels are not buried they require frequent refilling If carefully covered to prevent evaporation, the interval of filling is lengthened. Should the water in the barrel get low from any cause, the barrel is usually permanently injured by having the tops of the staves dry out—a condition very difficult to remedy. A prolific cause of leaky barrels is the tendency of the idle man or boy with a gun to use them for targets. Axes and hammers are sometimes used as a means of destruction.

Barrels must be substantially covered to prevent evaporation. When tight barrels are buried at the end of the trestle and well covered, refilling is seldom needed more than once a year. Covering is also necessary on account of the tendency of cattle in the dry season to drink the water up. It seems impossible to cover them so tightly as to prevent large crops of mosquitoes from being raised. Barrel covers which sink below the outer rim of the barrel are very advantageous, as they catch all the rainfall and allow it to run into the barrel. Where no leaks occur, this is sufficient in many climates to keep the barrels full.

Unless inspections of the barrels are made at frequent intervals by a responsible officer, they are likely to go to pieces early and be absent or empty at the time most needed. It is not sufficient for the inspector to merely call attention to the defects, but each one should be followed up immediately and remedied.

When barrels are first installed, they should be filled by the party installing them; after this, they should be given over to the section foreman, whose duty it should be to keep them properly filled.

Water barrels can be effective only in the incipiency of a fire. More effective means must be had when the fire has assumed some headway. How to get the water out of the barrel and put it on the fire is a question. On some divisions oyster and tomato cans are sunk to the bottom of the barrel

* From a paper presented before the Engineering Association of the South, January 22nd, 1912.

or fastened to the underside of the top by a wire. Sometimes an old paint bucket is used and sometimes a box made of heavy plank. The object is to use something that nobody wants to take away. It is almost impossible to maintain such vessels in the barrels, and the best way is to assume that the person who discovers the fire will use his hat, shoe or something else until organized help arrives. In studying the water barrel question the concrete barrel has come in for its share of discussion, and two experimental barrels were made two years ago. They have the self-feeding top—that is the top is depressed so as to catch the rain water. Neither has required refilling. Both have proved themselves to be proof against bullets fired from a 38-calibre revolver. Below is a table of the estimated cost of making these barrels:

Covers:		
Galvanized iron, 5 square feet at 3 cents..	$0.15	
Hinge, bolts, rivets and wire, 5 cents....	.05	
Cost of making, one man one hour.......	.20—	$0.40
Barrel:		
17 square feet expanded metal (0.6 pound, 4 feet) at 3 cents.....................	$0.51	
10 cubic yards 1:2:4 concrete at $2.40....	.24	
Cost of forms (assuming twenty-five barrels to one set)	.10	
Cost of labor for making barrels at 15 cents	.30—	1.15
		$1.55
Add 10 per cent. for engineering and incidentals..		.15
Total cost		$1.70

Another experiment has been tried, consisting of a concrete box let into the ground all but about one foot, this upper part being used for the number of the trestle.

It is believed that good concrete water barrels, with metal tops, can be made for $1.30 each when made in large quantities. The wooden barrel is the most expensive of the two, considering its capitalized cost on a basis of six years' life, which is reasonable, leaving out all consideration of increased cost of maintenance.

Other experiments have been made, using galvanized iron forms, and poultry netting reinforcement. Plastering the mortar on has not resulted in tight barrels, but 1:2:4 concrete cast and rammed into forms has given good results. Experiment is also being made with joints of 24-in. clay pipe with concrete bottom, with the bell set upward and buried in the ground.

The ballasted deck trestle is rapidly becoming the standard on most roads, however, and it is thought that in the future the water barrel will seldom be needed.

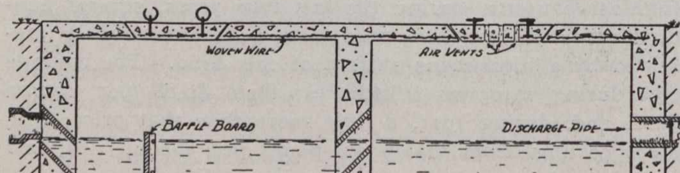
AMERICAN TEST OF WIRE ROPE.

The United States Bureau of Standards has decided to make a series of tests upon wire rope, and, in asking the cooperation of manufacturers, puts forward the following points:—(1) What should be proposed as a standard tensile test? (a) Proper length of specimen, taking account of that critical length over and above which the strands will act as a unit. (b) Type of end sockets or connection. (c) Elongation, etc. (2) What importance should attach to the torsion test? (Some authorities believe this to be superfluous) and what should be a standard test for torsion? (3) What is suggested in the way of cold bend test over the usual methods. (4) Little has been published in the matter of impact tests. It would seem as if this field is important and recommendations are desirable. (5) What should be done in the matter of abrasive tests? (6) Biggart, Stone and others have proposed and made tests in which the life of cables, and other properties, are investigated by passing them over a series of pulleys direct and reversed, the cables being subject to different direct tensions. What is the relative value of such tests, and how should they be carried out? (7) Samples of cables have been taken under actual service conditions after a number of years' usage in mine or elevator service, and tests compared with the unused original material. Is anything in this line desirable? (8) Are any other physical tests necessary (9) Chemical tests will be made. What are the suggestions in this respect (10) What number of duplicate tests is suggested for any one type or specimen? Tetmajer used two in his tests. Three would seem more desirable. For the individual wires he used eleven. Would not a lesser number, say six, be sufficient?

SEWAGE DISPOSAL FOR COUNTRY HOMES.

The general use in country homes of the modern conveniences of the bath and toilet has made necessary some effective and inexpensive means of disposing of the sewage. Otherwise the drinking water will be polluted and the health of the family endangered. Entire satisfaction is obtained by the use of the septic tank, which is nothing but a long water-tight cistern through which the sewage passes very slowly and evenly. The purified sewage may be discharged into an ordinary farm drain tile.

Although the odor from a small septic tank is practically unnoticeable, yet it is best to locate it at least a hundred and fifty feet from the house. Choose a spot where it can be sunk to ground level and will be out of danger of flood waters. The tank should be large enough to hold the entire sewage for one day. For a family of eight to ten, plan a concrete tank of two compartments each 4 by 4 by 5 feet long. Since the top and bottom are each 4 inches thick and the division and sidewalls 8 inches, dig the pit 4 feet 8 inches deep, 5 feet 4 inches wide and 12 feet long.



Cross-Section Through Tank.

If the ground stands firm, only inside forms will be needed. Make two, each 4 by 4 by 5 feet long. Old 1-inch lumber will do for the siding. The compartment into which the sewage first enters is called the "charge tank." In each end of the wooden form for this tank cut openings for a 5-inch tile with the lower edge of the hole 16 inches above the bottom of the form. Through each of the sidewalls of this same form, 18 inches from the inlet end and 1½ and 2 feet above bottom, bore 1-inch holes and insert in them greased wooden pegs extending 4 inches into the future sidewalls. Likewise, in the other form for the discharge tank, cut openings for a 5-inch tile, this time with the lower edge of the hole 2 feet above the bottom.

Mix the concrete one part Portland cement to two parts sand to four parts crushed rock, or one part cement to four parts pit gravel. Place the 4 inches of concrete in the bottom and trowel to an even surface. Immediately set the forms in place so as to leave room for 8-inch division and sidewalls. Fill the forms with mushy wet concrete. At the proper heights insert the 5-inch drain tile through the holes in the forms. Be careful that the outside end of the inlet tile to the charge tank is 2 feet and its other end 16 inches above tank bottom. The pipe leading from the charge tank is also set at the same sharp slope. The outlet tile from the discharge tank is 2 feet above bottom and with both ends level. By this arrangement of pipes, the sewage is kept in the tank to the depth of 2 feet and the ends of the tile in the charge tank are trapped or air-sealed, which aids the activity of a certain kind of bacteria. Likewise, other bacteria are developed in the discharge tank by means of the free circulation of air through the discharge drain tile and holes in the manhole cover.

After the sidewalls are three days old, floor over the top of the forms and prepare to lay the 4-inch concrete top. As molds for the manhole covers, have the tinner make two round bottomless dishpans, 18 inches in diameter at the bottom and 24 inches at the top. Grease these tin molds and set one on the wooden floor over each compartment. Bore six 1-inch holes in the floor inside the one manhole mold over the discharge tank and insert in them greased pegs projecting upward six inches.

Place one inch of concrete over the entire floor and at once lay on it, crosswise the tank, strips of heavy woven-wire fencing 5 feet 2 inches long, or ⅜-inch rods running in both directions and spaced one foot. Likewise reinforce the manhole covers. Immediately place the remaining 3 inches of concrete and do not stop until the tank top and manhole covers are finished. Provide two lifting-rings for each cover by setting in them halves of old bridle-bits, or hitching-post rings, fitted with knobs of wire or with nuts and large washers. If a square wooden manhole mold is used, the concrete cover cannot be cast at once. In such case, carefully remove the wooden manhole form five hours after the top has been finished. Three days later mold the cover the same as for the tin form with this important exception—place heavy paper or cardboard around the edges of the opening to prevent the fresh concrete of the cover from setting to the old concrete.

When the top of the tank is ten days old, lift off the manhole covers, saw openings in the wooden top and remove the forms. In the holes made in the sidewall by the greased wooden pegs, insert ½-inch bolts and set them with mortar. To these bolts fasten the 1 by 12-inch wooden baffle-board which extends across the tank and breaks up the current of the inflowing sewage. To carry the sewage from the house to the tank, use 4-inch sewer pipe laid with tight mortar joints. Connect the discharge end of the tank with a string of drain tile.

The materials required for the tank described above are 5½ cubic yards of crushed rock, 2¾ cubic yards of sand and 9 barrels of Portland cement. If good pit gravel is used, no additional sand will be required.

When the septic tank is two weeks old it may be put to use. It will need cleaning at intervals of two to three years. By its use the health of the family will be protected and life in the country home will be made much more comfortable.

A NEW LINE OF BLOWERS DESIGNED FOR TURBINE DRIVE.

It is an established fact that turbines driving pumps or blowers in power plant service, where the exhaust is used to heat feed water or for steam heating, are more economical than the main driving units, even if these are run condensing. With the exception of a slight loss through radiation, what heat is not converted into mechanical work is either returned to the boilers or utilized, so that the heat efficiency closely approaches 100 per cent. This certainly commends turbo-auxiliaries as economical as well as reliable to maintain over-all plant efficiency.

However, as is well known, turbine power increases with the revolutions per minute up to a best speed that is invariably higher than that of ordinary turbine pumps or ordinary blowers. The writer has in mind a small steam turbine that develops 15 brake horsepower at 1000 r.p.m. and 40 horsepower at 3500 r.p.m. with the same pressure and total steam per hour. A larger turbine of another type develops 80 brake horsepower at 600 r.p.m. and 160 brake horsepower at 1600 r.p.m. with the same pressure and total steam per hour. The best pumps or blowers for these two turbines would therefore be the ones having economical speeds close to the higher turbine speed figures in each instance.

With these considerations in mind, Mr. C. V. Kerr, inventor of the original Kerr Turbine, has designed, and McEwen Brothers of Wellsville, N.Y., are now marketing a

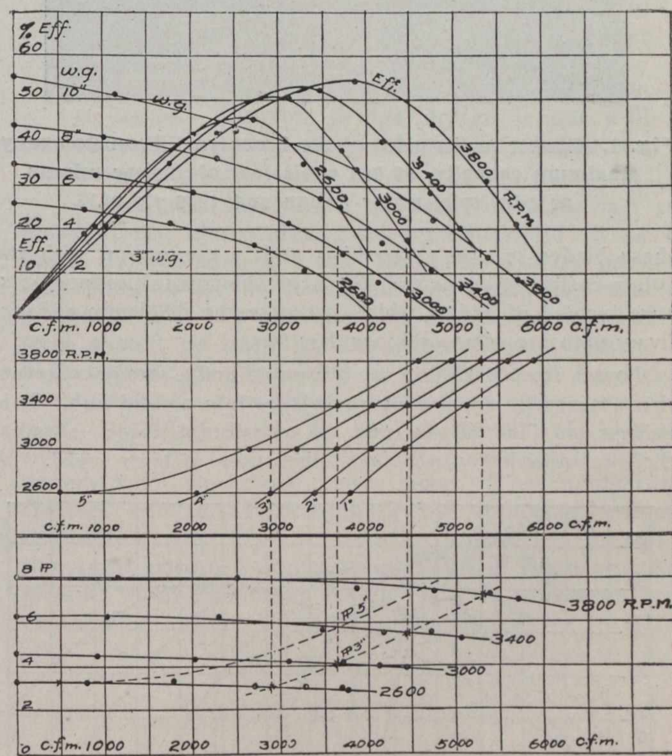


Fig. 1. Test of 16-in. Blower with helical impellers.

new line of pumps and blowers for turbine drive, having best speeds practically the same as those for the turbine and having an economical range within 25 per cent. above, to 25 per cent. below, rated capacity.

The blowers, are built in two types, the smaller sizes with double helical runners and the larger with increase pitch propellers. The manufacturers claim for both types a unit economy or steam per air horsepower better than ever reached before, especially on forced draft pressures. Both types have the runners opposed and balanced for high speed and have a central deflector to prevent cross flow. The runners are removable endwise and may be reversed on the shaft for right or left hand discharge. The bearings are lead-bronze, or babbitt lined, ring oiled and dust proof. The helical runner type has a solid cast-iron volute, and the propeller type is made with cast-iron sides and steel volutes.

The former, is designed especially for forced draft for forges and furnaces and in connection with underfeed stokers. Tests on a 16-inch blower of this type, and made with a calibrated steam turbine, Pitot tube and a series of nozzles showed the results indicated in Figure 1.

The propeller type blower, shown in Figure 2, has blades with an increase-pitch helical surface to reduce the shock losses due to impact at entrance. The kinetic efficiency of

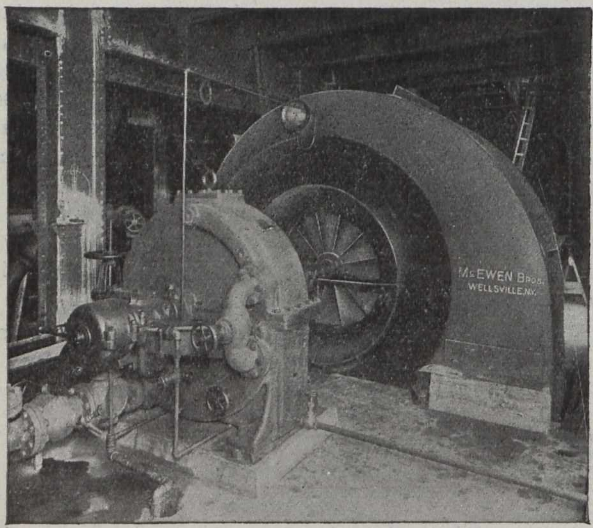


Fig. 2. Blower in the plant of the Brooklyn Edison Company, Maximum capacity, 80,000 cubic feet of air per minute at 4-in. total water gauge and 1500 r.p.m.

these blades is said to be high and in connection with the volute casing, reduces the discharge velocity to produce pressure instead of eddies which decrease the efficiency and delivery pressure of an ordinary disc fan.

Losses from back flow are prevented and a strong construction assured by dovetailing the blades into a solid hub. It is evident too that as the pull of centrifugal force is radial there is practically no blade distortion at high speed. A

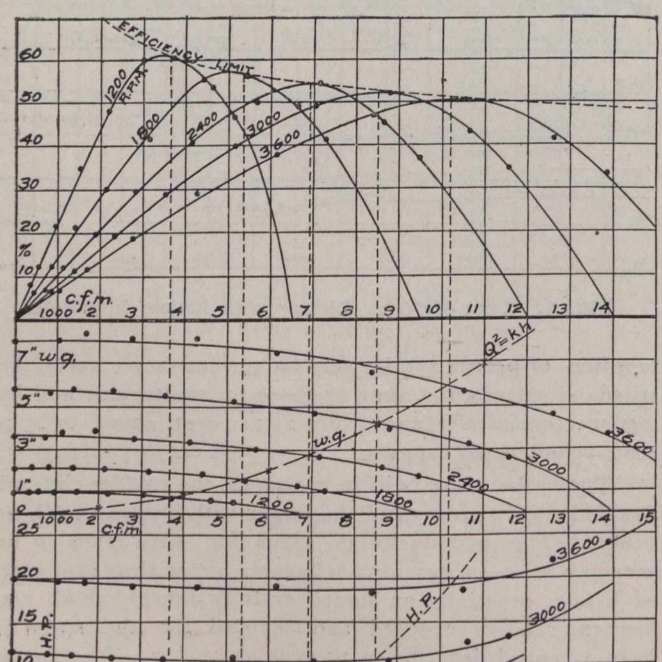


Fig. 3. Test of an 18-in. Propeller Blower.

peculiarity of this make of blower is the use of interchangeable wheels in the same casing, to produce different pressures for approximately the same speeds and capacities.

The performance of a blower of this type, the smallest of the series offered is shown in Figure 3.

These tests also were made with a calibrated turbine, Pitot tube and a series of nozzles at the end of a duct. The smoothness to which the points plot can be taken as an indication of accuracy of observation. The relation of the parabola of highest efficiency, $Q^2=KH$, (Q=quantity, H=head, K=constant), to the dot at the top of efficiency curve located by the same nozzle in each case is worthy of note. This suggests that if the discharge connection is reduced to the proper area the blower can be operated always at highest efficiency, regardless of speed. Beyond this throat the duct should be expanded to reduce velocity losses.

The head or pressure curves show the facility with which a number of these blowers can operate in parallel on the same duct, and how rapidly the dischage increases at constant head with increase of speed. The variation of power required as the blower is worked along the path of highest efficiency is also worthy of note.

Incidentally, the test results show that this blower, developed especially for forced draft work, is practical with either steam turbine or motor drive. On account of high efficiency and noiseless running at required pressures this blower is also useful for heating and ventilating service, including mine ventilation.

THE STRENGTH OF CROSSARMS.

The strength of crossarms has been tested by the Forest Service of the United States and it was found that for all ordinary pole-line conditions the crossarm is stronger than the pole. The arms tested were of Douglas fir, long-leaf pine (50 per cent. to 100 per cent. heart), short-leaf pine (plain and creosoted) and white cedar. The arms were about 3 x 4 in. in section (somewhat varying) and 6 ft. long, with three 1½-in. vertical pin-holes on either side of the centre. The two inner pin-holes were each 8 in. from the middle. For the test the crossarm was gained and bolted to a short piece of pole and the outer end of the attachment bolt was supported by an iron strap bracket. Vertical load was applied by the testing machine acting on a series of distributing levers, which brought equal load to bear on rods passing through the six pin-holes. The maximum load which the crossarm carried ranged from 4,800 to 10,240 lb. (based on a standard section of 3.16 x 4.10 in., the average size of Douglas fir arms). The crossarms of long-leaf pine were strongest, ranging from 9,000 to 10,240. Douglas fir and short-leaf pine were slightly weaker. White cedar showed a strength of only about 5,000 lb.; the failure in the case of white cedar was in nearly all cases a brash tension failure. In each case the corresponding lateral strength of the arm would be about 80 per cent. of the vertical strength, or about 4,000 lb. for the white cedar crossarm. Since tests of poles have shown that their resistance to side pull is rarely as high as 3,000 lb., and usually below 2,000, it is seen that the crossarm is the stronger. The values above given are all averages of a considerable number of samples.

The compressive strength of the wood in these crossarms ranged from 4,700 lb. per sq. in. for the white cedar to 9,000 lb. for the better samples of long-leaf pine and about 7,000 lb. for Douglas fir. Short-leaf pine ranged from 7,300 for the plain arms to something below 6,000 lb. per sq. in. for the creosoted arms.

It is concluded that for standard 6-ft. crossarms the question of strength need not enter into calculations of line construction except in rare cases of abrupt change in grade. The ability of the timber to resist decay, and methods of preventing decay, are much more important.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc. MANAGING EDITOR · A. E. JENNINGS, ADVERTISING MANAGER · P. G. CHERRY, B.A.Sc. CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	$1.75 (7s.)	$1.00 (4s.)

Copies Antedating This Issue by More Than One Month, 25 Cents Each.
Copies Antedating This Issue by More Than Six Months, 50 Cents Each.

ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main 7404, 7405 or 7406, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol 23 TORONTO, CANADA, AUGUST 8, 1912. No. 6

CONTENTS OF THIS ISSUE.

THE BLOOR STREET VIADUCT.

The following is extracted from a report by Commissioner of Works Harris, of the city of Toronto, to the Board of Control on the proposed Bloor Street viaduct:—

> "We are making a thorough survey of the route adopted for the Bloor Street viaduct, and taking the necessary levels and cross-sections, to enable us to prepare plans and specifications for the proposed bridge. I have gone into the matter thoroughly with Mr. C. W. Power, Engineer of Railways and Bridges, who advises me that a concrete bridge would involve minimum maintenance charge, but that other considerations enter into its construction, which renders it inadvisable to use this material. Extensive bridges of this class are, as yet, an experiment, and we do not think that the city of Toronto should make any investment along experimental lines, especially where the issue is so much in doubt. It is found, frequently, in structural concrete, that the slighting of a comparatively small portion of the work destroys the integrity of the whole structure. **Concrete bridge design is not well understood, while that of steel is upon an assured basis.**"

Mr. Harris surely did not desire that the last sentence of the above should be read literally. If he did mean it, we can only say that Mr. Harris has misunderstood what he has been told regarding concrete bridge design. To the question of whether concrete or steel should be used for the Bloor Street viaduct, we have nothing to say. That is a question to be decided on the local conditions—foundations cost, maintenance, suitability, etc. To the statement of Commissioner Harris that "concrete bridge design is not well understood" we must take issue. The analysis of stresses and the knowledge of the action of concrete is to-day on as high a plane as any other branch of structural design. Commissioner Harris is on uncertain ground when his duties compel him to report on work demanding a knowledge of engineering.

WATER STERILIZATION.

In an engineering contemporary the treatment of drinking water by means of violet ray sterilization, in Chicago, is described. The plant is the initial installation for sterilizing water by this means in a commercial way in America, and it is, therefore, interesting to note what results have been obtained. One of the most interesting features of it has been the experience with air. It seems that the water to be treated must be perfectly free from turbidity, either in the form of solid material or in the gaseous state as from liberated air. Erratic results were obtained with a perfectly clear water until the experimenters one day noticed through the peek-hole of the lamp that the water in the sterilizer appeared cloudy to the eye, although the final product was crystal clear. The installation of a tank to eliminate the air solved this problem. In an 11½-in. diameter sterilizer the proper position for the lamp was found to be 2½ in. from the surface. The brilliancy given to water by treatment with aluminum sulphate seems to be particularly advantageous in permitting the rays to penetrate the water.

There is some evidence to indicate that violet rays kill spores as well as vegetative bacteria. Ordinarily, a sterile water offers a nidus for a host of harmless organisms, but the analyses of samples taken from commercial bottles at Chicago at various intervals up to a month gave insignificant counts. Such results are manifestly dependent on the care with which the empties are washed. It is to be hoped that further corroborative results on a number of these points, as well as the limits in the rate at which water can be treated, will be obtained. The current cost at this plant is necessarily so low that it is hardly a factor in the total expense.

However, assuming a 110-volt, 4½-ampere lamp capable of sterilizing 150 gallons of water per hour, and estimating the cost of electricity at $25 per kilowatt per year, or 0.3 cents per kw-hour, the cost for 1,000,000 gallons is only $10, a figure not beyond the reach of those who wish a final polish on a water already coagulated, settled and filtered, and who do not care to take the possible chance of a taste and odor due to a chemical sterilization. For small domestic supplies, such as high-class residence towns, hotels and bottled-water service, this new method of meeting the ever-increasing demand for a more safe drinking water will bear study.

ANOTHER SEWAGE DISPOSAL SCHEME.

We noted in last week's issue that the United States Secretary of War had decided to refuse the application of the Sanitary District of Chicago for the right to divert an increased amount of water from Lake Michigan. This question has been up for discussion for some time, and Canadians will be pleased to note the action of the Secretary of War. A new scheme has now appeared, which, if allowed to materialize, would cause ill effects as great as increased diversion of water for the Chicago Drainage Canal.

The municipalities along the Niagara frontier, from Buffalo to Lewiston, in New York State, are investigating the possibilities of joint action with regard to their sewage disposal. It has been suggested that the towns and cities in that vicinity collect their sewage in a trunk sewer tunnel, which would run from Buffalo, on Lake Erie, to Lewiston, on Lake Ontario. As the fall from Lake Erie to Lake Ontario is over three hundred feet, by this means it is expected that about 250,000 horse-power would be utilizable by the installation of a power house at Lake Ontario or on the Niagara River. Leaving aside the practical difficulties, such as irregularity of flow, necessity of a pressure tunnel, and the consequent difficulty in collecting sewage from the towns along the route, etc., the promoters of this visionary scheme neglect to consider the effect of dumping the combined sewage of practically a million people, without treatment, into Lake Ontario. It is extremely likely that a good deal of opposition will develop if it is attempted to carry out the plan. The scheme, on the face of it, looks like a veiled attempt to secure water power privileges for the interested municipalities. No doubt the Canadian Branch of the International Joint Commission and the Commission of Conservation will look after Canadian interests when the right time comes. Their energetic action in the case of the Chicago Drainage Canal diversion cannot be too highly commended.

EDITORIAL COMMENT.

It is stated that President Maurice Connolly, of the Borough of Queens, New York City, has prepared an ordinance providing for a tax of $1 on every funeral cortege which passes through the borough, for the purpose of establishing a fund for maintaining the roads of the borough. The proposed tax would be a revival of a former ordinance covering nearly the same ground. Practically all the convenient routes which lead to the several cemeteries in which the dead of New York are buried lie in the Borough of Queens. The income which would be derived from such a source is estimated to amount to about $100,000 annually. The present state of Yonge Street, Toronto, might warrant the York County Highway Board raising a fund in a similar way. There are four cemeteries on Yonge Street, and no doubt the annual income from such a source would be large. We offer this suggestion to them gratis, if it will in any way help in Yonge Street improvement.

* * * *

Ottawa is reaping the harvest from the council's policy of procrastination with regard to the water supply situation. Two typhoid epidemics in two years would appear sufficient to justify more action and less talk.

LETTER TO THE EDITOR.

CONCRETE FOR THE BLOOR STREET VIADUCT, TORONTO.

Sir,—According to the reports in the daily press the Commissioner of Works of the city of Toronto has recommended the city council to consider only the use of steel in the construction of the Bloor Street viaduct. He is reported to have added to this recommendation some reflections on the permanence of concrete construction which are liable to recoil on his department which, under his predecessor, has been a very successful user of concrete on a large scale, and in some novel and unusual ways. Doubt as to the strength and permanence of the Harbord Street bridge and of the poles of the city's hydro-electric system may be counted on to follow such comment, and we shall probably hear from Pro Bono Publico recommendations for the thorough painting of these and other structures before their permanence is seriously impaired.

It is unfortunate that concrete construction should thus seem to be attacked by one who, from his position, will be looked on by outsiders as an expert. By those who are able to appreciate the magnificent possibilities of concrete work this action will be taken as amusing or deplorable, according as they view it as a personal opinion or as the policy of the engineering department of a large city. By the general public it will be taken either as a sweeping condemnation of concrete or as another instance of the worthlessness of expert advice. In any event, the city council will be well advised if the recommendation is rejected.

Whether concrete or steel is the cheaper material there can be little doubt that from an architectural standpoint a much more pleasing effect can be secured from concrete. There are several steel viaducts in the city of Toronto, but only one of these, the Wilton Avenue bridge, has any artistic merit. The remainder stand as examples of what the bridge engineer can create when cheapness is the first and only consideration. Several of these refuse really to stand, but vibrate to such an extent that the city has given up the attempt to keep them lighted with electric lights. They are a continuous source of expense, and call for frequent renewals of the wooden floors and sometimes call in vain for paint. They were at their strongest the day they were erected and are weaker for every day they stand—concrete built at the same time would now be over ten per cent. stronger. A fine effect is, of course, possible with steel, but Toronto can only show one example in steel, while the

Harbord Street arch and the concrete bridges at Centre Island show what the works department has accomplished in the past in very satisfactorily harmonizing structures to their surroundings.

Great stress is laid on the fact that good foundations must be obtained for a concrete arch, and this elementary engineering consideration is granted. The steel superstructures of the skyscraper office buildings can stand an amount of settlement which would wreck a concrete arch, but they are carried to rock on concrete footings. The foundations of a steel viaduct ought to be at least as secure, and, if made so, can as safely carry a superstructure of concrete as of steel. As a matter of fact, it is doubtful if the foundations for the Bloor Street viaduct would require to be carried as far down as the piers under the C.P.R. building. In the absence of information to the contrary it is fair to assume that only ordinary difficulties would have to be overcome in getting down to depth.

The point has been raised that failures of concrete structures have occurred. Leaving out the "tu quoque" arguments of the failure of brick and steel which prove nothing concerning concrete, the fact need only be emphasized that in every case the contributing cause was outside entirely of the material used—dishonest or unskillful workmanship or design, not poor material.

One argument on which might be poured the choicest sarcasm of a Macaulay flaying a Montgomery is that it is inadvisable for the city of Toronto to take the lead in using concrete for a work of such unheard-of magnitude. With a graduate of Toronto University building the largest steel truss bridge in the world, another responsible for the foundations of most of the office buildings in America and a Toronto engineer building concrete arches unsurpassed for magnitude in Canada, it is time some one awakened the Rip-van-Winkle responsible for this amazing argument. Without leaving this continent for examples we can find one viaduct with foundations going to double the depth required, another of double the proposed height, another of double the length, and still have left the notable achievement at the Florida Keys of one running over two miles over the ocean. If these are too far afield we shall be content to mention that the pioneer work has been done by Port Arthur and that before the Bloor Street viaduct is designed in steel the city of St. Catharines will have one of concrete 70 feet high and 700 feet long.

Were it not for the size and importance of the city of Toronto it would not be worth while to take up this matter seriously. But we have here a case in which steel is to be recommended to the express exclusion of concrete when the latter is necessarily permanent as against the certain deterioration of steel, whence an artistic architectural effect is certain to be obtained in concrete and almost certainly not in steel, and where it is within the bounds of possibility that concrete construction may be cheaper in first cost and is certain to be cheaper if a fair valuation is placed on maintenance expenses.

The Canadian Cement and Concrete Association is not opposed to steel construction and will not oppose steel for the Bloor Street viaduct if a committee of engineers should recommend it. The stand taken by the association is that the city of Toronto has much to gain and nothing to lose by rejecting the present recommendation of the Commissioner of Works and allowing concrete and steel to compete on equal terms for use in the construction of the Bloor Street viaduct.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.
W. SNAITH,
Secretary-Treasurer.

Toronto, August 6th, 1912.

PROGRAM FOR THE SIXTH ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY TO BE HELD AT HOTEL CLIFTON, NIAGARA FALLS, ONT., SEPTEMBER 16th to 19th, 1912.

1. Report of Committee on Progress. This report will deal with the recent progress and developments in the lighting industry both in this country and abroad.

2. A report of the Committee on Nomenclature and Standards, which will deal with certain definitions and terminology of illuminating engineering.

3. "Steel Mill Lighting"—a report of the committee on illumination of the Association of Iron and Steel Electrical Engineers—to be presented by the chairman, Mr. C. J. Mundo.

4. "High Pressure Gas Lighting," by Mr. F. W. Goodenough, chairman of council, Illuminating Engineering Society, London, Eng.

5. "The Status of High Pressure Gas Lighting," by Mr. George S. Barrows. This paper will be a collation of domestic and foreign correspondence pertaining to high pressure gas lighting.

6. "Recent Developments in Gas Lighting," by Mr. R. F. Pierce.

7. "Indirect and Semi-Indirect Illumination," by Mr. T. W. Rolph.

8. "Recent Developments in Series Street Lighting," by Dr. C. P. Steinmetz.

9. "Research Methods," by Dr. E. P. Hyde.

10. "The Problem of Heterochromatic Photometry and a Rational Standard of Light," by Dr. H. E. Ives.

11. "Reflection from Colored Surfaces," by Claude W. Jordan.

12. "Diffuse Reflection," by Dr. P. G. Nutting.

13. A Study of Natural and Artificial Light Distribution in Interiors," by Mr. M. Luckiesh.

14. "The Physiology of Vision," by Dr. T. A. Woodruff.

15. "The Efficiency of the Eye Under Different Systems of Illumination," by Dr. C. E. Ferree. This paper will be a report of a research carried on for the American Medical Association.

16. "A Proposed Method of Determining the Diffusion of Translucent Media," by Mr. E. L. Elliott.

17. "Illumination Charts," by Mr. F. A. Beuford.

18. "The Determination of Illumination Efficiency," by Mr. E. L. Elliott.

19. "An Absolute Reflectometer," by Dr. P. G. Nutting.

20. "Colored Values of Illuminated Surfaces," by Mr. Bassett Jones, Jr. This subject will be presented in the form of a series of experimental demonstrations.

21. One session will be arranged for, a potpourri, at which discussions will be in order on miscellaneous phases of illuminating engineering. It is expected that this session will bring out interesting and valuable points not particularly covered by the above papers and reports.

The scenic wonders of the Falls render possible an entertainment program which will surpass that given at any previous convention of this society.

Inspection tours of the power houses and other wonderful development enterprises peculiar to this location have been arranged for.

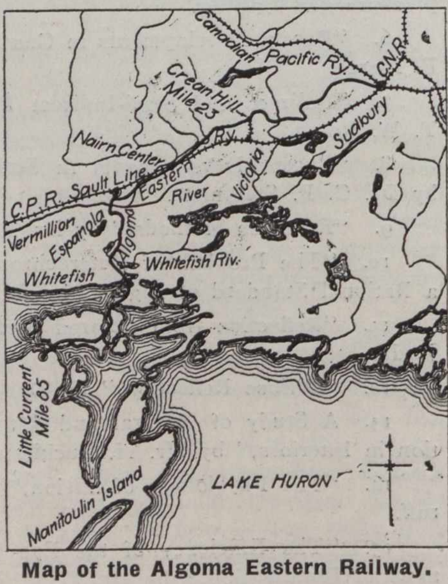
Reduced railroad fares will be available for delegates.

THE CONSTRUCTION OF THE ALGOMA CENTRAL AND HUDSON BAY RAILWAY, AND THE ALGOMA EASTERN RAILWAY.

By R. S. M'Cormick.*

Algoma Central and Hudson Bay.—The construction of the Algoma Central & Hudson Bay was begun in the spring of 1900 by the Old Lake Superior Corporation, under the management of F. H. Clergue, a land grant and subsidy being arranged for at that time with the Canadian Government. In the spring of 1903 a continuous line had been graded from Sault Ste. Marie, Ont., to Josephine Junction, 170½ miles north, with a line extending down to Lake Superior, at Michipicoten harbor. This section, 20 miles long, was built in 1899-1900 to gain access to valuable iron mines in this territory, owned by the corporation. The grading work on the main line was not completely finished, however, as financial misfortunes overtook the corporation. Track was only laid to a point about 55 miles north of the "Soo." A large number of bridges and trestles between this point and Josephine Junction were not built, but otherwise the line was completed to subgrade.

Between the years 1903 and 1908 additional track was laid to bring the end of steel at mile 68, no other work being done north of this point, however. In 1909 active measures were begun by an English syndicate to complete the road, which had, in the meantime, secured control of the Lake Superior Corporation, including the Algoma Steel Company and the railway and other transportation and industrial interests at Sault Ste. Marie. Before undertaking the completion and proposed extension of the railway, a report was made for the management on the whole project by F. H. McGuigan, of Toronto. Mr. McGuigan reported favorably on the completion and extension of the line to connect with the National Transcontinental Railway, Canada's new coast to coast railway.

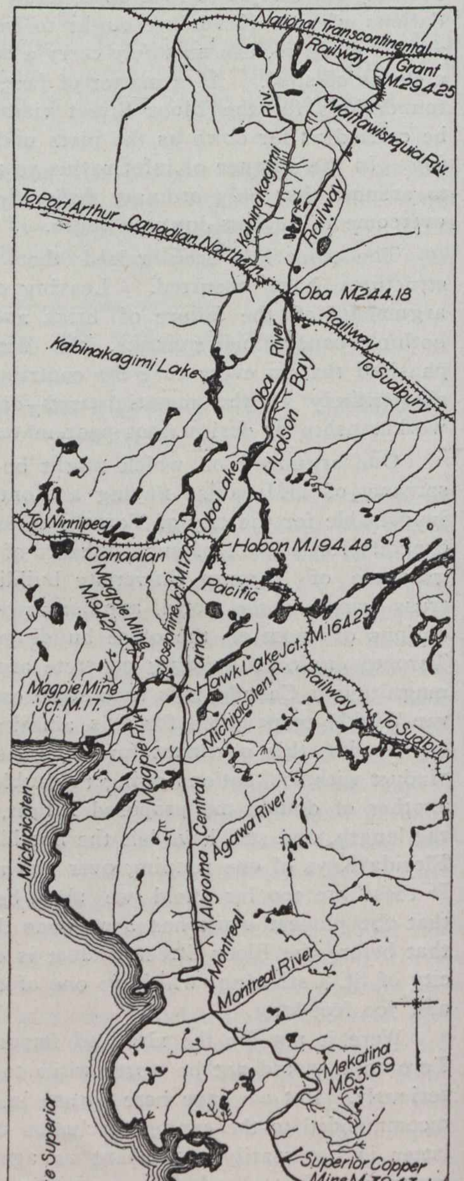


Map of the Algoma Eastern Railway.

The necessary financial arrangements being successfully completed, the first work undertaken was the locating of a line to connect the old grade near Hawk Lake with the Canadian Pacific. This was accomplished by the location and construction of 30 miles of line from Hawk Lake Junction to Hobon. S. Keemle, locating engineer, Toronto, was in charge of the locating party on this work. A 0.6 per cent. compensated, 6 deg. maximum curve, line was secured at a cost of about $38,000 per mile complete, including track and structures. In May, 1910, a contract was let to the O'Boyle Bros. Construction Company, of Sault Ste. Marie, for this section, and on July 1 another contract to the same company for the completion of the main line from mile 68 to Josephine Junction, mile 170½, including regrading in cuts where slides had occurred, bringing up settled embankments, all the bridging (excepting Montreal River), track laying and ballasting.

In the meantime a spur of 9½ miles long was located from a point 17 miles from Michipicoten harbor on the line extending from the lake to the mines, northerly to a new iron mine known as the Magpie mine. In May, 1910, active work was started on this section. The company also started to repair and re-tie the upper 10 miles of the 20 miles extending from the harbor to Josephine Junction known as the Josephine branch, which had been wholly unused for over eight years. This line was in wretched shape. The ties were rotten, and as very little ballast had originally been used it was necessary to re-ballast the whole section. This work was done with company forces, with some help from the O'Boyle company.

From May, 1910, to August, 1911, the work on the main line, north from mile 68 and south from Josephine Junction, the grading of the Hawk Lake—Hobon section, the building of the Magpie branch and the re-building of the 10 miles of the Josephine branch, proceeded with the usual ups and downs peculiar to railway construction work in such a country. Labor was poor and generally scarce, and bush fires, whiskey and all the troubles incident thereto had to be fought continually. By August 1st, 1911, the Magpie branch was completed, at a cost of practically $275,000. The line was built on a 1.5 per cent. compensated grade against the traffic and 2.5 per cent. flat, with the traffic.



Map of the Location of the Algoma Central & Hudson Bay Railway.

The first four and one-half miles from the junction to the crossing of the Magpie River was light work, except for some heavy side cutting descending the slope to cross the river, at which point the adverse grade of 1.5 per cent. compensated,

*Chief Engineer, Algoma Central & Hudson Bay and the Algoma Eastern.

was located. From the river crossing to the mine the line is heavy, and at mile 7½ there is a timber trestle 900 ft. long, 80 ft. high, located on a 12 deg. curve and a 1.75 per cent. grade. Up to this point the grade is 2 per cent. maximum, from here to the mine site it is 2½ per cent., 12 deg. being the maximum curve. Very large expenditures are being made by the company in opening the mine, and in addition to a plant for treating the siderite ore a model mining town is being built. This branch is laid with 80 lb. A. S. C. E. rail, with tie plates on all curves, and is most substantially built in all respects, except that timber and piles were used in bridging.

On July 15th the sub-contractors on the Hawk Lake—Hobon section finished the grading. These sub-contractors were Murdock Brothers on the lower 19 miles, and Cavicchi & Pegano on the upper 11 miles. The work was quite heavy, the grading quantities being 732,933 cu. yds. classified, 261,269 cu. yds. solid rock, 94,378 cu. yds. loose rock, and 377,286 cu. yds. common excavation. In addition there was 20,178 cu. yds. over break in rock cuttings, and overhaul amounting to 1,500,000 cu. yds. About 3,000,000 ft. B. M. of bridge timber, 40,000 lineal feet of piling, 170,000 ft. B. M. of culvert timber, 220,000 lbs. of bridge iron, 291 cu. yds. of dry stone masonry, 423 cu. yds. of cement masonry and other small items were required for this work.

The rock work was exceptionally well done, as the specifications only allowed common excavation for over break, and all the time the work was in progress this was enforced. On final estimate, however, a fair amount of over break was given as solid rock. Track laying and some ballasting was done this year, and the bridge work was completed. On January 10th, 1912, track was connected up giving a railway connection from the Canadian Pacific into the mines of the Michipicoten district. Some ballasting was also done this year.

Laying Track on Algoma Trestle.

Work on the main line completion progressed slowly from June, 1910, to May, 1911, at which time track had reached the Montreal River, mile 91½ north of the "Soo." Here a steel viaduct 1,550 ft. long and 130 ft. high located at the head of the falls 150 ft. high had to be built. This viaduct was designed in 1902 by Boller & Hodge, New York and was erected under contract by the Canadian Bridge Company. There are 1,745 tons of steel in this viaduct, and as the alinement is on a curve at each end, it was a very interesting piece of erection. The viaduct consists of tower girders supported on steel legs with concrete pedestal piers and end abutments. There are 13 30-ft. and 1 40-ft. tower girders situated on an island in the middle of the river. The intermediate girders consist of 1 85-ft., 5 75-ft., 10 60-ft., and 2 30-ft. spans. The structure is designed under the Dominion Government specifications, class 1 loading. Some poor work in concreting the piers requiring their rebuilding, delayed the erection, but track was laid over the viaduct in October, 1911.

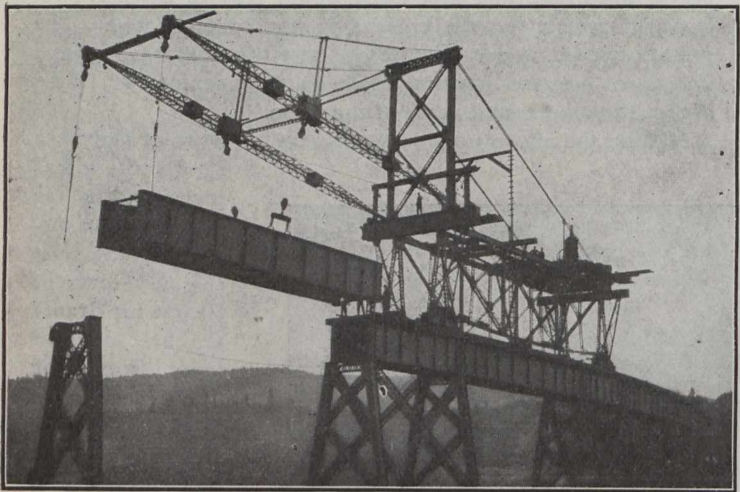
In the meantime track laying had progressed on the north end, the gap being closed about the middle of June, 1912. The slow progress made in track laying is due principally to the excessive amount of bridging and trestling on this line. Between the "Soo" and Josephine Junction there is about 16,000,000 ft. B. M. of bridge timber in 140 structures, besides 100,000 lineal feet of piling. Some of these bridges are very large, and as all the bridge timber used, excepting a few thousand feet cut in the country, is British Columbia fir, it is necessary to build these bridges from the end of steel.

The old line from Sault Ste. Marie to Hawk Lake Junction is through a most difficult country to build in, and while the location secured was good on the whole, the line is badly handicapped with heavy grades and sharp curvature. To improve this grade and alinement would require extensive relocating, which for the present is not contemplated. The route, however, is very picturesque and travelers have a treat in rugged scenery awaiting them on the opening for traffic of the Algoma Central north of the "Soo."

While the above work was progressing south of Hobon, a location was made north to the Transcontinental Railway at the new town of Hearst (or Grant) the first division point west of Cochrane, 101 miles north of the Canadian Pacific. This location is on the same grades and curvature as that of the Hawk Lake-Hobon section, viz., 0.6 per cent. compensated grade and 6 deg. maximum curves. Louis Whitman, locating engineer, had charge of the locating with Sanford Hazelwood and W. H. Wilkie in charge of the parties The route traversed by this line is through rough country for 30 miles north of the Canadian Pacific, but north of this the line enters the great clay belt of northern Ontario, and the grading work is light. The south 30 miles, however, bring up the average cost of this line to about $30,000 per mile, including track and structures.

The crossings of the Canadian Pacific and the Canadian Northern Ontario extension (under construction) are made at grade. There are very few bridges on this 100 miles, and none at all of any size excepting a bay crossing of Oba Lake, where four pile trestles were driven, one of them being 1,302 ft. long, with deck 10 ft. above the water. The balance of the bridging consists of pile structures, the largest being the crossing of the Mattawishquia River, 700 ft. long, near Hearst at the junction with the National Transcontinental. The grading quantities on this 100 miles will be, approximately, 360,000 cu. yds. solid rock, 250,000 cu. yds. loose rock, 1,500,000 common excavation, and 3,500,000 cu. yds. overhaul. About 80,000 lineal feet of piling and 1,500,000 ft. B. M. bridge timber are required. Corrugated ingot iron pipe is used principally for culverts, there being a few of native timber, but none of concrete. In August, 1911, a contract was let to the Superior Construction Company, Sudbury, Ont., for the construction of this section complete, including grading, bridging, track laying and ballasting. The grading is more than 60 per cent. completed, and track laying was started about June 15th, at Hobon. It is expected to reach the Canadian Northern crossing in October, thus placing the Algoma Central in a position to deliver construction material and supplies to the contractors for this line at Oba.

Explorations for extensions of the Algoma Central & Hudson Bay north of the National Transcontinental have been made. A copper metallic circuit telephone line has been constructed from Sault Ste. Marie, through to Michipicoten Harbor and extension to the mines and north to Hobon and Hearst will be made this summer.



Construction of Montreal Viaduct.

At Sault Ste. Marie, new terminals, consisting of a modern engine house, machine shop, store and office building and a new terminal station and office building are all contracted for and the work started. This work involves the expenditure of about $500,000, and includes an extension of the main line to reach nearer the centre of the city of Sault Ste. Marie. A new yard will be built at Tagona, the industrial centre, where extensive alterations and additions to the terminal facilities are being made. The company will also build a large coal and ore dock at Michipicoten Harbor in the near future.

The Algoma Eastern.—The original charter for the 85 miles of this railway now being completed from Sudbury to Little Current on the Manitoulin Island, was obtained by F. H. Clergue at about the same time the Algoma Central project was launched. As in the case of the latter road a land grant and subsidy accompanied the granting of the charter. Actual construction of the line was delayed from year to year, after the first section of 13 miles, extending from Sudbury to Gertrude Mine, was constructed in 1900-1901. An extension of 10 miles from Gertrude Mine to Crean Hill was built in 1909-10, bringing the end of steel 23 miles west of Sudbury where connection was made with a spur track connecting with the Canadian Pacific at Victoria Mine station. This spur, three miles long, is owned by the Canadian Copper Company and connects the Crean Hill Mine with the Canadian Pacific. This 23 miles of line passes through the famous Sudbury nickel district, the richest deposit in the world. Practically the entire revenue derived from the road's operation is for handling the ore from the Creighton and Crean Hill Mines to the roasting yards of the Canadian Copper Company at Copp r Cliff.

In 1909-1910 surveys were undertaken to locate an extension of this railway to Little Current on the Manitoulin Island. A party, in charge of Louis Whitman, locating engineer, was started at Little Current on a route over which the writer had run a line for the old Sault Company in 1900. This line traversed the islands and skirted the shore of the north channel to the mainland at the mouth of the Whitefish River where it cut through a range of high rock hills facing the lake, thence to a connection with the Canadian Pacific at a point on the Spanish River called Espanola. A section of 1½ miles of this original surveyed line was constructed in 1901 connecting the Spanish River Pulp & Paper Company's plant on the Spanish River with the Canadian Pacific Sault branch. This little section of spur was constructed by the Sault Company and turned over to the Canadian Pacific to operate, under an agreement contemplating the ultimate completion of the whole project.

When the writer took charge of the work, a location was pushed through to connect with the Sudbury end at Crean Hill, a distance of 62 miles from Little Current line with a maximum 1.25 per cent. compensated grade and maximum 11 deg. curves (with a 12 deg. curve near Whitefish) was secured at a cost of about $32,000 per mile complete including track, ballast and building. In July, 1910, a contract was let to the O'Boyle Bros. Construction Company for building the 20-mile section from Little Current to the main shore at Whitefish, and in March, 1911, another contract was let to the Superior Construction Company for the balance of the work from Whitefish to Crean Hill, 42 miles. The grading work on this 62 miles is practically complete and track laying has just been started at Espanola. The 62 miles of track will be laid and ballasted about October 30th, next.

The country traversed by this railway is almost wholly unsettled and south of Espanola is very rugged. From the Whitefish River to Little Current the scenery is most picturesque as the line here follows close to the water and winds around the headlands and bays of that section of the North Channel known as the Bay of Islands. The grading on this section,

End of Steel A. E. Ry., May 22nd, 1912.

while practically all solid rock, was not excessive in cost, averaging about $20,000 per mile, including bridging. From Espanola easterly to the junction with the old line at Crean Hill the line passes over a better country, but, from an agricultural point of view, of little value.

An under crossing of the Canadian Pacific Sault branch is obtained near the village of Nairn Centre, the Canadian Pacific tracks being carried over the Algoma Eastern on a 27 ft. 7 in. skewed deck plate girder span on concrete wing abutments. The bridging on the entire line from Sudbury to Little Current is light for such a country. The steel structures consist of one 105 ft. and one 60 ft. deck plate girder span on stone abutments and centre pier at the Vermillion River crossing, 17 miles west of Sudbury, one 180 ft. through riveted truss span at the Spanish River crossing, mile 42, one 176 ft. through riveted truss span at the second crossing of the Spanish River at Espanola (built in 1901) and two 100 ft. girder spans at two other points together with a 36 ft. deck girder span on concrete at an overhead crossing of the government trunk road near Espanola. These major structures are supplemented by a number of timber trestles and pile bridges. At Little Current, in order to cross the channel, in front of the town, through which there is considerable vessel traffic, a bridge, some 600 ft. long with a draw span is required. This structure will be erected this year.

View of Roadbed at Mileage 87, S. C. & H. B. Ry.

The traffic expected for this railway consists of ore, pulp and paper, coal and the products of the Manitoulin Island, which previous to the construction of this line, was entirely dependent on water communication with the main land. This island is 90 miles long averaging 8 to 12 miles wide, and is capable of great development. The population at present is about 20,000 and at least one-half of the island is fine agricultural land, particularly adapted to hay and stock raising. The construction of the Algoma Eastern formerly known as the Manitoulin & North Shore Railway has been most eagerly looked forward to for years by the Manitoulin Islanders.

The above work has all been in charge of the writer, as chief engineer of both roads. On the Algoma Central & Hudson Bay G. F. Horsey and C. Le B. Miles are in charge of the work at the north end, and L. C. Maxwell and J. A. Hedgecock at the south end as division engineers. B. E. Barnhill is division engineer of the Algoma Eastern with headquarters at Sudbury. W. C. Franz is general manager and G. A. Montgomery superintendent of both roads.

ANOTHER ACCIDENT ON WELLAND CANAL.

Navigation in the Welland Canal is tied up as the result of an accident at lock 23, near Thorold, at 11.30 a.m. August 2nd, when the steamer Wiley M. Egan, bound light from Deseronto to Ashtabula, crashed into the lock and carried away all four gates. Water from the upper levels rushed through the narrow enclosure into the lower level of lock 22, carrying the boat back some distance.

New gates were sent from Port Dalhousie, and Superintendent Sullivan notified, but the placing of them will take some time. The loss is estimated at about $8,000.

PORT ARTHUR WATER SUPPLY.

The city of Port Arthur and Fort William in experiencing the growth and development which has been their lot during the past few years have at last had to face the problem of an abundant supply of pure water for drinking and domestic purposes. The supply of these centres has for many years been Lake Superior, and with the intake many thousands of feet from the shore this source left nothing to be desired, until the industries, many of which located along the water front began to pollute the water front with their discharged refuse; when this pollution reached the proximity of the intake, the matter took on such a serious aspect that the corporation council requested Mr. T. Aird Murray of Toronto to make a report on a possible future supply from certain sources north of the cities, and generally known as Hazelwood Lake and Current River; if this were not practical to make such recommendations as would give the citizens a clean and efficient service for considerable time to come.

In addition to the fact that the water on the land side of the municipalities was practically free from pathogenic bacteria and organisms, this source commended itself on account of the possibility of drawing the supply to the taps by gravity and thus reducing pumpage expenses.

That it is entirely feasible to obtain an abundant supply of water from the Current River at a static head requisite for city purposes, has been demonstrated by surveys and levels. At a point immediately above the Cascades a level of water may be obtained about 400 feet above the level of Lake Superior. This is practically the nearest point from which water can be diverted by a gravity system and the relative costs and efficiencies between a gravity and lake supply are based upon water being diverted from the river immediately above the Cascades.

In order to make a favorable comparison between the two systems it is necessary to assume an equal volume of supply by both gravity and pumping. In the preparation of the report Mr. Murray assumed that the quantity made available be 10,000,000 gallons per day, equal to a per capita supply of 100 gallons for a population of 100,000.

The feasibility of obtaining a supply from Hazelwood Lake was discarded after an investigation, owing to the boggy nature of the water shed and the increased distance from the cities which necessitated additional outlay for pipe, etc.

Chemically and characteristically, the water in Lake Hazelwood, in Hazelwood Creek near the junction at Current River, and in the Current River itself are the same for all purposes.

It is reported that, before the natural level of Hazelwood Lake was raised and flooded lands added, that the water was clear instead of bog colored as at present. At the present time the bog coloring matter both in Hazelwood Creek and in the Current River, is extremely high and for all practical purposes, may be taken as similar in content. So high was the color of this water that the different phases of the chemical analyses of the same, depending on the color of the reagents and precipitates, was rendered extremely difficult and to this fact the slight variations in the table of analysis is due. In the tabulation of the ammonias, this, of course, does not hold, for the water is distilled at as constant a temperature as possible before the reagent is added to compare the tint.

It is possible that if the flood land was scraped and al brush, weeds, tree stumps and soil to a depth of at least one foot were removed that the original clear color might be recovered.

The drainage area of Hazelwood Lake is about 24 square miles and the lake itself about 1,875 square miles, and it is at once seen that this would involve an immense amount of work and an expenditure of about $201,666. That this water ever was sufficiently clear to allow of its use as a domestic supply is based upon hearsay evidence, and that the removal of the organic soil and vegetation will effect the removal of the present bog coloring matter sufficiently to render it suitable for domestic supply without artificial treatment, is problematical.

The question, however, of a gravity supply from Current River deserves serious consideration as the water may be conveyed from a point much nearer the city and the quantity available is ample for all future city requirements.

The waters of the Current River watershed appear to be free from sewage contamination, but reference to the chemical analysis proves this water to be heavily charged with organic matter. The oxygen consumed averages 19 parts in million. The water is very soft, averaging 53 parts in one million, equal to 3.71 grains of hardness to the gallon. The total alkalinity of the Current River waters is low, being 25 parts in one million; and the alkalinity of Hazelwood Lake and Cre k is still lower, being 18.5 parts in one million. The amount of vegetable dye or peaty coloring matter in this water is also extremely high and shows a color content of 156 parts per million on the platinum cobalt scale. Generally speaking the water is fit for human consumption but owing to the coloring matter it is extremely objectionable.

The examination of the waters was made in the early spring, and it must be anticipated that the vegetable content will prove much more objectionable in the autumn when the process of decay sets in.

The coloring matter is in almost perfect solution, and cannot be removed by filtration alone, but can be removed by a combined method of filtration and coagulation. It has been shown that to remove 57 per cent. of the coloring matter, leaving a color content of 67 parts per million, will require the use of 3 grains of alumina sulphate per gallon and 7/10ths of a grain of soda ash. No data is to hand of such large quantities of coagulant being necessary elsewhere. The color of this water is extremely difficult of coagulation, owing to the low alkalinity of the water, as water required a pronounced alkaline base in order to set up the necessary reaction.

ITEMS INCLUDED IN COST OF GRAVITY SCHEME TO PROVIDE 10,000,000 GALLONS PER DAY FROM CURRENT RIVER.

Head works and dam	$ 11,750.00
Clear water reservoir	36,700.00
Filtration plant and coagulation basin	120,000.00
Duplicate 24-inch mains, head works to reservoir	78,416.00
Single 24-inch main, reservoir to River Street	114,240.00
Single 24-inch main, reservoir to pump-house	166,150.00
Single 24-inch main, River Street to High Street, Balsam and Van Norman	20,205.00
Single 12-inch main, River Street, Balsam to Peter Street	2,920.00
	$550,381.00
Supervision and contingencies	50,238.00
	$600,619.00

The cost of sodium carbonate and sulphate of alumina in this country is very high as it is not manufactured in this country and is, therefore, subject to duty. Calculations of the cost of sulphate of alumina and soda ash delivered at Port Arthur show that the cost of coagulants at the above ratio of treatment amount to $9.30 per one million gallons decolored, and that if 97 per cent. of the color be removed the cost is $22.08 per one million gallons of water decolored. Apart from this cost there must be considered the cost of cartage from the rail cars to the treatment works and the expense of filtering.

It will be readily seen that owing to the density of the coloring matter and the low alkalinity of the Current River waters, that the removal of this color is its chief objection to its availability. Although the color is less in Hazelwood Lake and Creek than in the main stream, the alkalinity is lower and the cost of treatment is much the same, there being required a greater proportion of soda ash than alum.

Items included in cost of pumping scheme to provide 10,000,000 gallons of water from Lake Superior, with an intake at city limits:

Duplicate 24-inch water pipe	$ 55,000.00
24-inch mains	350,000.00
12-inch mains	26,264.00
Pumphouse	8,000.00
Pumps	24,000.00
Removing old pumps	3,000.00
New well	4,500.00
Two houses	7,000.00
	$477,764.00
Deduct cost of pumps not required at present	12,000.00
	$465,764.00
Add 10 per cent. for contingencies, supervision, etc.	46,576.00
	$512,340.00

In order to compare the relative cost and efficiency of a gravity supply with a pumping supply, it is necessary to estimate the cost of a pumping supply delivering from a point at the city limits 10,000,000 gallons of water per day to the city. And a plan has been prepared which shows the layout of a force main system, designed to deliver 10,000,000 gallons of water per day. It is suggested that duplicate steel intake pipes be laid into about 41 feet of water 2,500 feet in length, working under a static head of 15 feet 0 inches. Each of the pipes will be capable of delivering to the pump well approximately 8,000,000 gallons per day, or a total deliveiy of 16,000,000. The suggestion, as far as a steel pipe is concerned, is only tentative, as no borings have been made at this point to prove the class of strata. If solid rock, which is probable, it will be as economical and more efficient, to construct a tunnel.

Duplicate lines of 24-inch force main are shown from the pump-house to the corner of Algoma and McDougall Streets. In former reports 18-inch force mains were suggested, but this was for a smaller volume of supply than 10,000,000 gallons per day.

Under a 10,000,000 gallon per day supply, allowing that each 24-inch pipe delivers 5,000,000, the energy required to force this water from the pump-house to McDougall and Algoma is 26 pounds to the square inch. If the pipes be 18 inches diameter, then the energy required is 113 pounds to the square inch.

COST OF INSTALLING PUMPING SUPPLY FROM CITY LIMITS AND 24-INCH DUPLICATE FORCE MAINS IN ORDER TO SUPPLY 10,000,000 GALLONS PER DAY, IN ACCORDANCE WITH PLAN, $512,340.

Operating Cost.

To pump 10,000,000 gallons per day for low level supply requires 953 H.P., and for high level supply 238 H.P. Total horsepower, 1,191.

Above is for a head of 500 feet, assuming that low and high level is half this amount, or 250 feet head in each level.

*1,191 H.P. at $15	$17,865.00
Operating for 365 days at $10	3,650.00
Incidental expenses per annum	500.00
Annual operating expenses	22,015.00
$22,015.00 capitalized at 5 per cent. equals a capital amount of	440,300.00
Total capitalized cost of pumping scheme from city limits, delivering 10,000,000 gallons per day	952,640.00

***Note.**—Power costs fifteen dollars per H.P. when consumption reaches 10,000,000 gallons.

Capitalized Cost of Gravity and Pumping Supplies Compared.

With 57 per cent. of the color removed:—	
Current River scheme	$1,432,819.00
Pumping scheme	952,640.00
Balance in favor of pumping	$ 480,179.00
With 97 per cent. of the color removed:—	
Current River scheme	$1,861,500.00
Pumping scheme	952,640.00
Balance in favor of pumping	$ 908,860.00
With no color removed:—	
Current River scheme	$ 644,319.00
Pumping scheme	952,640.00
Balance in favor of gravity scheme	$ 308,321.00
Cost of gravity scheme apart from operating expenses	$ 600,619.00
Cost of pumping scheme apart from operating expenses	512,340.00
Balance in favor of pumping	$ 88,279.00
Cost of gravity scheme, capitalized operating expenses only	$ 832,200.00
Cost of pumping, operating expenses only	440,300.00
Balance in favor of pumping	$ 391,900.00

The question has been raised as to what effect the choice of either of the above alternative systems may have upon the problem of the disposal of the city sewage.

At present the sewage of both Fort William and Port Arthur is discharged in a raw state into Thunder Bay. It has been felt that any decision to rely upon Thunder Bay water for purposes of domestic supply will entail the necessity, in the near future, of a large expenditure in trunk sewers and efficient disposal works for the purification of the sewage before it enters the bay. Fort William has a supply of water by gravity independent of the bay water, and it has been suggested that if Port Arthur could also obtain a similar source of supply, then the necessity for sewage disposal will cease to exist.

The real question to be asked is: Apart from any law of the land prohibiting the discharge of raw sewage into fresh water, will the citizens themselves be content to turn their harbor into a cesspool and sewage disposal area? Apart from the question as to any effect such a discharge of sewage may have upon the domestic water supply, is it not possible and very probable that as the Twin Cities grow in population and the amount of raw sewage increases and the effect upon surrounding waters becomes apparent to the senses, that the citizens will demand that the nuisance be removed.

The history of the pollution of Toronto harbor and the demand by the people that an apparent nuisance be removed by the construction of trunk sewers and disposal works, is an illustration to hand.

In Toronto there has recently been installed an up-to-date filtration plant to remove turbidity and bacteria from the water; also there has been constructed trunk sewers and sewage disposal works, not with the object of removing disease infection from the sewage and safeguarding the water supply, but simply for the purpose of removing from the bay what has been considered a nuisance and disgraceful condition in Toronto harbor.

With similar increase in population, conditions will gradually assume just as objectionable features at Port Arthur and Fort William as at Toronto.

Apart from the actual water consumed from the tap, there is also a summer floating population to be considered, which will at times consume the water direct from the bay.

The question of sewage disposal has not been gone into in any detail, but it is considered that when this problem is taken up, that a trunk sewer system should be constructed from north to south, with disposal works located west of the Canadian Pacific Railway, and north of the McIntyre River. The area suggested is hatched with black lines on Plan B.

Conclusions of the Report.—That owing to the density of color matter in the Current River and its branches, that this watershed does not present a character of water which can economically be presented as an efficient domestic supply to the city.

That a pumping supply be installed at the north city limits.

That duplicate 24-inch intakes be installed.

That the pumping units at the new pump-house consist of the present turbine pump, and a new 2,000 gallons a minute turbine pump.

That the routes for the new 24-inch duplicate force mains be adopted.

That the present water wheel driven pump be maintained at the present pump-house as an auxiliary supply.

That hypochlorite treatment apparatus be installed for use only when required.

The estimated cost of construction of scheme is $512,340.

NEW GRAIN ELEVATOR FOR WEST ST. JOHN, N.B.

The Canadian Pacific Railway have recently concluded arrangements for the construction of a one-million bushel grain elevator at the above-mentioned point.

The elevator will be of reinforced concrete. It will be capable of unloading 160 cars in 10 hours, and of shipping to ocean vessels at several different berths. The elevator will be electrically-driven, a power plant for the generation of electric power being included in the contract. An extensive shipping gallery system will also be a part of the work. The elevator is to be ready for the winter shipping season of 1913 to 1914.

The approximate cost of this work is $500,000, and the John S. Metcalf Company, Limited, of Montreal, have been awarded the contract to erect the structure.

ALUMINUM OVERHEAD CONDUCTORS.

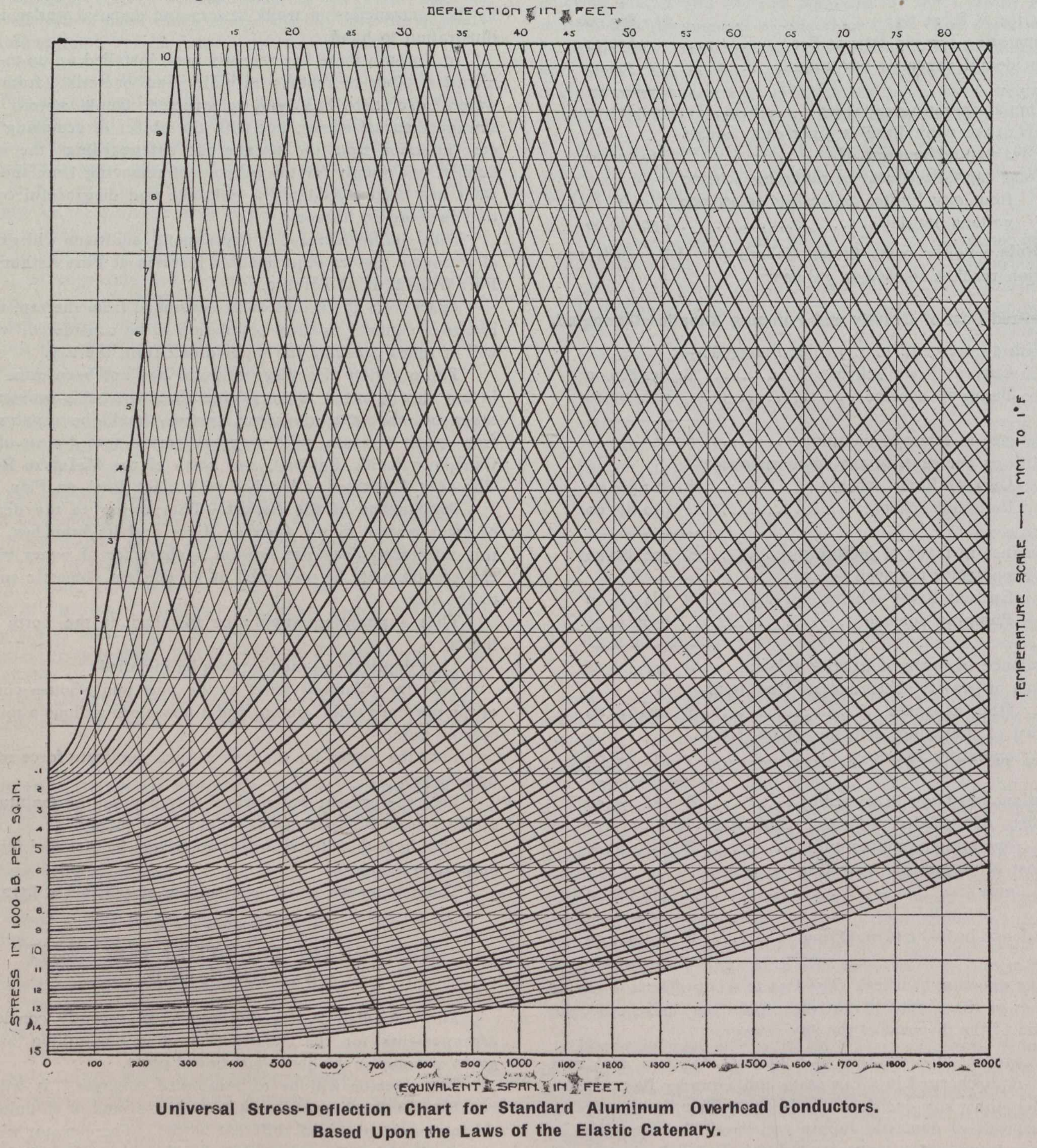
The accompanying chart has been developed by the British Aluminum Company, Limited, of 109 Queen Victoria Street, E.C., for the purpose of determining the deflection and stress in overhead conductors of aluminum. The Electrical Review received permission to reproduce the chart, of which the company retains the copyright. As the use of metal is increasing, we present the matter herewith to our readers.

The company claims that this is the first logically correct means of determining the physical characteristics of aluminum conductors that has yet been issued in this country, and it should take the place of the calculations, often only rough approximations, which have hitherto served. Information not found on the chart will be readily supplied by the company; a useful and complete comparison between copper and aluminum conductors will also be found in the article by Mr. E. V. Pannell, which was published in *The Canadian Engineer* issue of July 18th, 1912.

It is important to note that the chart as here reproduced is reduced in the ratio 5:2; the temperature scale is therefore modified, and each division represents 20 mm., or 20 deg. Fahr.

1. At constant temperature the intercept of the ordinate of the span with the curve of required stress will give the corresponding deflection; e.g., span 700 ft., stress 10,000 lb. per sq. in. Deflection 7.2 ft.

2. To allow for a rise of temperature follow the ordinate vertically upwards (1 mm. to 1° Fahr.); e.g., as above, allowing for a rise of 70° Fahr. Deflection 11.8 ft., stress 6,100 lb. per sq. in.



Universal Stress-Deflection Chart for Standard Aluminum Overhead Conductors. Based Upon the Laws of the Elastic Catenary.

Modulus of elasticity 9,000,000 lb. per sq. in. Coefficient of linear expansion 0.0000130 per 1° Fahr. Weight per sq. in. per ft. run 1.175 lb.

3. Again, as example 1, but taking into account a wind pressure of 30 lb. per sq. ft. on a conductor of 0.6 sq. in., the stress to be as before, multiply the span by the appropriate value of "q" given below, i.e., 700 × 2.33 = 1,631. Proceed as before, but divide the deflection so obtained by "q," i.e., 39/2.33 = 16.7 ft.

4. The deflection on the line in still air will be found by following the horizontal line through the point just determined until it intercepts the ordinate corresponding to the true span of 700 ft., giving a deflection of 13.6 ft., and a stress of 5,300 lb. per sq. in.

The value of "q" is the ratio of the total loading per ft. run to the weight of conductor per ft. run. Thus, if "w" be the weight and "p" be the effective wind pressure per ft. run of projected area (reduction factor 0.6) then $q = \sqrt{w^2 + p^2}/w$.

Cross-section of conductor, sq. in.		0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
Value of "q" with wind pressure of	30 lb. per sq. ft.	5.21	3.48	2.77	2.33	2.08	1.92	1.79	1.71	1.64
	20 lb. per sq. ft.	3.58	2.61	1.99	1.72	1.57	1.48	1.41	1.36	1.32
	10 lb. per sq. ft.	1.98	1.51	1.32	1.22	1.17	1.14	1.12	1.10	1.09

FIRST REPORT OF MONTREAL TRAMWAYS COMPANY

The first comprehensive report of the Montreal Tramways Company has just been compiled. The appearance of this report has been awaited with interest, the reason being the many changes which have taken place in connection with the affairs of the company during the past year. It is only two years since the present management assumed control of the street railway. It was not until about a year ago that, in the reorganization, the Montreal Tramways Company took the place of the Montreal Street Railway Company. Many changes have been effected during the year, among these being the formation of the holding company known as the Tramways and Power Company, through the medium of which the desired object of the present control was brought about—namely, the joining up of the street railway interests with those of the Canadian Light and Power Company.

The common stock of the Tramways Company, which company succeeded the Street Railway Company in all its rights, franchises and privileges, was in the nature of a bonus stock to accelerate the exchange of street railway shares on the basis of the offer made public at the time. The public was unwilling to commit itself to any very definite views regarding the value of the tramways common stock, some claiming that it was too much of the nature of water to be of much value, and others assuming that its value was somewhere in the vicinity of $30 to $35 per share. Of late this stock has been advancing constantly and recently it reached par. This week buyers were asking 110 for it.

Difficult as it has been to place any specific value on Tramways Common, the work of valuing Tramways and Power has been much more difficult, inasmuch as the latter company is a holding company into which go the surplus earnings on the stock of both the Tramways Company and the Canadian Light and Power, so that it becomes necessary to know somewhat of the earnings of both companies before the value of Tramways and Power can even be approximated. The stock has been experiencing a somewhat interesting movement of late and prices advanced to 60, later declining again to slightly above 50.

The financial report just issued shows that the company has made progress since the last annual report. The result of the nine months makes a good showing as compared even with the entire previous twelve months, as the following will show:—

	9 Months, 1912.	12 Months, 1911.
Gross earnings	$ 4,355,403	$ 4,775,300
Op. expenses	2,618,943	2,679,805
Exp. p.c. of earnings	60.13	56.12
Net earnings	1,736,549	2,095,080
Pass. carried	104,458,960	118,268,080
Car earnings per passenger	4.06	3.94
Transfers	34,947,315	40,488,545
Total pass. carried	139,406,275	158,756,625
Car earnings per pass. total carried	3.04	2.93

It will be observed that the car earnings per passenger shows a considerable increase. This is not surprising to Montrealers who have been raising objections to the overcrowding of cars. It is estimated that on the basis of passengers carried there should be an increase of 27,000,000 in passengers for the full year. The total carried last year was somewhat less than 159,000,000, while during the nine months period, according to report, somewhat less than 140,000,000 passengers were carried, making about 186,000,000 passengers per year.

It is also worthy of comment that the earnings for the nine months of this year are in excess of those for the full year ending September 30th, 1910, as well as for all full years previous thereto. The financial report for the nine months ending June 30th will, it is understood, be presented at the annual meeting on August the 6th and is as follows:—

Gross earnings		$4,355,403.57
Operating expenses		2,618,943.65
Net earnings		$1,736,459.92
From which deduct:—		
City percentage on earnings	$279,030.17	
Interest bonds and loans	449,513.67	
Interest debenture stock	600,000.00	
Taxes	50,850.00	
		1,379,393.84
Surplus		$ 357,066.08
From which has been appropriated for:—		
Contingent account		150,000.00
Transferred to general surplus		$ 207,066.08

No statement has heretofore been made of the number of shares of street railway which have actually been turned in for exchange. While President Robert in his report does not mention the actual number still outstanding, he states that only a few shares have not been exchanged. Reference is also made to negotiations in progress between the city and the railway for the purpose of securing a new contract.

The recent general manager, Mr. Duncan McDonald, has been succeeded by Mr. James E. Hutcheson, former superintendent of the Ottawa Street Railway, who has already taken up his work. It is understood that other changes will take place on the staff shortly.

FUEL OIL FOR SHIPPING

Officials of oil companies have learned that the Canadian Customs Department will probably decide to admit fuel oil for shipping use free of duty to Canada. Since July 12, when a tank steamer with a cargo of fuel oil for shipping use reached Vancouver from San Francisco, and a duty of 2½c. a gallon was demanded, the companies engaged in the fuel oil trade have been awaiting a decision by the Minister of Customs on an appeal taken as a result of this duty. Many of the trans-Pacific steamers of the Canadian Pacific and Grand Trunk railroads use fuel oil, and the imposition of such a duty would mean a doubling in the price of the product of these and other companies operating oil-burning ships.

Within the last seven years, according to oil authorities, practically all the local steamers at Vancouver and on Puget Sound have been converted into oil burners, while to-day a large majority of the larger off-shore liners are burning fuel oil. The saving in space and operating expenses has appealed to owners, and with the improvement in atomizing the fuel, its use has become much more satisfactory. Many manufacturing plants also have discarded coal for oil, and this ever-growing market has brought the importations of oil to Vancouver and vicinity to unexpected proportions.

Hon. Winston Churchill, the First Lord of the British Admiralty, recently announced that an investigation into oil fuel would be made. Oil burning engines are going to play an important part in many of the new crafts that are now being built and those in contemplation in the principal shipyards of the United States and England. According to a well-informed marine builder, there are no less than 242 steamers fitted for burning liquid fuel, the largest being the Toyo Kisen Kaisha liner's Tenyo Maru and Chiyo Maru of 13,454 tons gross and 13,431 tons gross respectively. In this connection it is of interest to note that the new Cunard liner Aquitania of 50,000 tons gross in the course of construction on the Clyde is to be similarly equipped, while the White Star boat of 18,000 tons which is now being built at Belfast for the Cape-Australian routes, and which is to be named the Ceramic is also to use oil. Quite a large number of the oil burners are now employed in the Pacific, two of them the Ventura and Sonoma recently inaugurated a service for the Ocean Steamship Company between San Francisco and Sydney, New South Wales. Another line of steamers burning oil fuel, the Crown Line, will soon be running between Pacific Coast ports and Australia.

The Colonial Transportation Company of Mexico is equipping its barges with oil engines and the use of oil for fuel promises to supersede other fuel upon nearly all the river and coastwise vessels on the east coast of Mexico. There is also an increased demand for crude oil for fuel by manufacturing plants in various parts of Canada and the United States.

Since the British coal strike in the early part of this year many of the large users of coal, including the railways, steamship companies and municipal corporations, have been considering more seriously than ever before the adoption of a substitute fuel. There has been an unprecedented demand for oil engines to replace or supplement steam engines. It is stated that the British towns of Barking, Reigate, Leatherhead, Fareham, Bude, Letchworth, Aldershot, Cosham, Chichester, Aberystwyth, Birmingham, Bath, Swadlincote, St. Albans, Leek, Hindhead, Rothesay, Oxford, Wakefield, Saltburn, Sheerness, Guildford, Bangor, Bridgewater and Liverpool will soon be partially or wholly independent or coal for their electrical supply.

Many municipal water works are also being made independent of coal and steam power. It is claimed by motor makers that many English firms are, as a result of the late strike, seriously considering the advantages of motor transport. Commercial travellers are using motor-cycles in increasing numbers when calling upon their customers, as they can travel, it is stated, a hundred miles upon a gallon of petrol (gasoline) and carry their samples, unless they are of great bulk, be entirely independent of the railways and be able to call upon a greater number of people than they possibly could if restricted to steam travel.

DISTRICT HEATING BUSINESS.*

By A. D. Spencer.

The district heating business is nearly as old as the electric lighting business. As early as 1890 a number of electric lighting companies were selling exhaust steam for heating purposes. At the present time there are over 300 heating plants in the United States. The National Electric Light Association committee gives answers from 100 companies, one-half considering the business directly profitable, while practically all agree that it is of great advantage in connection with electric supply.

While the value of a combination electric and heating system is being recognized more fully as the companies extend their field to include the large commercial establishments formerly considered out of the reach of the central station, it is impossible to find another business so well established and in which so many companies are engaged where one-half believes that the business is yielding no profit.

It is doubtful if a majority of heating companies have the necessary data to make up a reliable operating balance. Heating plants are outgrowths of the electric business and generally are operated in connection with it; therefore, the expenses frequently are not separated. The heating revenue is credited to the fuel account and often assumed to be practically all profit; a cost analysis is considered unnecessary. Where an analysis is made, it is many times inadequate, the general expenses, fixed charges and depreciation being omitted.

Failure to show profit may be due to inadequate rates. Many managers consider heating revenue practically all net gain and they establish schedules without considering the value of the service to the consumer or of its cost to the company. The popularity of the service shows conclusively its value.

The value to the consumer is easily from 10 to 25 per cent. more than the cost of maintaining his own plant, due to the absence of smoke and dust, to lower insurance rates, to the release of valuable space otherwise occupied by the plant, and to the greater convenience and reliability of the district heating service. The value of the service will generally permit rates based on the cost of supplying live steam, and rates should always be so based, rather than on the not always correct assumption that the steam is a byproduct.

Faulty construction or improper operation may cause a financial loss. The same care should be exercised in designing and constructing a heating system as in the electric-supply system. In general, the distribution system should be designed to secure the maximum density of business with the minimum length of mains. The load on existing mains should be increased and extensions made only where it is certain profitable business can be obtained.

* Presidential address to the National District Heating Association, at Detroit, Mich., July 25.

Customers' installations should be subject to supervision. Where flat rates are in use, rigid regulations should be enforced, underground construction should be of best quality to reduce maintenance costs and minimize heat losses. But it must be kept in mind that investment charges on expensive underground construction form a serious item in the cost of district heat supply, and construction costs must not become so heavy that the charges more than offset the resulting operating economies. Where meters are used, a thorough system of inspection and tests is necessary to prevent serious losses of revenue. Above all, adequate records are essential for intelligent and economical operation.

Local conditions have much to do with the success or failure of heating systems; and plants are operated in many places where local conditions do not warrant the investment. This is partly due to the idea that any heating revenue is net profit, and to considerations of policy, such as necessity for occupying the territory to prevent undesirable competition and the ability to offer heating service in connection with electric service. Among the points to be considered in local conditions are location of steam plant, density of available business, probable growth of district, obstructions to underground construction, probable loss of electric-plant capacity and efficiency due to back pressure, length and character of heating season, probable coördination of heating load and electric loads and relative costs of steam coal and domestic coal. These points apply to exhaust heating. Where live-steam heating is contemplated, other considerations enter and the chances of loss become much greater.

Plants depending principally on electrical business may be operating at a loss because they carry undesirable business, such as restaurants, etc., which require summer service. Low rates may be intentionally established to facilitate taking over private plants, with combined heating and electrical load, but this does not seem warranted except where the value of the service to the consumer will not permit higher rates and where the net result is an advantage to the entire electric business.

DEPRECIATION AND SINKING FUNDS.*

By C. A. Smith, A.C.U.A., Accountant Municipal Tramways Trust, Adelaide.

I have decided to continue the discussion on depreciation and sinking funds as introduced by George Macoun in his paper, which was read before the Australasian Tramway Officers' Association in Sydney on October 9th, 1908.

Mr. Macoun's object was evidently to open up ground for discussion with a view of promoting a better understanding of the subject generally. He quotes the statement of James Dalrymple (manager of the Glasgow Tramways), who, at the Municipal Tramways' Association at Leeds in September, 1906, said: "I have always looked upon municipal corporations very much as I look upon an individual. If I, as an individual, borrow £1,000 to start business, I must pay that £1,000 back before I am a free man," and concludes that he approves of the remark "that a sinking fund has nothing whatever to do with a depreciation fund." Undoubtedly Mr. Dalrymple is right in the latter contention, but his argument that because an individual should pay off his loans the corporation should do the same is not necessarily logical, nor is it incumbent upon the individual to repay his loans, unless, perhaps, with the borrowed capital. Mr. Dalrymple's ideal of a "free man" and "free corporation" is largely a matter of sentiment and will be dealt with in connection with municipal debt and credit later on. Mr. Macoun also says that at the same meeting G. W. Holford, general manager of the Salford Tramways, stated the view that rolling stock, buildings and overhead equipment could be maintained out of revenue, but that a reserve for renewals of permanent way is absolutely necessary. I do not think it advisable to introduce to such an extent different principles in the treatment of different parts of the undertaking, as this destroys to some extent the value of the comparative statements of operating costs. It is clearer and better to keep operating expenses, including ordinary maintenance, distinct from renewals, and separate accounts should be kept for the renewal of each class of plant and machinery, etc., but permanent buildings of an incalculable length of life may be maintained out of revenue.

The rates at which the various tramway undertakings provide for their depreciation reserve are as variable as they are interesting. Especially interesting is the reserve of the Glasgow Tramways, which to-day stands at about 50 per cent. of the capital cost. In the opinion of Mr. Dalrymple, therefore, the Glasgow Tramways have depreciated 50 per cent., notwithstanding their high standard of maintenance and the large sums already expended in renewals. This is referred to as being a very gratifying financial position for the Glasgow corporation; undoubtedly, nevertheless, the reserve may be unwarranted, and I have very grave doubts as to whether the Glasgow corporation values its assets at only half of the capital cost.

Obsolescence.—As Mr. Macoun has pointed out, obsolescence is a quantity as incalculable as an earthquake, and it may happen that in the reserve to cover obsolescence there may be a provision greatly in excess of the requirements of the more modern parts. Whichever way it may occur, in all probability it may only be partial in an electrical tramway system for a great number of years, and a large residual value may remain; but if it is a question of life or death, which we cannot cover by insurance, we must take the risk.

As a matter of course the renewal fund is raised from year to year, and renewals are made during the same periods, so improvements are introduced and obsolescence gradually gives place to modern inventions, and the great "bogey" obsolescence, which has hitherto been more imaginary than real, is no more to be provided for, other than in the renewal fund, than an earthquake.

Depreciation is not provided for generally by state governments, but they pay for their renewals, when convenient, out of the then current year's revenue. Such renewals sometimes include a proportion of capital expenditure left unrecorded as such. This is a system to be deprecated. Ultimately the undertaking may thereby show a greater percentage of revenue to the capital cost recorded in the books, but a government which treats its accounts in prosperous seasons in this manner shows fictitious results and deludes itself and the public, believing that its railways and tramways are subsequently paying, whereas, had the capital expenditure out of revenue been capitalized instead of written off as expended, a loss might have been manifest later. Revenue expenditure is thus imposed upon in prosperous seasons, and the so-called capital cost is kept far below the actual capital outlay.

This system is also to be deprecated because in poor seasons the permanent way and rolling stock become starved, and depreciation then sets in at on increased ratio and there is no provision to meet it. Generally speaking,

* Abstract of paper read at third conference of the Australasian Tramway Officers' Association.

however, the tendency is to load the capital and let the working cost down too lightly.

A company with keen competition and limited rights is situated very differently from a company with a monopoly and limited rights. Both of these must charge a price sufficient to cover all losses and also sufficient to provide profits with which to pay lucrative dividends. Again, a municipality with a monopoly and an unlimited franchise is situated so favorably that its costs of transport should be unapproached by any other system, being free from competition and the necessity of making profits. But under any system the price of the ticket should be sufficient to create an ample reserve for renewals, as this undoubtedly is required to provide for one of the losses which should be covered in the price paid for the fare, being the extent to which depreciation is estimated to have occurred.

Depreciation.—The subject is very wide because different classes of assets depreciate at different rates, but as a matter of principle when capital is spent in the purchase of machinery, plant, land or buildings with a view to a profit being earned, provision must be made for the replacement of the capital before the return can be regarded as profit.

In determining the rate of depreciation the main facts to be kept in view in reference to a particular subject are:

First—The original cost.

Second—The annual repairs required.

Third—The probable life.

Fourth—The market value.

Fifth—The break-up or residual value.

In allowing for depreciation the rate may be calculated on the original value or upon the diminishing value from which the depreciation of previous years has already been written off.

Where the depreciation allowed is on the original cost a much lower rate is sufficient than where the depreciation is calculated on the diminishing value. The usual method is to calculate depreciation on the diminishing values, the effect being that in later years the charges for depreciation are lighter; but this, as a rule, is counterbalanced by the increasing cost of repairs as the assets get older. As an example, if the life of a machine be taken at twelve years with a residual value of 10 per cent. of the prime cost, then depreciation would need to be written off at 7½ per cent. per annum each year. To arrive at the same result, if the percentage is written off the decreasing value each year, it will be necessary to write off at the rate of 17.46 per cent. per annum on the decreasing value; and again in providing a reserve for renewals to be invested at compound interest at current rates pending the amortization of the plant, a still lower percentage may be taken, shown as follows: £100 in twelve years on diminishing values, with a residual value of £10, equals 17.46 per cent. per annum; £100 in twelve years on original cost, with a residual value of £10, equals 7.50 per cent. per annum; £100 in twelve years invested at 3½ per cent. interest, with a residual value of £10, requires a reserve of 6.16 per cent. per annum.

The latter system of providing and investing the reserve is preferable, as the annual charge is regular and lower from the commencement, and there is provision available to carry out the renewals as they become necessary.

Reserve for Renewals and Sinking Fund.—The reserve for renewals should stand distinctly upon its own foundation and not be associated with the requirements of a sinking fund which may exist for distinctly different purposes.

The object of the reserve for renewals is to replace worn-out capital. The object of the sinking fund is to accumulate capital for the purpose of paying back borrowed capital.

The reserve for renewals and the sinking fund may be subject to the same natural law.

In determining the reserve for renewals we take into consideration the amortization of the plant and provide for its continuance, or, in other words, we keep up the value of the capital, either in plant or investments, and base its upkeep on its life.

In determining the sinking fund, should we not also consider the amortization of the community, which is responsible for paying off the loan, or whether the community may be considered at all to amortize? In the former case the machinery and plant will, we know, be entirely renewed in a given number of years, and the community using that machinery and plant will be obliged morally and economically to pay the cost; but having done that, the community, as a community, continues as juvenescent during the period of the depreciation and renewal of the whole undertaking. Also, as a sinking fund is the accumulated wealth of a continuing community, the question is, how far will the present generation participate in the advantages of the sinking fund? and just to this extent should they contribute toward it in the price they pay for their tram fare. It is not a simple proposition that if the life of a generation is forty years one-fortieth should be paid off yearly; but the proposition is this —provided that obsolescence is not contemplated, at what rate should a continuing, ever-juvenescent and increasing community accumulate capital in the form of a sinking fund, or is there any moral obligation or economic reason why it should create a sinking fund at all? In forty years, in all probability, owing to the increased population, the debt per head will have been reduced 50 per cent., and with increased land values I consider it quite unnecessary to bestow upon the next generation a system fully equipped and free of cost.

WATERPROOFING CONCRETE.

A method of treating concrete proposed in a report submitted to the National Association of Cement Users, is the following. On flat surfaces lay a base of concrete at least 2 inches thick, and plaster while still wet with ⅛ inch of neat cement, trowelled hard; follow with another layer of finishing concrete not less than 3 inches thick. On wall surfaces, as soon as the timbering has been removed, thoroughly wet the surface, trowel on ⅛ inch of neat cement, and follow with a 1 inch coat of 1 : 2 cement mortar before the neat cement has begun to set appreciably. If the surfaces treated in either way are of large areas, the materials applied should be reinforced to obviate cracking.

TESTS FOR INSULATED WIRE.

A revised set of regulations issued by the Electrical Department of New York City provide that the insulation shall be of rubber or other homogeneous compound which has been approved, and specify a definite thickness for each size of wire. As a protection against too soft an insulation, the rules stipulate certain tests, among which is the following: The braiding is carefully removed from a portion of the sample, and the copper wire is connected with one terminal of an electric circuit, of which a testing tool forms the other terminal. The portion of the sample from which the braiding has been removed is placed on a flat surface, and the tool edge, which is placed across the sample, is pressed down on to the insulating cover with a pressure of 5 lbs. which is maintained for about a quarter of an hour. The electric current, which must be at least 100 volts alternating, is then turned on, and the tool edge must not sink far enough through the insulation to touch the copper wire and complete the electric circuit.

MANUFACTURE OF RAILWAY TIES

Approximately 70% of ties purchased in Canada in 1910 were hewn. It is apparent that methods of manufacture of ties are not undergoing any great general and permanent changes. Sawn ties were 30 per cent. of the total, which is the same proportion as in 1909. The only important species which has a majority of sawn ties is oak, 95 per cent. of which were sawn ties. Cedar ties were 81 per cent. hewn, and 61 per cent. of the jack pine ties were hewn. Hemlock and Douglas fir were about evenly divided in the method of manufacture. In the case of tamarack, 98 per cent. were hewn ties, while the minor varieties were principally sawn ties. The hewn ties are nearly all pole ties, the sawn ties are made chiefly from larger timber.

Sawn ties cost on the average 36 cents per tie. Hewn ties cost 3 cents more, or 39 cents per tie. Oak was the most expensive of sawn ties, costing 74 cents per tie. White pine was the cheapest of the sawn ties, costing only 23 cents per tie. In hewn ties, oak was also the most expensive, costing 68 cents, and spruce ties were the cheapest, costing 25 cents per tie.

The steam railways use 96 per cent. of all the ties. The decrease in use of ties in 1910 is due chiefly to decreased purchase by the steam railways, which used 5,159,697 ties less in 1910 than in 1909. All the white pine and chestnut ties purchased in 1910 were purchased by steam roads.

Hewn cypress ties were imported, but not used by steam roads.

With electric roads 61.4 per cent. of the ties purchased were hewn, as contrasted with the steam roads, where 70 per cent. were hewn. Douglas fir constituted 50 per cent. of the sawn ties and cedar constituted 34 per cent. Cedar made up 57 per cent. of the hewn ties and Douglas fir 20.7 per cent. The species which are chiefly used sawn are cedar, Douglas fir and oak. The species which are chiefly used hewn are hemlock, tamarack, cypress, spruce and jack pine. All the cypress and jack pine ties used were hewn. The average price of hewn ties was 37 cents, or 2 cents per tie less than was paid by steam roads. It is interesting to note that whereas with steam roads hewn ties cost 3 cents per tie more than sawn ties, with electric roads sawn ties cost 9 cents per tie more than hewn ties.

Imports from the United States of cross-ties in 1910 amounted to $1,096,832. Exports in 1910 were 1,995,582 ties at a value of $463,508. Of this total $376,913 was to the United States. The balance of imports over exports was $633,324, which represents about 891,000 ties at the average price paid for ties in Canada in 1910.

Two plants are now being established for the chemical treatment of railway ties. One is being erected at Fort Frances, Ontario, and the other is being started at Winnipeg. It is stated that a plant will also be erected at Vancouver. The plant at Fort Frances will be capable of treating 2,000 ties per day. The zinc-chloride-aluminium patent immersing process will be used, which both prolongs the life of the timber and rends it fireproof. It is questionable if this process will give as good results in Canada as would creosote.

This is a matter which for some years has been necessary for the preservation of the forests of Canada. At the same time it would have reduced the annual cost of railway maintenance. The average life of untreated ties as reported by the steam roads is: cedar, 9 years; tamarack, 8 years; hemlock, 7 years; Douglas fir, 7 years; jack pine, 6 years; spruce, 6 years. As may be noted from the tables, cedar is the species principally used, because of its durability, but the supply of cedar is rapidly becoming exhausted. Unless preservative treatment of ties is introduced, the species of short life will have to be used untreated, which, on account of the necessary frequent renewal, will increase the cost of mileage maintenance. If treated ties were used, which would cost about 30 cents extra per tie for creosoting and equipping with tie plates, the inferior species, which are very plentiful and cheap in Canada, could be used with economy. With such a treatment these woods would last at least 15 years, and if protected from wear would probably last much longer.

The lodgepole pine of the West would be greatly increased in usefulness by this treatment. This species is used chiefly for mining timbers and props and occurs, fire-killed, in vast areas on the mountain slopes of Alberta and British Columbia. It cannot be used for lumber, on account of checking, and, if untreated, it lasts only about 5 years when used for railway ties. At present this wood stands dead and perfectly seasoned and would take chemical treatment readily, after which it would make lasting and economical ties. By the use of such inferior qualities of timber, railway companies would assist conservation and at the same time decrease the cost of railway maintenance.

HILL ROADS IN CANADA.

The Canadian Northern Railway has granted trackage rights from Emerson, Man., on the international boundary line, to Winnipeg, 68 miles, to a new company formed in the interest of the Great Northern and the Northern Pacific. The new corporation is known as the Midland Railway of Manitoba. The agreement is for 20 years with a provision for extending it to a total of 999 years.

Trains of the United States roads are allowed to be run into Winnipeg but are not to do any local business unless by order of the Railway Commission, in which case the Canadian Northern is to have 80% of the gross receipts. The rental of the Winnipeg Terminal is to be $2.50 for each revenue train movement, with 50 cents additional for every car above eight, and certain other charges.

The line to be used is a part of the 355 miles of Northern Pacific's road in Manitoba, all of which was leased in 1901 to the provisional government for 999 years and subleased by it to the Canadian Northern.

PERSONAL.

MR. W. H. SCOTT has been appointed general agent for the Manitoba Government Telephone Commission.

MR. W. W. POWELL has been appointed land surveyor in the offices of the city engineer of Vancouver, B.C.

MR. H. RUSSELL HILL, B.A.Sc., was recently appointed to the position of sales manager for the Tagona Water and Light Company at Sault Ste. Marie, Ont.

MR. F. F. LONGLEY, resident engineer of the Toronto filtration plant, has resigned his position on the city's service and has accepted a position in the firm of Allen Hazen, New York.

MESSSRS RIDOUT AND MAYBEE, patent solicitors, are removing from their present premises at Manning Chambers to new and more commodious quarters at 59 Yonge Street, corner of Colborne Street. Owing to the increase in the legal business of the firm, Mr. J. F. Edgar, barrister-at-law, has now been associated with the firm as counsel.

MR. C. H. RUST, municipal engineer, city of Victoria, B.C., has been honored by the American Society of Civil Engineers, having been elevated to the position of First Vice-president, the first time in the history of the society that a Canadian has been so honored.

MEETINGS.

The 23rd annual convention of the Canadian Association of Stationary Engineers closed on July 25th last in Belleville, Ont., with the installation of the following officers,—President, J. A. Robertson, Stratford; vice-president, C. Cosford, London; conductor, F. H. Chester, Belleville; doorkeeper, H. L. Bishop, Hamilton; secretary, A. Kastella, Stratford; treasurer, W. E. Archer, Toronto.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting o be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June. 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912. Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

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

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke Pipestone, Man.: Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

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

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

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

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

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

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.