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The Canadian Engineer

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FOR THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

PART II.

CHAP. I.—TRACK.

ARTICLE 1.—FORM OF ROADBED.

The first essential of a good track is proper drainage; there can hardly be good track without it, from which it naturally follows that too much care cannot be taken in forming a roadbed at the completion of its construction, which will have good drainage in itself; even with abundant and good ballast, drainage is necessary, while it may be the saving feature of a track surfaced with inferior or scanty ballast. Plate XXII. shows types of roadbeds in use in America, and it will be seen that most of them have a slight slope each way from the centre, forming a rounded surface onto which the ballast is laid; the crown at sub-grade should be 3 to 4 inches for a single track in cutting, but may be partially omitted on embankments, as future settlement tends to round off the corners and aid drainage. Should low spots exist in the centre of the roadbed beneath the ballast, water will lodge there and soften up the earth so that the ties will sink under the churning action of car and engine wheels. Although not essential or always done, it is an advantage and an economy of ballast to elevate the roadbed on curves parallel to the expected plane of the ties and rails; this practice also gives an elevated track before ballasting is commenced. Widths of roadbed vary with the climate and materials. Embankments vary from 10 feet for cheaply built roads in the Southern U.S.A. to an ordinary standard of 16 feet for Canadian and Northern U S.A. first-class roads; cuttings vary similarly, but are usually about 6 feet wider than the embankments for making ditches; for purposes of handling snow it is not found advisable to make cuttings less than 22 feet in Canada, although rock cuts with narrow ditches are sometimes made 20 feet. To all of these, 12 to 14 feet are added for each additional track, and in case of very wet cuttings extra width may be needed for proper drainage (see Fig. 8, Plate XXII.), or a tile may be laid beneath the cut ditches to drain the sub-soil (see Fig. 5, Plate XXII.). Ordinary cut ditches are about three feet wide and one foot deep, and may be wedge-shaped (Fig. 7) or trough-shaped (Fig. 8), but although the latter is often dug in the first place, the weight of evidence is in favor of the former, which is formed by a flat slope of from 2 to 1 to 6 to 1, starting from near the edge of the ballast and meeting the cut slope at an angle. The tendency of such a ditch is to direct the water well away from the track and thus prevent undermining of the ballast. Cut ditches should be led well away from the mouth of the cuttings to avoid scouring the foot of the adjacent bank, indeed, the cut ditch on the upper side should join the catchwater ditch and continue down to the entrance of the nearest culvert as a berme ditch placed five or six feet away from the foot of the bank. By a thorough system of ditching at the conclusion of construction much trouble and expense can be avoided and the energies of the track gangs during early maintenance may then be devoted to other things. To make the ditching system complete, catchwater ditches should be dug along the upper side of every cut, placed six or eight feet back from the top of the slope, the earth from them being placed inside; these ditches should collect all those small trickling streams and general hillside wash that would otherwise run down the cut slopes, carrying sediment into the cut ditches. These cut ditches are often soon neglected during early maintenance, and extra ties, heaps of unused ballast and stray boulders block the drainage, while in later years rotten ties and weeds need watching. Too great stress cannot be laid on having clean straight cut ditches with a uniform fall.

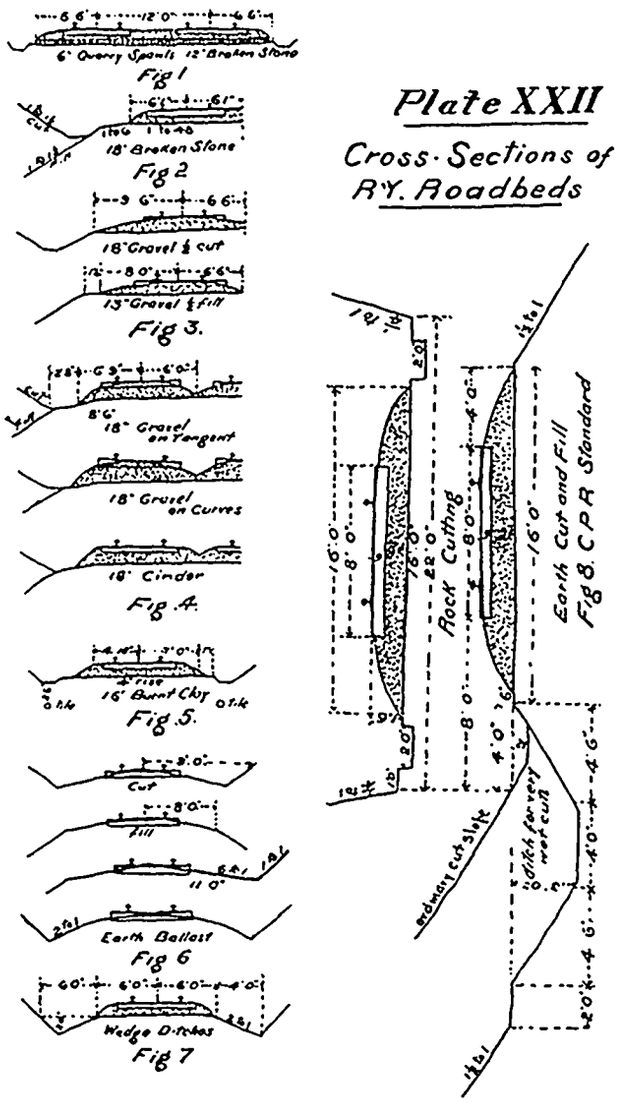
Of late years construction has been usually very rapid, and embankments, if made of earth, will rarely have completed more than half of their shrinkage; this will vary in amount with the method used in building the bank, being greatest when built with wheelbarrows or machine graders from side ditches, and least when flat or wheel-scraper work has trampled it in thin layers by the horses' feet, etc. For these reasons all banks made of earth ought to be left full width and a certain per cent. of height at each point above the theoretical grade line. Of course, abrupt changes in track surface are not desirable, even for a short time, and such allowance for shrinkage should be made with judgment according to the merits of the case in hand

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

at each point bearing in mind what the ballast is costing, the expense of re-lifting sunken track and the large amounts of extra high-priced material needed if this allowance for shrinkage is not made before grading is completed ; on page 150 the per cent. of shrinkage of different materials is given, which will serve as a basis for estimating how much extra height should be given to the banks ; if construction has been completed in one season at least one-half these amounts are necessary.

ARTICLE 2—BALLAST.

The quantity of ballast used is a purely financial question, and up to a usual limit of 12 inches underneath the ties, the more the better, can track be maintained for the same cost ; 12 inches under ties takes about 3,000 cubic



yards per mile; 6 inches under ties takes about 1,800 cubic yards, including filling around ties as in Fig. 8, Plate XXII., but with no allowance for sunken banks and extra material. The functions of ballast are:

(1) To afford lateral, longitudinal and vertical support to the ties sufficient to keep the track in line and surface without incessant track labor.

(2) To carry off all water as rapidly and thoroughly as possible after rain storms or thaws.

(3) By drainage to lessen the action of frost in heaving track during the winter and spring.

(4) To give elasticity to the roadbed.

The following materials are used more or less extensively for ballasting and are given in order of merit as nearly as may be:

(1) Broken stone to a 2-inch ring; coarser underneath.
(2) Furnace slag and cinder.
(3) Coarse, clean gravel.
(4) Broken bricks or any form of very hard burnt clay.
(5) Sand not so light as to be easily blown away.
(6) Earth, usually compact clay, seldom loam.

Broken stone ballast, although expensive and hard to tamp and surface with, gives the most durable and satisfactory track with least labor for maintenance; only roads with heavy traffic can afford to have it, as it costs from 75 cents to $1.25 per cubic yard in place. When used, it is generally flush with the top of the ties for about 1 foot beyond their ends, thus giving lateral support, and side slopes rather steep (about 1 to 1). A very finished appearance can be given by laying a margin of stones to line by hand, and keeping the rest of the roadbed, outside, free of ballast and grass. The slag from blast furnaces, if properly cooled and broken, makes a very good and durable ballast, but its use is evidently limited in area and the price will vary according to circumstances ; cinder also is a valuable ballast, but limited in quantities. Probably gravel may be looked on as the ballast more generally used in America than all other forms combined, because of its wide distribution and general utility. When clean and fairly free from sand and large boulders, it drains well, surfaces easily, and holds track from all but lateral movement ; in this it is deficient as it will not stand steep enough to admit of the ends of the ties being fully submerged, unless a very wide roadbed is used. (See Figs. 3, 7 and 8, Plate XXII.). The cost of gravel ballast in place varying with length of haul, may be put at 15 cents to 20 cents per cubic yard if loaded with steam shovels from a good pit and unloaded by ploughs, but will run as high as 40 cents when material is manually handled from pits with heavy stripping. In all cases the stripping of pits should be attended to, and all inferior material wasted or put on low or narrow banks. The ballast material should be of a uniform quality, as any patches of loam or clay mean just so many sunken spots in the track.

Sand ballast creates dust in summer which injures the rolling stock, does not hold a track well to surface or in line under heavy traffic, and has a tendency to hold water and heave track in the spring ; unless very coarse it is not at all a good investment if other ballast can be obtained. In such situations many roads have resorted to burnt clay or broken brick, but unless well and uniformly burnt, almost to vitrifaction, it is not a very durable material. In mild climates, such as Southern U.S.A., many railways have ballasted with clay taken from ordinary cuts, either from the cut slopes or hauled by train from the nearest point. If the clay is of a compact nature, and such a cross-section as one of those in Fig. 6, Plate XXII. is used, it will soon get beaten down and shed ordinary rains without any water permeating the roadbed. It is evidently a very cheap way to ballast, and in the absence of other cheap materials may be very justifiably used in such climates by roads of light traffic and meagre resources. Except in the case of broken stone, laid with teams, from adjacent fields, the ballast is put on, after the track is laid, by train loads, and, in so doing, unless the newly laid track is at once roughly surfaced, and trains run very slowly over it until a light "lift" is first put on and the track fairly well lined and surfaced before the ballast trains are allowed to run at a high speed, we may expect permanent injury in the form of bent rails and cracked angle bars, especially as the track is often not fully tied, spiked or bolted. In surfacing and lining track it is well to remember some general principles applicable to all materials and at all times.

(*a*) The coarser material available ought to be put underneath, *i.e.*, on the first lift.

(*b*) When the supply of ballast is limited and subgrade sunken on the banks, it is better to be satisfied with a track having local depressions below the theoretical grade line, rather than to rob the sides by building up a high, narrow track to the true grade, as such a track will soon sink and get out of line—being deficient in lateral support.

(*c*) Each tie should be tamped equally well, because even one tie, without support, acts like a force pump: each passing truck, by suddenly depressing it, compresses the air under it, forces out more ballast, until there is a cavity formed, a lodging place for water and a permanent sag in the rail.

(*d*) Ballast should be tamped more firmly under the rails than under the centre of the track, because a centre bearing will cause a rocking motion which will increase rapidly, especially on banks, where the sides are apt to sink more than the centre anyway.

(*e*) Surface is rather more important than alignment, although not so easily obtained or seen by a track foreman.

(*To be continued*).

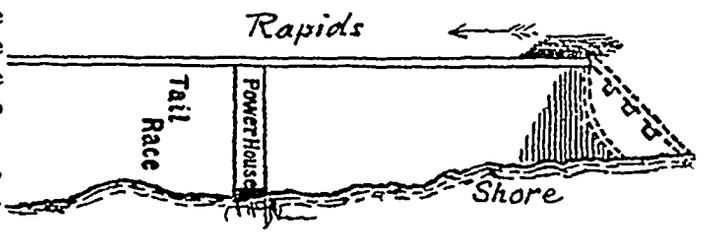
FRAZIL ICE IN THE LACHINE RAPIDS.

The Lachine Rapids Land and Hydraulic Company has been supplying electric current steadily to Montreal since last winter and has had four dynamos running, delivering 3,000 h.p. Some difficulty was again experienced, during the severe weather early last month, in obtaining a sufficient head of water to keep the plant in operation. The lighting companies subsidiary to the Lachine Rapids and Hydraulic Co., the Imperial and the Temple Cos., had to start up their steam plant, and the Imperial borrowed a dynamo from the Royal Electric Co.

The two chief difficulties in the problem of maintaining the head which the engineers of the Lachine rapids development had to contend with in winter were the sudden and very great fluctuations in the river level below the rapids, caused by ice jams in the river and the formation of frazil ice. It has been found that the changes in the river level at the city are not so important as was anticipated, but a great deal of trouble has been found through the formation of an ice dam on the rock bottom of the shallow stretches immediately below the tail-race. On the occasion referred to, we are informed, the level of the water in the tail-race rose ten feet owing to this cause and for a time the head was reduced to three feet. The removal of the rock in the shallows below the tail-race will probably remedy this defect, and it becomes only a question of how much the company is prepared to expend in securing itself against similar occurrences.

The second difficulty, that caused by frazil, is as yet unsolved, and if the report is true that the company intends to install a steam plant in Montreal as an auxiliary, capable of running all the arc lights in the city, it would suggest that the final solution was believed by the company to be still remote.

The recent obstruction of the intake which reduced the level of the water in the head race from nine to five feet, as we are informed, was due to the existence of frazil. The construction of the intake will be seen at the top of the accompanying rough diagram, which we reproduce from the Montreal Witness. Between the pier head and the shore are placed in a slanting line three rock-filled caissons, and along the upper side of these represented in the illustration by double dotted lines is stretched a boom thirty inches deep. A little lower down is a second boom represented by the lower pair of dotted lines. This latter is four feet deep. Between these two booms is maintained an open sheet of comparatively still water. These were constructed so that the frazil floating down the current would be stopped by the first boom and carried away by the current which sweeps along it. Should any get past this boom the clear space of quiet water was maintained for it to rise in, and the second boom constructed to catch it. The vertical shading in the illustration shows where a part of the construction dam has been left. Though this does not come up to the surface, it is so near it that pieces of ice catch in floating over it. This obstruction lessened the current sweeping the outer boom and also caused a large eddy. In this way the frazil was not carried off as it



should have been. The snow also, which fell heavily at the time, drifted into the open space between the two booms, formed slush, and this getting under the boom rose again immediately and froze to the underside of the ice. Thus between snow and frazil the intake became frozen solid from top to bottom over the area shown by the horizontal shading. This had to be blasted out. To prevent a recurrence of the snow difficulty, a snow fence has been constructed across the ice below the intake. The Witness states that, to prevent the frazil coming in, a few feet will be removed from the top of the old construction dam so that ice may pass over it freely and the outer boom be continually washed by a swift current.

There can be very little doubt that if any solution of he difficulty can be reached, the engineering staff of the company will arrive at it. It has been established that frazil does not form in ice-covered water that is warmer than the open stretches, and frazil is only formed in water whose temperature is below freezing. The vast amount of the St. Lawrence which is kept open by the rapids and swift currents materially cools a large body of water, and this is especially true of the river at Lachine, where for a distance of about six miles above the company's works the river is almost entirely open. In these open rapids frazil is formed in great quantities, and it is yet to be shown that at the bottom of such an extensive stretch of rough open water there can be maintained a sufficient area of still water by which the turbines may be driven and from which the frazil coming down the river can be excluded.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

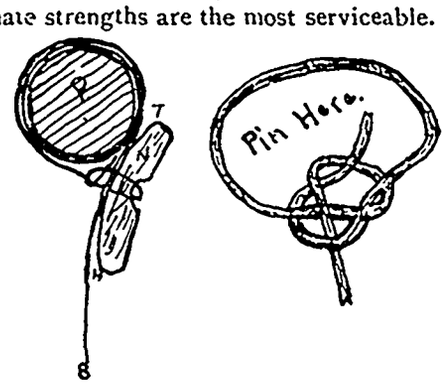
Almost all departments of engineering have been so thoroughly exploited that wherever you may carry your researches you find that you are by no means the pioneers. If this leaves less room for originality, yet it furnishes many useful hints in regard to methods to be pursued in order to obtain the best results with the least effort and in the most satisfactory manner. In our investigation of the strength and other qualities of ropes, it was assuredly not in the multitude of data, but in their absence, where lay our chief difficulty, or if these data existed we failed to get them within our reach, therefore, in so far as we are concerned, this thesis is almost wholly original.

Before entering on the subject of rope testing it might

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

be well to glance for a moment at the method of manufacture of the more ordinary kinds. In making the strand of the rope, the proper number of yarns are passed through a register plate, and from that into a tube into which they fit very tightly. This bundle of yarns is then fastened to the forming machine which travels backward down the walk, pulling the yarn through the tube and at the same time twisting the bundle of yarns into what is called a strand. The angle of this twist is in all cases as nearly as possible 37°. Three of these strands, having been hauled the whole length of the walk, are thrown over upon the laying track and each hooked on to a separate spindle of the laying machines which stand at each end of the walk. One machine is stationary and the other travels a little when the twist goes into the rope. This is on account of the rope shortening as it gets twisted. To prevent this machine moving too quickly, a brake is arranged to grip the rails. When the strands are thus hung upon the machines, at each end of the walk, each strand on its own spindle, and the brake in position, both machines are started so as to put more twist into the strand. This turn or twist of course reduces the length and the twist is regulated by the amount the strand is shortened. If 100 fathoms of rope is wanted with 6 per cent. of hard in it, 6 fathoms of hard is put into the strands, after the strands have first been formed at an angle of 37° as already mentioned. In other words, a strand, which has already been formed at an angle of 37°, is taken and twisted by these machines until it shortens say 6 per cent. of its original length; then we have a strand with 6 per cent. of "hard" in it. Generally speaking the hard ropes wear best, but are very difficult to handle in water. The soft ropes are much more pliable and easier to handle, but they do not stand wear as well as the harder qualities. The soft ropes are usually the stronger.

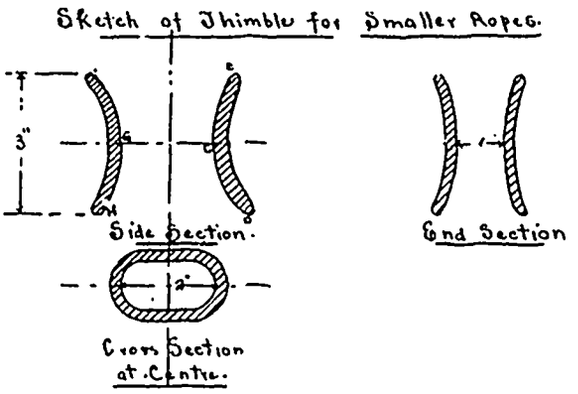
With this brief account of the process of manufacture we will now proceed to describe the testing of the ropes as carried out in the laboratory. At the very threshold the difficulty of holding the specimens was met. Wooden and iron specimens can be so formed that the portion gripped by the testing machine will be sufficiently strong to hold the specimen until fracture occurs in the test piece in the position desired. It is not so, however, with rope. Moreover, it is obvious that even where the rope is made fast round a pin of considerable diameter, some of the fibers will be strained greatly more than others, thus preventing the results obtained from being the ultimate strength of the material. It was this strength we desired to obtain, although it may seem that results gotten under conditions which obtain in actual practice might be more valuable. We desired comparable results and to this end the ultimate strengths are the most serviceable.

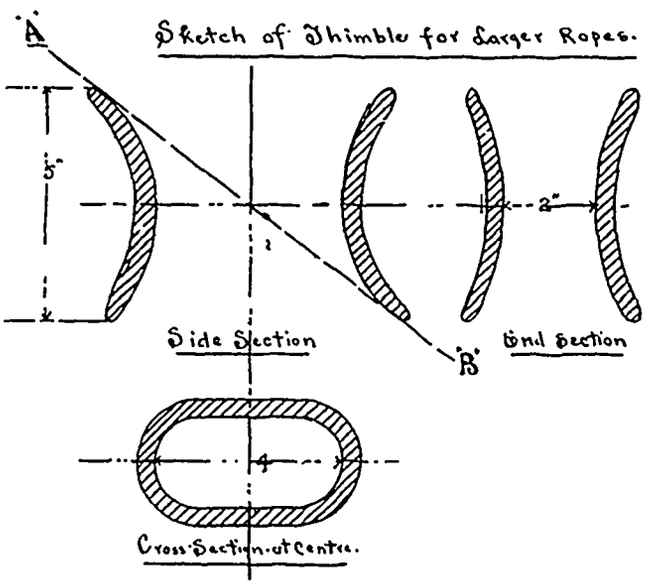


Much difficulty is usually found to hold ropes by means of knots when great stress is applied. By means of the "bowline" knot, a sketch of which is given, we overcame this trouble.

There was no slip nor give; but we soon saw that the strength of the rope was by no means fully developed. The rope failed invariably at the knot, so we were compelled to have recourse to some other contrivance. Splicing was, after consideration, rejected as requiring more time than we had at our disposal.

A contrivance as shown in the sketch below was tried





with some success. P is the pin of the testing machine; N is a block of hard wood. A groove is cut in this along the circular face, TH, in which the specimen to be tested, S, lies. The line, S, goes round the pin twice and is then taken to the block, N, and tied around it, also enclosing the rope, S. The friction of the rope on the pin so decreased the pull on the end tied round the block that the knot on the block never once failed to hold. On account of the difficulty encountered in holding the direction of the block parallel to that of the rope, the device was abandoned. We had the satisfaction, however, of seeing the specimens tested in this manner break in the free, straight portion and not at the fastening. Failure was a successful tutor. We began to clearly perceive the principles underlying a satisfactory holder, and we next tried an oval shaped thimble with flaring ends which were open. The idea was to obtain a holder which would not injure the fiber of the rope; which would not occasion any sharp bends in the strained portion, and at the same time would leave the specimen free to move in the direction of the stress. The thimbles answered very well indeed. The following is a description of them which, with the accompanying sketch, will clearly exemplify the method of working.

The thimbles were made of iron, the smaller about ½ inch thick and the larger ¾ inch thick. The dimensions were as shown on sketch. It will be noticed that the radius of curvature along the surface, CD, is the same as

that along FG. The radius along CE being also same as that along GH. The radius along CD and FG is less than that along CE and GH. The fact that the thimbles when in use would not remain in a vertical position rendered this feature of the design necessary, so that a line joining the two extreme corners would be tangent to the curve where the line entered and left the thimbles, as

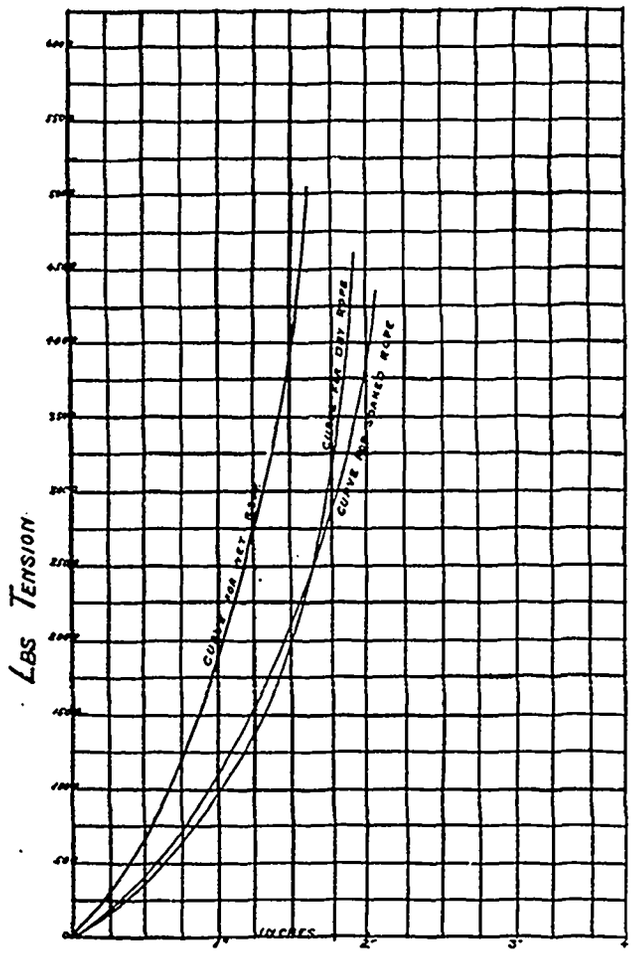


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD FOR MANILLA AND HEMP (TARRED) ROPE

AB. When this was the case a rope could not possibly be injured by the curve of the thimble, although the great pressure, even of a smooth surface against the strands of the rope, might possibly crush the fibers to some slight degree. The method of securing the rope was as follows: The free end of the rope was put up through the thimble, passed completely round the pin and brought down again through the thimble. The end was then tied with one or two knots to a short piece of piping about one inch in diameter. This piping reached across and rested against the lower end of the thimble, thus preventing the end of the rope from passing up through the thimble. It was found that, on account of the friction of the rope against the pin, one knot of the rope on the toggle was quite sufficient to hold it. In fact in some instances there was not sufficient rope to tie one knot around the toggle. When this was the case the rope was unstranded and the toggle inserted between the strands and the strands tied around it; even this method of making the fastening never failed.

The Wicksteed testing machine—a machine of the balance type—was the one used. The total range of the machine for ordinary work is about three feet. This was, however, found inadequate for our work owing to the excessive elongation of the rope, especially when wet, and we were compelled to dismantle the machine to some extent. The part C and the corresponding part together with the vertical rods D, P, E, F, (see accompanying illustration) were removed, leaving the pins B and A with their eyes surrounding them. This gave a range of about five feet six inches, which in a solitary instance was not enough. The vertical rod, G, with a corresponding one opposite to it connect the crosshead, J, to both a hydraulic and an electric motor, the former for heavy work where speed is not a desideratum, and the latter for more rapid work where power not beyond 5,000 lbs. pressure is needed. The range of the hydraulic ram was about 10 inches. This was needed whenever the power exceeded 5,000 lbs. When the test was begun the crossheads were usually about two feet apart; yet the distance between them often reached 5 feet 6 inches before rupture. The pins were about 3 inches diameter, and the rope was usually placed twice on the pin in order to increase the friction.

The method of getting the extension was as follows: Owing to the great stretch of the rope no extensometer could be employed. The unequal give at the different ends excluded the setting up a scale beside or attached to the specimen. Workings on the surface were debarred by the want of definition. Fine, smooth tacks were inserted

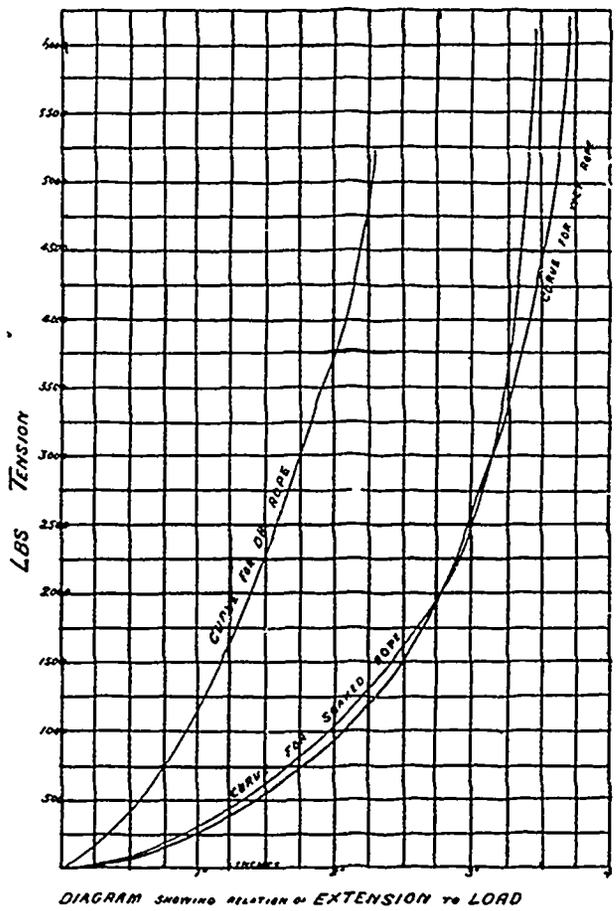
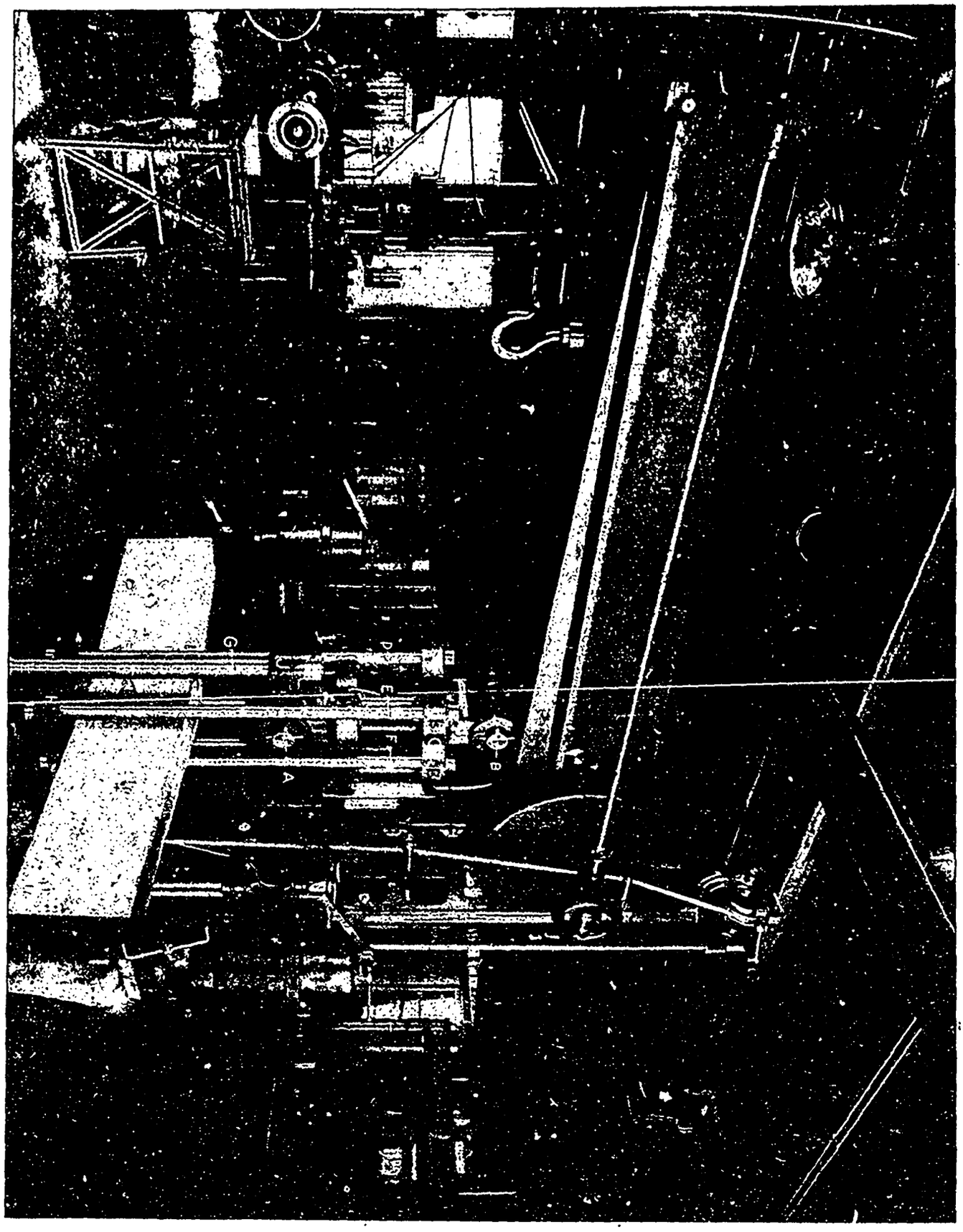


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD FOR MANILLA AND HEMP (UNTARRED) ROPE

in the rope at the required distance apart. The distance could be conveniently measured, and we hoped this was a final arrangement, but here again we were doomed to disappointment. Incredible as it may seem even these very small tacks caused the rupture to take place at the points of their insertion, as the tabulated results will show. A very convenient and easily adjusted device was finally employed. It was the adaptation of a contrivance based upon the principle of the pinch-cock to our work.

SHRINKAGE.

The percentage of shrinkage for the different kinds of



rope under different degrees of saturation is given in the following table :

Kind of Rope.	Time Immersed 2-6 days.	Time Immersed 6 weeks.
Manilla	5.0 per cent.	5.7 per cent.
Tarred manilla.....	2.0 "	2.8 "
Manilla bolt rope.....	6.9 "	6.0 "
" " yarn.....	3.5 "	6.2 "
" yarn.....	5.5 "	7.6 "
Sisal	5.7 "	7.6 "
Tarred hemp ratline	6.7 "	8.0 "
" " bolt rope	6.6 "	7.9 "

The table speaks for itself. It will be seen that the rope shrunk more when immersed for six weeks than when immersed for one week. The wetting had not such an effect in this direction on the tarred as on the untarred specimens. The above results are averages. In the same kind of rope there was some variation owing, no doubt, to the many factors entering into the work which tended to make the results not uniform. The principal one of these was the probably unequal tension put on the rope when measuring, dry and after soaking. The tension should have been measured with a spring balance to get the best results. On account of the ropes having to be immersed in a coiled position (the smallness of the trough at our disposal preventing them being laid out at full length) it was

found almost impossible to thoroughly straighten the larger ones after wetting without putting them under considerable strain. This fact would tend to make the percentage of shrinkage less than it otherwise would be.

(To be continued).

For The Canadian Engineer.

A SYSTEM OF PLUMBING.

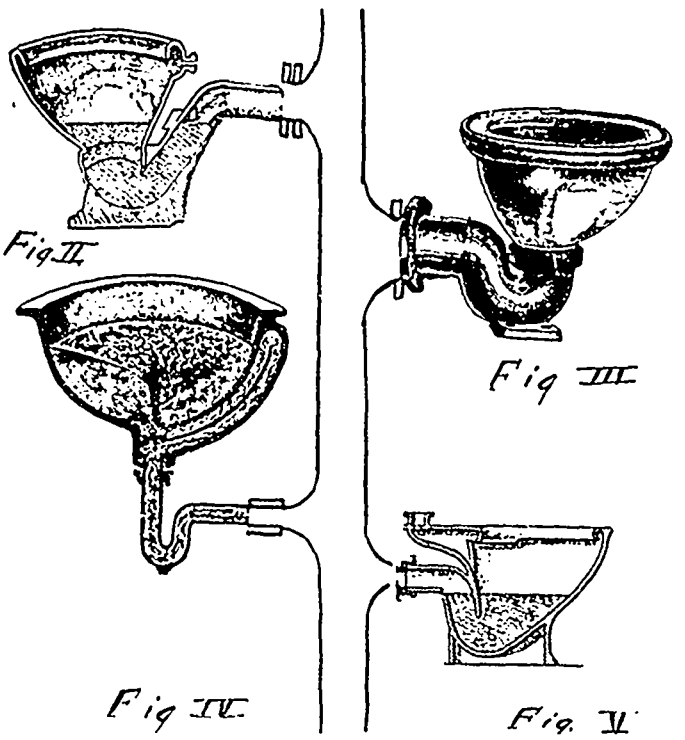
BY W. M. WATSON, TORONTO.

For upwards of two years articles dwelling on sanitary appliances have appeared in the columns of The Canadian Engineer, and its readers will more readily understand the arguments used in this paper if they have read the articles in previous issues. I have shown that such sanitary appliances should always be plain and easy to repair and understand; that the excesses adopted lately in constructing plumbing appliances and public sewers by some professional sanitary and municipal engineers, is dangerous to the public health, and unnecessarily expensive.

In a former article on sanitary appliances, I stated that the plumbing and sanitary arrangements of last century were healthier than the elaborate obstructions of the present system. At that time they had the good judgment to cause all pipes carrying foul matters to pass to the outside of the building at the nearest possible point and to have as short a length of pipe and as few bends as the arrangements of pipes would allow. The sewage and refuse were hurried from the premises by slowly turned bends and direct routes, bnt the engineers and medical officers of he present day demand numerous obstructions, and often call for the most roundabout method of laying down private drains, so that they require inspection or lamp holes, together with special ventilation shafts to prevent the drains becoming blocked and the sewer gas that they generate from poisoning the inhabitants.

E. M. Close, chairman of the health department of the Birmingham Sanitary Institute, England, when giving his annual address at the 17th Congress in September last, stated that placing interception traps and breather pipes on private drains was wrong, and that all private drains and public sewers should have free and uninterrupted ventilation throughout, and in another remark declared that the architects of the present day appeared to have entirely lost sight of the question or art of drainage. At the same meeting W. Hannan stated that house drainage could easily be kept free from sewer gases; it was only necessary to arrange the waste pipes so that sewage would secure plenty of aeration, which would cause it to remain fresh during the time the fluid was rolling from the house to the outfall end of the main sewer. He also stated that all traps were putrefying machines and incubators, where dangerous germs are bred that pass out into the sewers and rapidly multiply. The whole discussion of this select company of sanitarians at the Congress showed that to improve sanitary apparatus. the use of traps and similar impediments should if possible be avoided. Some expressed the opinion that the time was not far distant when the use of traps to keep back sewer gases would be totally discontinued and become unnecessary.

This seems to me exceedingly probable, for I see no reason why a new town cannot so arrange its refuse and sewage business that it can be removed in a way that sewer gas and foul, unhealthy odors cannot possibly generate in any part of the pipes, and also having the advantage of costing considerably less than the intricate obstructive system at present forced on the people. To do this there must be separate drains and sewers, one set to carry the sewage and the water from the roof and yard of dwellings, and another set to carry the storm water from the streets and land, together with any clean water springs that are within the watershed. To do this the sewers must not be too large. Every branch taken from the street sewers must be taken from the crown, and continue with an upward grade, void of any interruption or interception



traps, to the highest point of the building it serves, or the nearest building or large tree. Every separate line of sewer serving a street must have a shaft at its lowest point for the inlet of fresh air, and another of the highest terminating point to form an outlet of air in a way that even the smallest pocket is avoided where it might be possible for air to lodge, and to ensure a free and rapid circulation of air from the lowest point of each and all the street sewers to above the housetops. Then the plumbers must fix the waste-pipes in the interior of the buildings on the same plan, viz., every separate line of waste-pipes must be continued to above the roof, independently, and in no case must any two or more lines be joined together. It is important that care should be taken to ensure the above related points being carried out in the smallest details, because those who have followed my remarks in previous articles will know that sewage contains the germs that will if properly set to work purify and make clean again the polluted fluid, and all that is necessary for the engineer and mechanic to do is to so arrange the carrying pipes that the sewage during its transit is broken up into particles, and that an unlimited supply of fresh atmospheric air is provided at all points and places, ready to be absorbed by the fluid when needed.

If this be done no sewer gas will ever be generated, because the sewage will remain fresh if kept in rapid motion until it reaches the terminating end at the outfall. If no sewer gas is generated then there need be no appliances used to prevent sewer gas doing injury to the public health. The experiments made by Herr Unna, at Cologne, proved that when sewage was falling down a vertical line of pipe it split and divided into thin threads that enlarged the stream to the full size of the soil or other pipe used for the discharge, and that during its fall down the vertical pipe it got mixed and carried with it at least four times its own volume of atmospheric air, drawn

in through the open end above the roof. All plumbers should bear this in mind, for it proves that their work is very important, not only in preventing sewage from generating poisonous gases, but that they can by properly arranging their lines of waste-pipes cause the sewage to commence purifying itself at the very moment that the clean fluid has got fouled. In previous issues I have supplied illustrations and descriptions how to do this, and tried to prove that the system of connecting two or more lines of pipes together is decidedly wrong and injures rather than assists ventilation by retarding the proper circulation of air through the whole length of waste-pipes, which must be the object aimed at to ensure a high standard of health.

It is the practice in cold countries where the atmosphere is impregnated with sea salt, or where the temperature during any part of the year does not fall too much below the freezing point, to continue the old eighteenth century method of running all soil and waste-pipes outside the walls of the buildings, and passing all waste-pipes from interior water-closets and other sanitary appliances through the house walls at the nearest convenient points, and they all work well, but the practice would not work smoothly in the northern parts of this continent. I have a system of this kind working here in Toronto on the outside soil-pipe plan, and so long as I attend to the arrangements myself it answers all right, but if a tap be leaking and allowing the water to dribble down the waste-pipes when the temperature is below zero, it freezes at the point where the short piece of horizontal pipe that passes through the wall joins the vertical pipe fastened to the face of the outside wall, but when this small leakage is avoided, it answers well even here at the lowest temperatures, but the latest American system of erecting stacks of soil-pipes of good metal and joints, on the open principle, vertically through the interior of the buildings, can be made quite as safe and sanitary, and have the advantage of not being subject to frost. I have before suggested a way of arranging waste-pipes that would ensure the freedom from sewer gases in dwelling houses when a connection has been made to the present sewers or sewers that manufacture sewer gas because they have not been laid so as to be self-cleansing, aerated properly (see article on sanitary appliances published in THE CANADIAN ENGINEER in April, 1897), and I here propose to show a way of connecting the branches from sanitary fixtures to vertical soil-pipes or any other line of waste-pipes serving other fixtures that are too far removed from the soil-pipes to be properly connected with it, in the way shown by these illustrations. I might add that no two lines of waste-pipe which terminate with an open end above the house roof should be joined together on the vertical line, except on the street side of the quarter bend at the foot, and in no case where there is another waste-pipe that branches into the vertical stack at a lower point. When this error is made the suction of air that passes down the lines of pipe when slop water is sent down, is impeded, and the current of air that comes up from the street sewers to the housetop is curtailed by friction, having to split at the dividing junction.

It should be the aim of all plumbers to avoid as much as possible low-grated horizontal pipes and pipes too large for the fixture or for the waste plugs in the fixtures they serve. They should avoid all sharp angles and junctions on main lines of waste-pipes, and any roughness or solder drops on the inside of the waste-pipes. They should also aim at having the insides of all waste-pipes smooth and free from the least impediment throughout the whole length of the pipes, and neither increase or decrease the bore of any vertical line of waste-pipes from the junction at the ground line to the terminating point above the roof. Herr Unna shows why care on this point should be observed in the Cologne experiments. They should also do away with the dirty, unsanitary practice of placing waste-pipes, bath traps and water-closet bends between the floor boards and the ceiling, because they are apt to freeze and defects cannot easily be seen or repaired. The sweating of the pipes when the temperature of the air is higher than the water passing through them causes the ceiling to soften and smell, and there are also more angles and sharp turns in the pipes than there need be or is good to have in waste-pipes for the health of the inhabitants. For the sake of securing a fine outside appearance nothing should be done to jeopardize the smoothness or increase the friction, or retard the flow of air or fluid within the pipes. All branches made in hard metal pipes should be made to bend slowly both above and below the branch inlet to allow for the easy escape of the air as well as the sewage (see Fig. 1 to 5), and at the same time leave the vertical pipe free to pass down the atmosphere air drawn in by the falling sewage, and also to do away with the shoulder space that is at present usually created if an ordinary T. Y. is used, which always forms an air pocket and breeding space for microbes. In joining lead pipes together this could not be done, nor is it necessary, because in the usual course of fitting a short length of horizontal pipe of about 1 inch bore and 2 feet long would be used to carry the waste water from a wash-basin to a 2-inch or 1½-inch vertical stack of lead pipe; the fluid would rush through the short length of pipe fixed between the basin and vertical line of larger lead pipe at full bore, and dash to the opposite side of the larger stack of vertical pipe, whose top end was open and extended to above the roof, then the fluid would split up and suck down the air from the roof and take a large quantity with it down to the common sewer. And if the basins, the baths, the sinks and wash tubs can all be placed close to the vertical line of the soil-pipe they should be joined to it on the same principle as shown (see Fig. 3) because the more a pipe is used the better for health.

The illustrations show four different kinds of water-closets. The syphon is a closet, a pattern that I cannot approve because it contains a double trap, one which cannot easily be emptied or inspected. Then it delivers the water down the soil-pipe with a rush in bulk and unbroken, therefore the fluid does not get mixed with air in the vertical soil-pipe as it should do, but draws the air behind it in a bulk form which never mixes with the sewage, and when the air reaches the point where the sewer is larger in bore than the interior of the soil-pipe, and the vacuum becomes broken, then the air returns to the outside atmosphere the easiest way possible without performing any aeration of sewage. Fig. 2 is a similar closet without the syphonic part, which I approve because the trap part is independent of the bowl and can be set to point to the right or left hand, so that the soil-pipe can be erected on either side of the closet bowl, and the bowl can be set with the flushing horn to the rear, which is the proper position to receive the flush-pipe from the cistern. The trap can be made of brass, nickel plated if desired, or cast in lead, and joined together by a mixture called earthenware solder, which easily makes a joint as safe and strong as the body of the basin, so that having a joint under water is now of no detriment. Fig. 3 is a common basin that has not sufficient area of watered surface to receive the droppings or keep the interior of the bowl clean. Fig. 5 is the simplest and most satisfactory sanitary closet of the four, but to connect this kind of closet to the soil-pipe in the way that it

is manufactured and shown, the soil-pipe must be placed at the rear of the closet and the flush-pipe at the same place. This arrangement would in nearly all cases be very inconvenient, and make it hard to join other connections to the vertical soil-pipes. By Fig. 4 I show how any wash basin, bath, sink or set of wash-tubs should be connected, taking care to fix the short branches level, so that no pocket of air can accumulate between the fixture trap and the vertical soil-pipe. If by reason of the great distance between the fitting and the vertical waste-pipe, a perfectly level pipe is too long and would not work well, then another line of vertical pipe must be made that can be set nearer the fitting to accept the short branch. No line need be erected perfectly plumb from the foot to head, but may be bent to suit circumstances, on condition that a good upward grade is always obtained in every part, and all branches are inserted in the vertical portion and not into the graded portion. The reason for this will be obvious to mechanics.

A few years ago the improvement in drainage and plumbing took a wrong turn and large sums of money were being wasted by municipalities, causing the people at the present time to be slow to spend more money to undo the evils thus created. But there are other towns which would not reorganize their sanitary laws to comply with the new ideas because of the large expense it entailed, and the nuisance of the long delays and inspection, etc., required. Then some experienced sanitarians could not see the advantages stated by the promoters of the new system, only the one that would increase the cost and circulate money. These towns are fortunate, for the experiments lately made have not only proved the extreme folly of the obstructive system (which can easily be proved by watching the gases coming out of the street grates on a hard frosty day), but have found out how easy it is to arrange both sewers and plumbing so that no sewer gas can be manufactured in them, therefore the public could not be poisoned with it, and our private drains and main sewers may by using reasonable intelligence during construction be made as odorless as any other part of our inhabitable premises.

THE ETHICS OF CIVIL ENGINEERING.*

I do not intend to inflict upon you a long historical sketch of the engineering works which have been commenced or completed during the past year, for the daily papers with their well written articles and photographic accompaniments bring these matters attractively to our notice, and the technical journals record them with such close detail and elaborate drawings that they are in everyone's mind or on our book shelves as works of reference, far more valuable and with infinitely greater facility for reference than any words of mine would possess. A few words to the students and young members of our society may, however, be of some service, and, if devoid of any other merit, will, I promise you, possess the merit of brevity. With such institutions as McGill College, which the young man of to-day, especially those within easy reach of Montreal, possesses, he will be well equipped for, and should move forward erect and with a firm and steady step, indicative of his honesty and firmness of purpose. In due course he will no doubt secure an engagement on some public work (thanks to his McGill diploma), and his success will be in his own hands. He will probably be located in some small town or village, a stranger to everyone, and, if he has not already done so, he should formulate for his guidance rules of conduct based on common sense, which will win for him the confidence and respect of the community, which are as necessary for his advancement as technical knowledge. He should be cheerful and affable. He should move slowly in forming acquaintances, that he may not make mistakes which it would embarrass him to correct. He should not pose as a puritan, but should avoid saloons and gambling as he would the plague. He should be early in the field and late in the office when the necessities of work require. He should make it a point to have his work well laid out in advance and detailed plans prepared early, that the contractor may have no grounds to complain of delay on his part, for it is of the first importance that the contractor should have facilities for changing his men from place to place or putting on a large force when conditions are favorable. It may also affect the contractor's profits if plans of structures are not furnished at an early day, that he may arrange for materials when prices and conditions are in his favor. In preparing detailed plans, utility and durability should be studied. Standard sizes and shapes should be used as far as conditions will permit, as a departure from standards means not only increased cost, but difficulty and often serious delay in obtaining materials. He should cultivate the habit of observing closely what is being done upon the work, how and with what appliances it is being done, and who is doing it. He should make himself familiar with the roads and sho' ats in the neighborhood of the work, and their varying conditions as affected by the weather and seasons. In short, he should be perfectly at home in everything connected with the work and its surroundings, that he may be eligible for advancement when opportunity offers. When measuring the work for the monthly estimates, he should, as far as time will permit of his doing so, return the actual quantities of work done and materials delivered, as it would be unfair to the contractor to underestimate the work, and an unkindness to him to over-estimate it, as to do so would be misleading and disappointing when actual quantities were returned, as they would eventually have to be. By assisting the contractor in the various ways above mentioned, it will be less difficult for the young engineer to say no when his duty requires him to do so, and that unpleasant duty will, no doubt, have to be occasionally performed, particularly about estimate time, when large estimates are often asked for by the contractor "to tide over pressing needs, and to be adjusted in the next month's estimate." Such a course should never be followed. The actual quantities should be returned to the senior engineer with the statement of facts. Young engineers beginning practice to-day have advantages which their seniors educated in this country have never had, and no more genuine and sincere assurance of the appreciation of the munificent donations which have made McGill College what it is can be given the donors than to see the lecture and experimental rooms and museums thronged with bright and earnest students making every possible effort to possess themselves of the wealth of knowledge so generously placed within their reach, and so easily acquired with the assistance of McGill's able professors. A thorough grounding in the fundamental principles of any profession or calling is as necessary for the individual independence and stability which every man should strive to possess, as a solid foundation is for the stability of a structure. This thorough grounding McGill College affords, with facilities which cannot be surpassed, and I would urge upon our students and young members to avail themselves of these advantages to the fullest extent possible. Theory and a large portion of practice, especially in the results obtainable from the testing machines, here go hand in hand, and the earnest and painstaking

*Being the opening address of President W. G. McN. Thompson at the annual Convention of the Canadian Society of Civil Engineers.

young engineer, almost at the commencement of his career, may be in possession of information which others have picked up like crumbs here and there in course of a lifetime, as failures of works or "accidents" have offered opportunities to careful students, for we are all students in engineering until the curtain falls in the last act of this existence. The college course, however, will soon come to an end, and the young engineer must start out to make his way in the world. If he is well grounded, as we will assume, has a McGill diploma in his pocket, his trust in Providence and his powder dry, at such a time the prudence of not accepting presents or having any money dealings with the contractor will be fully realized. He should carefully check the work in the field and in the office, remembering that, in addition to his duty to himself, he owes it to McGill College to maintain the standard which his diploma should give assurance of. He should be reticent about the work, excepting with his senior officer, to whom he should give a full measure of loyalty and carry out his instructions promptly and cheerfully. He should be free from prejudice and strictly fair. If he will observe these rules, and it needs but a little firmness and self-denial to do so, he will forge steadily ahead, as men of such character are always in demand.

—After a squabble lasting for years the contract for the elevators in Toronto's new city hall has been let to Leitch & Turnbull of Hamilton, at a figure much below the tender of the Fensom Co. of Toronto. After the contract was let the architect, as is his habit, found a few alterations necessary and it is said the figures for the plant will after all be about the same as the Fensom Co.'s price.

—At the last annual meeting of the American Public Health Association, at Ottawa, J. W. Hughes, Montreal, read a paper entitled, The Intercepting Trap in Private Sewers, in which he quoted very fully from the series of articles in THE CANADIAN ENGINEER on that subject from the pen of W. M. Watson. In the published reports of the paper in this country, Mr. Hughes kindly credited the author and publication, but in the report published in the Surveyor and Municipal and County Engineer, London, Dec. 30th, 1898, we find, no doubt through inadvertence, no mention of an author other than Mr. Hughes, though the paragraphs quoted by the Surveyor are from the columns of THE CANADIAN ENGINEER.

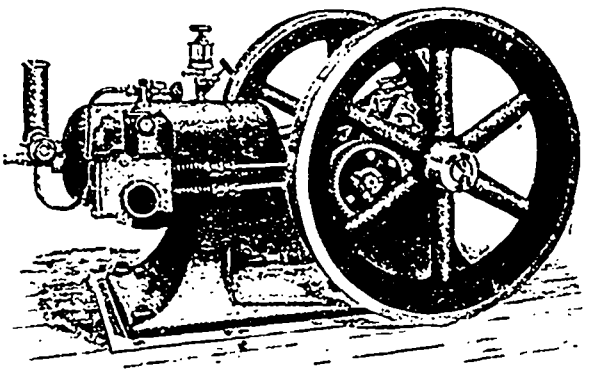
—The great solidity of the masonry of old Montreal buildings and of the fortification walls and other masonry throughout the province of Quebec generally, has been the admiration of engineers and the dismay of contractors who have occasionally had to dismantle these structures. A correspondent informs us that the secret of this great strength is that the French Canadian builders of old made a practice of seasoning their mortar by burying it in the earth over winter. The mortar was prepared in the autumn; a pit was dug below the frost line, the bottom being lined with sand and a wall of sand being put in the sides as the mortar was dumped in. The top was then also covered with sand and the bed covered deep enough with earth to keep away the frost.

THE QUEBEC BRIDGE.

The company proposing to construct the bridge at Quebec will open the tenders after March 1st. The story recently published in the daily press, and even repeated by some of the technical journals, to the effect that the Government was asking leading firms to tender, is of course untrue, and the Government has nothing to do with the matter. The bridge is in the hands of a company which hopes to receive aid, as has been promised, from the Dominion, Provincial, and municipal governments, but the company alone is in conduct of the business of the erection and maintenance of the structure. At present the cost of the structure is estimated at from 2½ to 3½ million of dollars for the bridge itself, the shore approaches probably costing another million.

THE MODEL GAS ENGINE.

A constant demand from users of small power for an efficient engine that could be handled with little expense and without the aid of an engineer, has brought into existence the gas and gasoline engine, and the makers of the Model Gas Engine unhesitatingly state their confidence in its ability to perform satisfactorily every requirement of the work it is calculated to do. The advantages of the Model Gas and Gasoline Engine are claimed to be many. We mention a few:—It can be run at trifling expense; no expense when not running; little floor space, no explosions; no danger; no smoke, dirt or noise; ready in five minutes, can be operated by a boy; can be run with either gas or gasoline. To start the Model Gas and Gasoline Engine, turn balance wheel a half turn forward, then a half turn backwards, and the engine



starts. This is within the power of a fifteen year old boy, even if the engine is 12 horse-power. The Model is wonderfully simple. So few are its working parts that it seems almost incredible it should do its work so perfectly. There is not a lever, rod or working part of any description inside the bed plate, not even a cylinder head or water joint. There are no joints opening from the water jacket into the bore of the cylinder.

The "Model" takes the gasoline direct from a tank supplied by a pump. The gasoline tank is situated outside the building at any distance desired, and the gasoline is pumped to a small tank at the engine. This small tank is kept constantly full and has an overflow back to the large tank. We use the hot tube igniter in preference to the electric spark, as the latter is so hard to keep in order. However, the makers will furnish same if desired. The governor of the Model Gas and Gasoline Engine is of the type that regulates the supply of gasoline according to the amount of work being done, by shutting off the supply when the speed increases above the normal. The advantages of this over a graduated charge governor lie in the fact, the makers state, that if a small charge be admitted it will not explode and be thus wasted. The governor in use on the "Model," it is said, overcomes all these objections, and keeps the speed as regular as possible in a gas engine. The Model Gas and Gasoline Engine is made by The Goldie & McCulloch Co., Limited, Galt, Ont., who make any size, and give particulars of large sizes on application.

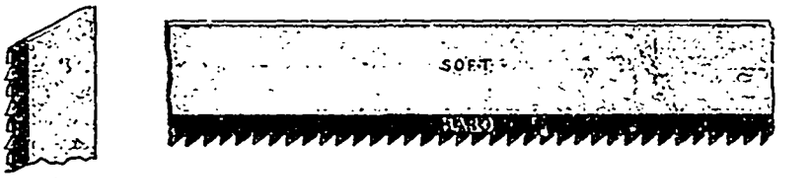
SAWS FOR CUTTING METALS.

Comparatively speaking, it is not many years ago when the only saw known on the market for cutting metals was one in which the blade was made of steel drawn down to a spring temper, and hardened equally throughout, consequently the hardness of the teeth and back were the same. The result was:—1st: That the teeth having only the hardness of spring temper, could not cut any metal harder than itself; 2nd. When dulled by use, required to be re-sharpened by a file; 3rd: The blades were expensive, which precluded their universal use, in addition to their limited capacity. It was the custom in machine shops, when a piece of steel was to be cut, and especially hard tool steel, either to cut it in a lathe or planer, or send it out to the blacksmith to heat and cut; both these methods were expensive, but the latter had the additional disadvantage of deteriorating by heating in the forge, and its being returned in such a rough shape as to require additional machining. The advent of saws made on the flexible back principle, has changed the old system, and now it is a very rare occurrence when a blade equally tempered throughout is either found in a machine shop or, in fact, on

the shelves of hardware dealers. The reason for this is, that by the flexible back principle (see cut) the teeth only are hard, the back remaining soft.

The advantages are · 1st The hardness of the teeth being such that a file will not touch them, thereby enabling the Eureka flexible back hack saws to cut any metal a file will touch It is an every-day occurrence its makers claim that the Eureka flexible back saws are cutting not only unannealed tool steel, but every metal and substance imaginable: 2nd. The back being soft prevents the saw from snapping or breaking in two, consequently the life of the saw is insured until it is absolutely worn out by use 3rd. By improved methods of machinery, the Eureka flexible back hack saws are not only manufactured with an accuracy hitherto unattainable, but are put on the market at such an exceedingly low figure that when worn out they are thrown away, the labor and cost of files in re-sharpening being greater than the cost of a new saw.

In the old days any piece of steel with teeth on one edge was called a saw, and was used for every purpose up to its capacity, which, however, was very limited; but in these days of specialties, experience has taught that a saw blade should be made adaptable to the work, and not the work to the blade. By studying the requirements of different classes of workers in metals, the Eureka flexible back hack saws are made with especial objects in view, and therefore differ not only in the number of teeth to the inch, but also in temper or degrees of hardness. Another method of cutting metals, which has revolutionized old systems, is the use of the automatic power metal sawing machines. These machines use saws attached to an arm, having a reciprocating motion, and as they work automatically, when the work is put in the machine no further attention is required, and when the metal is cut through, the machine stops; a boy can run, and does in some factories,



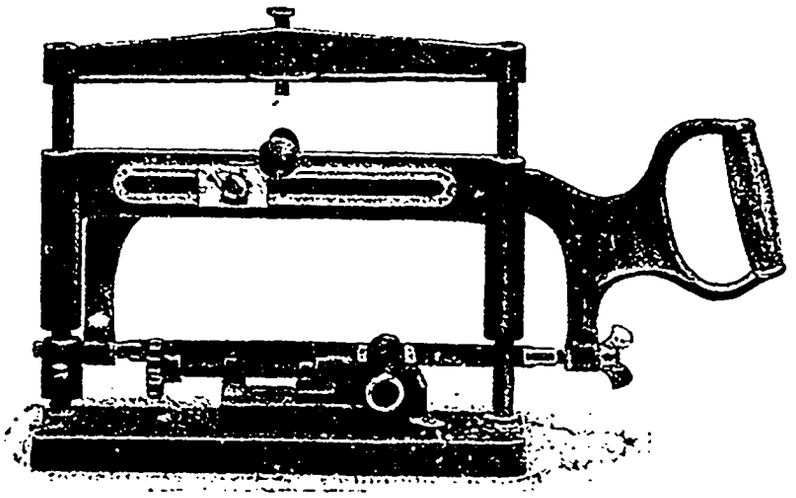
the makers assure us, a dozen machines. In many other cases a lathe or planer hand has sufficient time to run one or more automatic machines without detriment to his special work; hence the work of cutting the metal costs practically nothing in labor, besides effecting a saving in material over the old methods. The X L power saws have met with a widespread success in use in these machines, for the reason that they are not only made on the flexible back principle,—hence, no breakage, and assuring the life of the blade until worn out,—but are constructed of steel of heavy gauge, thereby preventing any bending or bowing of the blade and causing the blade to run straight. Although the automatic power sawing machines fill a long felt want, still their scope is limited to straight cutting. There remains a demand for a proper cutting instrument to cut irregular sizes, curves, metal sprews and castings, or any metal outside of straight cutting, in fact the scope of automatic power sawing machines is limited even in straight cutting; hence the success of the band metal sawing machine, for the reasons. 1st. It cuts continuously, there being no loss, as in reciprocating machines. 2nd. Its speed is very much greater, as the saw is driven in conformity with the hardness of the metal to be cut, hence the reason why a four-cone pulley is recommended for each band saw frame, thereby enabling the operator to cut the softest brass or the hardest unnannealed tool steel on one machine.

Heretofore band saws for cutting metals have been imported from France and Belgium, but these importations have practically ceased, it is said, for these reasons 1st They are made from spring-tempered steel, consequently cannot cut any substance harder than itself, i. e. cannot cut tool steel. 2nd. As they are made from steel, spring-tempered, so called, they are hardened throughout, thereby causing rapid crystallization, hence breakage; again, when dull, require filing, but on account of the crystallization above stated, the saw will admit of but few filings. These defects are overcome by the use of the Thompson flexible back band saws (see cut). The teeth are hard, harder than the metal to be cut, but the back is soft, thereby preventing crystallization. The saws are so inexpensive that they are never re-filed, in fact it would not pay to expend the time of labor and the cost of files in so doing.

The Thompson flexible back band saws, manufactured by the Henry G. Thompson & Son Co., New Haven, Conn., U.S.A., are not an experiment, but have been in use for a dozen years in cutting almost every conceivable substance, from onyx and pearl, down to the softest metals:—as iron, steel, brass, copper, bronze, sheet metal, tubing, sprews, pearl, onyx, etc., in fact any substance that a file will cut, by manufacturers of machinery, jewelry, dies, irregular shapes, scrolls, chandeliers, cornices, steel, roofing, stamped ware, cutlery, silverware, tubing, specialties, mica, slate, etc.

The tubing and sheet metal saw is made from steel 23 gauge, 30 teeth to the inch. It is designed expressly for cutting thin iron, steel, brass, and copper tubing, and sheet metals. The makers state it is just what is wanted by bicycle makers and repairers.

Those interested in this subject can obtain full information from Aikenhead Hardware Co., Toronto.



GOODELL BENCH HACK SAW.

The Goodell bench hack saw, made by the Goodell Brothers Co., will saw squares, angles, tubing or rods. It is well made. The Aikenhead Hardware Co., Toronto, will give prices, etc.

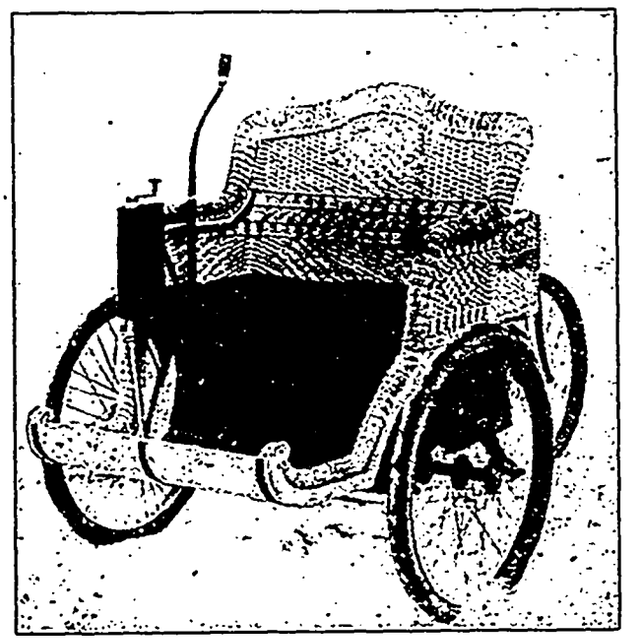
METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports of interest to the metal trades during December, 1897 and 1898, and the twelve months ending December, 1897 and 1898:—

	Month of December.		Year.	
	1897	1898.	1897.	1898.
Hardware	£4,327	£1,549	£68,172	£25,717
Cutlery	..	9,677	..	116,850
Pig iron	225	42	9,447	11,322
Bar, etc	263	1,653	8,892	13,315
Railroad	..	3,518	45,796	28,766
Hoops, sheets, etc.	112	1,664	77,954	64,893
Galvanized sheets	5,185	761	57,573	65,968
Tin plates	7,149	13,386	224,470	172,362
Cast, wrought, etc., iron	4,625	2,802	34,066	34,696
Old (for re-manufacture)	170	..	7,524	3,574
Steel	3,946	2,372	55,704	49,483
Lead	978	1,667	28,379	36,943
Tin, unwrought	3,356	1,003	21,021	18,272
Alkali	1,361	1,736	44,550	50,608
Cement	2,701	636	22,536	26,018

THE AUTOCAR INDUSTRY.

The chief feature of progress during the past month has been a Canadian production of novel construction and appearance which is illustrated on this page A representative of THE CANADIAN ENGINEER has had the pleasure of riding in this electric motet with the inventor of the battery and motet, W. J. Still, mechanical engineer of the Canadian Motor Syndicate, on whose design the carriage was constructed The motor is slung over the front axle, and the two front wheels drive, while the hind wheel steers by means of the handle held in the left hand of the driver. In going over rough block pavements the effect of having the single wheel drawn over the roads from behind instead of pushed in front is very noticeable. In the ordinary tricycle construction, where the single wheel precedes, every depression and obstruction in the road produces a shock which is immediately felt, to the great discomfort of the occupant. In this electric motet it was noticeable that the block pavements, which on some of the streets traversed were very rough and full of deep ruts, did not materially affect the comfort of riding, the shock of contact being minimized by the two front wheels, and the dropping of the hind wheel into the depressions having no perceptible effect on the occupants. It starts



CANADIAN ELECTRIC MOTET.

Total weight, 400 lbs.; battery weight, 180 lbs. (Still Patent Battery); capacity, 2 persons and 30 lbs. of baggage, or, fitted for light delivery, 250 lbs. and driver; speed, 12 to 15 miles per hour, range (without recharging) 30 miles, steers by hind wheel, guided by left hand; steering handle lifted, as shown in photo, when occupant leaves seat, controller (in right hand) has four positions, reverse and brake; current used, 15 amperes on ordinary roads, power from special motor, designed by W. J. Still, giving 3½ h.p. for 70 lbs. weight; extreme length of wheel base, 4 feet, extreme width of wheel base, 4 feet; cost of running, ½c. per mile; turns in smaller space than a bicycle; price, f.o.b. Toronto, $400

and stops without any of the jerking which we have noticed in other autocars we have examined The motet presents an unusual appearance which is pleasing to the eye, while the rattan body mounted on spiral springs, adds elegance as well as comfort to the vehicle. The absence of the conventional dashboard gives the rider a peculiar sensation at first, but as he is prepared for novelty this feature becomes only one of many contributing to the pleasurable sensation of a rapid run. The facility of movement is one of the strong features of this little vehicle, which turns in less space than a bicycle requires. It is equipped with the Still patent storage battery weighing 180 lbs., and has a range of 30 miles. By increasing this weight to 300 lbs. the range could be increased to 40 miles without recharging—a greater range than has yet been obtained by any electric carriage. It may be added that the cells with which this motet was equipped at the time of our ride were the old ones that had been used in the electric victoria formerly described in these columns, and which on account of an accident to that carriage had been idle for about eight weeks Mr Still stated that with an equipment of new cells made upon his latest type of construction he could secure a range of 40 miles with a battery weight of about 200 lbs. The cells can be charged from any circuit. The motor, also invented by Mr. Still, is of special design, giving great power, but details were not available for publication at this stage At the reasonable price asked for the motet there should be a large and immediate sale for them. The construction of this beautiful and serviceable carriage opens a large field for various types of bodies, ranging from a light delivery vehicle consisting of a simple box with seat in front, to a miniature hansom with the driver seated in the rear of the box, the front being enclosed in glass, so that the view of the occupants would be entirely unobstructed. Such a carriage would be able to accomplish all that is now obtained by the large and cumbrous hansom cabs in London and New York, the total weight of which is 3,200 lbs.—eight times that of the Canadian electric motet. In spite of the smallness of this vehicle—or perhaps because of it—the motet carried Mr. Still and a passenger weighing 240 lbs.—a total load of nearly 500 lbs.—up hill on Avenue road, Toronto, a grade of 10 per cent Two motor carriages of other makers—one electric and one gasolene—failed to accomplish this feat. For city use, and even for professional men who have country practice, electric carriages are found to fully answer all demands, the investigations made by Col. Pope—who placed cyclometers on ordinary run-about conveyances of a number of private citizens, surgeons, expressmen, etc.—having shown an average mileage of 18 miles per day, and with one exception a maximum mileage not exceeding 25. Of course with a duplicate battery 100 miles per day could be made.

Since our last issue further details are to hand in reference to the exploitation of compressed air in New York, to which we referred in last issue. The following are the names of the companies already organized American Air Power Company, capital $7,000,000, controlling works in New York city and compressed air street cars for United States; International Air Power Company, capital $7,000,000, with works at Worcester, Mass., and Providence, R.I., to sell compressed air auto-trucks, engines, locomotives and automobiles; New York Auto-Truck Company, capital $1,000,000, general truckmen, using International Air Power trucks, and owning charging stations throughout New York; Chicago Auto-Truck Company, capital $10,000,000, controlled by the Leiter-Hoadley Syndicate, the same business as New York Auto-Truck Company; Philadelphia Motor Wagon Co., capital $1,500,000, for manufacture of self propelled wagons and for vehicles, supposed to be connected with the Cramp-Hoadley Syndicate of New York; Philadelphia Auto-Truck Company, reported capital, $10,000,000. A certain air of mystery surrounds these companies, and although the newspapers are careful to state that "no stock is for sale," we predict that when the promoters think the time is ripe the stock will be put upon the market at a big premium. As proof of this we point to the fact that the stock of the New York Auto-Truck Company, which was listed at 9 in September, 1898, was sold at 48½ on January 14th, 1899, the day on which the present organization was completed; jumped to 62 on January 16th, to 68 on January 17th and on January 18th was quoted at 71. Mr. Knight, one of the inventors, in an interview stated that owing to pressure from large financial men he had been induced to increase the capital stock of the International Air Power Co. from $1,000,000 to $7,000,000. This explains why the stock jumped. Of the $7,000,000 capital above referred to, $6,400,000 represents property and $600,000 is to be put on the market as preferential stock with 3 per cent. cumulative dividend. The surplus over this $600,000 will represent profits made by the promoters.

With regard to compressed air vehicles, there is one point of considerable interest to all engineers who are watching this problem. We observe the power is stored in steel bottles charged with 4,000 lbs. to the square inch. This is considerably more than has ever been attempted before, and we notice that the tubes are only 5-16 inches thick. Of course there is no doubt that nickel-steel has a very high tensile strain, and it is just possible the bottles made of this substance may stand the test, as stated in the reports, of 1,8000 lbs. to the square inch, but there is a point worthy of very careful consideration as to whether these bottles will withstand the constant vibration they will experience on the road without very rapid crystallization of the steel. This would be especially likely to take place, suspended as these are upon the reach of the vehicle. This we think should be thoroughly tested before any such vehicles are put on our public streets, as the danger of

explosion of such a bottle as this loaded to 4,000 lbs. to the square inch would be a severe menace to life and property. The destructive results of the rupture of one of these tubes would be much increased by the fact that with their fibers crystallized by constant jarring they would inevitably shatter to fragments, and the pieces would be scattered in all directions.

Considering the fact that the Hoadley-Knight compressed air car made but 15 miles upon steel rails with air reservoirs weighing 3,000 lbs., a very large amount of improvement will have to be produced before it is possible to drive compressed air vehicles over our ordinary thoroughfares for anything like reasonable distances, and we are extremely doubtful whether with the charging stations at one mile apart, as suggested by Hugh Dolner, the use of the storage battery would not be a preferred system.

Compressed Air, the monthly journal published in New York, contained in its issue of August, 1897, some correspondence which is of special interest just now. A correspondent having asked for information as to running a horseless carriage by compressed air, the editor replied as follows: "Compressed air as a motive power has many economical and useful applications, but it has its limitations. Our hope in this direction seems to be confined to the possibilities that might result from the use of liquid air. At present there does not seem to be much encouragement in the use of compressed air for motor carriages. The limited space obtainable and the weight of the apparatus seems prohibitive. A steel tube of one cubic foot capacity with air at 2,000 lbs. pressure (say 9 inches diameter) will contain 268 cubic feet free air, and power required to compress this quantity per minute will be 268 x .43-115 h.p.; or if done in one hour's time will be 2 h.p., and this calculation is based upon the very best type of 4-stage compressor with perfect intercoolers. A pair of 2½ inches x 5 inches single-acting cylinders operating at 100 lbs. pressure require each 32 cubic feet free air when running at best speed (say 400 revolutions per minute), so that out of a storage reservoir of 2 cubic feet, you will only get a run of about four minutes. The weight of a Mannesman steel tube 9 inches diameter, per cubic feet storage, is 82 2 lbs., and weight of 1 cubic foot air at 2,000 lbs., is 10.2 lbs., making a total weight of 92 4 lbs. for every 2 minutes the carriage will run." This reply must have been discouraging to the correspondent, for it would mean that a run of two hours would involve a weight of 5,544 lbs.! And the correspondent wanted to build a carriage on "bicycle lines." The editor's calculation, however, is evidently based on the assumption that the air is used without expansion. This practically is never done in modern compressed air engines. The result of the calculation, therefore, is scarcely fair to modern compressed air systems.

In opening its fourth yearly volume, The Autocar takes occasion to review the present position of the autocar industry throughout the world. The record of progress is interesting. In Britain a year ago there were less than fifty autocars, to-day English-built vehicles, both cycles and cars, may be numbered by the hundred, and with importations would total 500. The British output has trebled, being six vehicles per week. In France a twelvemonth ago the cars were counted by hundreds; now they are estimated by thousands. Germany is going steadily ahead; the United States is beginning to make up for lost ground; and Canada has entered the list of autocar manufacturers. The cab trials in June last brought electricity for the first time in competition with the gas engine, and, to the surprise of all who attended the trials, electricity carried everything before it as a power for the propulsion of public vehicles in large cities. The electric cab fulfilled all the conditions of the Paris companies, even to the question of working cost. The heavy autocar trials demonstrated that electricity must be taken into very serious account in the future for the driving of heavy vehicles, several of which are now running in Paris. The greatest advance in this class of vehicles has been the raising of steam with liquid fuel, and the Serpollet car has shown the possibility of applying this power under conditions where steam has not hitherto been practicable. A good many heavy vehicles have been sent to North Africa, Senegal and other countries. In France, also, steam road traction has undergone an extension, and several new lines of steam cars have been inaugurated during the year.

Our critical comments last month on the reported "fifteen million dollar deal" in autocars by Count Jotemps of Paris, have been fully justified by the facts which have since come to light. The sum and substance of the matter is simply this. Count Jotemps, whose wife is an American, took a tour of the motor carriage factories, with the following result: He secured the agency for the Stanley steam carriage in France and Belgium; ordered three carriages from Holyoke Motor Works, contracting to take 50 vehicles during the coming season; did nothing with the Overman Wheel Co., whose carriage was not ready to show; and he arranged with the Fischer Equipment Co., of Chicago, for 100 carriages per year for ten years. Total business, about a million dollars extending over ten years.

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The seventh annual meeting of Ontario Land Surveyors (fourteenth annual meeting of organized Land Surveyors of the Province) will open on the 28th February at the Parliament buildings, and will occupy three days. One of the chief items of business for the Association will be the discussion of revised by-laws for ratification. The programme is as yet by no means complete, but the following papers are expected —Exploration Surveys, by James Dickson, Fenelon Falls; Survey Act, by P. S. Gibson, Willowdale; Survey of the Boundary between Nipissing and Algoma Districts, A Niven, Haliburton; Azimuth, S. B. Stewart, Toronto; Railway Location Survey, J. D. Evans, Trenton; Permanent Way, W. E. McMullen, St. John, N.B.; Dominion Lands Surveys, C. F. Aylesworth, jr., Madoc; A Railway to James' Bay, Villiers Sankey, Toronto, A Trip to Yukon and Return, Lewis Bolton, Listowel, Surveying and Surveyors, Jos. Cozens, Sault Ste. Marie; Evidence, by M. J. Butler, Napanee; Lake Wawanosh Drainage Scheme, J. H. Jones, Sarnia; Impressions in the Rocky Mountains, B J. Saunders, Brockville; Forestry and its Relation to Flood Prevention, Thos Southworth, Toronto, Drains of Field Tile, W. F Van Buskirk, Stratford, Highway Culverts and Bridges, A. W. Campbell, Toronto. Papers are also expected from H. J. Bowman, Berlin; G. A Mountain, Ottawa, C. A. Jones, Petrolea, and others.

STONE WORK CLEANING BY SAND BLAST.

Editor CANADIAN ENGINEER.

SIR,—In your issue for December, 1897, page 238, I notice an enquiry for "washing and whitening stone walls," from W. P. M., of Halifax, N.S., but in your reply thereto you have overlooked a method which has, I believe, been successfully used in both the United States and England. It is the employment of the now well-known "sand blast," the current of sand being projected against the face of the building from a hose supplied with air under pressure from any convenient source. This current of air-driven sand effectually cleans all dirt, etc., from the face of the stone and leaves it clean as if fresh from the tool, while it also has this great advantage that it can be applied without injury to carved work, thus saving the great expense of recutting same. It is curious and instructive to remember that the use of "sand blast" was suggested to Gen. Tilgman, who was the first to make commercial use of it, by his observance of the sharp wearing away of the stone of which the Pyramids and Sphinx in Egypt are composed by the sand driven against them by the winds of the desert. In many parts of the East of England, where there is a sandy tract bordering the sea, the window glass will be seen to be ground by the same agency and appears like frosted glass.

When in England last year I noticed enquiries for cheap doors and sashes and wood pulp—both kinds. Possibly you might be able to give pointers on these matters to your subscribers. Yours,

Toronto, Jan. 28th, 1899. H. E. KYLE.

THE PRACTICAL MAN.

To Soften Cast Iron for Drilling.—Heat to a cherry-red, having it lie level in the fire. Then with tongs, put on a piece of brimstone, a little less in size than the hole is to be. This softens the iron entirely through. Let it lie in the fire until slightly cooled, when it is ready to drill.

To Soften Steel.—Cover it over with tallow, heat it to a cherry-red in a clear coal fire and let it cool of itself.

Tinning Surfaces.—Articles of brass or copper boiled in a solution of stannate of potassa mixed with turnings or scraps of tin, in a few moments become covered with a firmly attached layer of fine tin. A similar effect is produced by boiling the articles with tin turnings or scraps and caustic alkali, or cream of tartar. In either way, articles made of copper or brass may be easily and perfectly tinned.

Varnish on joints is better than the average red lead.

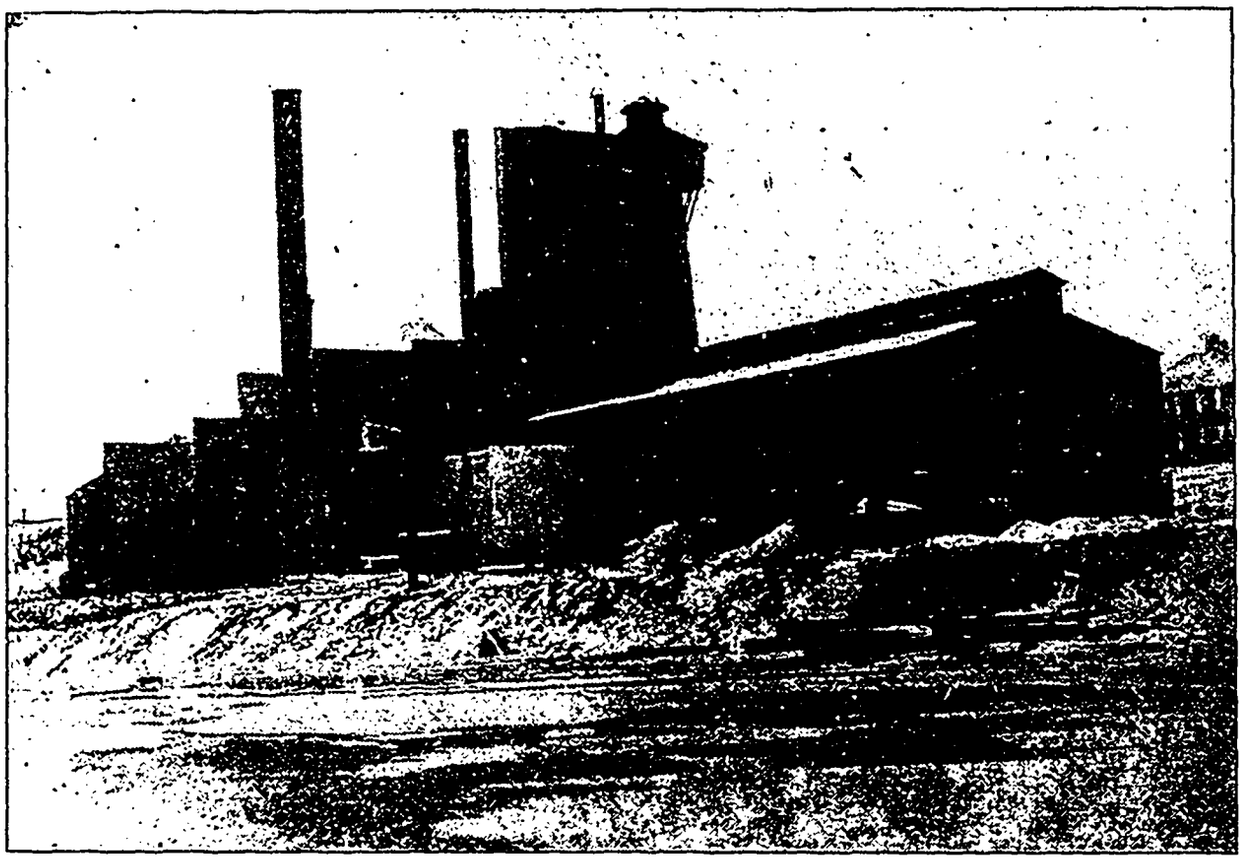
To Restore Burnt Steel and Improve Poor Steel.—Borax, 3 ozs.; sal ammoniac, 8 ozs.; prussiate of potash, 3 ozs.; blue clay, 2 ozs.; rosin, 1½ lbs.; water, 1 gill; alcohol, 1 gill. Put all over a slow fire, let it simmer until it dries to a powder. Heat the steel not above a cherry-red, dip into this powder and afterward hammer.

Rosin on the blacksmith's forge improves and toughens steel. When the tool is hot dip it into the rosin, then hammer.

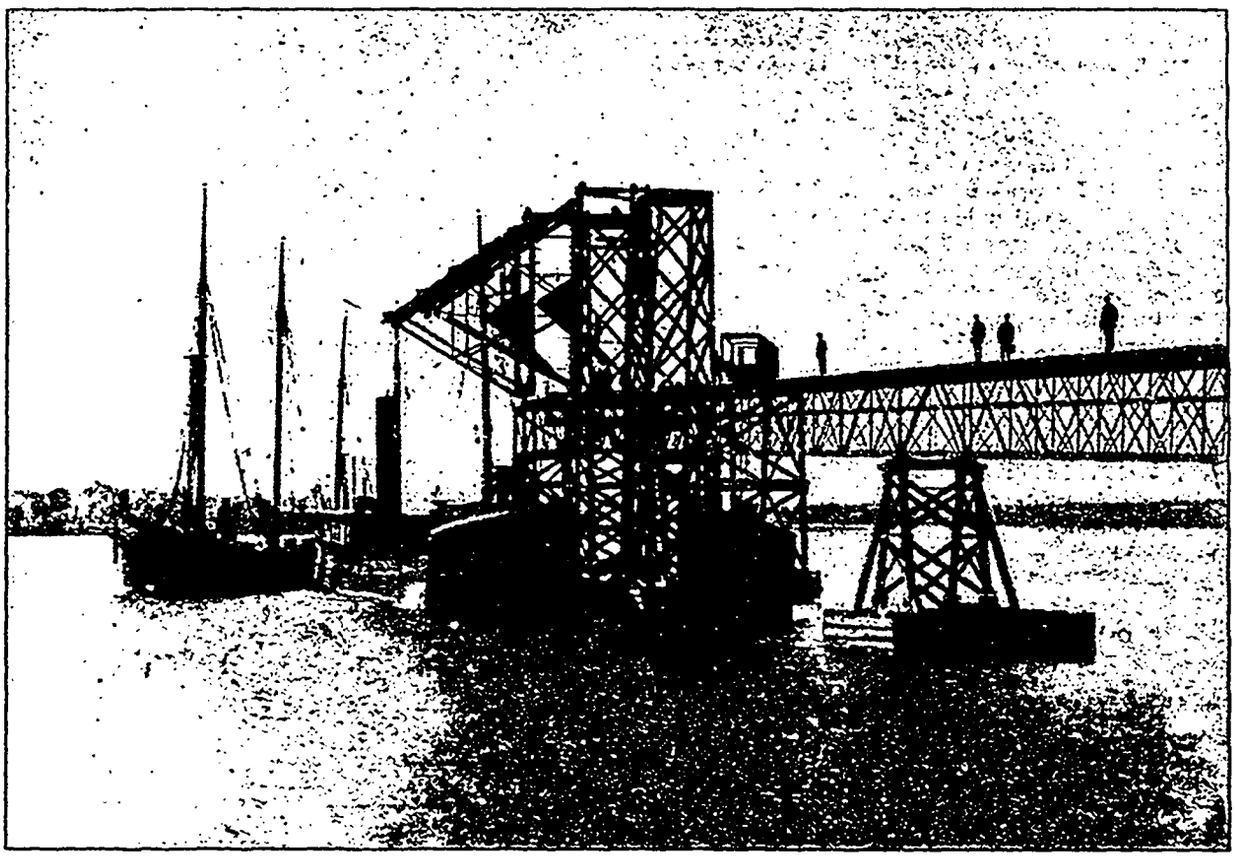
To Copper the Surface of Iron or Steel Wire.—Have the wire perfectly clean, then wash with the following solution, when it will present at once a coppered surface: Rain water, three pounds sulphate of copper, one pound.

THE DESERONTO IRON CO.

The manufacture of charcoal iron was begun by the Deseronto Iron Co., at Deseronto, Ont., on Jan. 25th, 1899, as reported in the Deseronto Tribune. The manufacture of charcoal iron, although for many years carried on extensively in various parts of the United States, has never attained large proportions in Canada The only plant in active operation is that at Radnor Forges, in Quebec. Many years ago smelting works on a small scale were started at Marmora and in Algoma in Ontaro, and there was also a small plant near Woodstock, N.B. At that time the market for such iron was comparatively limited in Canada and there were other obstacles which discouraged the promoters. The undertaking at Marmora has revived several times, but the promoters met with severe losses and were obliged to nbandon it. Although Canada has such vast areas of wooded lands and though in many parts of the country there are extensive deposits of iron ore, it is somewhat surprising that capitalists, during the past twenty years, have so little directed their attention to the smelting of iron by means of charcoal. The iron thus produced is almost indispensable in several lines of manufacturing and there is a market for it in Europe as well as on this continent.



THE DESERONTO IRON CO.—MAIN BUILDING AND FURNACE—VIEW FROM THE BAY.



THE DESERONTO IRON CO.—THE ORE DOCK AND TRESTLE.

The location of the new charcoal iron smelting plant at Deseronto,

Ont., is primarily the result of a plan formed by the late H. B Rathbun, founder of Deseronto, and his sons, E W. Rathbun and the late F. S, Rathbun. They early conceived the idea of turning to account the waste material of their saw mills, and founded several factories with that end in view. To this end gas works for the conversion of sawdust into gas were started. The town was illuminated in this way for one year, but it was found to be unprofitable and afterwards the manufacture of fire proofing terra cotta was entered upon. Wood distillation was, after a number of costly experiments, made a success, and has been carried on for several years, the charcoal being exported to Detroit for the smelting works in that city E. W. Rathbun, general manager of the Rathbun Company, entered into negotiations with the Gaylord Iron Company, Detroit, and other United States' capitalists, and after some years succeeded in enlisting their active co-operation. The wood distillation plant of the Standard Chemical Co., which was described in a recent issue of THE CANADIAN ENGINEER, will produce the necessary charcoal for the smelter. Even at the present contemplated output of 12,000 tons of iron per annum, the wood distillation plant, in order to furnish the necessary charcoal for the smelting, will require annually about 20,000 cords of coarse timber. The supplying of this material will furnish employment, during the cold weather, to at least 200 men and 80 teams of horses. In addition to these are the hands employed in the transportation of this wood by water and rail. The works are situated in the west end of the town south of Main street and directly on the shore of the Bay of Quinte. The line of the Bay of Quinte Railway has been extended to the works, thus giving connection by rail and water. The ore dock has three hoists for lifting the ore from the holds of vessels, and with a trestle and tramway for carrying the ore to the piling ground adjoining the furnace. The accompanying cut will give the reader a good idea of the dock and trestle. The works cover an area of four acres of ground.

The plant and works were erected under the supervision of M. C. Furstenau, C.E , Detroit. F. B. Gaylord is general manager of the Deseronto Iron Co. Miss Sherwood is assayer and chemist. Felix de Claqui is the engineer, and Stephen Fallon founder.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

Toronto C.A.S.E., No. 1, met Feb. 1. A committee was appointed to look after the interests of those applying for the situation of engineer at the new Toronto municipal buildings. The following resolution was passed: "That the members of Toronto No. 1, C.A.S.E., deeply deplore the loss of life and personal injury to the innocent victims who suffered at the recent boiler explosion at the ice house in the east end of the city, and as a body of engineers wish to place ourselves upon record as concurring with the verdict of the coroner's jury which clearly set out the fact that the man in charge was incompetent; and that all boilers should be under the charge of practical engineers who have certificates, and that each boiler be inspected yearly by some competent person."

The annual At-Home of Toronto No. 1, C A S.E., will be held on Wednesday, Feb 15th A fine programme has been prepared and anyone going will be assured of a good time.

At the regular meeting of Hamilton No. 2, Jan. 3rd, after the formal part of the proceedings, the question box was opened and the "Vacuum" discussed Much gratification was expressed at the election of Ald. R. C Pettigrew, who headed the polls at the January elections and is one of the hardest working members of Hamilton No. 2.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

ANNUAL MEETING IN MONTREAL.

The thirteenth annual meeting of the Canadian Society of Civil Engineers was held at the society's rooms, 112 Mansfield Street, Montreal, opening on the 10th and closing on the 13th of last month The attendance was unusually good and the convention, taking all its features together, was the best in the history of the society.

Among those present, on one or more days of the convention, were the following K. W Blackwell, Prof. C. H. McLeod, William McNab, H Irwin, J G G. Kerry, Prof. John T Nicholson, Dean Bovey, E. P. Hannaford, J H Parent, William Kennedy, Junior, Geo Holland, E A. Rhys-Roberts, M Perrault, O. Arcand, L A Amos, F P Shearwood, W. C Thompson, A Massey, J. M McCarthy, L. B. Copeland, J. H. Walters, J. S. Vindin, T. W Lesage G H Duggan, Stuart Howard, Ernest Marceau, W. McLea Walbank, Joseph W. Heckman, N. Hanson Greene, W. J. Sproule, F. C. Laberge, L. J. Marion, C. R Coutlée, C. de B. Leprohon, Chas. S. Leach, H. Y. Bertrand, G. Legrand, W. A. Sanders, Duncan McPherson, A. Dedman, A. J. Bachand, L. S. Pariseau, Lewis Skaife, Frank S. St. George, L. G. Papineau, J. A. U. Beaudry, Dr. J. B. Porter, A. J. Corriveau, G. H. Garden, G. L. Mattice, Carl Reinhardt, L F. Gagnon, L. A Dufresne, James Ewing, J. G. MacGregor, J. P B. Casgrain, R W. Leonard, all of Montreal; W. T. Jennings, Willis Chipman, E. H. Keating, C H. Rust, Henry A. Gray, Henry J. Duck, F. L. Somerville, H Lindsay of Toronto; J. W Fraser, A. St. Laurent, F. W. Cowie, Robt. Surtees, J. T. Farmer, Wm. Crawford, A. H. Bruce, G. A. Mountain, W. B. Anderson, G. H. Pinhey, of Ottawa; Henry O'Sullivan, Owen O'Sullivan, Thomas Breen, L. A Vallee, Charles Baillairge, F. X. Berlinguet, of Quebec; R. Adams Davy and G J. Desbarats of Iroquois, Thomas Monro, Coteau Landing; F. G Butler. Napanee Mills; C. H. Ellacott, Westmount; B. J. Saunders, Ft William, F. P. Strickland, Sydney, N.S.W; J. S. Armstrong, St John, N B, H.T Hazen, Ste. Anne de Bellevue; R. and W. Russell, Pembroke; Rich T. Gough, Halifax, N S; J S. Bertrand, Fraserville; Wm Burns, Renfrew; G. K Addie, Sherbrooke; R B Rogers and W. J. Francis, Peterboro; M. J. Butler, Deseronto; E. G. Matheson, Charlottetown, P.E.I.; Geo A. McCarthy, Moncton; N. E. Brooks, Calgary; J. D. Barnett, Stratford; Henry Zlapka, Hamilton, Prof. W. R Butler, Kingston; Armitage Rhodes, Quebec; Geo. E. Thomas, Chicago; E. Berryman, Winnipeg; P. S. Hildreth, of R. W. Hildreth & Co., New York; Kenneth Moodie, Chicago; C. H. Osler, F. G. B. Allan, Napanee Mills.

The chair was occupied by K. W. Blackwell, vice-president, who calling the meeting to order, read a letter from W. G. N. Thompson, the president, regretting his inability to attend, owing to the illness of members of his staff.

The secretary, Prof. C H. McLeod, read the programme of the meeting and then read the minutes of the last annual meeting, which were confirmed.

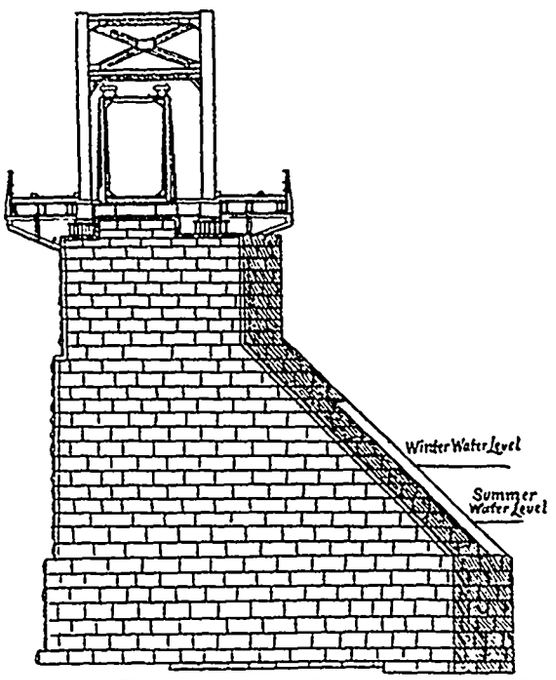
Messrs. F. W. Cowie, L. Skaife and Frank St George were appointed scrutineers of the ballot for the election of officers and members of the Council; while Messrs. J. W. Heckman, C. de B. Leprohon and Geo A. McCarthy were appointed scrutineers for the Nominating Committee.

The chairman announced that the Grand Trunk Railway Company had extended an invitation to the members to visit the new Victoria Jubilee Bridge, and that a special train would await the party at Bonaventure Station at 2 o'clock. The meeting then adjourned and in the afternoon a large party took advantage of the Grand Trunk's courteous offer. The day was very cold and a keen wind swept across the river, raising wreaths of steam over the only unfrozen spot in the St. Lawrence, just at the big central span, where the party halted General admiration was expressed at the excellence of the bridge-work and masonry, and the skill that had been shown in surmounting the special problems of construction presented in replacing the former tubular structure by this famous bridge. After inspecting the features of the great central span the visitors were taken to the St Lambert end, so that on their return they could admire the approach to the city from the bridge. They were highly pleased with the trip, notwithstanding the zero temperature of the day. Joseph Hobson, Chief Engineer of the Bridge and of the Grand Trunk Railway System, accompanied the party, and explained many important details of the works.

The evening was pleasantly and profitably taken up with a general description of the Bridge, by Wm. McNab, Librarian of the Society, and assistant engineer of the Grand Trunk Railway System. The chairman first announced that a detailed account of the new bridge was being prepared by Joseph Hobson, Chief Engineer, and this description would be incorporated with the Society's Transactions of the current year.

The rooms were crowded, a large number of ladies being present, and Mr McNab's address, aided by the stereopticon, in charge of F. R. Redpath, was most instructive. In beginning his description Mr McNab remarked that no bridge of that period attracted as much attention throughout the world, or commanded as much admiration as the Victoria Tubular Bridge at Montreal which was erected between the years 1854 and 1859. When it was recollected that there were few precedents for the engineers to go upon in regard to many important matters, and that some of the difficulties to be overcome were here presented for the first time, and on such a great scale, we are bound even now to acknowledge the foresight and skill displayed by its designers and builders. The Victoria Bridge consists of 24 spans, varying from 242 feet to 248 feet in length, in the clear, and a centre span of 330 feet in the clear. The capacity of the old bridge was thought ample for all the traffic that would ever pass over it, and certainly no one could have thought that within thirty-eight years from its completion they would need the double track structure which the traffic of the present day requires. The engineer at that time had difficulty in making up a train weighing one ton per lineal foot, and to do it he had to put on three locomotives, and a specially loaded

train. The new bridge is designed to carry a moving load in either direction, on each of the two tracks, consisting of two consolidation engines and tenders, followed by a uniformly distributed load, weighing 4,000 lbs per lineal foot; also a moving load in either direction on each of the extended roadways of 1,300 lbs. per lineal foot. In the new structure provision is made for two tracks, which may be used both for steam traffic and for electric railways, and a vehicle and a foot passenger roadway is provided on each side, outside of the main trusses, formed by an extension of the great floor beams. This is shown in the accompanying diagram. So liberal had the original



THE JUBILEE VICTORIA BRIDGE—PIER AND SECTION OF SPAN.

engineers been in the design of the capacity of the piers, that none of the foundations had to be extended, or even touched. All that was required was the extension of the masonry on the upper ends of each pier, by building up over the saddle of the cut water. This extension was about seven feet, and as there was no place below to pile the stone, the material for this addition had to be let down by a traveler working on top of the old tube. Each course of masonry was exactly the same thickness as the course in the old piers, of which it formed an extension, and each joint was made to overlap that on each course next below by twelve inches. The stones of each course were clamped together by clamps turned down 2½ inches, and embedded in the stone, there being both vertical and horizontal clamps. The stones were set in the most approved manner, and the pointing and grouting received the best treatment. Mr. McNab gave an interesting explanation of each picture thrown on the screen, showing the method of carrying out the pier beams and floor beams, the erection trusses, the method of placing the temporary cantilever spans to connect with the centre erection truss used on the big centre span; but as these will be described in detail in Mr. Hobson's forthcoming paper, they are not fully described here. For the building of the steel superstructure a sorting yard was laid out at each end of the bridge and the various bridge members were piled in the order in which they were to be used, the heavy members being placed under the great traveling crane, and the lighter ones outside the track, and handled by its cantilever arms. As the traffic had to be maintained while rebuilding, and false works in the river were out of the question, the idea of the traveling erection truss was adopted. These trusses, of which there was one on each side of the centre, were of the exact length of the small spans of the bridge, and were a little greater in width than the old tube, and a little less than the permanent truss of the new bridge. The pier beams were placed in sets of seven, one set on each side of the tube, and were lowered to place by means of a hoisting engine. Each set weighed seven tons. After the pier beams were placed, the end floor beams were riveted to them by web connections, and thus bound this part of the work both transversely and longitudinally, and distributed the weight uniformly over the piers.

The erection truss was traveled from pier to pier by means of a series of trucks moving on the rails or top of the tubes. Wooden blocking was placed on these trucks to carry the truss by means of its top members, and the wheels were so placed as to distribute the weight as uniformly as possible in passing over the tube, and it really strained the old tube less thon did the ordinary train traffic. The truss was drawn across each span by means of block and tackle, worked by a stationary engine securely placed on top of the next tube.

As instances of how perfect the arrangements were for the moving of the temporary truss, it may be stated that the time occupied in the actual passage from pier to pier, was only from 4 to 6 minutes. After the truss had been placed exactly over its bearings on the piers, it was lowered in place, and the entire weight removed from the tube. The aggregate time for each span connected with the moving of the temporary truss and lowering it to its bearings, was only about half an hour. One erecting truss worked from each end towards the central span, upon reaching which the central erection truss was formed by the two trusses on an ingenious modification of the cantilever principle. From the 23rd March to 19th August, twenty-four spans were assembled and put in position. In removing the old tube, the body was removed in sections small enough (about 7 ft. x 18 ft.) to be handled and placed on the cars, and disposed of so as not to interrupt the daily traffic.

Pneumatic chisels were used to take the heads off of the rivets, and pneumatic hammers for backing the rivets out. In removing some of the bottom pieces a rail saw was used. The spans were adjusted to permanent level by hydraulic jacks of commensurate capacity. Mr. McNab's instructive sketch closed with pictures of the end view and a general view of the magnificent structure as it now appears.

The lecture was heartily applauded, and at its conclusion, E. H. Keating, of Toronto, proposed a vote of thanks to Mr. McNab. Mr. Keating said he was intensely interested in this great work, which was formerly reckoned one of the wonders of the world, and if it was so regarded then, what would its designers think of the remarkable work of its present reconstruction, in which problems then considered insoluble were carried out. Great credit was due to the engineers who designed it and the contractors who carried it out.

Charles Baillairge, of Quebec, warmly seconded the motion and said he had been greatly impressed, on their visit this afternoon with the beautiful outlines of the bridge, as well as its great strength and solidity. A heavy train passed along while he stood on the bridge, but hardly the least tremor could be felt. There were other great bridges in the world such as the Forth, the Menai and Brooklyn bridges, but in some respects, the Victoria was still the greatest structure of the kind in the world.

On motion of J D. Barnett, of Stratford, a vote of thanks was also passed to Mr. Redpath for his good management of the lantern slides.

Prof. Bovey took occasion to refer to the great skill shown by Mr. Hobson in connection with this and other engineering works carried out for the Grand Trunk, and he regarded the present structure as one of the engineering triumphs of the Jubilee reign of Queen Victoria. He then gave a general invitation to the visiting members of the society to inspect the applied science departments of McGill University.

An interesting fact connected with the visit to the bridge was that John Duckworth, whom they all had met on the bridge that afternoon, had been inspector of the old tubular bridge since it was originally opened for traffic, and he it was who handled the implement which held the last rivet whilst the Prince of Wales drove it "home," at the inauguration of the bridge in 1860.

After partaking of light refreshments in the adjoining rooms the first day's proceedings closed.

WEDNESDAY, JAN. 11TH.

This day was very pleasantly taken up by an excursion to the works of the Laurentide Pulp Co. at Grand' Mère. Sir William Van-Horne, who is president of the company, had a train of parlor cars placed at the service of the society for the day, and the large turn-out of the members showed that the courtesy was fully appreciated. The five cars were quite filled when a contingent from Quebec joined the party at Three Rivers. The train left Montreal about 8.30 a.m., arriving at Grand' Mère about 12.30. On alighting they were met by Russell A. Alger, Jr, son of the Hon. Russell A Alger, and secretary of the company, who with H. Meurer, manager of construction, and other officers of the company, showed the visitors over the great works which have created around them a town of 3,000 where there was only a hamlet when the mills began operations. When the falls from which the great water power is derived were visited by the French settlers, the contour of the projecting rocks showed the profile of an old woman hence the name it acquired of Grand' Mère (grandmother). This rock was blasted away in forming the dam, but the name still survives, maintaining the natural relation between grandmother and dam. The falls are capable of yielding 70,000 h.p. at low water and 90,000 h.p. at high water. About eight hundred hands are employed in these mills, besides 1,400 outside who are engaged in getting out the wood from the forest. The pulp wood pile at the mills covers more than an acre, and in some places is piled to the height of 30 or 40 ft., making about 80,000,000 of lumber

measurement. These mills produce paper, card-board and pulp for export, and the daily capacity of the three departments is as follows — 40 tons of paper, 35 tons of cardboard, 110 tons of mechanical fiber (pulp), and 70 tons of sulphite fiber. There are 30 pulp grinders, three digesters, 45 ft. in height by 14 ft. diameter, one 112-inch Fourdrinier machine, one 90-inch machine and one board machine. In total capacity it is the largest mill in Canada, and one of the large paper and pulp mills of the world After showing the party through each department the management of the mill invited their visitors to a luncheon served on improvised tables with big sheets of card-board for table-cloths, and heaped with huge turkeys, hams, ribs of beef and the kind of accompaniments which were most appreciated on a cold day. From the appearance of the tables after the lunch was over the managers could have had no doubt of the enjoyment of their guests. After thanking their hosts the party returned to the train and arrived in Montreal about 9 p.m.

Among the members and friends attending the excursion whose names have not been already mentioned were the following: R C. Alexander, H. B Sims, W. F. Angus, J. Ewing, J W. Brock, J. F. Ellis, J. A. Burnette, R Kenrick, R. F. Gough, A. Burnette, B. A. Davis, W. M. Young, J C. Denis, R. S. Lea, E. G. Coker, J. P. B. Casgrain, J. H Larmonth, E. A. Stone, S H. Capper, G. Taylor, H. R. Ives, and J. T. Shearer.

THURSDAY, JAN. 12TH.

The meeting was called to order at 10.30 a.m., the chair being taken by G. H. Duggan, who called on Thomas Monro to read his paper on "The Soulanges Canal," which, with the discussion on it, will appear in another issue.

At the afternoon session, when J. D. Barnett presided, a paper on the Trent Valley Canal was read by R. B. Rogers, engineer-in-charge of that work. A summary of this paper will be given in a later issue.

In the absence of H. K. Wicksteed, the chairman called on G. A. Mountain to read that gentleman's paper on the Georgian Bay and Ottawa Ship Canal, which is summarized in another part of this issue.

In moving a vote of thanks Ernest Marceau expressed the hope hat this great scheme would be carried out at no distant date.

In seconding the motion, which was carried, J. S. Armstrong said he looked upon it as a work of great importance to Canada at large and to Montreal in particular.

FRIDAY, JAN. 13TH

At the morning session the chair was occupied by Mr. Blackwell.

The secretary read the report of council for the past year, of which the following is a summary.

During the year eight members, twenty-one associate members, two associates, and twenty-two students were elected. Three associate members have been transferred to the class of member, and eight students to the class of associate member. One associate member and one student, removed from the roll for non-payment of dues, have been re-instated upon payment of their arrears. The elections under the Quebec Act, Vic. 61, Chap. 32, comprised four members, fifty associate members, and one student. Five students were admitted as associate members under the Quebec Act. Resignations have been received from two members, two associate members, one associate, and one student. The deaths have been: Of Honorary Members—Sir John Fowler, Bart., K.C.M.G., LL.D.; of Members—Col. Sir C. S. Gzowski, A.D.C., K C.M.G.; William Kingsford, LL.D., and Joseph DeGurse.

At present the membership stands as follows:—Honorary Members, 7; Members, 294; Associate Members, 232; Associates, 41; Students, 142; Total, 716. At the same date last year the total membership was 628.

Eighty-seven applications for admission into the society are now pending, against nine at date of last annual meeting. The Act concerning Civil Engineers in the Province of Quebec became law on Jan. 8th, 1898. This Act is known as Vict. 61, Chap. 32, of the Statutes of the Province of Quebec. No further Legislative enactments have at this date been obtained. In the Province of Nova Scotia an Act was brought before the Provincial Legislature during its last session, but, owing to local conditions, was not passed. In the Province of Ontario several conferences have been held with the Ontario Land Surveyors, and the Provincial Committee has drafted a bill based upon the Quebec Act and corresponding to it in essential features, which it is hoped will meet with the approval of the Government and become law during the next session. The committees in charge of legislation are as follows:— Central Committee.— P. W. St. George, W. J. Sproule, H. Irwin and C. H. McLeod.

Nova Scotia.—M. Murphy, C. E. W. Dodwell, W. G. Matheson and H. S. Poole.

New Brunswick.—Hurd Peters, P. S. Archibald and H. R. Lordly.

Quebec.—St George Boswell, L. A. Vallée, E. Marceau, T. Breen and J. M McCarthy.

Ontario.—W. Chipman, A. L. Hertzberg, M. J. Butler, E. H. Keating and C. H. Rust.

Manitoba.—H. N Ruttan, G. H. Webster and J. Woodman.

N. W. Territories.—W. D Barclay, G A. Stewart and W. T. Thompson.

British Columbia.—H. J. Cambie, A. J. Hill, H. Abbott, F. C. Gamble and E. A. Wilmot.

The Council desires to point out that hereafter, all persons desirous of practising as Civil Engineers in the province of Quebec should become members of the society under the provisions of the Quebec Act, *i.e.*, they should pass the examinations therein prescribed and otherwise conform to the requirements of the Act. In accordance with the requirements of the Act a Board of Examiners has been constituted as follows: E. Marceau, R. J. Durley, T. Breen, C. H. McLeod, R. S. Lea and Prof. F. S. Duval. No examinations have yet been conducted, as no candidates have applied for admission except under Articles 2 and 3, which provided for practising engineers and land surveyors joining during the year 1898. This avenue of access to the society is now closed, except as regards provincial land surveyors, who were practising at the time of the passing of the Act.

An employment registry is now kept in the Society's rooms for the benefit of members. The president and secretary of the Institution of Civil Engineers extend a welcome to their institute to members of the Canadian Society who may be visiting the next World's Fair in Paris. Reference was made to the death of Sir Casimir Gzowski, who was founder of the only medal in the gift of the Society. Attention was called to the fact that the by-law fixing the admission fee at $20 was now in full force. Under the Quebec Act the fee for students is $20, and for associate members $40.

The report of the Library Committee by Wm. McNab, librarian, showed that this Committee had held five meetings during the year. The reading rooms are now well supplied with technical journals, and during the year a good many donations of books were received.

The following was the treasurer's statement:

Balance from 31st December, 1897			$6,970 65
GENERAL RECEIPTS.			
Subscriptions:—			
Arrears	$1,287 15		
Current	2,351 26		
Advance	749 66		
		$4,388 07	
Transactions sold		17 50	
Dividend on Canada Permanent Loan Co.'s stock		4 50	
Donations to Library		26 16	
Donation towards expense of Annual Meeting		2 00	
Bank interest on current account		46 99	
Bank interest on deposit account		111 81	
			$4,597 03
BUILDING FUND			
Balance from 31st December, 1897		4,026 03	
Ketchem bequest transferred from general fund		500 00	
Interest to 31st December, 1898		130 70	
			4,656 73
			$16,224 41

GENERAL EXPENDITURE.	
Transactions printed and published	$ 897 10
Advance proofs	66 54
Printing, stationery and binding	267 95
Charter, By-laws and List of Members	85 25
Postage and post cards	176 98
Messengers and telegrams	29 41
Cabs, cartage, etc.	8 70
Secretary's salary, including 7 months of 1897	475 00
Assistant secretary's salary for year	488 07
Caretaker's wages for year	140 00
Caretaker for washing towels	6 00
Cost of keeping rooms open at night	62 00
Rent of rooms for year	675 00
Telephone service, including 6 months of 1897	45 00
Bank commissions on cheques	13 22
Water rates	25 22
Electric lighting for year	76 69
Books and magazines and library expenses	95 30
Expenses *re* Close Corporation	863 83
Expenses at meetings	20 75
Engrossing diplomas	22 50
Gzowski medal and engraving	11 48
Office furniture and alterations	609 38
Rent of drawer in bank vault for year	5 00
Amount transferred to building fund	500 00
Gas for grate fire	2 00
Treasurer's expenses, car fares, etc	4 34
Petty cash in hands of Asst. Secretary	1 75
	$5,674 46

BALANCES

General Fund Treasurer	$5,893 22	
Building Fund Treasurer	4,656 73	
		$10,549 95
		$16,224 41

H Irwin, Treasurer
K W. Blackwell, W McLea Walbank, Auditors

On motion of J M McCarthy, seconded by Lewis Skaife, the reports were adopted.

The question of the removal of the Society's quarters and the project of purchasing a building for the Society's exclusive use led to a long discussion The secretary explained that the owners of the present building, the Bank of Montreal, had declined to make certain small alterations to improve the lighting of the entrance, but instead proposed to allow the Society to do it, deducting the cost from the rent, but holding the Society responsible for any damage to the building. The Council did not wish to be put into a trap of this kind, and as the defect was caused by the owners blocking up the natural light at the rear they considered they were entitled to have the defect remedied without being held liable to possible damages in making the necessary changes. The discussion was resumed at a later stage, when E. P. Hannaford, who took strong ground in favor of remaining in the present rooms, moved that the present rooms be secured for a period of 3 to 5 years, and that the Council be instructed to arrange terms with the landlords.

This led to a discussion of the policy of purchasing a building or erecting one for the Society's future use. Several members expressed themselves in favor of building or purchasing, but others while in favor of the policy of having a home for the Society, thought the condition of the Society's funds did not justify the step at the present time Messrs. Skaife, Leprohon, Vindin, and Lesage had been appointed a committee to investigate the question of new temporary rooms, and this committee now reported that two fairly suitable properties could be purchased, one in Osborne street, at $14,000, and the other in Union avenue, at $18,000. The annual cost of the former was computed at $810, and of the latter $875. The rent of present buildings is $700. After discussion Mr Hannaford's motion was defeated, and a motion by J M. McCarthy, seconded by C H Rust, was carried, leaving the whole question in the hands of the Council

Several members desired a definition of the society's policy on the building question and this was put on record by two resolutions, the first by Wm Kennedy, seconded by J M McCarthy, stating that in the opinion of the society it was not advisable to build or purchase permanent quarters at the present time, and the second, proposed by Lewis Skaife seconded by W B. Anderson, that it is the policy of this society to purchase a building as soon as the state of the funds shall warrant such action

Mr. Chipman suggested that the treasurer's statement should hereafter be drawn up in the form of a balance sheet designed to show more clearly the assets and liabilities of the society for the benefit of outside members

Mr Jennings and others agreed with this suggestion

The committee on the Civil Engineer's Bill for Ontario, consisting of W. T. Jennings, V L. Hertzberg, C. H Rust, E. H Keating, M. J. Butler and Willis Chipman, then presented their report through the last-named gentleman, who was chairman. Mr. Chipman read the draft of the proposed act, which was based largely on the act passed by the Manitoba Legislature in 1896 and the Quebec Legislature in 1897, which established the qualifications necessary to permit persons to practice as civil engineers in those provinces. By those acts no person can practice engineering in the province unless he is a member of the Canadian Society of Civil Engineers In Ontario it is proposed, however, to allow engineers who are now practicing to continue to do so without joining the society, provided they are qualified as engineers. The Ontario Act provides that any member who so desires, may at any time withdraw from the society and have his name struck off the register and may join again if he wishes to resume practice. Much more latitude is allowed the board of examiners under the Ontario bill than under the Quebec Act, and provision is made for consulting engineers from abroad.

On motion of Stuart Howard, seconded by Lewis Skaife, the committee on this bill was continued for the present year.

The committee on Standard Measures, which had no report to present, was also continued in office

The committee on the Gzowski medal award recommended that the medal for the best paper for the past year be awarded to John Taylor Farmer for his paper on "Impulse Water Wheel." The announcement was received with applause.

A letter was read from the Association of Architects of the Province of Quebec, calling attention to a provision in the amended charter of Montreal, that the Board of Expropriation should consist of five men, namely, one lawyer, one architect, one civil engineer, one contractor and one real estate man, each of whom should have been at least ten years in practice.

The secretary called attention to the fact that a member had paid in to his assistant $8 without leaving his name. The member in question did not reveal himself

The following was the result of the ballot for the election of officers for 1899.

President—W T. Jennings, Toronto.

Vice-Presidents—P. W. St. George, Montreal, K. W. Blackwell, Montreal; and E H Keating, Toronto

Treasurer—H Irwin, Montreal.

Secretary—Prof. C. H. McLeod, Montreal.

Librarian—Wm McNab, Montreal.

Council—G. H Duggan, Montreal; John Kennedy, Montreal; Thos. Monro, Coteau Landing, H. N Ruttan, Winnipeg; C. H. Rust, Toronto, G A Monntain, Ottawa, Duncan MacPherson, Montreal; C. E. W Dodwell, Halifax, St George Boswell, Quebec; W B. McKenzie, Moncton, Ernest Marceau, Montreal; Willis Chipman, Toronto, John Galbraith, Toronto; Stuart Howard, Montreal; G. A. Wilmot, Victoria.

The Nominating Committee was as follows. For Quebec, H. Irwin and Stuart Howard; for Ontario, C. H Rust, John Galbraith and E H. Keating; for the Maritime Provinces, Dr. Martin Murphy; for the Northwest Provinces, H. N Ruttan; for non-residents of Canada, W. J. Sproule.

Scrutineers—J. W. Heckman, Geo A. McCarthy and P. de B Leprohon.

After luncheon, the retiring president's address was read by the secretary, and a vote of thanks was passed to the scrutineers.

W T. Jennings, the president elect, was then moved to the chair. In thanking the members for the honor they had conferred on him, Mr. Jennings said that though he had been a member of the Society since its organization, he had unfortunately not been able to be present at many of the annual meetings, and had therefore never taken a prominent part in its proceedings He had, however, always taken a keen interest in the progress of the Society and he should now feel bound more than ever to promote its prosperity and help to obtain the corporate rights which the Society desired He urged members to contribute to the stock of knowledge of the Society, especially by papers and by monographs, relating their experience in pieces of work out of the common He hoped the members would not be found working as cliques, but would remain united in the broad interest of the Society.

On motion of Lewis Skaife, seconded by P de B. Leprohon, it was decided to print the Quebec Act in the next issue of the transactions.

It was moved by J M. McCarthy, seconded by W. J. Sproule, that in view of the fact that it is the settled policy of this society to establish one civil engineers' society for the whole of Canada, which shall include all branches of the art, this council be instructed to draw the attention of the universities to the entirely different signification of the term "civil engineer" as employed by them, and as understood by this society, and request them to consider if they cannot arrange to use the term only with the full signification given to it in the charter of this society.

Mr. Jennings pointed out that last year Toronto University conferred its degree in civil engineering on a new plan, and that body not only conformed to the standard of this society, but appointed a member of the society as its own examiner in civil engineering.

It was moved by W. J. Sproule, seconded by Lewis Skaife, that it is expedient that a representative committee be appointed at this meeting to enquire into the question of the official appointment of engineers with a view to attaining uniformity in the designation of engineers, so that the terms "Chief Engineer," "Assistant Chief Engineer," "District Engineer," "Divisional Engineer," etc., may have the same definite meanings as nearly as possible, and that this committee report to the next annual meeting. Carried.

On motion of G H. Garden, seconded by J. M. McCarthy, a vote of thanks was passed to the Grand Trunk Ry., and on motion of Mr. McNab, seconded by J. G. G. Kerry, a vote of thanks was passed to the C. P. Ry., for the courtesies extended to the society by those corporations.

On motion of Wm. Kennedy, seconded by J. G. G. Kerry, a vote of thanks was passed to the Laurentide Pulp Co. for the company's hospitality to members on their visit to Grand' Mere.

On motion of C. de B. Leprohon, seconded by W. J. Sproule, it was decided that the Nominating Committee be furnished with a note of the attendance of members of Council during the year, with explanations of the cause of absence of members from the meetings.

On the suggestion of Mr. Irwin it was decided to address a letter to Thos. C. Keefer and Walter Shanly conveying the good wishes of

o society to those veteran members, and regrets that they were not able to be present.

The meeting closed with votes of thanks to the officers for their services during the year.

The annual dinner of the Canadian Society of Civil Engineers was held on the evening of Thursday, 12th Jan., at the Windsor Hotel, and was voted to be one of the best, if not the very best, since the society was established.

K. W. Blackwell, Vice-President, presided, and made an excellent chairman. On his right were W. T Jennings, President-elect, Prof. S. H. Capper, E. P Hannaford. Louis A. Vallee and Charles Baillairge, and on his left were Thos. Monro, Dean Bovey, C W. Spencer, Edw. J. Featherstonhaugh and Major Henry A Gray Among the other guests present were Henry O'Sullivan, Owen O'Sullivan, R W. Leonard, J. A. Marion, J. A. G. Goulet, R S Lea, J. M. McCarthy, J. P. B. Casgrain, F W. Cowie, A. Boyer, J G Macklin, Wm. McNab, W J. Francis, Geo E Thomas, Henry F Duck, C. H Rust, M. J. Butler, R. B Rogers, L B. Copeland, Wm I. Bishop, L. M Lovelace, H Lindsor, R P. Rogers, W R Butler, Jos W Heckman, J. G. Armstrong, R. Adams Davy, G. J Desbarats, G H Garden, Robt Surtees, Wm Kennedy Jr., F X. Berlinguet, J. G G. Kerry, Owen N Evans, H R. Ives, G A Mountain, Duncan McPherson, Arthur H N. Bruce, T. P. Shearwood, H L St. George, J. E. Dore, R. F. Ogilvy, Jas. H. Parent, John H Walters. T. W. Lesage, E. A. Rhys-Roberts, J S. Vindin, C. de B Leprohon, Lewis Skaife, Frank T. St. George, N. E. Brooks, B. J Saunders, Wm P. Anderson, Prof C H. McLeod, Willis Chipman, J. Atkinson Douglas, Maurice Perrault, H. Irwin, Stuart Howard, G H Duggan, James Traill Shearer, and E. B. Biggar, of the CANADIAN ENGINEER, and members of the local press. The dinner was good, and the arrangements reflected credit on the Dinner Committee, which consisted of Messrs. Frank St. George (chairman) J. G G Kerry (sec.), C. H. McLeod, H. Irwin, Wm. McNab and C. de B. Leprohon.

After the "Queen" had been loyally drunk the chairman proposed the "Sister Societies," and in doing so spoke of the progress of learned societies in recent years, a progress greatly accelerated by unity of action and exchange of knowledge He alluded to the presence of members of the Quebec Association of Architects, and coupled the name of Prof. Capper with the toast. Prof. Capper, in responding, said he did not know why his friend Mr. Kerry had selected him to reply to this toast. Everybody knew an architect was a man who ought to be an engineer, but is not; and as to mining, which he was also expected to include, the only thing he remembered about it was the unmitigated pleasure it gave him to get up again out of a mine after having got down into it. However, it did not matter how many subjects his reply should include—which reminded him of the story of a lady who was travelling on the Great Western Railway, of England, and who resented the intrusion of a strange gentleman in the compartment. "Sir," she demanded, as the gentleman persisted in keeping his seat, "do you know who I am?" "Madam," he replied, "I haven't the faintest idea." "I," said the lady haughtily, "am one of the directors' wives!" "Madam," he returned, coolly, "it would not have made the slightest difference if you had been the director's only wife" Prof Capper made a number of witty hits and was well received Stuart Howard then sang "Soldiers of the Queen," and was heartily applauded. The chairman proposed the Corporations to whose courtesies they were indebted for their entertainment, especially the two railway companies who had provided the excursions. C. W. Spencer, of the C P R., in response said the engineers had performed their part in the evolution of railways, for if it were not for them the railways would not exist. As for the excursions, it had given the companies more pleasure in providing them than it had given their guests in participating in them. Mr. Lesage gave Sir Geo. Cartier's song "O Canada Mon Pays Mes Amours" in very good style. The toast of Visiting Members was coupled with the names of Chas. Baillairge of Quebec, and J. S. Armstrong of St John, N.B. Mr. Baillairge said the warmth of the reception given the visiting members made up for the coldness of the atmosphere. It had been said that there was no beauty in engineering, but a man who stood on the axis of the new Victoria Bridge and viewed its magnificent proportions and immense perspective must be fascinated by the sight. We must not forget that it was a Canadian engineer, T. C. Keefer, who selected the site and laid out the work, and so well was it done that the engineers of the new bridge were enabled to rebuild it without altering the foundations at all. He made some interesting comparisons of this bridge with that of the Forth and Menai bridges; and then gave an account of the St. Charles Aqueduct at Quebec, which he had built, and around which they had erected a bridge without turning off the water. He threw two pipes across the river in the form of an arch, so that if the protecting boxes were destroyed the tubes would be self-sustaining. These two pipes were braced together so that the wind could not blow them over. To show how water may wear away iron he mentioned that a slight flaw in the pipe led to a small pin hole, which developed into a hole 2 inches in length, a result which might easily happen under a head of 486 ft. or a pressure of 208 lbs. per square inch This society had given some light to the engineering world, for one of its members had solved the mystery of the ball-nozzle, which was a puzzle to scientists for some time, and had also anticipated the investigations carried on at the Forth bridge, and at the Tower bridge in London, when it was found that the actual pressure of the wind fell short of the indications of the anemometer by 40 per cent. The explanation was due to the same principle in both cases—the back pressure caused by the vacuum formed by the on-rush of water or air. This Society had accomplished a good deal, and should be destined for a great career. Mr. Armstrong followed, and expressed his admiration of the great engineering developments of Montreal and its vicinity. With institutions like McGill University and the two great railway headquarters, there were many incentives to engineering activity. Montreal seemed destined to be the railway and canal centre of half the continent. In the east we have the city of St. John, with its open winter port and its ambition to cope with all the increased trade that must flow to the Atlantic. The C P.R. had done a good deal to second the efforts of St. John, and he was glad to see the G T R pushing its way down to the picturesque city by the sea. We have possession there of the largest wet dock in the world, and with five miles of open water which never freezes, the city and port of St. John could look with every confidence to the future. Lewis Skaife sang Kipling's "Fuzzy-Wuzzy," winning hearty adplause The chairman then handed over the balance of the toast list to Mr. Kerry, to whose energy and thoughtfulness so much of the success of the dinner was due. Mr Kerry gave "Our Society," and then called on Dean Bovey, who pointed out that all our comforts in transportation were due to the engineer. With weather at zero we were now able to go from room to room, from street to street, from town to town, and from country to country, carrying our fires with us, and having our choice of coal, steam or electricity as the heating medium. He gave a sketch of the formation of the Canadian Society of Civil Engineers, much of the work of organizing which was done by the late Alan Macdougall He hoped the time would come when one set of laws regulating the practice of civil engineers would apply to all provinces in the Dominion. Mr. Leprohon sang the "Deux Gendarmes," and received a hearty encore. Mr McPherson gave an account of the work of the Council, on whom a great deal of detail labor fell. The Council, while willing to accept its responsibilities and shoulder the work, was also willing to listen to suggestions and get instruction from any member Henry O'Sullivan, Inspector of Surveys for the Quebec Government, sang an amusing song, "The Old Irish Stew," to the tune of the Red, White and Blue, and supplemented his song with some interesting facts about the undeveloped resources of the Province of Quebec, especially those comparatively unknown northern regions where enormous water powers existed in close proximity to deposits of minerals and immense forests of spruce and other timber. Mr. Jennings, the in-coming president, was then called on, and congratulated the Society on the headway it had made. He would see that no stone was left unturned to advance its interests. It only remained for the members to be loyal to each other G. E. Thomas then gave a song which was much appreciated, and Mr. St George made a short but humorous reply to the toast of the "Ladies." Mr Skaife proposed a bumper to Mr Leprohon as acting chairman to dinner committee, and the company rose shortly after 12 o'clock with "Auld Lang Syne" and hands all round.

William Tyndale Jennings, President for 1899, of the Canadian Society of Civil Engineers, was born in Toronto, 19th of May, 1846, his father being the late Rev Dr. Jennings, pastor of the First United Presbyterian Church He was educated at the Model Grammar School, and at the Upper Canada College. His professional career began in 1869, when he commenced field work under T. N. Molesworth, engineer of Public Works, and brother of the well known compiler of Molesworth's Engineer's Pocket Book. After a year's work on the drainage improvements of the Crown lands of Ontario, under Mr. Molesworth, he entered the service of the Great Western Railway in 1870 under George Lowe Reid, chief engineer. After some experience in survey, location and construction work, he was appointed in 1873 resident engineer of the Air Line Division of the G W R., the London and Port Stanley and the Welland branches, under John Kennedy, chief engineer During this time he made an exhaustive survey of the Detroit River, the company having in contemplation a bridge across the river near Detroit city. This was a joint enterprise of the G.W R. and Michigan Central, but both it and the tunnel which had been constructed about half way from the American side, and for

about 500 feet on the Canadian side, in 1871 were abandoned Through the kindness of Messrs. Gzowski and McPherson, engineers and contractors of the international bridge at Buffalo. Mr Jennings was allowed special facilities for studying all the details of that great work, and in his subsequent official positions, he was fortunate in being frequently sent on missions of investigation into new works to various parts of the continent, which enabled him to acquire a vast store of technical knowledge, of which he has been able to make good use in his professional work. In 1875 the work of construction on the G.W.R. being over, he gave up the position of resident engineer, preferring more varied work, and went into the service of the Dominion Government on the Canadian Pacific Railway under Sanford Fleming, chief engineer He went to British Columbia as locating engineer on the B.C. Division, remaining there till 1879, and during that time, among other things, located the present line through the canyons of the Fraser River and other intricate sections On completion of location he was

Yours truly
W. H. Jennings

moved to the Lake of the Woods as district engineer in charge of the heavy construction work from Rat Portage to Eagle River, 69 miles, and on the completion of that work returned to British Columbia, as superintending engineer for the Dominion Government under Collingwood Schreiber, Mr. Fleming having in the meantime retired. In 1882 he came east for a time on account of his wife's illness, and in the following year was offered an inspectorship of Government railways, but preferring more active work he returned to B.C. in 1883 as chief engineer for the Construction Company headed by A. Onderdonk, and acting manager during Mr. Onderdonk's absence. This work comprised 350 miles of the road from the Pacific Coast eastward, which was completed in 1885. He then took up work for the C P.R. in Ontario, building the lines from Woodstock to London, from London to Detroit, the Wingham extension, the eastern entrance to Toronto, the Guelph Junction (as consulting engineer), and various locations of surveys, also the Toronto wharves of the C P. R. from Yonge Street westward. In 1890 he was offered the position of city engineer of Toronto, and having accepted it, reorganized the engineer's department for the city, and made many improvements of a permanent and substantial character, such as the Sherbourne street bridge, the Carlaw avenue, and King street subways (the last named from plans of his predecessor, Mr Sproatt), the island ferry slips, etc. He also brought about a settlement in a dispute between the railway and the city as to the occupancy of the water frontage. The city having obtained the street railway franchise, released the same under specifications prepared by Mr. Jennings, which were so carefully drawn that they have formed the basis of many like franchises since obtained by large cities in the United States About this time he was offered the chief engineership of the Public Works Department, but declined the offer, much to the surprise of many of his friends and of some members of the Government. Mr Jennings gave up the office of city engineer, and entered into private practice in 1891, since when he has built the Niagara Falls Park & River Railway, the Galt, Preston and Hespeler Electric Railway, the Tilsonburg & Port Burwell Railway, and a number of other works of greater or less importance From 1892 to 1895 he was chief engineer of the British Columbia Southern Railway, now better known as the Crow's Nest Railway, the route for which he examined and located in such a way as to open up to best advantage the enormous coal deposits which are now considered the key to the successful development of the mining interests of the Pacific province. In 1897 he was requested by the Government to examine into the feasibility of the route from the Pacific Coast at Fort Wrangel to Teslin Lake by way of the Stikeen River, and to examine the T slin Lake and Hoctalinqua River to determine its navigability, and further to examine the passes at the head of Lynne Canal, such as the White, the Chilcat and Chilcoot passes. This work was successfully carried out, and his report on this subject has already been referred to in these columns. Last year the Toronto and Hudson Bay Commission created by the City Council of Toronto, selected Mr. Jennings to examine the country from North Bay to James Bay, embracing the Temiscamingue, Temagami, Blanche River, Montreal River and Wahnapitae, which he did during the past summer, obtaining a great amount of information on a comparatively little known region of country, and which information is being laid before the commission for future action with regard to a projected railway to Hudson Bay. Mr. Jennings is a member of the Institution of Civil Engineers of Great Britain, a member of the American Society of Civil Engineers, of the British Association for the Advancement of Science, and of the Imperial Institute. In 1897 he was appointed by Toronto University as examiner in the Department of Civil Engineering under the new system introduced in that year for the conferring of the degree of civil engineer, an honor which may be considered of all the greater value by reason of having been made without his previous knowledge, and by reason of his selection as sole examiner. In 1876 Mr. Jennings married Miss McKay, daughter of the Registrar of the county of Elgin. Mrs. Jennings died in 1887, leaving one son, Gordon T. Jennings, now at the Royal Military College, Kingston, with every prospect of a worthy military career Mr. Jennings has always had a high conception of the profession of a civil engineer, and his election to the highest honor in the gift of the society is a happy reward for a career marked by faithful adhesion to public and private duty.

GEORGE A. MOUNTAIN.

George A Mountain was born in Quebec in 1860, and served his apprenticeship in the office of the city engineer of Quebec. In 1878 he served on the engineering staff of Kinniple & Morris, civil engineers, London and Greenock, on the surveys of the Quebec graving dock and the Louise embankments; in 1879 he was assistant engineer on the surveys of the Quebec and Lake St John Railway; in 1880, assistant engineer on the surveys of the Island Railway, Newfoundland; 1881 to 1886, divisional engineer on the Canada Atlantic Railway, and from 1886 to the present time chief engineer of the Canada Atlantic Railway; 1889, chief engineer of the Coteau bridge across the St. Lawrence River from its inception to its completion; 1891, chief engineer of the St. Lawrence and Adirondack Railway; 1890, to the present time, has been chief engineer of the Ottawa, Arnprior and Parry Sound Railway; and from its commencement also chief engineer of the Parry Sound Colonization Railway from 1892 to 1896. Mr. Mountain became a member of the Canadian Society of Civil Engineers at its organization in 1887. He is a D.L.S., O.L.S.,

P.L.S. At the present time Mr. Mountain is chief engineer in charge of construction and maintenance-of-way on what is known as the Booth system of railways, comprising Canada Atlantic Railway; Ottawa, Arnprior and Parry Sound Railway; Vermont and Province Line Railway; Nipissing and Nosbonsing Railway.

C. E. W. DODWELL, MEM. CAN. SOC. C.E.

C. E. W. Dodwell, B.A., is a son of the late Rev. G. B. Dodwell, M.A. He was born in England in 1853, and in 1862 he came to Canada, beginning his education at Bishop's College school, Lennoxville, and finished at King's College, Windsor, N.S., where he took a full course of engineering and the degree of bachelor of arts, with high honors in mathematics and natural sciences. From 1873 to 1877 he was employed as assistant engineer on the location and construction of the principal lines of railways in Nova Scotia, namely, the Western Counties, the Nova Scotia Central and the Eastern Extension Railways. In 1877 he was appointed assistant provincial engineer under the Government of Nova Scotia. This position he resigned in 1881 to accept an appointment upon the staff of the Canadian Pacific Railway in Montreal. Mr. Dodwell was in the service of this company for about eight years, and during that time was engaged almost exclusively upon construction. The preliminary surveys and estimates for the St. Lawrence bridge were his first work, performed for the company with G. H. Massey, C.E. He was next employed upon the construction of the Ontario and Quebec Railway, first in the position of section engineer, subsequently in charge of the construction office in Toronto. He was next resident engineer in charge of the portion of the C.P.R. from Montreal to Vaudreuil (24 miles), which comprised some heavy work, namely, the large stone viaduct entering the city and the bridges, 33 spans of steel, over the Ottawa River at St. Anne's and Vaudreuil on which latter work he submitted a very clever paper to the Canadian Society of Civil Engineers in 1888. (See Vol. II., part I.) In 1889 he resigned his position on the C.P.R., and in partnership with A. L. Hogg, M.I.C.E., Mem. Can. Soc. C.E., established the firm of Dodwell & Hogg, for a general engineering practice. Occupying his time at this period may be mentioned the waterworks and sewerage systems of Dartmouth, and the waterworks of Amherst N.S. In 1891 he accepted an appointment under the Federal Government as resident engineer of the Public Works Department, at Halifax, N.S., which position he still occupies. Mr. Dodwell was elected an associate member of the Institution of Civil Engineers in 1881, and he was transferred to the class of members in 1891. He took an active part in the formation of the Canadian Society of Civil Engineers, being one of the original Montreal committee.

FIRES OF THE MONTH.

Jan. 10th. Joyner & Elkington's grist mill, Fort Qu'Appelle, N.W.T., burned; loss is $25,000.——Jan. 11th. Bell & Co.'s tannery, Tilsonburg, Ont.——Jan. 12th. Tara, Ont., public school; loss, $3,000.——Jan. 15th. The charcoal works at Bridgeville, N.S., burned down; loss, $10,000.——Jan. 15th. St. Anne's College, Digby, N.S., loss, $75,000.——Jan. 20th. Roman Catholic church at Rockland, Ont., destroyed.——Jan. 22nd. I.C.R. coal sheds at Moncton, N.B., loss, $1,500.——Jan. 24th. Hercules' Cement Works, Hamilton, Ont.; buildings gutted and stock destroyed.——Jan. 26th. Small fire in Montreal Gas Co.'s works, Montreal, caused damage of $500.

CORRECTIONS.

On page 242 of the January issue of The Canadian Engineer, in the last paragraph of J. M. Williams' article, "Oiling Up," the word "animal" was used instead of "mineral." The sentence should read: " . . . we may be satisfied that in the mineral oils and greases, with their great range of body, their freedom from impairment by atmospheric action and other physical changes, that we may obtain a lubricant fitted especially for our requirements. . . ."

The editorial paragraph in the December issue of The Canadian Engineer did not imply that the Quebec gold areas were the property of the De Lery family, but stated that those of the seignory of Rigaud-Vaudreuil were so held.

REVIEWS.

The Canadian Magazine for February contains some interesting Canadian matter; the portraits of forty editors of Canadian dailies and biographical sketches of each; St. George's Cathedral, Kingston, which was destroyed by fire recently, is the frontispiece; Joanna E. Woods' novel is continued, and the usual complement of short stories and poems finds its place. Unfortunately the series of papers on actors and actresses is kept up. The public will not pay twenty-five cents for a magazine which publishes theatrical portraits. It is distinctly a "marked down" commodity and should be dropped.

Diane of Ville Marie is the title of a new romance of French Canada by Blanche Lucile Macdonell, of Montreal. Miss Macdonell is the author of a number of charming sketches of French-Canadian history and folk-lore, and the present tale, her most ambitious venture, founded on events which took place on the Island of Montreal at the close of the 17th century, shows her to be well versed in early Canadian history. It is well for English-Canadians to know how rich French Canada was in the material of heroes and heroines, for the story is woven around the personalities and lives of actual historical personages, as stated in the preface. The work is handsomely produced from the press of Wm. Briggs, Toronto.

La Quincena Rural.—We have received the first two numbers of this journal published in Buenos Ayres, which is devoted to agriculture and the kindred arts. As its name implies, it will be published twice a month. The subscription price is $20 per year for the capital, and $22 in the country, rates which it is feared will not ensure a large circulation. The rates for advertising are in proportion. One article complains of the want of affection for rural life in the young people of the country preferring to agriculture almost any other occupation, and even "passa los dias en intrigues politias." Sons of the Spanish-American farmers everywhere possessing a territorial patrimony cannot be induced to continue to reside on it, much less to study its proper management. From this practice the agriculture of the country suffers severely. The deserters of the country districts do not appear to despise their properties, but either leave the management of them to a dependent or try to direct the management from the town in which they have taken up their residence. And as the proprietor does not know how to manage the property advantageously each of these plans is equally fated. The small farmers who remain on the land manage much better. The work is done by the family, male and female, and the surplus produce sold. Here in Canada we know as a rule very little about South America. It is obvious from this glance that there is much in the agriculture of that country that is similar to what is found in ours. The editorials in this paper are brightly written and are of a very high class, comparing favorably with the best we have in America.

A NEW GENERAL FORMULA FOR TRAIN RESISTANCE.*

The alchemists of old sought diligently for the philosopher's stone, the inventors of a later age for perpetual motion, and engineers of the nineteenth century have been almost as eager to obtain a general formula which shall reconcile all existing data and experiments upon train resistance. The first two objects of effort are now known to be unattainable, and the third has until now baffled the best minds in the railroad profession. Only a month ago Locomotive Engineering, which for years past has devoted special attention to this subject, said editorially: "We do not believe that it is possible to devise a formula that will show an approximation of the resistance due to different kinds of trains at different speeds when train tons are the basis of calculation."

A general formula which appears to be applicable to passenger trains of all weights, running at all speeds up to the highest limits so far reached, has been lately worked out, however, by John Lundie as a result of a long series of tests of trains in actual service, and is here given to the engineering public for the first time. His methods of obtaining data are decidedly different from, and much more satisfactory than those commonly employed hitherto, where indicator cards of engines drawing trains at constant (?) speed on level (?) track have been made the basis (with an arbitrary allowance for engine friction) of estimates of resistance per ton moved. In order to be of any value such tests must be made in long distance runs, and it is almost impossible to find a hundred miles or more of absolutely level track for the purpose, while it is also difficult to obtain perfectly uniform speed even on a dead level. Mr. Lundie's method of determining train resistance is based on an examination of the speed curves of a train when coasting from any speed to a dead stop. The possibilities of such a method will be instantly evident to an engineer, and it may be said, at once, that the results warrant a decided predisposition in its favor. It is not only possible to obtain the gross resistance due to track and journal friction and air resistance combined, but to differentiate between the air and the friction elements. The frictional resistance of a train being reasonably constant within somewhat wide limits of speed, the speed curve should be a nearly straight descending line from full speed to a point somewhere near a full stop. Now the actual speed curve dips below this straight line, as seen in Fig. 2, clearly showing a decreasing retarding force (due to air resistance), with decreasing speed.

In Fig. 1 are shown in graphic form the results calculated from more than 150 runs made by Mr. Lundie with trains of different weights on the South Side Elevated Railroad of Chicago. It will be seen that these results expressed by the location of points on the diagram, cluster around "straight line curves," and that these lines intercept each other, with surprising accuracy, at a single point located at a definite distance above the origin. This indicates, of course, that the first step in obtaining the final formula has been reached, in the establishment of a constant, representing the minimum possible train resistance for all speeds and weights, and it is interesting to note, by the way, that in none of the recorded experiments so far made on passenger or freight trains of all weights has the resistance per ton been less than the figure indicated by this constant—4 pounds.

Mr. Lundie's formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

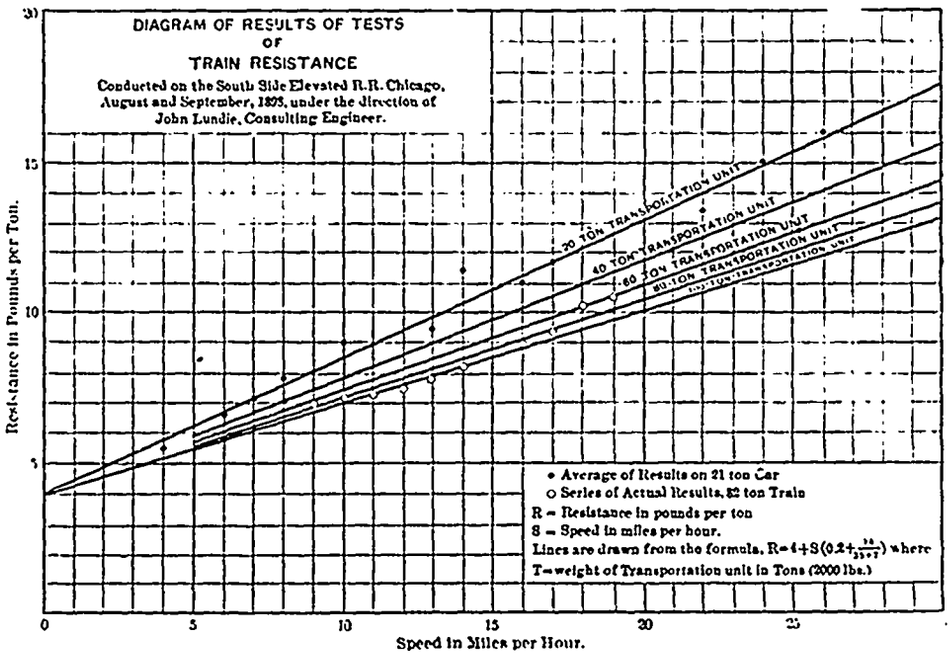
where

T=the weight of the transportation unit in tons (2,000 lbs.)

R=resistance in pounds per ton.

S=speed in miles per hour.

It will be seen at once that unlike most previous formulae, there are here two variables after the constant, namely speed and train weight. Many other investigators have endeavored to accomplish this, but unsuccessfully, and in the formula which has been in most general use in engineering hand-books, that of D. K. Clark, speed only appears as a variable. From a careful



study of his results, Mr. Lundie developed the formula on the following mathematical basis: The expression by which "S" is multipled is proportional to the tangents of the angles made by the lines developed for different weights, as shown in Fig. 1, and is the characteristic of a rectangular hyperbola which (throughout the range of tests made) co-ordinates quite accurately the relations between train weights and the inclinations of the lines mentioned for corresponding weights. The term 0.2 is an intercept on the axis of y; 14 is the constant product of x and y, with the intersection of the asymptotes as origin; and 35 is an intercept on the axis of x.

The test of any formula lies in its application. Gauged by this test, Mr. Lundie's formula unifies in a remarkably close manner nearly all recently published experiments, together with other formulae of more limited application, as will be seen by an inspection of the accompanying table. The Stroudley, Sinclair and Dudley tests of train resistance scheduled in this table were brought together by A. M. Wellington in The Engineering News in 1892, and referred to as intrinsically worthy of confidence on account of the careful manner in which they were made. To these we have added further experiments made on the Philadelphia & Reading Railroad in 1889, and on the Central Railroad of New Jersey in 1892, so that a fairly complete range of train weights from 200 to 400 tons, and of train speeds from 40 to 70 miles per hour is given in the table. The Lundie formula checks up all these tests very closely, though in all but one case the results obtained by its use are slightly

*From the Street Railway Journal, Feb., 1899.

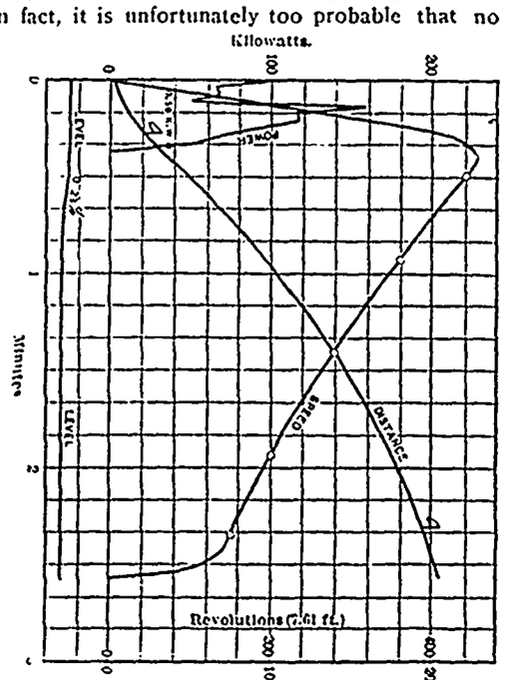
higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16)$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.



An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3,428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work the train resistance will approach the minimum, and the New York Central experiment above referred to indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable, probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation. We believe this formula to be so valuable a part of the technical equipment of a railroad engineer, that we earnestly hope it will excite the widest possible comment and criticism in the engineering press to the end of bringing out all the evidence bearing upon its reliability.

TABLE SHOWING APPLICATION OF LUNDIE FORMULA TO TRAIN RESISTANCE TESTS.

Test made by	Year.	On.	Mem.	Average Speed. Miles p. h.	Train Weight. Tons.	—Train Resistance— Observed.	Lundie Formula.
William Stroudley..	1885	London, Brighton & South Coast.	Single test	43.3	376	13.2	14.1
Angus Sinclair.....	1892	New York Central	Mean of six tests	70.	270	19.03	21.1
" "	1892	" "	Single test	69.6	270	19.8	21.2
P. H. Dudley.....	1882	" "	Single test	51.43	313	16.9	16.35
" "	1889	Philadelphia and Reading	Single test	60.	242.5	18.35	19.0
" "	1889	" " "	Single test	63.5	242.5	19.8	19.9
" "	1892	C. R. R. N. J.	Single test	63.2	213	19.0	20.2
Clark formula.....	....	.....	.....	10	100	7.74	7.04
" "	....	.....	.....	10	200	7.74	6.6
" "	....	.....	.....	10	300	7.74	6.4
" "	....	.....	.....	20	100	9.5	10.06
" "	....	.....	.....	20	200	9.5	9.2
" "	....	.....	.....	20	300	9.5	8.8
" "	....	.....	.....	30	100	12.42	13.1
" "	....	.....	.....	30	200	12.42	11.8
" "	....	.....	.....	30	300	12.42	11.3

ACCIDENTS.

E. Donald, an employee of the Record Foundry and Machine Co., Moncton, N.B., was caught while oiling some shafting about 15 feet above the floor a short time ago. His clothing was completely stripped off and he escaped without other injury than a few bruises, and a severe nervous shock.

Chas. H. Martin, some years ago of Martin & Son, iron founders, Belleville, Ont., was killed by the bursting of an emery wheel in Chicago, a short time ago.

Cornelius McGourty, contractor, St. John, N.B., was killed, January 6th, by a dynamite explosion near the Mispec pulp mills. A bag containing dynamite caught fire and Mr. McGourty tried to carry it to the stream close by, but the explosion came before he reached it, and he was blown to pieces, the workmen,

whom he had called on to save themselves when the fire was first noticed, all making their escape.

William Tossel, employed at the Imperial Oil Co.'s works, Petrolia, Ont., had occasion to go on top of the stills recently, and by some means he fell to the ground and was killed.

Arthur Dunnett, employed by the Brantford, Ont., Starch Co., came in contact with a belt and received serious injuries before he could be rescued.

J. McTavish, North Bay, Ont., a C.P.R. brakeman, was run over by his train at Eau Claire, Jan. 21st, and received injuries from which he very shortly afterwards died.

By the explosion of the boiler in the ice house of the Knickerbocker Ice Co., Toronto, A. Evoy was killed. The jury found that the neglect of the engineer had been the cause of his own death.

Industrial Notes.

Hamilton, Ont., will begin its new $30.000 sewer on Birge avenue this year.

The capital stock of the Gurney Foundry Co., Ltd., has been increased from $350.000 to $750.000.

The Canadian Rubber Co., Montreal, has ordered a 30 h.p engine from the Robb Engineering Co., Amherst, N.S.

During 1898 the Galt, Ont., waterworks pumped 236,999,941 gallons and the gross revenue was $12.381.94

The Diamond Glass Co., Ltd., is applying to Parliament for leave to enlarge its capital from $500.000 to $1.000,000.

The Perth, Ont., Public School will be enlarged at a cost of $5,050. Geo. Bradford, Almonte, Ont., has the contract.

It is announced that the Manufacturers' Life Insurance Company will erect a $35.000 building at Brantford, Ont.

The laborers in the Frost & Wood works, Smith's Falls, had a 10 per cent advance in wages given them January 1st.

A by-law guaranteeing the interest on $15.000 bonds of the Chatham Cold Storage Company was defeated at Chatham recently.

H. J. Powell's plans have been accepted for the Melville Presbyterian church at Fergus, Ont., to be built at a cost of about $15.000.

Messrs. Knight Bros., Burks Falls, Ont., have ordered a 60 h.p. automatic engine from the Robb Engineering Co., Amherst, N.S.

The Bras d'Or Gazette states that surveys are to be made at Glace Bay as well as Louisburg for a site for the proposed smelting works.

There are three suits for damages pending against the City of London in connection with the City Hall catastrophe that took place a year ago.

The Hamilton and Toronto Sewer Pipe Company will build a three-story structure, costing $11,400, to replace the burned buildings in Hamilton, Ont.

A Vancouver firm has been awarded the contract for supplying that city with four miles of 22-inch double riveted steel water pipe and fittings at a cost of $20.000.

The Thousand Island Carriage Company, Gananoque, Ont., has gone into liquidation, with J. T. Green as liquidator. The works have not been running since Christmas.

Campbelltown, N.B., has an arbitrators' bill of $8.000 and almost as much more for legal expenses to pay before it can take up the award in the recent waterworks arbitration.

C. A. Matheson, Perth, Ont, who owns some swamp land near the town, has bought a fuel peat plant, and the patent right to manufacture peat fuel in the county of Lanark.

Letters patent have been issued incorporating R. Gray, J. S. Gray, M. Daniels, J. A. McKeon, M. Campbell, Chatham, Ont., as the William Gray & Sons Co., Ltd. to manufacture carriages and other vehicles and also bicycles in Chatham, Ont., with a capital of $150.000.

Kincardine, Ont., will make a loan of $4,000 to Hunter Bros., manufacturers of boilers, etc.

An explosion wrecked one of the buildings of the Stratford, Ont., gas works recently. Damages were about $2,000.

Jas. Fleming, St. John, N.B., has supplied the boilers for W. H. Fowler's new flour mill, Rodney wharf, St. John.

A citizens' committee has been appointed in Guelph, Ont., to forward the installation of a system of sewage disposal.

Robert Bell, iron founder and machinist, Seaforth, Ont., will receive a loan of $17,000 from the town to extend his business.

Woodstock, Ont., Board of Trade proposes to raise by taxation $25,000 "to be given to new industries which may locate in Woodstock."

The Macdonald Mnfg. Co., Toronto, whose premises were burned some time ago, is about to build a $32,000 factory to accommodate 125 hands.

The employees of the Ontario Rolling Mills, Hamilton, held a ball January 21st at Grimsby, Ont., going down on a special on the H.G. & B. electric railway.

Seaforth, Ont., asks leave of the Ontario Legislature to make a loan without interest to T. R. F. Case & Co. of $20,000. to enable them to establish a pork-packing industry in the town.

In one week, not long ago, a Waterloo furniture manufacturer shipped a car-load of office desks to Liverpool and took an order for the furnishing of a church in Cape Town, South Africa.

The Montreal Water Commissioners have decided to secure an engine temporarily for the high level pumping station until the new boilers which are considered necessary can be supplied.

The Quebec Bridge Company have held a meeting, under the presidency of Mayor Parent, and decided to award the contract on March 1st, and go on with the work as far as their finances will allow.

The property owners of Oshawa, Ont., voted on Jan. 21st on a by-law to raise $110.000 by issuing debentures for a waterworks and sewerage system, resulting in the by-law being carried by a majority of 67.

An explosion of acetylene gas recently in the general store of the A. B. Scott Co., Millbrook, Ont., caused, it is said, by recharging the generator while in use, partially wrecked the building but only slightly injured the employees.

Robert Arnott has rebuilt his cheese-box factory at Peterboro, Ont., which was damaged by fire last June. The new factory is equipped with all the newest and most modern machinery. It has a capacity of 100,000 boxes per season.

An experiment of interest to people in the Ottawa Valley is to be tried at Trenton, Ont. A number of mechanics in that town have formed a co-operative lumber cutting and furniture manufacturing company, with a capital stock of $30,000. They expect to employ 75 men and the business will be managed by seven mechanics.

Application will be made at the next session of Parliament to amend the charter of the Alberta Irrigation Company by changing the name of the company to the Canadian Northwest Irrigation Company; changing the place of head office to London, England; authorizing directors to vote by proxy; increasing capital to $1,000.000.

The $20,000 necessary to establish the building and plant for the proposed pork packing industry at Middleton, N.S., has been subscribed, but as almost as much would be necessary to carry on the business the project will not be gone on with for some months, though the capital will undoubtedly be soon subscribed. E. D. Davison, Bridgewater, N.S., is president of the company.

The Commissioner of Crown Lands for Ontario has offered a prize of $10, to be competed for by the students of the School of Practical Science, Toronto, in some subject relating to forestry, to be named by the principal. The announcement was made by Thomas Southworth, chief of the Forestry Department of Ontario, to the Engineering Society of the School of Practical Science, which he addressed on the subject of Engineering as Related to Forestry in Ontario.

It is learned that the Dominion estimates for the ensuing year will contain votes for the erection of a new building for the Geological Survey and Museum, and also one for the records and archives.

The following officers of the Toronto Board of Trade have been elected by acclamation: President—A. E. Kemp; first vice-president—A. E. Ames; second vice-president—W. E. H. Massey; treasurer—J. L. Spink.

T. T. W. Bready, J. Love and C. R. Tryon, Winnipeg, Man., and J. Carruthers and C. W. Band, Toronto, are applying for a Dominion charter as the Winnipeg Elevator Company, Ltd., with a capital of $300,000.

W. P. McMicking, D. J. Bastien, W. H. Spillman, E. E. Adams, J. McC. Field, W. Smith, J. S. Greenhill, Leamington, Ont., and W. E. Lee, Virgil, Ont., have been incorporated as the Leamington Veneer and Basket Co., Ltd.; capital, $3,000.

A. W. Campbell, Provincial Road Instructor, recently went to Cornwall, Ont., to consult with the Town Council there regarding the disposition of $20,000, which has been voted by the ratepayers for the purchase of machinery and the construction of a number of new roads.

C. Cannom, G. N. Weeks, L. Nichols, J. H. Dunn, R. A. Little, and G. F. Morris, London, and J. E. McGuffin, Township of London, have been incorporated as the Cannom Stove and Oven Company, Ltd., with a capital of $20,000, to do business as manufacturers of stoves etc., in London, Ont.

W. Sproule and S. W. Trusler, Plympton, Lambton county, Ont.; G. Knight, T. Carrick, Sarnia, and R. E. Moss, M.D., Port Huron, Mich., have been incorporated as the Lambton Oil Co., Ltd., to deal in and refine oil, etc.; capital, $20,000; chief place of business Sarnia, Ont.

The advertisement of the wire rope output of the B. Greening Wire Co., Hamilton, reminds us of the fact that that old and firmly established firm is now being managed by the third generation of its founder's family, as is pleasantly told by the portraits of the three members of the Greening family on the calendar issued by the firm.

It is reported that the total sales of lumber in Manitoba and the Northwest this year exceed those of last year by about 30,000,000 feet. The quantity of spruce cut in Manitoba mills is estimated at 15,000,000 feet in excess of last year. The growth of the trade in imported lumber from the United States has been very great. In 1892, before the duty was taken off, the importation of rough lumber was only a little over a million feet, while that of dressed lumber was very much smaller. In 1897 the importation from the States amounted to 16,000,000, and in 1898, 35,000,000 feet. This is of course, chiefly undressed lumber. The quantity of pine from the Rat Portage mills is estimated at over 50,000,000 feet.

W. M. Watson, Toronto, has designed and completed a model of a square built hot air furnace. The height is 5½ feet by 3 feet by 3 feet square. The fire pot is circular, measuring 22 inches across, and is 12 inches deep. The cold air enters at the floor line, and is conducted by bent channels upward in thin streams over the radiating plates in a way that causes a very rapid current and great heating power. The advantage of this method of heating air is, the inventor claims, that about 75 per cent. more cold air can be heated to a given temperature with the same weight of coal as is used by the present hot air furnaces, because it contains over 150 square feet of direct heating surface plates that are self cleansing and cannot become coated by soot or dust. This furnace can, it is stated, be manufactured quite as cheaply and would be as durable as any other furnace.

The Fairbanks Co., which for many years has had an agency in Montreal for its well-known scales, has opened a warehouse of its own. The Fairbanks Co. controls besides its scales, the output of a number of factories, and at the show rooms their products are on exhibition. The asbestos disc valve of this company, for which an advertisement is inserted on another page, is an article of the highest grade. Asbestos seat gate valves, asbestos packed cocks, and Vulcabeston packings complete this line. Trucks of all kinds are in evidence. Norton emery wheels and Nicholson files are also carried. In the basement is a 6 h.p. gas engine of the Fairbanks' Company's own make, used to work the lift and furnish power for the repair shop. The Fairbanks Co. has just issued a 240 page catalogue of supplies, which they will gladly send on request.

Electric Flashes.

Hanson Bros. syndicate of Montreal has taken possession of the Havana street railway.

At Ottawa the Sunday car vote resulted in an overwhelming majority for the cars. The figures are: For, 4,628; against, 1,664; majority for, 2,964.

A vote was taken January 9th in Bradford, Ont., on a by-law to raise $6,000 for the purpose of putting in an electric light plant. The by-law was defeated.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co. for additional apparatus to be used at the Sault Ste. Marie Canal.

The Bell Telephone Company has decided to place more of its wires under ground in Hamilton, Ont., as there has been very great loss occasioned by sleet storms on more than one occasion.

The Hawthorn Woolen Mill Co., of Carleton Place, Ont., is increasing its lighting plant and has placed an order with the Royal Electric Co. for a 25-k.w. bipolar generator, which is to be installed at once.

The Canadian General Electric Co. is installing for H. A. Lozier & Co., Toronto Junction, Ont., one of their 200-light dynamos, with marble panel, and wiring up some 200 incandescent lights, in their new factory.

The Watson Mnfg. Co., St. Catharines, Ont., is removing to its new factory at Paris, Ont., and has placed an order with the Canadian General Electric Co. for the wiring up of the factory, and installing a plant to furnish some 250-16 c.p. lamps.

Incorporation is sought for a company under the name of the British Columbia Telephones, Ltd., to acquire the New Westminster, B.C., and Burrard Inlet Telephone Company, Ltd., and the Vernon and Nelson, B.C., Telephone Company.

The Central Construction Co., 263 Main street, Buffalo, N.Y., whose specialty is water, steam and electric power plant construction, has the contract for the Orillia, Ont., electric power plant at $75,000, for which the ratepayers voted the necessary funds on February 6th.

At the electric railway car shops, Niagara Falls, Ont., eight men are employed in the building of six large new open cars for the use of the road during the summer, and one of the cars is now completed. It is a double truck, 35 feet long, with a seating capacity of 75 people.

Incorporation is asked for the Hamilton and Caledonia Ry. Co. to construct a railway from Hamilton, Ont., to Caledonia and Cayuga, and extend it to Selkirk, a point on the shore of Lake Erie. The line may be operated by steam or electricity, and will also deal in natural gas.

N. P. Tanquay, Esq., of Weedon, Quebec, has contracted with the Canadian General Electric Co. for a standard 55-k.w. new type multi-polar generator, and a 35-h.p. motor, together with marble panels and all line material and supplies required for carrying out the transmission of the above power.

The works of the Chambly Mnfg. Co., have been somewhat damaged owing to ice breaking the apron of the dam. A new timber apron has been constructed, five feet thick, and no further trouble is believed to be possible. The installation is expected to be entirely complete, and the current turned on about May 1st.

The Bruce Mines and Algoma Railway Company asks for an Ontario charter to construct a railway from Bruce Mines, Ont., northerly to the Rock Lake Copper Mines, thence northerly a distance of thirty miles, with power to equip by steam or electricity, and if the latter, with power to sell the surplus electric energy for light, heat and power purposes, and to supply the miners with electricity for their mines, and also to construct branch lines of railways not exceeding twelve miles in length.

The Canadian General Electric Co. has just received another order from the Montreal Ry. Co., for 12 standard G.E. 1,000 railway motors.

The Stanstead Electric Light Co., Stanstead, Que., has recently purchased a 2,000-light single-phase alternator from the Canadian General Electric Co.

The Canadian General Electric Company has closed a contract with A. S & W. H. Masterman, Montreal, for a new type multi-polar 200 light generator.

A. Gagnon & Co., Arthabaskaville, Que., have recently installed a new 2,000-light single-phase alternator of the Canadian General Electric Co.'s new type.

The Ottawa Electric Co., Ottawa, has recently added to its arc lighting equipment, one No. 12 125-light Brush arc dynamo, purchased from the Canadian General Electric Co.

The Hamilton, Ont., Street Railway Co. paid the city for mileage and percentages on gross receipts for the last quarter of 1898, $3,602.21. For the same quarter in 1897 the amount was $4,163.49.

The Guelph Light & Power Co. has recently purchased a new 1,000 light single-phase alternator from the Canadian General Electric Co., together with marble switchboard panels for the control of two machines.

The R. & O. Navigation Co. has placed an order with the Canadian General Electric Co. for a standard 30-k.w. direct-current generator, to be direct connected to an "Ideal" engine, manufactured by the Goldie & McCulloch Co., of Galt.

The town of Essex, Ont., is to have an incandescent system of electric lighting. C. E. Naylor, of that place, having undertaken the operation of the system, has purchased from the Canadian General Electric Co., a 750-light machine for the purpose.

The Canadian General Electric Co. has recently installed for Robertson, Rowland & Co., Walkerton, Ont., a 2,000-light single-phase alternator. This company has been operating a 60-k.w. machine, of a similar type, for the past four years, and has met with great success in the electrical lighting.

The corporation of the town of Bothwell, Ont., has awarded a contract to the Canadian General Electric Co., for a 500-light plant, to be used for commercial and street lighting purposes. The lighting of the streets will be done by 15 enclosed arc lamps, of the latest type, which will be operated from the same machine.

The E. T. Wright Company, Hamilton, Ont., is having installed in its factory a 50-h.p. S.K.C. motor to drive the factories. The power by which this motor is driven is taken from the Cataract Power Company's wires. This is the 10th installation from this company's service into factories in Hamilton up to date.

The Montreal Water & Power Company of Montreal is installing in its pumping station a 400 h.p. S.K.C. two-phase motor operating at 180 r.p.m. This motor is intended to operate the waterworks pumps, and will be driven by current generated at Chambly rapids, a distance of sixteen miles away. This is one of the largest single motor installations in Canada.

The Royal Electric Co. has received an additional order from the Hamilton Electric Light & Power Company for a 500 h.p. S.K.C. two-phase synchronous motor, which is to operate a shaft driving their arc circuits and street railway power circuits. This is an addition to the two 350-h.p. motors noted in these columns recently.

Corley & Collins, Mount Forest, Ont. have experienced such an increased demand for lighting during the past two months that they were compelled to increase their facilities, and have purchased from the Canadian General Electric Co., a standard 1,000 light single-phase alternator, with marble panel switchboard and exciter, to meet these requirements.

There is an application to the Dominion Parliament for a charter for an electric railway from Ottawa, through the township of Nepean, Ont., by Kingsmere to Meach's Lake, in the District of Ottawa, in Quebec; also to construct to Hog's Back and Graham's Bay, in Nepean, and the town of Aylmer and city of Hull, Que.; also to construct a railway, foot passenger and vehicular bridge across the Ottawa River from Nepean to Hull at the Remous Rapids, in the township of Nepean.

R. G. Code, A. F. May, A. Macfarlane, E. F. Burritt, C. T. Moffat, Ottawa, Ont., will be incorporated as the Royal Telegraph Co., Ltd., to build, buy or operate telegraph and telephone lines in any part of Canada. The capital is to be $100,000, and the chief place of business, Ontario.

A trust for electric carbons has been formed in Chicago under the name of the National Carbon Company with a capital of ten millions, and taking in the twelve largest carbon factories on the continent. One of these was said to be the Ottawa Carbon Works, which controls the business in Canada.

E. S. Jenison has completed his surveys for the power canal from Kakabeka Falls to Port Arthur. The reservoir will be on the highlands west of Port Arthur and will cover an area of four thousand acres, with a depth of from fifty to seventy-five feet. Its surface will be three hundred and three feet above Lake Superior.

The London Electric Co., has placed an order with the Canadian General Electric Co. for another No. 12 4-circuit 125-light Brush arc dynamo, and an additional 300-k.w. revolving field single-phase alternator. When these are installed this company will have one of the most complete lighting stations in Canada.

The steamer "Pro Patria," of Halifax, N.S., is being equipped electrically, and for the purpose of lighting the steamer and operating searchlights, an order has been placed with the Canadian General Electric Co. for the complete outfit, which will consist of a standard C.G.E. direct connected equipment, including engine, dynamo, switchboard, searchlight and wiring complete.

Jas. Madden, jr., formerly of Welland, Ont., who recently graduated from the Peterboro works of the Canadian General Electrical works, has been appointed to a position with the Lachine Rapids Hydraulic and Land Company of Montreal, where he has been temporarily located since graduation. His duties are the charge of the switch board of the company and the supervision of the repairs in the company's electrical lines.

The Canadian General Electric Co. has been awarded, by the Department of Railways and Canals, the contract for the erection of a power house, and the complete equipment of the Soulanges canal with electrical apparatus, for operating the locks by means of electric motors. The entire canal, covering a distance of 14 miles, will be illuminated by arc lamps. Owing to the success met with by the Department in the operation of electricity of the canal at Sault Ste. Marie, Ont., as applied to the locks, it has decided to make a more extensive application of the use of electricity, in the illumination and electrical operation of the locks of the Soulanges canal.

The Queen Victoria Niagara Falls Park Commissioners met in Toronto on the 4th inst. to consider amended plans of the proposed works on the Canadian side, which the Niagara Falls Power Company has submitted for their approval. These plans involve the removal of the power-house from just under the bluff, at a point about 200 yards from the street railway power-house, to a site much nearer the river, and close to Cedar Island. This will greatly shorten the intake leading to the power buildings, but will necessitate a much longer tunnel, to a point below the Falls, for the purpose of conveying off the waste water. The commissioners will carefully consider the changes in order to see that the plans do not deface the park and the scenery to a greater extent than those approved of four years ago.

The Canadian General Electric Co. has recently sold to Evans & Hastings, printers, Vancouver, B.C., a 6 k.w. Edison dynamo; to Braid & Co., of Vancouver, B.C., a 10-h.p. motor for use in their spice mills; a 50-light dynamo to be installed in the premises of a customer at Edmonton, N.W.T.; to the Savoy Theatre at Vancouver, B.C., a 250-light incandescent lighting dynamo, of the multipolar slow speed type; to McKenzie Bros., of Victoria, B.C., a 6-k.w. Edison motor; to the British Columbia Electric Railways Co., to be used in driving the blower apparatus in the power house, a 12-k.w. Edison motor; to Hoffmeister Bros., Vancouver, B.C., a 25-light incandescent lighting dynamo; to J. C. Woodrow, Vancouver, B.C., a 3-k.w. Edison motor, and to Hinton & Co., Vancouver, B.C., to be installed on a steamer navigating Lake Bennett, a 25-light incandescent dynamo.

Peterborough is asking the Ontario Legislature for leave to develop water power on the Otonabee River, and supply electric light, heat and power.

Sir William Meredith, B. B. Osler, Q.C., and F. P. Sargent have completed their arbitration in the Grand Trunk telegraphers dispute, and have made an award fixing a time and wage schedule, and providing for over time pay, etc.

Dr. Arthur E. Kennelly, the president of the American Institute of Electrical Engineers, has come to Montreal to deliver a series of four lectures at McGill University A popular lecture on Submarine Telegraphy was given in the Physics building, McGill, January 30th.

John Philip, Grand Valley, Ont., is supplying the town of Grand Valley and the town of Arthur, Ont., which is thirteen miles away, with incandescent light from his incandescent lighting plant in Grand Valley. He has had such success with transmission plant from Grand Valley to Arthur that he has purchased from the Royal Electric Company a 75-k.w. S.K.C. two-phase alternator, which he is installing in his power station. This will enable him to deliver at least 1,000 lights, wired up, in Arthur, and also to serve everything in Grand Valley. As heretofore noted this is a new departure in lighting, as the power-house depends for fuel upon the refuse from a sawmill, which before the present plant was installed was a nuisance, but is now a valued source of income.

Railway Matters.

Trains are now running from Skagway to Log Cabin over the White Pass Railway.

The C.P.R. car shops at Perth, Ont., are turning out this winter 300 box cars, 60 coal cars and 50 flat cars.

The Lake Erie & Detroit River Railway has decided to erect a new swing bridge over the Thames river at Chatham, Ont.

The preferred stock, $1,000,000, of the Kingston and Pembroke Company, authorized by the Government, has all been subscribed.

Application will be made for the right to build a line of railway from Edmonton to Victoria, and Beaver Lake to South Edmonton, N.W.T.

The Gatineau Valley Railway will be extended this year from Gracefield, the present terminus, to Maniwaki, a distance of twenty-eight miles.

Hereafter the Lake Manitoba Railway and Canal Company will be known as the Canada Northern Railway and a charter secured authorizing the building of a line from Lake Winnipegosis or thereabouts to Edmonton or thereabouts.

George Appleby of Darling's Island, Kings county, N.B., is doing the work on his contract in connection with the I.C.R. improvements of removing the St. John Bridge and railway extension track to such a point as may be deemed advisable.

Application will be made for a charter for a railway from Edmonton, N.W.T., thence via Athabasca Landing and Lesser Slave Lake to Peace River; also to permit the railway company to own vessels and navigate the Athabasca River from Athabasca Landing to the mouth of Little Slave River and up the same into and through Lesser Slave Lake.

The Lake Erie & Detroit River Railway Company has taken over on lease from the United States & Ontario Steamship Navigation Company the car ferry "Shenango No. 1" and the slip docks at Port Dover, Ont., and Conneaut, Ohio, for a term of five years. This means that the Lake Erie & Detroit River Railway Company have secured control of the ferry business on Lake Erie.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, vice J. D. Barnett resigned. He was formerly locomotive foreman in that section, and was for some time previous connected with the erecting shops. He was removed from Montreal to Toronto some years ago, and upon the advent of the new management was removed to Fort Gratiot, Mich., as master mechanic of the Chicago and Grand Trunk, succeeding William Roberts.

S. F. Barker, Hamilton, Ont., has been elected president of the St. Louis, Kansas and Southwestern Railway, and J. N. Young, who was the original promoter of the Toronto-Hamilton and Buffalo Railway, has been elected vice-president and manager. Three months ago, Mr. Barker representing Canadian holders of bonds to the value of $800,000, bought the road at auction for $150,000.

The Toronto, Lindsay and Pembroke Railway Company is applying for incorporation to construct a railway from Golden Lake, Ont., to a point on the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, in the county of Hastings, there to connect with the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, or any other railway. To be operated with steam or electricity.

At the present session of the Ontario Legislature application will be made for an Act to incorporate the North Lanark Railway Co., with power to build a line from the Kingston & Pembroke Railway, near Mile Lake, in Renfrew county, to the C.P.R. or O.,A. & P.S. Railway at Arnprior. The route of the proposed road has been surveyed by A. Bell, C.E., of Almonte, acting for a number of capitalists interested in iron mining.

The Canadian Pacific Railway Company intends making application at the forthcoming session of Parliament, says The Vancouver World, for a charter to build a line of railroad from a point at or near Cranbrook or Fort Steele, B.C., on the line of the Crow's Nest Pass Railway, northerly along the Kootenay and Columbia River, to a point at or near Golden, with power to operate branch lines of railway extending from the proposed new line a distance of not more than 30 miles.

It is proposed to build a railway from the outlet of Kamloops Lake; thence by the most direct and feasible route to the plateau of the Bonaparte River; thence to a point on the Cariboo wagon road near the One Hundred-Mile House; thence following generally the route of the Cariboo wagon road to the mouth of Quesnelle River; thence northwesterly, following generally the route of the Telegraph Trail to Hazelton, at the Forks of the Skeena River; and thence north and northwest by the most convenient and feasible route to a point in the vicinity of Atlin Lake; with power to build a branch line to Teslin Lake.

D. C. Fraser, M.P., for Guysboro, N.S., who introduced the British Yukon Railway Bill into Parliament, and who has since visited the scene of the company's operations, says that after completing the track from Skagway to Lake Bennett, 37 miles, they will build 100 miles of road into the Atlin country, joining the Hootalinqua River, and thus securing good navigation to Dawson City. He further says that the line is practically located all the way to Selkirk and that if Canada wishes for it, there is nothing to prevent her from securing the whole of the Yukon trade.

Application is being made for a charter for the Worthington & Onaping Railway Company, with power to construct, lay out, and build a railway from a point at or near Worthington Station, in the township of Drury, Algoma; thence northerly near the Inez mine in the said township, thence northeasterly to the Sultana nickel mine in the township of Trill, thence northerly and easterly a distance of about fifty miles, crossing the main line of the Canada Pacific Railway at or near Onaping Station, and with power to equip and operate the same by steam or electricity.

Vancouver, Northern & Yukon Railway Company is applying for a British Columbia charter to construct a railway from some point at Vancouver, or other point on the shore of Burrard Inlet, thence running in a northerly direction by way of Seymour Creek, to the Squamish Valley; thence through the Pemberton Meadows to Lillooet; thence northerly to Quesnelle; thence northwesterly to Hazelton, or some other point on the Skeena River; and thence northerly to the northern boundary of the province; with power to build a branch line from Hazelton along the valley of the Black River to the northern boundary of the province; with power to build branch lines to Fort St. John; with power also to build branch lines east and west from the main line along the north shore of Burrard Inlet to Howe Sound and the west shore of the North Arm of Burrard Inlet; with power also to build and operate branch lines from time to time to groups of mines and to farming lands from any point on the main line or any of its branches; and to use steam or electricity.

The C.P.R. is to spend $500,000 on its Detroit-Megantic section this season in improvements.

Application will be made for the revival of the charter of the Lindsay, Bobcaygeon and Pontypool Railway Co.

An action has been taken in Toronto by the Alberta Coal & Railway Company against Mackenzie & Mann, the late Yukon railway contractors, the plaintiffs claiming from that firm the sum of $100,000, alleged to be due for rails and rolling stock.

The Algoma Central Railway will apply for an Ontario charter at the next session of the Legislature; the proposed line will run from Sault Ste. Marie, Ont., to the Michipicoten River, thence northerly to the C.P.R., and southerly to Michipicoten harbor on Lake Superior.

Application will be made for the right to build a line of railway from Chute Aux Iroquois, in the county of Labelle, Que., to a point near Lake Nommingue, in the county, and thence to a point near Lake Temiscamingue, and to operate lines of telephone and telegraph alongside the same.

The Kootenay Valley & Burlington Railroad is being built by Foley Bros., Larson & Stevens. The entire distance to be built is 50 miles, and the contract provides for its construction by July 1, 1899. It will require the employment of 5,000 men to complete the work, which will be rapidly prosecuted.

The Deseronto car works are turning out a large order of box cars for the Intercolonial Railway. Each car is of 60,000 lbs. capacity, and will be built of the very best material. The cars will be fitted with Sterlingworth brake beams, Westinghouse air-brakes, automatic couplers, steel trucks, Chicago roofing patent grained doors, etc.

In the financial year just past the Quebec Government gave to the Quebec, Montmorency & Charlebois Railway, $15,191.15; to the East Richelieu Valley Railway, $5,000, and to the Great Northern, $120,093.97. The Government announces that no bonuses will be paid to railways this year, and all the promises of the late Government are repudiated.

Thirty-two years ago Nova Scotia granted the Windsor & Annapolis Railway Company a drawback of duties on materials and stock used for the construction and operating of the road. Parliament in 1896 authorized the extinguishment of the right, and $100,000 has been paid to the Dominion Atlantic Railway Company, successors of the original incorporators, in commutation of it under an agreement signed October 7. The last Gazette contains a proclamation repealing the legislation granting the concession.

Application is being made for an Ontario charter for the Thunder Bay, Nepigon and St. Joe Railway. The route proposed is from Port Arthur via Dog Lake and Black Sturgeon Lake to Black Sturgeon Bay on Lake Nepigon, a distance of 68 miles. A surveying party has returned to Port Arthur after making a preliminary survey. They report finding good country throughout the distance, free from difficulties in construction. The country is level, well wooded with pine, tamarac, spruce, cedar and birch. Fully one-third of the country is occupied by small lakes simply teeming with fish, and there are several million acres of good agricultural land near the upper part of the line. Deposits of limestone and marble, useful for fluxing purposes, iron ore, salt and lignite are said to have been found in the district.

Mining Matters.

The Dominion Coal Co. has closed down the mining works at Bridgeport, Cape Breton.

A Wabigoon, Ont., correspondent gives news of the existence of a large vein of hematite iron ore to the north of Wabigoon.

The Canadian General Electric Co. has recently sold to the Comstock Concentrator, Silverton, B.C., a 25-light Edison dynamo.

J. H. Fraser, Petrolia, driller, has given up for the season prospecting for the Standard Oil Co. in Manitoulin. The exploration will be resumed in the spring.

Hastings county, Ont., felspar is now in demand in England for glazing purposes, and users state that it is much superior to the Scandinavian product now almost exclusively used.

The Canadian General Electric Co. has recently sold to the Athabasca Gold Mining Co., Nelson, B.C., a 100-light Edison dynamo, to be used in lighting the work buildings at the mines.

The Canadian General Electric Company has recently sold to the Scottish Colonial Mining & Milling Co., of Three Forks, B.C., a 100-light 16-c.p. incandescent dynamo, to be used in lighting buildings at the mine.

Work on the Zenith zinc mine to the east of Fort William, Ont., near Rossport, owned by H. J. Beemer, of Montreal, is being pushed. Warehouses have been put up, stables built and the Canadian Pacific Railway have arranged to run a spur track twelve miles out to it.

The Wm. Hamilton Mnfg. Co., Peterborough, Ont., has received the contract for the erection of a 10-stamp mill on the Bend 'Or property in the Bridge River district, B.C. There is ample water power and the company has agreed to have everything in running order by July 1st, 1899.

Sultana Island, upon which is situated the celebrated Caldwell gold mine, has an area of about 500 acres. The Caldwell property comprises 47 acres. The ownership of the balance of the island, known as the Ophir property, has been in dispute since 1889. The Commissioner of Crown Lands has recently given final judgment in the case, and decided that the Ontario Mining Company is entitled to an undivided third of the claim; Margaret Johnston and associates to an undivided third, and the Canadian Pacific Mining and Prospecting Company and the Seybold Syndicate to the remaining third.

There is to be a new graphite company at Grenville, Que., which will be capitalized at $500,000 and is composed of Pennsylvanians. The application for incorporation is now being made. The property at Grenville was worked in 1860, but since then has not been touched. The graphite is said to be 98 per cent. pure and the deposit large. It is the intention of the company to operate at St. Malachi also, where a fine property has been secured. The company will, it is said, erect mills at both places, but at present the work of taking out the ore is all that is being done.

Bay de Verde district in Newfoundland has benefited greatly the past year from the mining boom there, says The St. John's, Nfld., Herald, and is likely to enlarge upon this during the present season. The Iron Co. has named its headquarters Workington, and has 16 square miles of territory under lease, all of it said to be rich in this mineral. They have two shafts sunk near there, two others at Island Cove and a fifth at Northern Bay. Stores, offices, sleeping quarters, and messhouses have been built, and a railway is laid to Perlican, so that there is every assurance that the property will be worked to the fullest possible extent.

A considerable deposit of kaolin—used in the manufacture of china—has been found to exist at Plow Rapids near the mouth of Stag Creek on the Gatineau. The place is about 40 miles from Ottawa and is owned by an Ottawa man. The kaolin was discovered first in 1860 by the late W. L. Holland. Samples of the material were later on sent to St. John's, Quebec, and to the United States where it was successfully used. It should be possible to successfully make use of this deposit in a country where electrical power is limited only by the amount of apparatus set up, the water power being unlimited.

The American Copper Mining Company, in its combination of six plants, expects, it is said, to control the copper mining industry of the world. The Boston and Montana and the Butte and Boston mining companies, the old Dominion Copper Company of Arizona, and the Arcadian, Tamarack & Osceola Mining Companies of Michigan are named as the component parts of the new organization. It is understood that the American company will reach into Canada and absorb important copper mines there, thus making the combination international, but the Calumet and Hecla Company, the largest producer in the Lake Superior region, has so far declined to enter the combination.

War Eagle Gold Mining and Development Co. has received a refund of $16,000 from the Trail, B.C., smelter, on account of the mine having furnished the stipulated 175 tons of ore daily for the past six months. During that time the shipments amounted in round numbers to 32,000 tons, and the refund was on the basis of 50 cents per ton. The War Eagle smelter rate is $7 per ton.

Marine News.

Nicholas and Michael Connolly have secured the contract from the Department of Railways and Canals to build a large wharf for the I.C.R. terminus at St. John, N.B.

It is now said that the "Pharsalia," the latest addition to the battle line, will be launched at an early day. Captain Smith of Yarmouth, N.S., and formerly in the "Arbela," will command her.

The White Star Line steamer "Oceanic," the largest ship ever built, was successfully launched at Harlan & Wolff's yard. Belfast, Ireland, January 14th, in the presence of an enormous crowd. A grand stand was specially erected to accommodate 5,000 persons.

Incorporation is being sought for a company to construct a canal or ship canal for navigation from some point on Lake St. Clair, in the county of Essex, or in the county of Kent, to some point on Lake Erie between Point Pelee and Rondeau Harbor.

G. N. Ducharme, Ste. Cunegonde; M. F. Pauze, Montreal; A. A. Bernard, M.D., St. Henry; L. A. Bernard, Montreal; T. Bienvenu, Labelle, Que., are to be incorporated as the Lake Labelle Navigation Co., Ltd., Montreal. The capital of the company will be $10,000.

R. Roy, Dominion engineer, has started a large gang of men to work to improve the navigation on the Kootenay River from Fort Steels to Wardner, for which a grant of $5,000 has been given. The bulk of the work will be done on Wild Horse bar, which is the worst impediment to navigation.

The Richelieu and Ontario Navigation Company will put on a daily service up the Saguenay next summer and the Hamilton service will be augmented by additional vessels. The steamer "Saguenay" will be renovated this winter and new boilers and electric plant will be introduced.

The latest addition to the fleet of the Dominion Atlantic Railway steamers, the "Prince George," is proving a very fine ship, she has now been making regular trips for some time between Yarmouth and Boston. The sister ship, "Prince Arthur," now building at Hull, Eng., will probably be placed on the route in the spring.

A further proviso has been added to the contract with the Allan and Dominion steamship companies for the Atlantic mail service, by which the vessels of these companies will be required to await at Halifax the arrival of the Chinese mail, which by special contract with the Imperial Government is carried by the Canadian Pacific Railway.

At the annual meeting of the Great Northern Transit Company it was decided to build a modern steamer for the Sault Ste. Marie route to replace the "Pacific," which was recently destroyed by fire. It was also decided to purchase a new steamer for the North Shore route, to replace the "Belle," also destroyed during the past season.

Recently the Quebec Harbor Board granted an exemption from harbor dues to any ocean steamship line which would make it a regular port of call, and the Elder-Dempster Line made a contract. The board has also given permission to the Great Northern Railway to erect on the quay an elevator, with a capacity of 1,000,000 bushels, to be finished by May 1, 1900.

At the annual meeting of the Canadian Marine Engineers' Association the following officers were elected: Hon. president, O. P. St. John; president, Harry Parker (acclamation); 1st vice-president, A. J. Woodward; secretary, S. A. Mills; treasurer, H. Brownley; inside guard, H. Bowler; auditors, D. L. Foley and E. J. O'Dell; council, Thomas Good, William Horwood, Rees Binch, P. J. Carr and J. E. Kane. Port Dalhousie.

The Polson Iron Works Company, Ltd., Toronto, has been given the contract of building for the Richelieu & Ontario Navigation Co. a new boat, which will be a steel screw craft, 112 feet long, 22 feet 6 inches beam, to draw 6 feet of water, and to make a speed of 15 miles an hour. She will be fitted with a fore and aft compound engine and a Fitzgibbon boiler. The price is said to be $20,000. The steamer will be especially adapted for river service.

The Canadian Marine Engineers' Association held its fifth annual "At Home" in the Confederation Life Building, Toronto, February 1st. O. P. St. John, hon. president, occupied the chair and made an interesting and instructive speech on the advantages of education along technical lines to the engineer. A very good concert was given and a pleasant dance and excellent supper concluded the evening's pleasure. Among those present besides the members were noticed: J. R. Dillon, Hamilton; E. W. McKean, Sarnia; Wm. Lewis, Owen Sound; Capt. Rees, Kingston; D. McEvoy, Gutta Percha Mnfg. Co., Ltd., Toronto; A. W. Smith, Aikenhead Hardware Co., Toronto. The committee in charge of the arrangements were: O. P. St. John, H. Brownley, D. F. Campbell, T. Crossley, S. A. Mills, D. Foley, E. Abbey, H. Bowles, A. J. Woodward.

Personal

Angus G. Macdonald, city electrician of Halifax, N.S., is dead.

Samuel Hall, one of the oldest employees of the Grand Trunk Railway at Belleville, Ont., died Jan. 4th.

James Cunningham, an engineer on the M.C.R., dropped dead in the Queen's Hotel, St. Thomas, Jan. 6th.

W. R. Campbell, general manager of the Dominion Atlantic Railway, died suddenly in London, Jan. 8th, after a short illness.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, Ont., in place of J. D. Barnett, resigned.

R. J. Armstrong, Fort William, travelling inspector of fuel and engines on the C.P.R., has had his office transferred to Winnipeg.

Capt. Thos. Donnelly, Kingston, has been appointed inspector for Lloyds, and will at an early date resign his position as Government steamboat inspector. The new position is worth $2,000 a year.

Yorke Kirton, formerly of the Lancaster Machine Works, and who has spent the past eight months in the employ of John Bertram & Sons, Dundas, Ont., is now employed in the cotton mills at Valleyfield, Que.

Lieut. Adams, R.E., formerly of Kingston, Ont., and a graduate of the Royal Military College, has been appointed to the important and lucrative position of manager of the Nile Delta Light Railway.

Ronald T. McDonald, the late president and general manager of the Fort Wayne Electric Corporation, while on a business trip to New Orleans, La., and Dallas, Texas, contracted a severe cold, which resulted in double pneumonia, causing his death December 24th.

E. A. Wilmot, Mem. Can. Soc., C.E., city engineer Victoria, B.C., was dismissed by resolution of the city council, January 26th. To be dismissed by this particular municipal council is no reflection on Mr. Wilmot's professional status, it is of course understood.

J. A. Sarvis, lately of Fort William, Ont., has been engaged as traveller by the B. Greening Wire Co., Hamilton, Ont. He will represent the firm in northern Ontario, thus allowing the secretary of the company, Mr. R. H. Merriman, to devote more time to the office.

John C. Gardner, late secretary and manager of the Canadian Manufacturer Publishing Co., Ltd., has been appointed president and managing director of the Might Directory Co., of Toronto, Ltd., vice J. M. Might, retired. Mr. Gardner has had a long experience in the directory business, having been some eight years in that special field before he went with the Canadian Manufacturer.

W. C. White, who is well-known in business circles in Montreal, died at his residence there a short time ago. Mr. White was a manufacturer of boilers and lead pipe. He was born at Paisley, Scotland, in 1829, and came to Montreal in 1853. In 1860 he became a boiler and boat builder, and at the time of the construction of the Victoria Bridge was a sub-contractor. Mr White was the proprietor of a manufacturing establishment at Sorel, and there built a number of vessels for the Richelieu and Ontario Navigation Company.

The report of the death of Lieutenant Keating, son of the general manager of the Toronto Railway Co., shows that he sacrificed his life in an effort to save a wounded corporal. It was in the fight near Yelwa, on the Niger, and the little British force consisted of Lieutenant Keating, Corporal Gale and fourteen native soldiers. Corporal Gale was shot by the blacks, but Lieutenant Keating by cutting down several of the boldest of them brought the badly wounded corporal to the river bank. When helping him into the canoe the fatal shot was fired from a close ambush.

LITERARY NOTES.

A. O. Norton, Boston, Mass., U.S.A., has issued a very complete catalogue of his patent ball-bearing jacks and "Sure Drop" track jacks.

The proceedings of the eighth annual convention of the Association of Railway Superintendents of Bridges and Buildings have been issued in a volume of nearly 300 pages.

The 21st annual edition of the Maine Record, Cleveland, O., U.S.A., was published January 26th and comes to hand with 52 pages of advertisements and interesting reading matter.

The Standard Tool Co., Cleveland, O., U.S.A., which makes a specialty of electric welding, has forwarded us a catalogue of the electrically welded bicycle parts, which are a well known product of this firm.

At the October meeting of the American Institute of Mining Engineers, H. H. Stock read a paper on the history of the International Correspondence Schools, Scranton, Pa., U.S.A., which has now been issued in pamphlet form.

The Mechanics Supply Co., Quebec, has just issued catalogue "M," which deals exclusively with acetylene gas fittings, etc. This is commendable enterprise, as it is the first catalogue of acetylene gas fixtures which has reached us.

The Hamilton Bridge Works, Ltd., Hamilton, Ont., has many points of interest in its 1899 catalogue just received. The illustrations showing the various recent works of the firm are very well done. The catalogue will be sent free on application.

Charts for Low Pressure Steam Heating for the use of engineers, architects, contractors and steam fitters is the title of a very comprehensive publication prepared by J. H. Kinealy, D.E., Mem. Am. Soc. Mech. Eng., and Am. Soc. Heating and Ventilating Engineers. We shall make further reference to this valuable work.

The Model Engineer and Amateur Electrician has reached us from London, Eng. It is a journal of mechanics and electricity for amateurs and students.

The Technology Review has just issued its first number. It is a quarterly magazine relating to the Massachusetts Institute of Technology, and is published at 71 Newbury street, Boston, by the Association of Class Secretaries.

The British Fire Prevention Committee has just issued as No. 12 of its official publications, the Effect of Fire, which is a report on the Horne building fire in Pittsburg, U.S.A., by G. Kaufman, C.E.; E. Swenson, C.E., and F. L. Garlinghouse, C.E.

The Canadian General Electric Co. has issued a handsome calendar for 1899, which is decorated with a picture of a female figure operating an electric search light whose rays fall upon the extensive works of the company at Peterboro, and show up brightly that huge industrial hive.

We have before us the profusely illustrated catalogue of the Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester, Eng. It is a most valuable work on power transmission, entitled the Economical Transmission of Power, and contains over 150 pages of the most condensed information, many pages of statistics and other tabulated facts, which are of interest to all users of power.

We have received a circular from the Committee of Organization and Administration of the Congreso Industrial of Argentino, Lorea 80. It is proposed to hold an Industrial Exhibition at Buenos Ayres, capital of the Republic, in the month of May next. Exhibits will not be received after April 15th. Foreign exhibitions besides receiving diplomas without cost will have all the rights in connection with the exhibition that belong to natives of the country.

It is proposed to hold at Toronto in May an Historical Exhibition under the auspices of the Ontario Historical Society. The exhibition is intended to be both attractive and instructive, to illustrate the history of Ontario in particular, during the century now ending, and to demonstrate the progress of our people along commercial, social and intellectual lines; the history of localities as well as of the entire province; the advancement made in social and domestic comforts; and in scientific and domestic economy. It is not intended, however, to confine the exhibits to Ontario, although it should be given first place, but to include anything relating to the history of Canada. The Ontario Historical Society has already available the nucleus of such an exhibition, and it is believed that the various local societies and a large number of generous citizens will lend enough additional material to make this one of the most comprehensive and representative exhibitions of the period. All exhibits loaned will be properly taken care of and their safe return guaranteed. The proceeds of the exhibition are to be devoted towards the establishment of a permanent historical museum. Miss Fitzgibbon, 1 Avenue Chambers, Toronto, is the secretary of the exhibition committee.