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The Canadian Engineer

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WATER SUPPLIES.

W. M. WATSON.

In a former article it was intimated that the water supply of Montreal was supposed to be responsible for the high death rate of that city. As therein stated I have never examined into the details of their supply and on that ground I cannot give an opinion, but I will now try to show how a supply can become the cause of an abnormal death rate, and the risk there is in towns drawing their supply of water from drainage rivers, and while doing so I shall partly draw from the works published by Dr. John C. Thresh and Dr. Parkes, both trusted and experienced medical officers of the British Government.

Rivers flowing through very thinly populated districts may yield water to which no possible objection could be taken. Many rivers, however, are utilized as sources of a public water supply which are constantly receiving sewage from towns that are situated above the intake pipe of their own town, and on that account are liable to draw into their own supply poisonous germs ejected from diseased persons or animals.

The Rivers Pollution Commissioners appointed by the Imperial Government to thoroughly investigate such matters reported in the year 1874, that after a thorough examination they had come to the conclusion, that whether they examined the organic pollution of a river at the different points of its flow, or the rate of disappearance of the organic matter contained in the sewage that gets mixed up in fresh water and incorporated with it by some violent agitation in contact with air, or, finally, the rate at which organic matter contained in sewage is dissolved and disappears in fresh water when polluted with 5 per cent. of sewage fluids, they were in each case compelled to come to the conclusion that the oxidation of organic matters in fresh water caused by introduction of sewage proceeds with great slowness, and they found it impossible to state how far sewage must flow along with the fresh water of rivers before it becomes thoroughly oxidized and harmless.

The city of Greater London draws some of its domestic water supply from the rivers Lea and Thames at a point below where the sewage of a small town is discharged into each of them, yet we are told that the inhabitants who use the water are healthy, and this fact is used to prove that water slightly contaminated with sewage is harmless, but there is a good reason why the polluted waters of the Lea and Thames are wholesome when consumed by the people of London, viz., that after it is drawn from the rivers it flows for over twenty miles in a broad, shallow, open canal which exposes the water to the purifying influences of the air and sun and by so doing it probably secures oxidation.

The characteristics of a good domestic water supply are, freedom from color, odor, taste, turbidity and the total absence of sewage germs and other injurious substances, whether animal, vegetable or mineral. Its appearance in an open reservoir will have a bluish tint. Should a body of water show a yellow-green tint, the water cannot be good, because that color indicates the presence of vegetable or animal matters in the process of decomposition. If the tint be brown it usually proves the water is collected from peaty soils, which may be unpleasant to the eye and taste, yet is generally considered harmless. If water is of a reddish tint, it indicates the presence of iron in the water, which can be eliminated by a process of thorough aeration, which will turn the color to an opalescent appearance, that will settle out of the fluid if the water is allowed to rest quietly in a reservoir for a few days, when the water will become bright and tasteless. Any water that emits an odor when boiled should be classed as unsuitable for a town's supply. Water collected from peat land is very soft and an excellent fluid to use in steam boilers and for washing purposes, but unsuitable for the manufacturing of fine paper, or to be run through lead service pipes, because the acid extracted from the vegetation that grows on peaty soil sets up a chemical action with the lead if allowed to stand idle in the pipe for a few hours, and creates a deadly poison that is delivered at the house drawing taps, and gives the consumers the lead poison which turns their gums and teeth blue and deteriorates the blood.

It is stated in the Massachusetts health report that over 1,400 samples of drinking water were examined, taken from reservoirs, lakes, rivers, brooks, etc., and only 275 of the samples were entirely free from odors. G. N. Calkins, who makes a study of water, remarks that there are three classes of odors that have come under his notice: First,

waters that contain chemical or putrefactive decomposition, second, waters that contain odors of growth, third, water containing physical disintegration, the last two being due to odorous oils.

Thresh states that the fishy smell often found in drinking water is due to a microbe called Uroglena Americana, Professor Remson says it is due to a decomposition of a fresh water sponge, while Mr. Rafter says that it is caused by a germ named Valvax Globator.

The storage reservoir of Norwood at Plymouth, Mass., was well charged with the germ Uroglena Americana in 1892, but as long as the water remained in the reservoir and the germs were in active life, the waters did not smell, but when they were drawn into the water-mains life became extinct and they became completely disintegrated and liberated a strong smelling, oily element that was very unpleasant and unhealthy.

In a village in Essex, Eng., the water supply was poisoned by dead fish that had died in the water during the time the reservoir was frozen over, and afterward set up putrefaction; another village in the same county had the water in the watermains poisoned by a large number of small eels that were drawn into the supply pipes where they lost their life and set up decomposition. (See British Local Government report for 1887.) I lately visited the source of supply of a town that draws from the waters of the Oswegatchie River and noticed that gas rose through the volume of water from which they took their supply in many places, just as if peas were shot upward through the water causing bubbles at the surface and miniature colored circles for a second on the water where the gas burst forth. The water of this river is of a reddish color which shows the presence of iron in the water, and the gas discharged proved that there were vegetable or animal substances in a state of decomposition in the water. This class of water I should consider unfit for a public supply unless well filtered.

Rivers are natural open sewers, where the filth discharged by the inhabitants living along the land contained within the water shed is carried away to the salt water of the sea for purification; during the passage of the water towards the sea most of the solid disagreeable matters the water contains settle to the bed of the streams, occasionally making their appearance when the waters of the river are violently disturbed and the filth raked up from the bottom by wind storms. At such times the water is unsafe to use for domestic purposes and the supply should be discontinued until the river becomes calm and settled again.

A couple of weeks since I was on a diver's raft attending the laying of a water pipe into a river; the diver was down about twenty feet when a due east wind storm occurred, churning up the river water as if a number of gigantic Ferris wheel bucket pumps had been set in motion. The water quickly turned from a bright, clear fluid to a bluish black, and the diver was soon unable to see but a few inches before his glass; when the turbulent water was placed in a tumbler it exposed a great number of particles of dirt and had a slight odor. Such sudden changes in a quality of river water are common where the sewage from the inhabitants and the refuse of manufacturers are discharged into it. The waters of rivers may easily purify the dirty fluids collected from the face of the land and stagnant pools, but they cannot also provide for the purification of the sewage of the inhabitants and the foul refuse cast out by lumber mills, dyehouses, soap works, sugar refineries, chemical works and other factories. When such substances enter the river they go down the stream, the particles clinging together, seldom mixing with the fresh water of the river until the heavy solids have settled down to the bed of the river, or by some means the fresh and sewage waters are violently agitated to compel incorporation. The solids carry with them anerobic germs which breed and multiply until disturbed by storms and they receive partial oxidation by the agitation it gets during the commotion. Should such water enter the town's waterpipe the dirt would settle to the invert of the water main, especially if such water mains are larger than are necessary to supply the water takers. When once the foul solids secure lodgment in the water mains they will ferment and breed more germs, and continue to breed and increase the contamination of the water supply until the germs and dirt are well washed out; this is why efficient provision should always be made to thoroughly clean out the water pipes.

(To be continued.)

ST. LAWRENCE LEVELS.

The Chicago Drainage Canal was opened January 2nd. The water should have been let in December 1st, but legal delays made themselves felt. It was to be hoped that these delays would continue. Not that we wished to have the people of Chicago supping sewage as has been their wont these many years, nor drawing all their liquid supplies from Milwaukee, as we fear there is danger, but if the St. Lawrence is to be maintained at anything like its present level and our costly canals to be available, the people of Chicago must still continue to receive their present filthy water supply of which their own analysts constantly report "unusable." The engineers appointed by the United States Government to enquire into the probable effects of the opening of the canal state that the lake levels will be reduced by at least six inches and perhaps three feet. We have not alarmed ourselves here in Canada hitherto about this matter because we knew that what we suffered in loss of harbors and ship channels would be small in comparison with the loss of such towns as Buffalo, where each inch of deficiency in the harbor costs one million dollars for dredging, but a new danger threatens us, and we must now take measures to protect our interests, and that at once, before our all too friendly Government at Ottawa has fallen into the trap which has been set for the Canadian interest. It is contained in the report of the engineers, designated to make surveys and examinations of deep waterways and routes between the great lakes and Atlantic tide waters, which recommends the regulation of the Lake Erie level by controlling the discharge through the Niagara River by a system of fixed weirs, built near the head of the Niagara River, and a series of sluices to be operated in connection with them so as to control the discharge of the lake, and reduce the *variation of its level to a small amount.*

This will, of course, entail the erection of wing dams on the St. Lawrence to make Lake Ontario ports and the St. Lawrence channels navigable .It is a scheme to throw all the loss of level due to the new canal onto Lake Ontario and the St. Lawrence. The dams will make whatever level is determined upon permanent, but whatever loss is due to the diminished flow will fall on the St. Lawrence. But more serious than that, in both its first cost and its disastrous delays, would be the absolutely necessary dam and locks below Montreal at the foot of Lake St. Peter.

The Chicago drainage canal may not ruin the Canadian lake and river towns and cities, and if it does it also

destroys many great cities of the United States. But the Chicago drainage and the Niagara dam together mean the absolute ruin of Montreal as an ocean port. It will be no more an ocean port than Lachine or Valleyfield, and Buffalo will maintain its position as the chief centre of the grain carrying trade.

MATHEMATICS IN THE MECHANICAL TRADES.*

BY J. S. PLASKETT, B.A.

The subject of this paper may be considered from two standpoints. The first, and to undergraduates the most familiar point of view, is from the standpoint of the student entering or intending to enter any of the mechanical trades. A graduate of a School of Science, about to put his knowledge to the test of practical application, being a good example of this class. The second is from the standpoint of the mechanic, who, ambitious to improve his standing, determines to apply himself to those studies most likely to be of benefit to him. At the outset, however, let me disclaim any intention of touching upon the subject of technical education. I will confine myself principally to discussing the subject from the second standpoint, giving examples of the application of mathematics to the mechanical trades. Examples will also be given in which mathematical methods are justifiably superseded by mechanical ones.

The question that naturally arises in the first place is what constitutes a mechanic, or what are the mechanical trades. According to the generally accepted definition, a mechanic is "one who works with machines or implements; one skilled in shaping or uniting materials, as wood, metal, etc., into any kind of structure, or machine, or other object requiring the use of tools or instruments." The mechanical trades then would embrace those occupations at which mechanics are engaged. The ordinary use of the term seems, however, to confine the mechanical trades to those in which metal is worked, and these are what will be considered almost entirely in this paper.

The mathematical knowledge of the average apprentice or journeyman in these trades is comprised in a short and inadequate Public School training in arithmetic. They have not even touched any other branches of mathematics, while their knowledge of arithmetic is very limited and quite insufficient to meet many of the demands that will be made upon it. Many of the operations which mechanics have to perform are done without being fully comprehended, while many others cannot be done unaided, simply from failing to understand, what would seem to even the tyro in mathematics a very simple problem.

In consequence the mechanical trades are burdened with innumerable rules and formulae, bearing on the difficulties most likely to arise, and in the hope of overcoming the lack of mathematical knowledge on the part of the operators. A very familiar instance, at least to machinists, of such rules is that relating to the cutting of screws on engine lathes. Screw cutting on a lathe depends, as no doubt most of you know, on the motion of the tool carriage at a rate definitely proportional to the revolutions of the spindle and work to be screwed.

*A paper read before the Mathematical and Physical Society of the University of Toronto, Dec. 1st, 1899.

As the carriage is moved by the revolution of a screw, called the lead screw, of a pitch which is usually 4, 6, or 8 threads to the inch, the problem resolves itself, in simple gearing, into finding two gear wheels among the set which accompanies the lathe, the numbers of whose teeth are in the ratio of the pitch required to the pitch of the lead screw. Thus, if a screw of 14 threads to the inch is required, and the lead screw is 6 threads to the inch, the gears must be in the ratio of 14 to 6. The gear on the spindle generally remains constant, say it has 36 teeth. Then on the lead screw will be required a gear of 14-6 x 36, or 84 teeth. The intermediate gear that connects the spindle and screw gears has no effect on the rate of motion, but simply serves to communicate the motion. This does not form a very intricate piece of calculation, and yet nine times out of ten you will see the machinist consulting his screw cutting tables, which, by the way, are always attached to the lathe, whenever a thread is to be cut.

If the gearing is compounded, that is if an extra pair of gears fastened to the same axle is introduced between the spindle and the screw gear, instead of the intermediate gear, the calculations are not quite so simple, although performed on the same principle, and

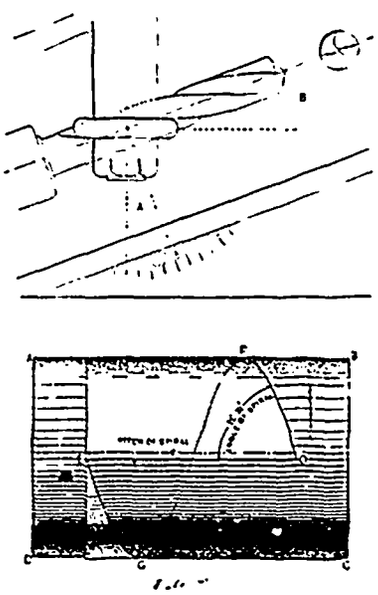


FIG 1.

are more intricate still when spirals are required to be cut on the milling machine, a familiar example of such a spiral being the groove in a twist drill. This groove is produced by a rotating cutter somewhat similar in principle to a small circular saw, only having teeth properly shaped to produce the groove. It is evident from the upper half of Fig. 1, that the work must rotate and move longitudinally at the same time, and that these movements must bear some definite ratio to one another. When we consider the fact that the longitudinal motion is given by the rotation of a screw, that the rotary motion of the work is produced by the rotation of a worm gearing into a worm wheel to whose axis the work is fastened, and that these two rotary motions are combined (Fig. 2), by connecting the worm shaft and the screw by gears, some idea of the trickiness, I can hardly call it difficulty, of the problem dawns upon us. In addition to this, the work and the cutter must be set at an angle to one another (Fig. 1), this angle depending on the diameter of the work and the pitch of the spiral; a spiral, technically speaking, being nothing

more than a screw of great pitch, from ten to one hundred times as great as an ordinary screw of the same diameter. The first part of the calculation requires arithmetic only, but the second a slight knowledge of trigonometry. As can readily be seen from the lower half of Fig. 1, the angle that the spiral makes with the axis of the work, and consequently the angle between the cutter and the work, is the angle whose natural tangent is the ratio of the circumference of the work to the pitch of the spiral. Of course tables are given to cover most of the cases that will arise, but the utility of being able to calculate the proper gears and angle appears when a spiral is to be cut which is not on the tables. Instances like the above of the necessity of arithmetical calculations in the mechanical trades may be multiplied indefinitely, while the inability of the average mechanic to undertake them is clearly shown by

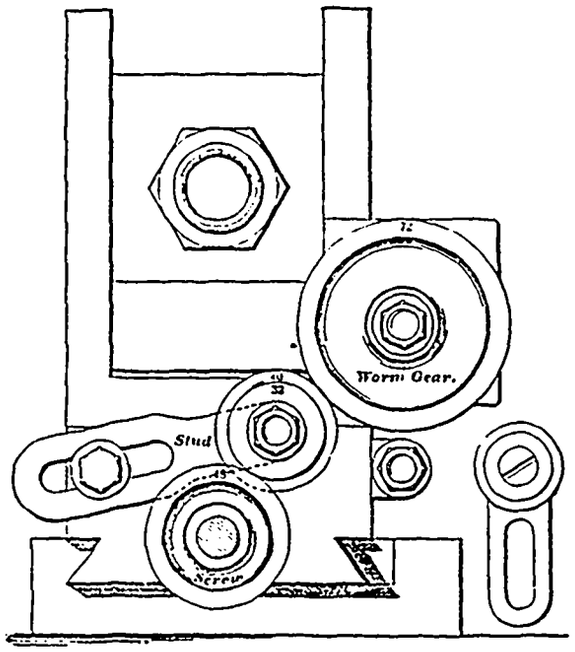


FIG. 2.

the rules, formulae and tables, which are met so frequently. I venture to say, however, that the one branch of mathematics most universally useful in all the mechanical trades is that of geometry. By geometry is not only meant the ordinary Collegiate Institute idea of the term, including practically only Euclid's elements, but also the more modern constructive and descriptive part of the subject, which is usually included in the study of mechanical drawing. Euclid, although useful, and, I think, necessary as a training for mechanics, and also as an aid in many problems likely to arise, is not so generally used practically as descriptive geometry. A knowledge of descriptive geometry and mechanical drawing will prove of very great service in every one of the mechanic arts, and is, in fact, indispensable in most of them. That mechanics should be able to read drawings is absolutely necessary. To be able to reproduce them would indicate the acquisition of a very fair knowledge of geometry, in no other way so easily attained.

To illustrate the importance of geometry in the mechanical trades seems hardly necessary, when you consider that every structure and machine is based on geometrical lines and conforms to geometrical principles. A few examples showing the application of geometry in some mechanical problems will, however, be given. How would the carpenter, if geometry were unknown, determine the forms and sizes of the various parts used in building construction? Or how would the tinsmith construct any vessels for domestic use?

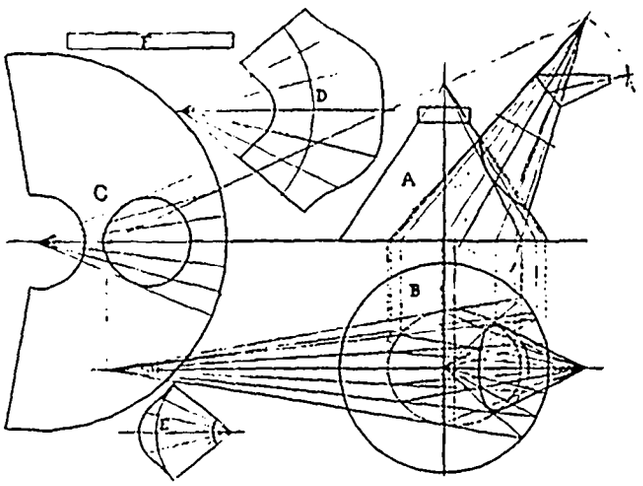


FIG. 3.

Even so simple a utensil as an ordinary tin pail would require some thought, perhaps, from our undergraduates in mathematics, in order to develop the proper form to cut the tin, that when rolled up and joined, it might be the correct shape. Again, let us consider another domestic utensil, a tin teapot. Although the tin is not beneficial to the flavor of the tea made in it, the construction of the pot itself forms a very fine problem. Figure 3, A, shows the general outline of the teapot, which I will grant is not an orthodox shape, but the peculiarities have been exaggerated for the sake of example. B. is the view from above showing the intersection of the body and spout. C. is the developed form of the body of the teapot; D. the form of the lower, E. of the upper part of the spout; F. is the band at the top, while the bottom, of course, will be a circle of the same diameter as B. The development of these forms would I fancy be rather too intricate for most of us. But you may say that tinsmiths cut the tin approximately to shape and then trim it afterwards, or that they have patterns. Well, how close an approximation would your

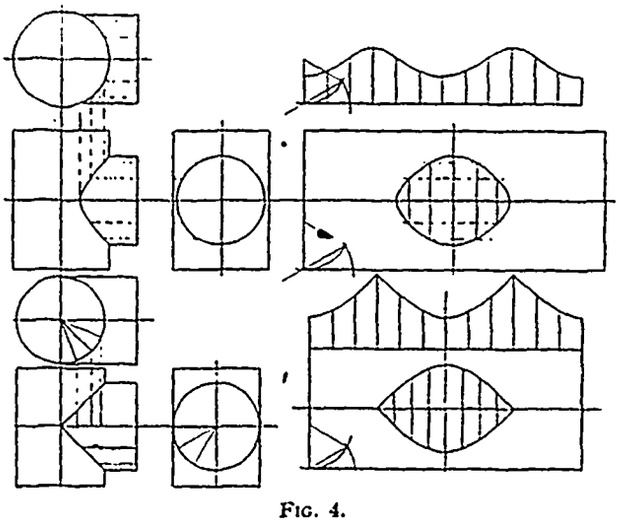


FIG. 4.

first guess of the shape of the spout be? Or how were the patterns obtained? How do boilermakers, in the construction of boilers, determine the forms to be given to the sheets, that, when rolled up, they may ex-

actly fit where two surfaces intersect, as at the junction of the dome to the main shell? The sheets are not very easily trimmed in this case. Figure 4 will illustrate the forms, the upper being the ordinary boiler and dome, and the lower the intersection of two circular cylinders of equal diameters at right angles.

In the construction of machines, work has often to be laid out, holes drilled, and other operations performed on pieces which have to come together exactly and fit perfectly, and which cannot be tried and made to suit. Geometrical methods are adapted to this purpose, and it is marvellous how accurately such work can be done. A similar example, and one perhaps more familiar to you, is in stonecutting. The stones are cut to shape and put in place, and I never remember seeing one taken down and altered. Many examples of difficult geometrical construction in stonework may be seen around the doorways and arches in University College.

From these examples it will be seen how universally geometry is employed in the mechanical trades, and how necessary a knowledge of its elementary principles at least is to all artisans. Let it not be understood, however, that it is always preferable in the practice of the mechanic arts to employ theoretical geometrical methods. Very often such is not the case, and mechanical aids are to be preferred. Who would think, for instance, of drawing a line perpendicular to another line, or of finding out if two plane surfaces were at right angles by Euclid's method, when an accurate steel square was obtainable? What would be thought of a

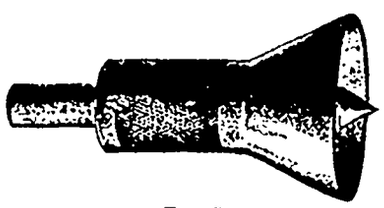


Fig. 5.
Bell Centering Punch.

machinist, who, when told to centre a circular shaft, tried to do so by bisecting the perpendicular through the middle point of any chord? As an example of mechanical methods, I will describe three ways in which this would usually be done. The bell centering punch (Fig 5), consists of a hollow cone with the punch constrained to move along the axis. This answers very well if the shafting is small and no great accuracy is required. A second method is to make a mark by a centre punch, as near the centre as possible, and then rotate the shaft between the lathe centres. It will be immediately seen when it is accurately centred by the periphery of the shaft revolving truly. If it does not run truly, the mark is punched over to the required side and again tested. As soon as the shaft runs truly, a small hole is drilled at the centre thus obtained, and this hole is countersunk by a centre reamer ground to the proper angle to fit the centres. A third and perhaps commoner method is to place the shaft in the lathe, the ordinary conical tail centre being replaced by what is called a square centre. This has the form of a square pyramid, the angle between the opposite edges being usually 60°. If the shaft is made to rotate against this square centre, while its periphery rubs against a bar firmly fixed in the tool post, it is evident that, as the sharp edges of the centre cut into the end of the shaft, they will form a conical hole. This hole will be exactly in the centre, for the outside of the shaft is constrained to move truly. The two latter methods depend of course on the geometrical property of the invariability in length of radii of the same circle.

Another problem continually arising is the division of circles, or rather the circumferences of circles, into any given number of equal parts. Euclid's method, by inscribing regular figures, is never used in practice. It

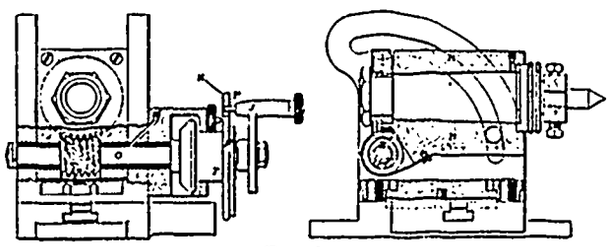


Fig. 6.

is too tedious, is only adapted for a few divisions, and is wanting in accuracy. When the division is made by hand, the circumference is always stepped off by trial with a pair of steel dividers with fine points. When the arc included by the dividers becomes so near the required one that the points cannot be moved a small enough distance by the adjusting screw, the final adjustment is made by rubbing down the proper sides of the points on an oil stone. It is by this method that large cast gears, used in mill work, three or four feet in diameter, and six inch face, have the teeth spaced off regularly, drawn to the proper form, and then chipped and filed to suit.

As in the method of centering, dividing by machine is decidedly more convenient, accurate, and expeditious. Wherever there is a milling machine, all dividing or indexing, as it is sometimes called, is performed by the index head of the machine. The head of which you see two views in the figure (Fig. 6), consists of a worm wheel, which is firmly attached to the work spindle, while gearing into this worm wheel is a worm attached to the spindle O. The worm wheel has usually 40 teeth, so that one revolution of the worm spindle, which has the crank J attached, gives 1-40th of a revolution of the work spindle, or will divide a circle attached to the work spindle into 40 parts. Suppose it is wished to divide a circle into, say, 76 parts. Then the worm

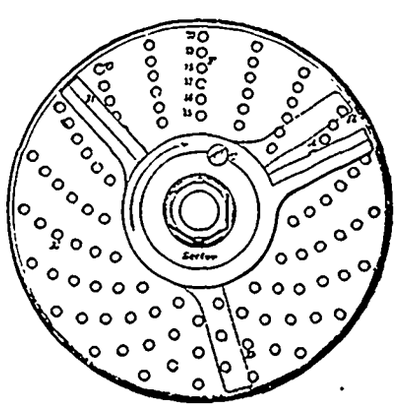


Fig 7.

must turn 40-76th's or 10-19th's of a revolution. Fastened to the side of the head (I, fig 6), concentric with the worm spindle is an index plate (fig. 7), consisting of circles of concentric equally spaced holes into

which the pin on the crank enters. To get 1-76th of a division, the pin must evidently move over 10 spaces in the 19-hole circle. By continuing to move over 10 spaces you finally divide the circle. The sectors shown are adjustable, and form a guide to the space moved over, obviating the necessity of counting at every division. Although the calculations required are not very intricate, the tables supplied are, I may safely say, always used.

This method, when the worm and wheel are accurately cut, furnishes excellent results, far excelling in speed and accuracy the ordinary stepping off process. But if it is wished to graduate circles for astronomical purposes, as near accuracy as possible is required. The divisions are made by a worm wheel and worm, as before, but in this case, in the most approved form, the worm wheel is nearly 4 ft. in diameter, and has 4,320 teeth around the circumference, each tooth, therefore, representing a division of five minutes of arc. This wheel is in the first place divided by hand and requires the most extreme care, delicacy of touch, and microscopical exactness.

One method of dividing it, due to John Troughton, is a method of bisection. The wheel is very carefully turned and polished (no scratches) on its edge and face, and along a fine circle drawn on the face near the periphery the divisions are laid out. The radius laid out from zero gives 60°. This arc bisected and the half laid off from 60° gives 90°. The arc between 60° and

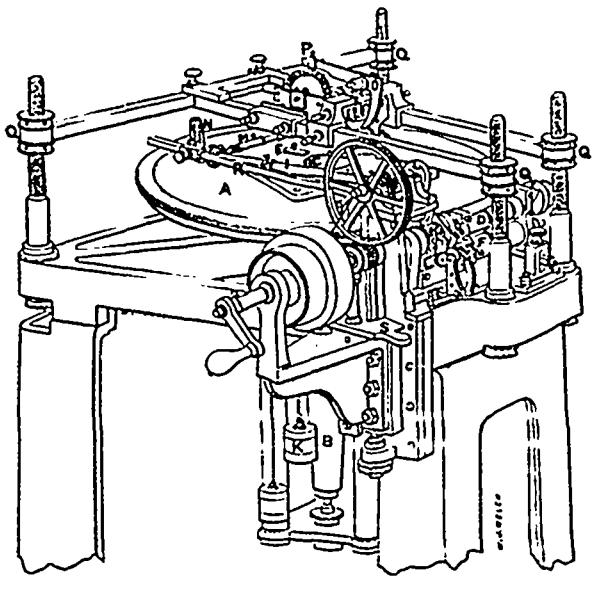


Fig 8
Dividing Engine.

90° bisected, gives 75°, and between 75° and 90° gives 82° 30′, while the arc between 82° 30′ and 90° bisected, gives 86° 15′. Further, the arc between 82° 30′ and 86° 15′, trisected, gives 85°, while the arc between 85° and 86° 15′, trisected, gives 85° 25′. Lastly, the arc between 85° and 85° 25′, quinquisected, gives 85° 20′, and this equals 5′ x 2″, and so can be finally divided by continual bisection. A very fine dot, visible only to the microscope, is made at each point of division, and the errors of these dots are determined and tabulated by the aid of reading microscopes, mounted on radial arms. Finally, the teeth are cut exactly opposite the corrected positions of the dots by a cutter. Fig. 8 shows the completed machine. The plate A. is 46 inches in diameter, and has two sets of divisions, one faint on a silver inlaid ring, and the other stronger on the gun-metal. The rest of the machinery is for making the scratch and turning the plate automatically.

Another and very appropriate example of the use of mathematics arises from the cutting of the teeth on such worm wheels. Given a wheel of given diameter, with a given number of teeth, find the pitch of the worm, and the converse, given the pitch of the worm, find the diameter of the wheel for any given number of teeth. Again, given the pitch and the diameter of the worm, find the angle at which the cutter must be set in order that the teeth and worm may exactly fit. Finally, given the shape of the worm thread, determine the form of the cutter, that the wheel and worm may work smoothly and uniformly together. To solve these problems will require, besides arithmetic, a fairly thorough knowledge of geometry and elementary trigonometry, and also a knowledge of the properties of, and an ability to trace two plane curves, the involute and the epicycloid.

Such problems are continually arising in machine work, and although rules and tables can be obtained for the guidance of workmen in standard cases, other cases are very likely to arise in which original calculations will have to be made. When such is the case, how much better it is that the workman should be able to undertake the calculations himself. He then has the satisfaction that always follows a problem solved, and moreover stands a much better chance of advancement than if he were a mere machine, able only to follow rules, and depending on the guidance of tables.

It follows, from the examples that have been given, that the mathematics required in the actual performance of ordinary operations, if the calculation is to be done by the mechanic, are a thorough knowledge of, and capability of applying the principles of arithmetic, a knowledge of geometry, including descriptive geometry and mechanical drawing, and a knowledge of the elements of plane trigonometry, particularly the solution of triangles. These seem to me to be necessary to the comprehension and intelligent performance of many common operations.

I can only, in conclusion, state my belief that, although mechanics manage to perform their work tolerably satisfactorily with their present very deficient mathematical training, if even such a course of mathematics as I have outlined could be imparted to every artisan, both the quality and quantity of the work produced would be considerably enhanced, and also there would result to the workman himself a very decided advantage.

—The Engineers' Club of Toronto, at its meeting Dec. 5th, heard a very interesting paper on the Trigonometrical Survey of the Dominion, by O. J. Klotz, Astronomer to the Department of the Interior, Ottawa. The club then discussed the sewage disposal report of C. H. Rust, city engineer, Toronto, and at the close of the discussion Prof. J. Galbraith moved and E. B. Temple seconded a resolution which calls for the disposal of Toronto's sewage otherwise than in the harbor, by building intercepting sewers and by "treating the sewage by the most approved modern methods." This seems easy enough in a resolution and the Engineers' Club doubtless felt that the sanitary condition of the city was being vastly improved, but it

might be more practicable if the "most approved modern methods" were known and agreed upon. Does the Engineers' Club feel able to pronounce on this point, or does it wish to leave the matter to the experts in the Toronto city council. Perhaps it is better to wait till the Royal Commission appointed by the British Government to determine this very point has reported. A lasting benefit would be conferred on the profession, not to mention the public, if the Engineers' Club would set this matter at rest.

—Victoria, B.C., is a storm centre from an engineering point of view. We have given some notes, from time to time, on the ups and downs of its professional advisers. There is now on hand an extra fine row over the sewage system, which is planned on the separate system, and into which it has been proposed to turn the storm water.

THE CANALS OF CANADA.*

The canals of Canada is a subject that has interested the Canadian people for more than a century. The greatest of our engineers, both civil and military, have labored in their development, our politicians have found in them the cause for bitterest controversy, and our merchants have looked forward time and again to supremacy in the export trade to Great Britain and Europe after their completion; and yet to-day, the existence of many of them is unknown to most of us, and the aid they have given to the growth of our commerce but little appreciated. Their story may best be told by considering, first their history, then their construction where viewed as examples of the engineer's art, and lastly, their commercial importance. The history of the westward movement of our civilization during the present century, is, in the main, the record of the triumphs of our engineers in developing means of transportation; and the periods of greatest activity in our political life have been followed by large expenditures upon roads, railroads and canals. To-day, confident as we are that owing to the justice of our governmental system and the fertility of our soil, our unoccupied lands present to the emigrant farmer attractions unequalled by those of any other government-held land in the world; we are still subsidizing freely every improvement in transportation facilities for the unoccupied districts, in the firm belief that our lands will not be taken up, until they are made readily accessible It is to this long recognized principle that our canals owe their commencement.

Montreal from the days of Maisonneuve to the days of Alexander McKenzie and his associates, had but one trade—the fur-trade, and that commerce taxed to the full, the transportation facilities of the country. Lachine was the western port of the city, and from it set out the trading expeditions, with their goods laden in either batteaux or canoes, that is in lumbermen's boats or in birch-bark canoes, as we know them on our rivers to-day. At the close of the 18th century they were about 30 feet long, with 6 feet beam, and could carry from three to five tons of cargo; the canoes being used on the Ottawa and Georgian Bay route, as their light weight of about 500 pounds made it possible to carry them across the numerous portages; and the batteaux were best suited to the rocky and dangerous rapids of the St. Lawrence. The profits of the trade must have been very great, for the length of time that was required to complete a transaction was appalling. Alexander Mackenzie, in his book of travels, states that it took over four years to get goods from London to trade them for furs in the Northwest, and to sell those furs in London.

It was to aid this trade that Dallier de Casson, the soldier, explorer and priest, then Superior of the Seminary of St. Sulpice, entered into contract with the engineer, Catalogne, for the construction of a cut across the divide between Lachine and little Lake St. Pierre, from which there was a canoe route to Montreal. This was in the year 1700, and although, owing to Dallier de Casson's death, the work was not completed, the gentlemen of the Seminary never ceased petitioning the King for its construction, until the old regime had passed away. The fur trade, rudely interrupted by the final struggle between France and England, was resuming its activities when the American War of Independence broke out, and after the shock of the Continental armies had broken in vain on the rock of Quebec, the soldier Governor Haldimand saw, that in order to maintain the fortified posts of the Crown in the west, built indeed largely for the benefit of the fur trade, he must have better means of forwarding supplies to them, and for that purpose he gave orders in 1779 for the building of the first St. Lawrence canal. This was built at the Cascades rapids under Capt. Twiss as engineer, and was completed in 1781; the lock being able to pass boats six feet wide, and drawing a foot and a half of water. By 1783 improvements were completed on this scale around all the rapids between Lake St. Louis and Lake St. Francis, and nothing further was done by the Government until after 1800.

But, while the Montreal traders were cheerfully paying toll to the War Department for the use of these locks, two great events of Canadian history had occurred, both in the year 1783. At that date the Northwestern Fur-Trading Company, of Montreal, began the brief, glorious and stormy life that was for awhile the life of Montreal. Its founders were men unsurpassed in our annals for vigor, courage, enterprise and ambition; their memories still linger in our streets, and are writ large upon the map of Canada; for they were the men who pushed our commercial confines to the Arctic and to the Pacific, and who, proving more than a match for John Jacob Astor and his New York associates, saved for us the Northwest. But their passions were as strong as their vigor and enterprise, and fiercely and jealously the great houses composing the company struggled against one another, and fiercely and jealously they made war upon the Hudson's Bay Company and the early Selkirk colonies, until worn out by the long struggle, the companies were at length amalgamated in 1821, and the fur trade passed away from Montreal. But in the legal records of their internal struggles Mr. Douglas Brymner found the particulars of a totally forgotten work; and a few years ago, guided by the information which he published in the Canadian Archives, engineers uncovered at Sault Ste. Marie the foundations of the first lock built by that rapid, a wooden structure, 30 feet long and 8½ feet wide, opened in 1798 by one section of the Northwest Company for the passage of their trade, and probably destroyed during the American war of 1812.

In 1783, also was signed the treaty of Versailles, perhaps the most disgraceful and cowardly action ever committed by Great Britain, when by it she abandoned the Loyalists, who had so staunchly stood for the United Empire, to persecution, confiscation and death at the hands of their enemies; but by that iniquity Canada was the gainer, and from 1784 to 1790 the Loyalists poured into her confines to build up the provinces of Ontario and New Brunswick. They had been among the ablest and most public-spirited of the citizens of the commonwealths from which they came, and from the time that they were fairly settled in Upper Canada, the cry for better access to the sea never ceased. A hundred years ago that cry could mean nothing but water-ways; a fact that is brought home to us with startling effect, when we read the speech of Adam Lymburner, a Canadian delegate sent to England to oppose the passage of the Constitution Act of 1791. That Act separated Upper and Lower Canada, and Lymburner contended that this separation was completely unnecessary as Canada never could extend beyond Hamilton, the Niagara Falls forming an insuperable obstacle.

To accommodate the rapid developing commerce of Upper Canada some improvements were made in the St. Lawrence route between 1800 and 1810, but only on the outbreak of the American War of 1812 was the insufficiency of the canals on the route fully realized by both people and Government. The building of the first Lachine canal was advised by Prevost, the Governor-General in 1815, but it was not until 1821 that the Government of Lower Canada, subsidized by the Imperial Government, undertook this work. It was completed in 1825 with stone locks 100 feet long, 20 feet wide, and 5 feet deep. While it was in progress the fur trade was passing away, and the great Quebec lumber trade was rapidly growing under the liberal fiscal policy of Great Britain towards her American colonies; its booms, dams and chutes were seen on every river; it

*From a paper by Arthur Weir, B.Sc., before the Applied Science students of McGill University.

crowded the ports of Quebec with numberless sailing vessels and built up the great fortunes of that city. The rafts of this trade passed Montreal by, but the grain trade for which our merchants and forwarders still struggle was greatly aided by the same liberal fiscal policy that extended to our grain exports that protection in the home markets that our producers now so earnestly covet.

While Lower Canada was building the Lachine canal, the Imperial Government was considering the safest means of securing water communication with Upper Canada. The works being built for purposes of defence the St. Lawrence route could not be utilized, and that by the Ottawa and Rideau rivers to Kingston was chosen. Upper Canada refused to contribute to this work on the ground that it would not furnish as suitable a commercial route as the St. Lawrence, and this refusal seems to have had the approval of the Royal Engineers, who for military reasons held that the War Department should have entire control of the canal. This view was long held and it was not until 1856 that the Home Government handed over the Rideau canal to Canada.

It was commenced by Col. By in 1826, and opened in 1832, the Carillon and Grenville canals on the Ottawa, which formed part of the route, being opened in 1834. The engineers of to-day sometimes make mistakes in their estimates, but it is questionable if their errors ever equal those made on the Rideau canal, which was commenced on an estimate of £160,000 and cost £800,000 to complete. It is but justice, however, to say that owing to the efforts of Col. By the magnitude of the work was greatly increased during construction, in order to make it suitable for steamboat traffic, which had been commenced upon the St. Lawrence by the Hon. John Molson in 1809. The Rideau route immediately became the route for heavy traffic to the west, and the attractions and the cuisine of its steamers were as energetically advertised as are those of the Empress steamers to-day. The locks were 134 x 32 x 5½, but the through route was throttled by three locks of the Grenville canal, which were built before the adoption of Col. By's report, with dimensions of 107 x 20 x 5½ and by a private lock at Vaudreuil. The Grenville locks were not rebuilt until after Confederation.

The Cascades and Cedar Rapids being within the limits of Lower Canada, the St. Lawrence route could not be opened except with the consent of that province, and it was openly charged in Upper Canada that the selfish interests of Montreal prevented this improvement. Angry at this indifference or opposition, out of sympathy with the military ends of Home Government, and urged on by that section of the province which lay below the mouth of the Rideau canal, Upper Canada was pushing on her own canal schemes. Chiefest of these was the Welland canal, built to connect Lake Erie with Lake Ontario, and to overcome Adam Lymburner's insuperable obstacle. Many claims have been made for the honor of the inception of this great enterprise, but that honor seems hardly worth striving for, for the historian Kingsford, himself an engineer, says of it, that "a wilder, more ill considered scheme than the one originally put forth, one showing more ignorance and recklessness on the part of the projectors, it is scarcely possible to conceive." Commenced in 1825 by a chartered company it was sufficiently completed by November, 1828, to let two vessels through its wooden locks of 100 x 22 x 7. But misfortune came fast, and no other chartered company perhaps has ever left such a record of intrigue, mismanagement, and disaster. Subscriptions were solicited everywhere, in Lower Canada, in New Brunswick, in New York and in England; subsidies were given by Upper Canada, by Lower Canada, and by England, and the company struggled on until the story was ended by the purchase of its works by Upper Canada in 1839. Those were troublous days in that province, and the struggle against the Family Compact was being carried on in all its intemperance and virulence, but of all the Parliamentary reports of the period none is more extraordinary than that dealing with the Welland Canal Company. It characterizes many of the proceedings of the directorate as "inexplicable; no statement has been heard which supports the justice or even expediency of arrangements which, if applied to the ordinary transactions of life, would be deemed not only ruinous but the result of insanity." And it ends, even as a Parliamentary enquiry of to-day, by exonerating everybody concerned.

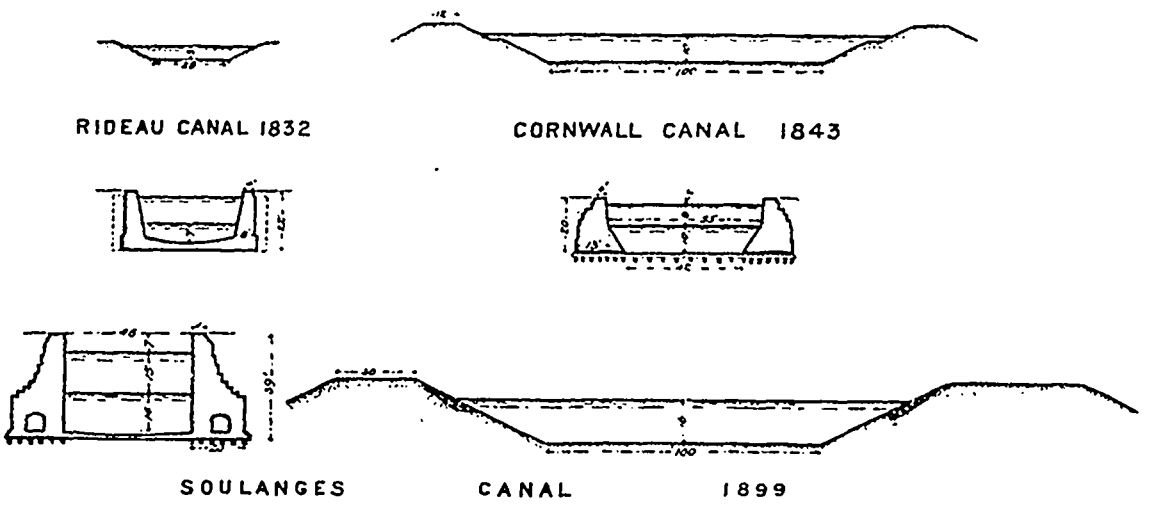
Upper Canada had commenced the Trent canal, and all but completed the Cornwall canal, when the great political struggle suddenly ended, and the adoption of Lord Durham's report brought about the union of the provinces in 1841. In 1840 Col. Philpotts, R.E., presented a report upon the canal navigation of the Canadas, which had been originally called for by Lord Durham. In it he recommends the St. Lawrence route as the only Canadian route that could be made to compete successfully with the Erie canal. Going into detail, he points out that the Welland canal with its badly built line and rotting locks must be reconstructed, that the Cornwall canal is unfinished and its structures rapidly deteriorating, that a new canal must be built past the Cascades and Cedars, and that the Lachine must be greatly enlarged.

Immediately after the union commenced an era of great activity in canal construction under the management of a Board of Works with H. H. Killaly as chairman, and S. Keefer as chief engineer. In these enterprises the Canadas were assured of the fullest support of the Imperial Government, both financial and military, if such were required. The recommendations of Col. Philpotts were closely followed, and by 1848, a nine foot route was open from Lake Erie to the sea. In the walls of its first completed work, the Cornwall canal remained for many years a record of changing conditions, for its locks alone of all the St. Lawrence canals were built 55 feet wide, the remainder being made 45 feet because the propeller screw had been invented and had proved more suitable for navigation than the paddle wheel. The locks of the St. Lawrence canals were built 200 x 45 x 9, and they were rapidly opened, the Cornwall in 1843, the Beauharnois in 1845 and the Lachine in 1848, and with their completion the traffic left the Rideau route forever, and it remains to-day a work of local utility, and a monument to the efforts that Great Britain put forth for the defence of Canada. In these enlargements there are two points worthy of note. The locks of the new Welland were built only 180 x 26½ feet, because the Governor-General did not think the country could bear the greater cost of the full sized locks, and the location of the Beauharnois canals gave rise to one of the bitterest political controversies of the day. It was charged that the Governor-General influenced by the Seignior of Beauharnois had caused the Board of Works to choose the present location, and that the canal ought to have been built upon the north shore of the river. The Board of Works seems, however, to have been supported by the best engineers of the day, and the controversy is only worthy of note now, because the last of the new 14 foot canals is being built upon the north shore location that was then so hotly advocated. While these works were progressing on the main route, the Chambly canal commenced by Lower Canada in the previous decade was completed, and the private lock at Vaudreuil rendered unnecessary by the opening of a Government lock at St. Annes.

The canal history of the next twenty years is one of minor developments and repairs, to accommodate a steadily increasing traffic; but with it grew a feeling that owing to the rapid increase in the size of the lake vessels, and the great activity displayed by the American railroads in concentrating the eastward traffic on the line from Buffalo to New York, that the canals must be greatly enlarged to enable our shippers to secure a share of that traffic. As more than once before, there was no practical outcome for this feeling until another great political change had come, and the Dominion was ushered in to carry on the policy instituted by Upper Canada and adopted by the United Canadas. In 1870 a commission with Hugh Allan as chairman, and S. Keefer as secretary, was appointed to consider canal enlargement. Their report of 1871 fully reviews the whole subject, and will be referred to later. They recommended enlarging the St. Lawrence canal to 12 feet draught, with locks of 270 x 45, and this work was promptly undertaken by the Government, although the draught was subsequently increased to 14 feet. It is not yet completed, but we may hope to see vessels drawing 14 feet of water coming down to Montreal in the latter part of 1899 or the beginning of 1900. The commission also recommended some improvements on the Ottawa river canals, which have been completed.

Thus at the close of the century Canada finds herself possessed of a system of inland navigation, which for extent and capacity is unequalled anywhere in the world, and of whose

construction and maintenance out of her slender resources she is justly proud. First, the St. Lawrence, extending for a total length of 71 miles, ascending a total height of 551 feet, and opening up a continuous 14 feet navigation from Montreal to Port Arthur, a distance of 1,274 miles. The locks, with one exception, are built to pass vessels 255 feet long and 44½ feet wide. The one exception is the Sault Ste. Marie lock, which is designed for the lake trade, and is 900 feet long, 60 feet wide and 20 feet deep. The separate canals in this system are, the Lachine, the Soulanges, the Cornwall, the Williamsburg, the Welland and the Sault Ste. Marie, containing in all 47 locks. Second, the Ottawa and Rideau system, from Lachine to Kingston by this route is 237 miles. The reach of it, that extends from Montreal to Ottawa, has been improved since Confederation, and by the St. Anne's, Carillon and Grenville canals passage is afforded for vessels less than 185 feet long by 44½ feet wide with 9 feet draught. Beyond Ottawa is the old Rideau canal, practically untouched since its original completion, and with no more than 4½ feet of water in some of its reaches. In all there are 55 locks and a total rise and fall to Lake Ontario of 309 feet. Third, the Richelieu, comprising the St. Ours' lock and the Chambly canal. These open up a navigation to New York, via Lake Champlain. There are 10 locks in all, overcoming a rise of 79 feet: the size of the locks is 118 feet long by 22½ feet wide by 7 feet draught. Fourth, the Trent, which has not yet been completed, and will be referred to later. Besides



these great systems, there are some minor works such as the Murray canal and the St. Peter's canal, which do not call for special mention.

Considering the canals next as works of engineering we find that two different systems of development have been used in their construction; the one being to overcome the rapids and shoals of the river by an artificial water-way dug around them, and the other to turn the river into a series of vast pools by building great dams across it. Locks are equally necessary in both systems. The Rideau and Trent navigations are constructed by the method of dams, or as it is called by the canalization of the river, while the St. Lawrence and the great part of the Ottawa and Richelieu works are canals proper.

The Rideau was and remains to-day perhaps the boldest and most extensive piece of canalization in the world, and although many of its details have now ceased to be regarded as the best engineering practice, its continued efficiency in service is a high tribute to the skill and judgment of the men who built it, especially when we consider the conditions under which they labored. It was built through an almost unexplored country, without local labor or means of sustenance, and its engineers were practically without data on which to base their designs, for there were no previously constructed works from whose failures and inconveniences they could draw their conclusions. The story of the growth of Bytown reads almost like the tales the modern newspapers tells us of Wady Halfa and the Soudan railways. It was in great measure the lack of labor that made the Royal Engineers adopt the method of dams, for by it they avoided large quantities of excavation which could at that date have been handled only at great cost; the backwater from the dams of course flooded large areas of ground, but that was uninhabited and valueless, and the broad channels created made it possible to operate boats with a freedom and speed not permissible in narrow canals. The method of construction made it unique in one notable particular; no tow path could be conveniently built, and the historic canal mule never trod its banks. This method of canalization is not, however, without its faults, and there are two grave engineering objections to it. The one absolute necessity of the canal engineer is water, and that in bountiful supply, and of full depth, for on that supply and depth depends the possibility of handling boats with full cargoes in the dry fall months, and the clearest proof of the engineer's lack of foresight and ability is his failure to provide them. Too often they are naturally lacking, and a system of broad, shallow pools, which greatly increase the local evaporation, intensifies this shortage, and such a difficulty is found on the Rideau.

(To be continued).

AN ACETYLENE GAS MACHINE PATENT IN COURT.

The action arose out of the contract made between the respondent and the appellants, dated 7th July, 1897, which recited that the respondent, McMurray, applied for a patent, and was the owner and inventor of an acetylene gas machine. This contained a device for shaking the carbide. By this contract the respondent, McMurray, agreed to sell to the appellants the patent to manufacture said machine, and all improvements and patents for said machine, that he might thereafter make in connection with the same, for the price of $3,000, payable $750 by promissory note, within ten days after the issuance of letters patent for Canada, and the assignments for same to appellants, the balance to be paid within two months after the issuance of letters patent for the United States, and the assignment thereof to the appellants. The respondent, McMurray, procured a patent for Canada, but between the date of the same and the issuance of the patent, a new shaking device was substituted for that which was in the machine, at the time of the contract, which the respondent, McMurray, claimed was an improvement on that of the former. The appellants accepted an assignment of it and paid for it. Subsequently a United States patent was applied for, and the United States Patent Office declined to patent the shaker at all, it being then old in the United States, and not the subject of a patent. The appellants thereupon declined to accept an assignment, claiming that the respondent had not fulfilled his part of the contract. The action was tried before the Hon. Mr. Justice Ferguson, whose judgment was delivered on the 20th day of September, 1898, directing judgment to be entered for the plaintiff against the defendants for the sum of $2,250, with interest from the commencement of the action, and with costs, and that the counter-claim of the defendants be dismissed with costs. The defendants appealed to the Court of Appeal for Ontario, and on the 29th day of June, 1899, got judgment, dismissing the appeal with costs. The defendants now appeal to the Supreme Court of Canada. The appellants appealed to the Supreme Court of Canada, and judgment has just been handed down, allowing the appeal with full costs. Biggar & McBrayne, Hamilton, Ont., were for the appellants, and Raymond & Cohoe, Welland, Ont., were for the respondents.

THE PRACTICAL MAN.

TABLE OF DIMENSIONS AND RESISTANCES OF PURE COPPER WIRE.*

Amer. Gauge B. & S. No	Diameter, Mills	Area. Circular Mils (d^2) 1 Mil = .001 in.	Area. Square in. ($d^2 \times .7854$)	Weight and Length, sp. gr. 8.9. Lbs. per 1000 ft.	Lbs. per Mile.	Feet per lb.	Resistance at 75° F. R Ohms per 1000 ft.	Ohms per mile.	Feet per Ohm.	Ohm per lb.
0000	460.000	211600.00	166190.	639.33	3375.7	1.56	.04906	.25903	20383.	.000076736
000	409.640	167805.00	131790.	507.01	2677.0	1.97	.06186	.32664	16165.	.00012039
00	364.800	133079.40	104520.	402.09	2123.0	2.49	.07801	.41187	12820.	.00019423
0	324.950	105592.50	82932.	319.04	1684.5	3.13	.09831	.51909	10409.	.00030772
1	289.300	83694.20	65733.	252.88	1335.2	3.95	.12404	.65490	8062.3	.00048994
2	257.630	66373.00	52130.	200.54	1058.8	4.99	.15640	.82582	6393.7	.00078045
3	229.420	52634.00	41339.	159.03	839.68	6.29	.19723	1.0414	5070.2	.0012406
4	204.310	41742.00	32784.	126.12	665.91	7.93	.24869	1.3131	4021.0	.0019721
5	181.940	33102.00	25998.	100.01	528 05	10.00	.31361	1.6558	3188.7	.0031361
6	162.020	26250.50	20617.	79.32	418.81	12.61	.39546	2 0881	2528.7	.0049868
7	144.280	20816.00	16349.	62.90	332.11	15.90	.49871	2.6331	2005.2	.0079294
8	128.490	16509.00	12966.	49.88	263.37	20.05	.62881	3.3201	1590.3	.012608
9	114.430	13594.00	10284.	39.56	208.88	25.28	.79281	4.1860	1261.3	.020042
10	101.890	10381.00	8153.2	31.37	165.63	31.38	1.	5.2800	1000.0	.031380
11	90.742	8234.00	6467.0	24.88	137.37	40.20	1.2607	6.6568	793.18	.050682
12	80.808	6529.90	5128.6	19.73	104.18	50 69	1.5898	8.3940	629.02	.080585
13	71.961	5178.40	4067.1	15.65	82.632	63.91	2.0047	10.585	498.83	.12841
14	64.084	4106 80	3146.9	12.41	65.525	80.59	2.5908	13.680	385.97	.20880
15	57.068	3256.7	2557.8	9.84	51.956	101.63	3.1150	16.477	321.02	.31658
16	50.820	2582.9	2028.6	7.81	41.237	128.14	4.0191	21.221	248.81	.51501
17	45.257	2048.2	1608.6	6.19	32.683	161.59	5.0683	26.761	197.30	.81900
18	40.303	1624.3	1275.7	4.91	25.925	203.76	6.3911	33.745	156.47	1.3023
19	35.390	1252.4	983.64	3.78	20.051	264.26	8.2889	43.765	120.64	2.1904
20	31.961	1021.5	802.28	3.09	16.315	324.00	10.163	53.658	98.401	3.2926
21	28.462	810.10	636.25	2.45	12.936	408.56	12.815	67.660	78.037	5.2355
22	25.347	642.70	504.78	1.94	10.243	515.15	16.152	85.283	61.911	8.320
23	22.571	509.45	400.12	1.54	8.1312	649.66	20.377	107.59	49.087	13.238
24	20.100	404.01	317.31	1.22	6.4416	819 21	25.695	135.67	38.918	21.050
25	17.900	320.40	251.64	.97	5.1216	1032.96	32.400	171.07	30.864	33.466
26	15.940	254.01	199.50	.77	4.0656	1302.61	40.868	215.79	24.469	35.235
27	14.195	201.50	158.26	.61	3.2208	1642.55	51.519	272.02	19.410	84.644
28	12.641	159.79	125.50	.48	2.5344	2071.22	64.966	343.02	15.393	131.56
29	11.257	126.72	99.526	.38	2.0064	2611.82	81.921	432.54	12.207	213.96
30	10.025	100.5	78.933	.30	1.5840	3293.97	103.30	545.39	9.6812	340.25
31	8.928	79.71	62.604	.24	1.2672	4152.22	127.27	671.99	7.8573	528.45
32	7.950	63.20	49.637	.19	1.0032	5236.66	164.26	867.27	6.0880	860.33
33	7.080	50.13	39.372	.15	.7920	6602.71	207.08	1093.4	4.8290	1367.3
34	6.304	39.74	31.212	.12	.6336	8328 30	261.23	1379.3	3.8281	2175.5
35	5.614	31.52	24.756	.10	.5280	10501.35	329.35	1738.9	3.0363	3458.5
36	5.000	25.000	19.635	.08	.4224	13238.83	415.24	2192.5	2.4082	5497.4
37	4.453	19.83	15.567	.06	.3168	16691 06	523.76	2765 5	1.9093	8742.1
38	3.965	15.72	12.347	.05	.2640	20854.65	660.37	3486.7	1.5143	13772.
39	3.531	12.47	9.7939	.04	.2112	26302.23	832.48	4395.5	1.2012	21896.
40	3.144	9.89	7.7676	.03	.1584	33175.94	1049.7	5542.1	.9527	34823.

* Calculated on the basis of Dr. Matthiessen's standard, viz., 1 mile of pure copper wire of 1-16-inch diameter equals 13.59 ohms at 15.5° C. or 59.9° F.

These tables are theoretically correct, but variations must be expected in practice.

TEMPERATURE.

C. A. S. E. Executive Office,
Lesson Paper No. 3.

Temperature means the sensible heat in anything, and is measured by an instrument called a thermometer. In general use we find three kinds of thermometers, Fahrenheit's, the Centigrade and Rheamur's. In Fahrenheit's the space between the freezing and the boiling points is divided into 180 spaces or degrees, the freezing point being 32°, and the boiling point being 212°. In the Centigrade the freezing is 0, and the boiling is 100°, the space between them thus being divided into 100 parts or degrees; hence its name, signifying 100 steps. In Rheamur's the freezing is 0 and the boiling is 80°, the space between being divided into 80 parts. The "0" on all these scales reads zero, all above it is plus and all below is minus, viz., a temperature of 10° below zero is written —10°.

You will clearly see by the above that 180° F. = 100° C. = 80° R., and from these we can get rules for comparing degrees of temperature on one scale to those of another. The freezing point on Fahrenheit's scale is 32° above zero, while all other thermometers have the zero at the freezing point; so that if you are given Fahrenheit, to find others from it you must first subtract 32°, but if you are given the others to find F., you should add 32° after the calculation is performed. Examples: What mark on a Centigrade will agree with 90° F.? First, 90° F.— 32° = 58° F. Then as 180° F. : 100° C. :: 58°, 100 x 58 ÷ 180 = 32.2° Centigrade. Ans.

What mark on a Fahrenheit will correspond with 124° on Centigrade? The proportion would be as follows: As 100° C. : 180° F. :: 124°, 124 x 180 ÷ 100 = 223.2 + 32 = 255.2. Answer.

All measurements of whatever nature are referred to some conventional unit of its kind: The unit of temperature is one degree F. or the 180th part of the distance on the thermometric

scale, between the freezing and boiling points, under a pressure of one atmosphere.

The unit of heat, or the British thermal heat unit, is that quantity of heat necessary to be added to 1 lb. of water (at or near its freezing point), to raise its temperature 1° Fahrenheit.

The unit of power is 1 lb. lifted 12 inches, or 1 lb. of force acting through 1 foot of distance, and is called the foot pound; 33,000 foot pounds, or units of work done in one minute, make a horse-power.

The unit of work is the raising of 1 lb. through one foot. and a unit of heat is equivalent to 778 units of work.

If water is at the temperature of 60° F., how many pounds of it will it take to condense 1 lb. of steam at 5 lbs. pressure, the resultant water to be 110° F.? It is evident to answer this question you must know how much heat is in the steam. Look up the steam tables in any of your hand-books, and you will see 1151° as the heat of the steam; this we will say is 1151° = T, and the 110° in the resultant water, is 110° = T_1.

Then we have $\frac{1150 - T_1}{T_1 - T} = P.$, or pounds of water required.

We now have our calculation to put down in this way: $\frac{1150 - 110}{110 - 60} = \frac{1040}{50} = 20.8$ lbs. Ans. And in this formula: T = temperature of the water, T¹ = heat in the resultant water, S = total heat units in the steam, P = amount of T to be used. The formula before any figures are substituted for the letters would stand thus:

$P = \frac{S - T_1}{T_1 - T}$ or in figures $\frac{1150 - 110}{110 - 60} = 20.8$ lbs. water.

Many everyday problems in connection with our engines and boilers can be worked out by the simple rules of arithmetic by understanding the thermal heat unit, and its value in foot lbs. For instance: How many thermal units of heat have we in the following engine, also how much coal will be burned per hour? Diameter of cylinder, 10 inches; stroke, 24 inches; revolutions, 110; and pressure throughout the stroke, 25 lbs. First, remember the value of one thermal heat unit (T H U), and the mechanical force it will exert, viz., 778 foot lbs., then we would have to first find the foot lbs., thus: $10^2 \times .7854 \times 25 \times 2 \times 220 = 863.940$ foot lbs., and $863.940 \div 778 = 1110.46$ heat units used in the cylinder per minute. Second, if one lb. of coal contains 12.000 heat units, and our losses between the furnace and the engine piston, from escaping heat in the smoke-stack, from radiation, condensation and exhaust discharge, is 9-10 of all the heat in the coal, this leaves us but 1-10 for available work, then $12,000 \div 10 = 1200$ heat units available, and $1110.46 \div 1200 = .925$ lbs. of coal per minute; $.925 \times 60 = 55.5$ lbs. per hour, and the h.p. of the engine would be $863.940 \div 33.000 = 26.2$, which would make the coal used per h.p. per hour $55.5 \div 26.2 = 2.1$ lbs.

Latent Heat.—The latent heat of steam is that quantity of heat required to change a body in a given state to another state or form, without changing its temperature. Experiments have shown that 966.6 B T U will convert one lb. of water at 212° F. into steam of the same temperature, hence it takes 966 times as much heat to change 1 lb. of water at 212° F. to steam, as it does to raise the same weight of water from 55° to 56°. The latent heat of steam changes as the temperature under which it is generated changes. If steam is generated under a higher temperature than 212° F., the sensible heat increases, and the latent heat decreases. To find the latent heat of steam at any temperature the following rule is very nearly correct: Let T = temperature of evaporation; latent heat = 966.6 — .7 (T — 212). Example: What is the latent heat of steam if the temperature is 228° F.? 966.6 — .7 (228 — 212) = 955.4; work the brackets first, then x by .7 and subtract the result from 966.6. Water is composed of millions of molecules, which are always in motion. At 461° F. below zero we would have absolute cold and the water would be perfectly still, at 32° F. there is some movement of the particles, and as we add heat this movement increases, sending the molecules farther and farther apart, thus increasing their speed, and the greater distance between the molecules the greater the space the water will occupy, and this goes on until one cubic inch of water at 212° F. will expand until it occupies 1644 cubic inches of space. the temperature of the whole still being 212° F.; and in causing this expansion we must have added 966.6 units of heat; these have been converted into the work of driving the molecules of water further apart, and can be recovered again if we use the steam where we can apply them, for they all leave the steam as it returns to water. If we take 1 lb. of steam at 212° F. and apply it to heating our building, by the time it is all condensed back to water it has given up 966.6 heat units. In mixing steam and water let W represent the weight of steam, t_1 the temperature of the steam, and w the weight of the water, and t the temperature of the water, and T the final temperature of the mixture of steam and water, and L the latent heat of the steam, we can then formulate this rule to find the temperature of the mixture: Add together the latent heat and temperature of the steam, and multiply the sum by the weight of the steam, to this add the product of the weight and temperature of the water, and divide this sum by the weights of the steam and water; the answer will be the temperature of the mixture. This is a long rule to write down, but in formula it appears thus: $T = \frac{W(L + t_1) + w \times t}{W + w}$

If 14 lbs. of steam at 212° is discharged into 200 lbs. of water at 46°, what will be the final temperature? The weight of the steam W = 14 lbs., the latent heat L, is 966, the temperature of it is $t_1 = 212°$, the weight of the water is w = 200 lbs., and its temperature is t = 46°, we then have

$T = W(L + t_1) + w \times t = \frac{14 \times (966 + 212) + 200 \times 46}{14 + 200}$ or

$966 + 212 = 1178 \times 14 = 16492$, and $200 \times 46 = 9200$, then

$9200 + 16492 = \frac{25692}{200 + 14} = \frac{25692}{214} = 120.5°$ the final temperature.

QUESTIONS.

If a Centigrade thermometer registers 120, what would be the corresponding mark upon a Fahrenheit scale?

If a Fahrenheit registers 305 what is the corresponding mark on a Centigrade?

How many heat units will be required at an engine piston if the conditions are as follows: Diameter of cylinder, 26 inches; length of stroke, 5 feet; revolutions, 60; average pressure throughout the stroke, 19½ lbs.?

A. M. WICKENS, Executive Secretary.

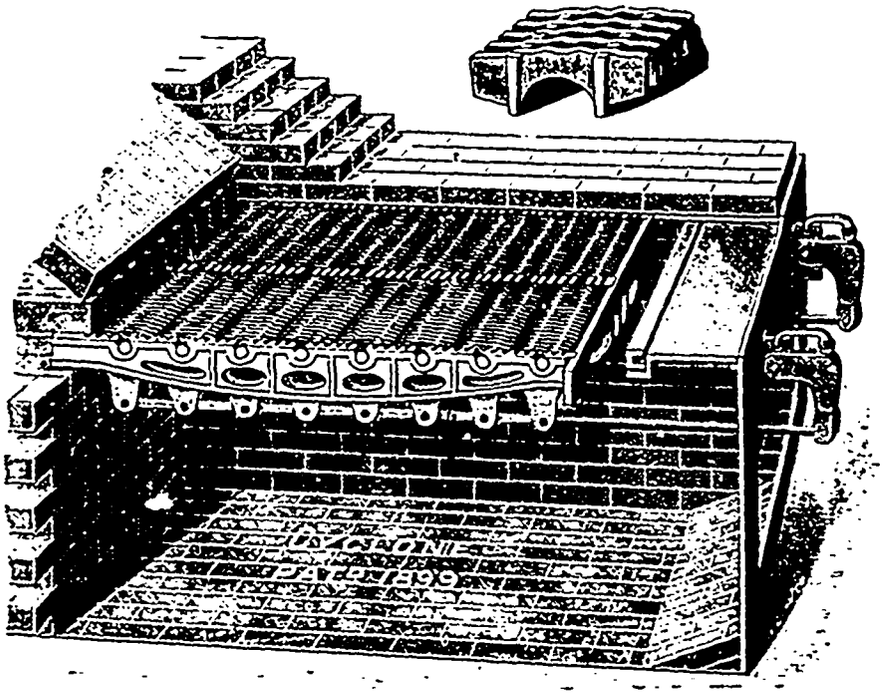
RAILWAY ENGINEERING.

The following criticism of Railway Engineering, by Cecil B. Smith, M.E., appears in a recent issue of The Railway Gazette, New York: *In his introduction the author explains that* this is intended as a "foundation course only," and that he has endeavored to epitomize his vast subject in such a way that a student or layman without previous knowledge can grasp it intelligently. He undertakes to cover the subject from the very beginning to the end—to tell the considerations that should govern in the general choice of the route and termini; to discuss the relations of grades and curves to future earning power and maintenance cost; to tell how all surveys are made and how roadbed, bridges, culverts and track are built; and finally to give an epitome of railroad law. He undertakes to analyze the difficult subject of train-resistance and to develop the somewhat intricate theory of easement curves. He treats of rails, their sections and chemistry, and of rail joints. All these things and much more he does in 200 pages of 500 words to the page. Obviously so much ground can be covered only superficially in a book physically so small, and the author quite truly says that the "work is not exhaustive, but merely introductory." Naturally, many things are said in a dogmatic and unqualified way that really cannot be accepted as said, without qualification. In the main, however, there is not much in the book that will seriously mislead, and generally it is safe and sound so far as it goes. It is written from the modern standpoint, indicates good theory and practice, and suggests lines of thought and study that may be profitably followed out. In this is its value, rather than as a complete and comprehensive guide to practice in any one branch of the subject treated. Biggar, Samuel & Co., publishers, Toronto and Montreal.

THE CYCLONE GRATE BAR.

There are many ways of economizing in steam production and consumption, but too much attention cannot be given to fuel economy, as the fire box is the source often of very great waste, and a loss in the initial development cannot be made up by any late method of saving. We wish to call our readers' attention to the Cyclone Grate Bar as a means of fire box economy. Presuming the majority of our readers to be interested in methods of economizing fuel, we present herewith some particulars of the Cyclone grate bar, one of the most improved devices for this purpose. In the invention and manufacture of this device, the fact has been kept in view that an enormous waste of fuel is constantly taking place by reason of the escaping of the carbonic oxides of the fuel. This is the result of imperfect combustion caused by imperfect draught, combustion chambers and bridge walls in boilers, together with imperfectly managed fires. While the inventor and manufacturers of the Cyclone grate bar do not claim it to be a smoke consumer, they do claim to reduce by from 40 to 65 per cent. the amount of carbonic oxides escaping through the chimney, which is a proof of its value as a fuel economizer.

It is claimed for this grate that it embodies the three most essential qualities, namely, durability, simplicity and economy of fuel. An examination of the accompanying illustration will, it is believed, show these claims to be well founded. The air is passed up and through the grate without a break in the current. There are no complicated parts to obstruct the draft and get out of order, while the sifting movement alone with the downward and backward movements cuts the ash evenly and cleanly from the bottom of the fire over the entire surface of the grate.



It is not claimed for this grate that it will grind up clinkers and separate them from the unconsumed coal without losing any of the latter material, but that it is so constructed as to prevent the formation of clinkers, by adding the necessary amount of air through the grate to ensure perfect combustion, and cause the heat to pass out of the fire box as fast as it accumulates, instead of allowing it to remain and melt the coal and form a melted clinker that no grate could break. It has been found in practice that the weight of air required to support combustion is much larger than that theoretically required in order to effect complete combustion. Complete combustion can be obtained with a supply of air not less than 50 per cent. in excess of the quantity necessary for theoretical combustion with natural draft, but it is usual to provide double the quantity of air theoretically required. This grate is especially adapted to burn cheap fuel, soft and hard coal, screenings, etc., and for use in marine boilers. Among the claims made for it by the manufacturers are the following:

It is claimed to be the best draft grate in the market; has no rockers and no complicated parts to get out of order underneath the bar or obstruct the draft; the rolling and lifting movement when shaken keeps the air space open and causes no friction on the draft passing through the bar; has ninety per cent. under draft; the frame locks together without bolts, and is easily placed under boiler; will not lock in frame, will not bind in frame; always shakes freely; space in ash-pit same as in ordinary bar, which is four inches; is a perfect bar for all internal fire boilers, no part is in the way to prevent the fireman cleaning out the ashes, the air is passed through and over top of frame—keeps frame cool and prevents warping; all parts of the bar and frame are trussed and bridged; will burn the cheapest fuel with the best results; will evaporate more water per pound of coal than any other device; is level at all times when locked; no bars stick up in fire and burn off, will not break boiler front when shaking. It is manufactured by the Cyclone Grate Bar Company, 10 King street west, Toronto, and is the invention of Henry Truesdell, who has spent the past fifteen years in perfecting it.

Last May, W. Cross, general master mechanic of the Canadian Pacific Railway shops at Winnipeg, Man., caused a test of the relative merits of the Cyclone and another grate to be made in his shops, and reporting thereon to Mr. Truesdell stated that the Cyclone showed up much more favorably than the other, and that the report of the inspector was also favorable, showing that the Cyclone was more easily managed and not as liable to get out of order. The test showed a saving of one ton of coal in each five hours of steaming, an increase in boiler capacity of 25.77 per cent., and an increase of revolutions of the engine 12.3 per minute. Under date of July 25, 1899, the Gurney Foundry Company wrote Mr. Truesdell as follows: "We have examined the Cyclone grate and Mr. Truesdell's ideas of same, and have so much confidence in the simplicity, durability and common sense construction, and find that it covers all the objections of the best grates now on the market, that we have arranged with Mr. Truesdell to manufacture same for our entire line of heating boilers, and have already gone to a very heavy expense in changing our grates, as we believe the advantages in using this grate in our line will more than repay us for this large outlay."

The officers of the Cyclone Grate Bar Company are: John R. Barber, Esq., M.L.A., president; George E. Challes, secretary-treasurer, and Henry Truesdell, business manager.

The tannery of Sadler & Haworth, Stanbridge East, Que., has undergone this season costly and extensive alterations in the way of an addition and new machinery, thus doubling their capacity. They are now turning out three hundred and twenty-five hides per week for belting purposes.

BEAVER PORTLAND CEMENT.

BY WM. G. HARTRANFT, ASSOCIATE AM. S. OF C. E.
Designer of the Beaver Portland Cement Co.'s Works.

One of the new industries of Canada is the manufacture of Portland cement, under the Rotary Kiln system of burning, at Marlbank, Ont. The plant is owned by the Beaver Portland Cement Company, limited, with headquarters in the Canada Life Building, Montreal, Que. This company purchased on Nov. 1st. 1898, the property of the English Portland Cement Company, limited, at Marlbank, and their new plant was erected and in operation, June, 1899.

The deposit of raw materials is at the site of the works, and consists of a dry lake of about 150 acres, on which there is a deposit of marl, varying from six to thirty feet or more in depth. This marl contains from 97 to 99 per cent. of carbonate of lime, and underlying this marl is clay suitable for the making of cement, to the depth of from three to fifteen feet.. Previous to the purchase of the deposit of raw materials at Marlbank, a large number of marl deposits, situated in different parts of the Dominion, were thoroughly examined and analyzed, and were found to contain a large amount of extraneous matter, which rendered them less suitable for making a uniform quality of cement, but the deposit owned by this company is so singularly pure and free from all objectionable ingredients that a perfect and uniform quality of cement can be regularly produced therefrom.

The high grade Portland cement of to-day is essentially a tri-calcic silicate, produced by burning a mixture of finely ground lime and silica to incipient vitrification, and pulverizing the resulting clinker. The burning is accomplished in either what is known as the stationary kiln method (intermittent or continuous) or in the rotary kiln method. With the use of the stationary kiln, the raw materials are made into bricks and dried; then placed in kilns with the fuel (coke or coal). The burning is then largely out of the hands of the manufacturer, and depends on the draught and other incidents beyond his control; the result is a varying product more or less over or under burnt. If this improperly burnt material is ground with the good clinker, the result will be a cement irregular in quality. The under burnt and over burnt material varies under this process of burning from 3 to 25 per cent. of the output of a kiln, and if sorted out and discarded by the manufacturer, it is done at a considerable loss.

With the rotary kiln process of burning, the raw materials are conveyed into the kiln in powdered form, if using the dry process, or pumped in if using the wet process. The kiln is a large steel shell, six feet in diameter and sixty feet long, lined with fire brick, and erected on a slight angle. It is built to revolve at the will of the operator, through the use of a variable speed regulator, from one revolution in thirty seconds, to one in every four minutes. The raw material is fed in at one end, and the fuel, oil, or pulverized coal being applied at the other end. The amount of fuel supplied to the kiln is also regulated by a variable speed device, so that by this process, over burning or under burning of the clinker is practically unknown, as the burning is absolutely under control at all times. The operator by the use of specially prepared eye glasses, watches the burning, and if the heat in the kiln is reduced from any cause, he retards the discharge of the clinker by slowing down his kiln, and then increasing his fuel. Or, on the other hand, if the heat in the kiln becomes too intense, he increases the speed of the kiln, and reduces the fuel; either of which is accomplished by pushing a lever close at hand. Although this rotary kiln process for the manufacture of high grade Portland cement is not new in other countries, it remained for the Beaver Portland Cement Company, limited, to introduce it into Canada. This process of burning was originally patented by Ransome, of England, and was first installed about 1885 in the Gibb's Portland Cement Works on the Thames, where it was not a financial success. Mr. Jose de Navarro purchased the rights to use the process in the United States, and it was in that country that the process was improved, and brought up to the present state of perfection. The great strides made under this system of burning in the United States can be noted by the following table:

	1890 Bbls.	1893 Bbls.	1896 Bbls.	1898 Bbls.	1899 (est.) Bbls.	1900 (est.) Bbls.
Rotary Kiln.....		119,000	633,370	2,170,782	3,500,000	5,000,000
Stationary Kiln...	350,000	441,653	950,653	1,521,502	1,500,000	1,500,000
Total.....	350,000	590,653	1,543,023	3,692,284	5,000,000	6,500,000
Per cent. of total burned in Rotary Kiln.....	0	25.2	41.0	58.8	70.0	76.9

The reason of this increased use of rotary kilns is due to the engineering profession to-day requiring high grade Portland cement, uniform in quality, and to get this result, the raw materials must be uniformly hard burnt. It is also worthy of note that two of the largest and best known German manufacturers, the Alsen Portland Cement Co., and the Hemmoor Portland Cement Co., are now erecting factories, in which the rotary system of burning will be used. Two rotary kilns have been in successful operation at Marlbank since June, 1899, and all the cement manufactured by the Beaver Portland Cement Company, limited, during the past season, has been distributed throughout the provinces of Ontario and Quebec, large quantities having been used in street pavements in the larger cities and towns, and also in the construction of dams, etc., where nothing but a high quality of cement was required to meet the specifications. The company has received from the various contractors and dealers, who have used the "Beaver" brand, numerous testimonials, which amply testify to its being a uniformly high grade article; all of which is amply borne out by the following tests made in various laboratories:

Aug. 4th. City of Ottawa, N. J. Ker, assistant city engineer, one inch briquettes, 7 days old.....607 lbs.
Aug. 19th. C. A. Ry., E. J. Chamberlain, gen. manager, Ottawa, one inch briquettes, 7 days old.....523 lbs.
Aug. 28th. Lathbury & Spackman's laboratory, Philadelphia, one inch briquettes, 7 days old.....795 lbs.
Oct. 12th. McGill University, Montreal, one inch briquettes, 7 days old .....705 lbs.

The company is now installing three more rotary kilns, which, in conjunction with the two kilns already in operation, will give their works a capacity in the neighborhood of 1,000 barrels per day, and will make them the largest producers of Portland cement in the Dominion of Canada. The company has no hesitation in putting its product forward as the highest grade of Portland cement manufactured, as well as the most economical for making artificial stone.

GOOD ROADS.

Upon the invitation of the York County Council, upwards of fifty gentlemen from various parts of Ontario, nearly all of them members of some municipal body, met in the York County Council chamber, Toronto, December 11th, in convention for discussion of the good roads problem. The chief feature under discussion was the assumption by counties of the construction and maintenance of certain main travelled roads in the county, the funds to be rased by a general taxation or by debentures. At the commencement of the afternoon session, W. C. Lundy, chairman of the Special Committee of the County Council, who had the matter in hand, was elected to the chair, while County Clerk Ramsden was chosen secretary. Mr. Lundy, in his opening address, after thanking the delegates for the honor conferred upon him, briefly stated the history of the road question in York county, from the toll gate days to the present, when the municipalities charged with their maintenance have failed to keep them up. At the June session of the council it had been proposed to take over some of the roads again. A committee was appointed to collect information, but so much had been received that it was felt advisable to hold a convention to discuss it.

A. F. Wood, ex-M.P.P., Madoc, Ont., then gave an address on the experience of the county of Hastings in dealing with roads. Mr. Wood sketched the history of the treatment of the roads in that county for the past forty years, beginning with the toll gate system, which was abandoned on account of the abuses which accompanied it. After several plans had been tried the county finally undertook to construct and maintain a proportion of the chief highways, constructing them of gravel. A Gravel Road Committee and a road superintendent were appointed to look after the work, employ the necessary labor

and purchase the necessary material. The result, Mr. Wood said, had been most satisfactory, and had resulted in a great saving by reason of the scientific methods of construction which experience led them to adopt. When Mr. Wood had concluded, he was besieged with questions, to which he replied fully.

J. F. Beam, Black Creek, Ont., read a spirited paper on Good Roads, Principles and Results. After referring to the failure of the statute labor system, he spoke of the example in the county of Hastings as it had been outlined by Mr. Wood. He was in full sympathy with the project of county maintenance of main roads, and expressed the strong conviction that the cities, which drew so much wealth from the county, should pay their share of the cost. He pointed out the example of a number of States where the Government gave substantial grants for the maintenance of public roads. The convention adjourned a little before five to allow the delegates to visit the new city hall.

When the evening session opened the first business was the appointment of a Committee on Resolutions, consisting of one delegate from each of the counties, represented as follows: Messrs. Harold Eagle, Haldimand; Col. McLean, Durham; J. B. Calder, Wentworth; M. Richardson, Grey; J. F. Beam, Welland; H. W. Fowlds, Northumberland; Robert Byrnes, Victoria, L. Kaufman, Oxford, W. H. Pugsley and W. C. Lundy, York; D. H. Moyer, Lincoln and F. W. Wilson, Lambton.

Andrew Pattullo, M.P.P., Woodstock, Ont., the organizer and first president of the Good Roads Association, followed. The fact that so many representatives of the people had gathered together, he said, was in itself a most hopeful sign for the success of the movement. It showed that public attention had been considerably aroused when these legislators met to seek information on the subject. The work of Mr. Campbell was appreciated at home, and now his reports were read and appreciated in other provinces and several European countries. Good roads were cheaper at any cost than bad roads. The transportation problem was the greatest one in Canada, and our duty now was to pay attention to our rural highways. He knew of no service or direction in which the councils could do so much good as to take hold of the management of the leading roads in their respective counties, and employ trained men to keep them in proper state of repair Their example would be followed by the township councils. The present Legislature was favorable to road improvement, and he suggested that the cause could be assisted by the Government guaranteeing the bonds by which the counties borrowed money for the purpose, whereby the latter could get funds at probably a half lower rate of interest Statute labor ought to be abolished; it was a relic of barbarism. He favored optional legislation by which municipalities could, if they wished, abolish the system. In conclusion, Mr Pattullo suggested that the convention adjourn instead of dissolving, and that its recommendations be sent to the municipalities to be discussed in the coming elections and also at the January meetings of council, after which it would have greater effect.

John A. Ramsden gave an instructive paper on "Reforestry." As a result of the clearance of this country of its forest by the pioneers snow and dust were now free to fly over the roads, rendering travelling disagreeable both winter and summer. The planting of trees both in rows and in blocks and belts would have a very beneficial effect in protecting the roads. Mr. Ramsden recommended that the attention of the Legislature be specially drawn to this matter.

At the second day's meeting addresses were given by Hon. E. J. Davis and A. W. Campbell. A. F. Woods, of Madoc, took the chair and gave many valuable suggestions Hon. E. J. Davis, after speaking of the early days, went on to speak of the transportation problem and the saving to farmers in good roads. Especially were they necessary for the cheese and butter industries, so that milk could be got easily to the factories. It would also help the new system of postal delivery by wagon. On behalf of the Premier and the Government, he expressed appreciation for the efforts now being made in the direction of good roads, and gave a hint that should a request be made for Legislative aid the request must be a very reasonable one to be granted.

A. W. Campbell, the provincial road instructor, dealt with the practical side of road-making, and told the delegates what could be done if they had the money to spend in that direction. He compared the roads of Hastings with the dreadful roads of York county, and went on to show that a large amount of money expended in road-making is absolutely wasted.

The afternoon was taken up in discussing the report of the Committee on Resolutions, which went through a great sifting process before being adopted. It inculcated the following principles when finally passed: (1) The assumption of main and leading highways by county councils. (2) Provincial aid towards making and maintaining leading highways assumed by county councils in a leading road system. (3) Legislative supervision of electric railways, more especially with a view to enabling suburban railways to have access to markets or other destinations through cities or towns which have granted franchises to railroads.

These main principles will be enlarged upon by a committee appointed to prepare them for publication in pamphlet form. The Provincial Minister of Agriculture will be asked to bear the cost of printing, and the pamphlet is to be circulated among the municipal officers of the province. This committee will consist of C. E. Lundy, York; M. Richardson, Flesherton; James Graham, Lindsay; D. H. Moyer, Lincoln; W. H. Pugsley, York; M. Buchanan, Ingersoll, and the secretary, Mr. Ramsden. Among those present were: H. W. Foulds, Northumberland county; Lieut.-Col. McLean, Port Hope; B. W. Kiteley, Sharon; Thomas F. Wallace, Woodbridge; J. B. Calder, E. Kenrich, Wentworth county; M. Richardson, Grey county; Andrew Pattullo, M.P.P., Woodstock; W. J. Stark, Stouffville; R. Maitland Roy, Hamilton; W. H. Pugsley, Richmond Hill; Andrew M. Miller, East Toronto; J. L. McCullouch, East Toronto; James McDougall, Toronto; F. Beam, Welland; C. H. Gill, Toronto township; Harold Eagle, Haldimand county; R. G. Gibson, Toronto; J. C. Stokes, King; J. W. Brown, Stouffville; R. Norman, York; James Lee, Scarboro'; John A. Boad, North Gwillimbury; John Gardhouse, Etobicoke; F. W. Wilson, Petrolia; Wm. C. Grubb, Etobicoke; S. Baker, Whitchurch; J. A. Duff, Toronto; F. K. Reesor, Markham; P. G. Savage, Markham; T. H. Syivanus, Hamilton; A. W. Campbell, provincial road instructor, Toronto; Henry Duncan, J. C. Miller, York; W. E. Switzer, Omemee; Robert Prynes, Lindsay; George Johnston, Cannington, and H. S. Cane, Newmarket.

NEW SHOPS OF THE CANADIAN RAND DRILL CO.

The extensive shops of the Canadian Rand Drill Co., Sherbrooke, Que., were opened December 9th for inspection, and from two to five o'clock there was a large attendance of citizens, who feel an interest in the progress and success of these important works F Lewis, president of the company, S. W. Jenckes, vice-president; A. Sangster, and others, received and showed the visitors about the premises, where nearly one hundred employees were busy at various kinds of work. After inspecting the shops and machinery the visitors were entertained with refreshments in the offices. The main shop is a brick structure, 95 feet wide by 200 feet long, well lighted from the sides and top which is filled with the latest and best patterns of wood and iron working machinery, which are to be augmented by others shortly. There are also three wings each 35 x 40 feet, the first being the office, two stories high, finished partly in wood with oak furniture, the lowest story being used for the office proper, and the upper flat for the draughting room. A fire-proof vault extends up through both stories. A second wing embraces the power house, fitted with a 90 h.p. engine, and the foundation for a large air compressor soon to be placed in position to supply the motive power for the electric crane, and the circulating pumps to supply the hot water system with which the building is heated. The third wing embraces the blacksmith shop, which will have four forges, the smoke of which will be taken by a 40-inch exhaust fan. There is also a large store house, 40 x 85 feet, west of the main shop. The C.P.R. has a siding beside the store house, and a track laid into the main shops for the purpose of handling the machinery with greater convenience. Stone foundations are laid for the heavy lathes, engines, etc. One side of the shops will be used for the compressor work and the other for pattern, drill and tool work. The heating will be done by the Evans-Almiral system of New York.

THE ARMSTRONG PLANER TOOL.

The Armstrong planer tool is especially adapted for the economical use of self-hardening steel in planer and shaper work.

This tool is, it is stated by the makers, pronounced by all who have seen or used it to be a money-saver. It is a decided and practical extension of the Armstrong idea. The shank is drop forged of steel and is case hardened. The cutters are of self-hardening steel, rectangular in shape and of stock sizes. By means of grooved seats, into which they are placed, the cutters may be quickly adjusted to any desirable angle, and at the same time so locked into position as to render slipping impossible.

Armstrong Bros. consider rectangular shaped steel preferable to square for a planer tool cutter, as it is stiffer and at the same time admits of being ground with more side rake than square steel; cutters of rectangular shape will also admit of sharpening oftener than square without reshaping the point. The Armstrong planer tool can be used either right or left hand (see Fig. 1), and when desirable or necessary, as for instance, when cutting a keyway, it may, by simply reversing the cutter and turning the tool around, be transformed into the equivalent of a "gouse neck" tool (see Fig. 2). One of these tools equipped with an assortment of properly ground cutters will, it is said, effectively equal a complete set of solid forged planer tools. Fig. 1 shows the Armstrong planer tool at work in close corners, giving a good general idea of clearance obtained. It shows also a few of the angles at which the cutter can be set. A job similar to one shown above could be finished with the planer tool, without shifting position of the work on bed. Figure 2 shows the Armstrong planer tool cutting a keyway with the cutter reversed and the tool turned around, thus throwing the cutting point behind centre of tool and practically working as a "goose-neck" tool.

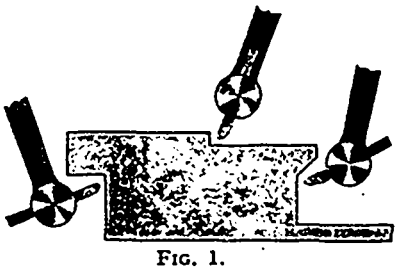


FIG. 1.

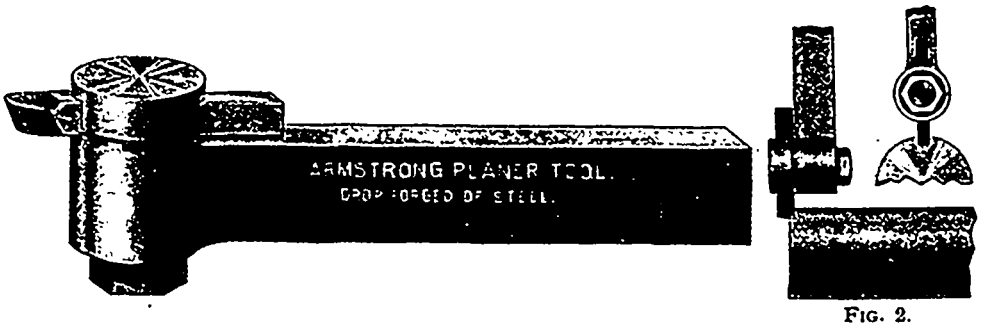


FIG. 2.

EXPLOSION AT THE DOMINION CARBIDE WORKS, OTTAWA.

(From a Correspondent).

The official investigation into the cause of the fire and explosion at the Dominion Carbide Works, Ottawa, in Nov., has resulted in the clearing away of a great deal of ignorance and prejudice that existed on the question of calcium carbide and acetylene gas. The reports telegraphed over the country were highly colored, and contained so many misleading statements as to be utterly unreliable. Of the eighteen men hurt in the explosion, one only is permanently injured, by the loss of one of his eyes. The majority of the others were at work again in a few days after the accident. The jury selected to investigate the question was composed of hard-headed, shrewd business men. Their finding was as follows:

1. We find that there has been no evidence before us that throws any light upon the origin of the fire, which started in the story above the carbide factory.

2. As to the cause of the explosion we have attentively listened to the evidence of all the witnesses who were present at the time of the fire, as well as to the testimony of the various experts, and believe that it resulted from the joint action of steam and gas, but whether the latter was acetylene or water gas, resulting from the water coming in contact with the intensely heated material, causing decomposition of the water, the evidence is not made clear.

3. We find that the manufacture of calcium carbide is considered hazardous under certain conditions, and that in England strict regulations are enforced, both as to its manufacture and storage. It was also shown in the evidence that there is danger if it is not under strict control in its manufacture and storage. Further, that the essential conditions, which should be enforced, are a fire and water-proof building. And when these conditions are observed, no danger is likely to result in its manufacture.

4. We would recommend that the pigs after coming from the crucibles and cooling should in all instances be removed to a separate room and compartments.

5. We also find that the city by-laws, dealing with manufactures of this character, have not been observed, and would urge that hereafter the same be strictly enforced.

6. We further find that the authority of the chief of the fire brigade was not accepted by the employees of the local firms having private fire appliances, and if the city by-laws do not place the chief in absolute authority at all fires within the city limits, they should be so amended as to make his authority supreme.

The verdict was evidently a compromise between the jurymen, who paid particular attention to the evidence of men who were not experts, and those who were influenced by the scientific and practical testimony given. Such scientists as Thomas Macfarlane, Dominion Analyst, Inland Revenue Department; Prof. Shutt, Analytical Chemist, Dominion Experimental Farm, Prof. McGill, of the Geological Survey, and the practical men who handle carbide every day, testified that it was not possible to generate acetylene from red hot carbide. The evidence also proved that when the gas began to generate from the cold, broken carbide on the floor, by the water dripping down on it, it was at once fired by burning wood dropping on it from the ventilating shaft, and was consumed as fast as made, so that the explosion could not have come from that source.

All agreed that the explosion occurred within the crucible. When it is considered that the crucible contained a thousand pounds of molten carbide, covered and surmounted with an infused mixture of powdered lime and coke, between it and the iron of the crucible, that on this porous material a large quantity of water poured down from the ceiling alone, one can easily understand how rapidly the water will be developed, by contact with the molten carbide, into a very high pressure steam with an irresistible explosive force.

There is no doubt whatever in the minds of mechanics, foundrymen and other practical men, that that is precisely what occurred. The City Council, acting on the coroner's finding, has issued instructions to prepare a by-law to regulate the manufacture and storage of carbide. The Dominion Carbide works are being rapidly prepared to comply with the regulations suggested by the jury. The factory is being made absolutely fire-proof, with steel girders and iron roof. It will be ready to resume operations this month, with a capacity of four to six tons per day. The Bronson factory, with a capacity of fifteen tons per day, is expected to commence smelting in February. At present such a carbide famine exists that many lighting plants have had to shut down. Once the Ottawa factories get running, there will be no more shortage.

Thos. Cantley, secretary of the Nova Scotia Steel Co., of this town, is at present in London, Eng., completing plans for the purchase of the General Mining Association coal mine at Sydney, C. B., says The New Glasgow Bulletin, recently.

AS OTHERS SEE US.

Biggar, Samuel & Co.:

Enclosed find postoffice order for $2, payment for your valuable paper, The Canadian Engineer, which pays to July, 1900. This should have been paid long ago, as the price is small considering the valuable information your paper contains.

JAS. FORDYCE,
Supt. W. W. Dept., Guelph.

Canadian Engineer:

Enclosed find my subscription for this present year. I have found great pleasure in consulting your excellent paper on all matters relating to engineering plans and designs, and especially on those articles relating to railroad building published this preceding year. Wishing your paper every success. I remain, ALEXANDER ROY, Wabigoon, Ont.

I miss The Engineer when it does not come.

J. F. MURPHY, Windsor, N.S.

In response to your post card just received, please find enclosed $1 in payment of Canadian Engineer, up to February next I think you give good value for the amount.

JAMES B. HEGAN,
Dept. of Public Works, Charlottetown, P.E.I.

Gentlemen:—Having had space for the past twelve months in The Canadian Engineer of Toronto, it has been productive of many enquiries, and resulted in a satisfactory business for us. We can recommend it to any manufacturer desirous of introducing his goods to the Canadian trade, as without exception it stands at the very head of publications of its kind in Canada, and in fact is the only desirable medium through which to reach the machinist, supply and general hardware trade We cheerfully speak of the satisfaction given us during the term of our subscription, and confidently recommend it to any firm desiring to reach the Canadian trade.

DIAMOND SAW & STAMPING WORKS.
Manufacturers of Hack Saws, etc., Buffalo, N.Y.

Gentlemen:—We have found very valuable information in "Practical Man" column; many of them worth much more than a year's subscription. Enclosed find $2, amount of our subscription. S. VESSOT & CO.,
Founders and Machinists, Joliette.

Enclosed is $1. The Engineer is really a gold mine of good assorted news, and most interesting and valuable. Mr. Watson's sanitary letters are grand. Your good management has made The Engineer a power in Canada, and I feel proud of it.

J. D. RONALD,
Mnfr. Fire Engines, Brussels, Ont.

PUMPING MACHINERY.*

BY C. E. MORGAN.

Perhaps the engineer in his varied experience with machinery has given but little thought to the important work that a steam pump is called upon to perform in connection with his boiler plant. I would commence by stating that although it is possible to feed a boiler with other appliances the steam pump undoubtedly is the best all round commercial article. I do not propose to enter into the question of economy of the steam pump as compared with other means of feeding boilers, such as injectors and power pumps, these no doubt have their uses as auxiliaries, and perhaps in some cases it is advantageous to use a power pump where the engine or prime mover is constantly running, as by so doing the water is pumped practically with the economy of the engine. A boiler feed pump is called upon frequently to handle water at various degrees of temperature, and this being the case certain mechanical features in its construction have to be considered. For instance, in handling water at normal temperature, say 70 degrees, the ordinary inside plunger type of pump is perhaps all that is desired, whereas should the water reach a temperature of 212 degrees the conditions are different, inasmuch as the temperature of the feed water expands all working parts of the pump, and it becomes necessary to have the machine so arranged that the water piston can be adjusted to meet these conditions. This feature is easily taken care of by using a special boiler feed pump, so constructed that its plungers are externally packed. This enables the engineer to immediately discern any leak which may have taken place, and to satisfy himself that the pump is fully efficient at every stroke. Some engineers have raised the objection to a certain amount of friction which is set up by the external adjustment of the plungers, but if the machine is properly made with deep well fitting neck bushes and glands, this feature is not of very much consideration, as under absolute tests the friction set up is a very small percentage.

Difficulty is often experienced when pumps are working on very hot water, but in cases that have come under my own notice, I have usually found that the trouble has arisen by the machine being placed in a position where it would practically have to raise the water by suction, while, in place of this, it should gravitate, as the formation of a vacuum in pump would be immediately filled by the vapor from the hot water, and would consequently interfere with the proper working of the machine. It is also very important to have valves of proper materials for handling water at high temperatures. Machines are frequently condemned when really the working parts are at fault.

In steam plants it sometimes happens that in feeding boilers the pumps used are much too small for the work required. In making a choice of a steam pump for feeding boilers it is well to have it of sufficient size so that it will do its work easily. For pumps having a 4-inch stroke it is possible to run them to 150 strokes per minute; 6-inch stroke, 130; 8-inch stroke, 120; 12-inch stroke, 100; 16-inch stroke, 85, and 18-inch stroke, 80. You will note that these are maximum speeds, and for boiler feeding purposes the machines should operate at about one-fourth of the above speeds. In estimating the capacity of the boiler feed pumps the following formulae is used:

$$\frac{\text{H. P.} \times 30 \times 28}{\text{Speed in inches} \times 60} = \text{area of high cylinder.}$$

This is for a single cylinder piston pump. Of course for a duplex it would be one-half this, and for a triplex so much. In very large steam plants the compounding of boiler feed pumps is possibly a move in the right direction, resulting in a considerably more economical consumption of steam. It is very probable that a compound steam boiler feed pump will shortly be introduced, which will not be very much more expensive than the ordinary high pressure machine, and would certainly be well worth the difference in cost. We have machines of this class operating to-day, with very good results.

These compound pumps are made of either the single or duplex type; some engineers preferring the duplex machine, and others favoring the single. So far as economy is concerned, possibly the single pump is the most economical, as there are less clearance spaces to be filled, and consequently a more economical use of steam. Another feature which the single pump possesses over the duplex is that in its length of stroke it is uniform, while the duplex pump invariably short strokes on either side, which further increases waste in the use of steam. The duplex pump, however, is perfectly positive in its steam end, while the single pump has been known to give some trouble in this respect. But this is usually due to the inferior construction of the automatic valve gear. There is no good reason why a steam thrown piston valve should not be equally as positive in its operation as the positively moved one, if the ports, both steam and exhaust, are properly proportioned, and made strictly to templates. I think the field of boiler feed pumps has been pretty well covered, and I will now for a few minutes take up the condenser question. The question of economy is being studied more closely to-day than was the case some few years ago, and the manufacturers are asking for the most economical steam plant that can be installed. In order to achieve these results, condensing engines of different styles are being called for, and independent condensers of many types are being made to-day. The horizontal single and duplex form, and the vertical single and double acting duplex or twin type, or the rotative type. The choice of any one of these condensers is regulated by the size of the plant, and for ordinary small plants possibly the horizontal single type of condenser is the cheapest. When

*A paper read before C. A. S. E. No. 1, Toronto.

large units, however, have to be considered, the most efficient and economical type of air pump and condenser should be installed.

Undoubtedly the most efficient type of air-pump to-day is the single acting vertical, its high efficiency being due to the fact that all clearance spaces can be practically dispensed with, and being of the single acting type the velocity of flow is not checked by diversion. Being provided with foot and bucket valves, and these valves always covered with water, there is very little clearance space.

The lack of efficiency in the double acting horizontal or vertical type of pump is largely due to the reverse of some of the above conditions, as by the failure of the valves in closing, and also a large space between the suction and delivery valves. The speed at which air pumps can be operated depends upon the valve area which they contain. This in a great many cases, is very much contracted, and accounts for the unpleasant noise which air pumps are sometimes known to make on board steamers. If this valve area could be increased the pump would work sometimes quieter.

Beyond doubt the most economical style of air pump is the rotative vertical type, as it enables you to use steam expansively. Its first cost, however, is very much greater than the direct acting vertical type, and on account of its rotative action it is considerably more expensive to maintain. I think it is possible to construct an air pump of a design which will allow of the valve area being very largely increased, and consequently a higher speed made practicable. This experiment is at present under test. and we have every reason to believe it will prove of great commercial value.

For the practical engineer, perhaps a rule which is used for the proportion of an independent air pump and condenser for certain sized engines would be well to remember. The data which is required before being able to estimate, is the class of engine which is being used, the pressure of steam supplied the engine, point of cut off, and the number of revolutions, or piston feet travel per minute.

The formula which is used for the proportioning of independent air pumps and condensers and engines of various sizes is written thus:

$$\frac{2 \times A \times S \times C \times N \times W}{15\ F.} = \text{Area of air pump.}$$

A = Area of H. P. steam cylinder, in inches.
S = Stroke " " " " "
C = Cut-off " " " " fraction of stroke.
N = Number of revolutions of engine per minute.
W = Weight of 1 cu. ft. steam at initial steam pressure.
F = Speed of air pump in feet per minute.

I have not thought it well to occupy your time with any other class of pumping machinery but what we are familiar with, and may say that the pumps which are used for mining, pumps that are used in pulp and paper mills, and the triplex power pump, and special pumps for special purposes have not been touched upon in this paper.

SOME EXPERIENCES WITH PORTLAND CEMENT.

BY W. K. ELDRIDGE, CITY ENGINEER, OF LAFAYETTE, IND.

(Continued from last issue).

But there is another danger attending the use of Portland cements, as now made, owing to their adulteration with slag cements, or possibly ground slag itself. A great and growing industry in this country as well as in others is the manufacture of cements from blast furnace slags, going under the name of "Portland" cements. Blast furnace slag being a waste product its use for such a purpose renders possible the making of a cheaper cement, which, if as good as the regular make, should not be kept out of use. And yet, for sidewalk purposes, any engineer having experimented with this material will not consent to take any more of it in sidewalks. At the same time, it has its legitimate uses, and when submitted to the regulation tests it rarely fails to fulfill all the standard requirements, and a contractor standing squarely on his rights and dignity can compel you to let him use it. So far this season I have barred it out of sidewalks by insisting that it is not a true Portland cement, but with the expectation some day of having my ruling contested and beaten. There are some slag cement walks which appear good and durable, made of a certain brand, the manufacturer explaining that he puts the slag through a roasting process before mixing and grinding, but I fear that the engineer who accepts even this cement too trustingly would lay himself liable to a roasting also. But if there be any distinction between slag cements for sidewalk use there is certainly so far no prescribed test by which this distinction can be determined. Ground basic slags are so unstable in their composition that they have to be kept tightly corked in the laboratory to hold them from the continuous disintegration which goes on during exposure to the air. In underground work, such as street and other foundations, slag cements seem to give good results and cheapen cost, but in the case of sidewalks, a granulating and rubbing off of the surface seems to be continually going on, as in some cases now under my observation, which cannot, I believe, be attributed solely to the traffic. There are so many different constituents in slags, and so many variations in their relative proportions in different slags, that a uniform and reliable product for such extreme service as sidewalk use can hardly be expected. It is only occasionally that ores and fluxes employed in blast furnaces will produce slag suitable for cement. Also, all such slags are devoid of hydraulic properties unless a change in their composition be effected.

A common use for slag cements which our experiments are pointing to is as an adulterant for regular made Portland cement by which the cost of production may be cheapened and output increased when demands are pressing. This was first noticed in some of the German cements, from which quite an appreciable amount of finely comminuted metallic iron or steel may be extracted by a common magnet, and the same thing was more recently found in two brands of American-made cement, amounting, even by this rough-and-ready method of analysis, to about one part in one thousand. It may be that the particles of metal themselves are not injurious except to the pocket, the purchaser buying one barrel of useless metal and 999 barrels of cement; but if such a complex and mysterious substance as basic slag be present, the risk remains of some one or more of the elements affecting a structure, such as a sidewalk exposed to all the effects of heat, cold, water, frost, etc. A sample of acknowledged slag cement showed one part in about 300 of metallic iron, so that the possibility remains of a Portland cement being adulterated with about 30 per cent. of slag, and yet pass all the customary tests, and under the usual specifications would have to be accepted. A statement of the foregoing was sent to a prominent New York engineering periodical, whose editor gravely advanced the explanation that the presence of iron could be accounted for by the wear of machinery. But since many cement plants produce 1,000 barrels per day, any set of machinery that can make a daily contribution of 400 pounds of its substance to its product must, like the widow's cruse of oil, have the miraculous faculty of self-restoration between days.

A series of simple tests for slag adulteration may be carried on by anyone with slight chemical knowledge and little paraphernalia. The presence of metallic steel is a sure indication, as no such particles should be present in an honestly made cement. Shake a little of the suspected cement in a glass of water, and stir with a bar magnet of fair strength. On examination, the pole of the magnet will be found more or less covered with minute sparkling particles of steel or iron, easily distinguishable under an ordinary pocket magnifying glass, and there will also be seen minute balls or agglomerations of magnetic material of a nondescript character, which nothing but slag ever contains. If a solution of the cement with hydro-chloric acid be made, there will usually be some insoluble residue; also, a strong odor of sulphuretted hydrogen, betraying compounds of sulphur of a possible dangerous character when exposed to the air; carbonate of lime, as betrayed by effervescence, may be present or absent. The presence of phosphorus, another element of basic slag, may be ascertained by the molybdate method as laid down in the publications of the official agricultural chemists, and noting a yellow precipitation. Bulletin 46, Chem. Div. U.S. Dept. Agriculture. We have one sidewalk laid about fifteen months ago, using a German Portland cement of high reputation and corresponding price, besides sustaining a high physical test, which lasted about

ten months before showing signs of cracking, and is now in an active stage of progressive disintegration. Securing some fragments of the top course, I had the foregoing tests made for slag, and in spite of the admixture with sand which had been made in laying the walk, all the characteristic reactions were obtained except the odor of sulphuretted hydrogen, which might be accounted for by the total change of the sulphides in that length of time. On crushing the mixture and testing with the magnet, we were still able to extract bright metallic steel, though much of what was originally there had evidently been oxidized. Carbonate of lime was present in force, also the sulphate of lime, and phosphoric acid. In fact, if we had continued farther, we should doubtless have found that if there were anything in the world that ought not to be in a cement, it would be found in that cement. It has been said that the Germans waste nothing; if their slag is high in phosphorus, they make a fertilizer; that which is low in phosphorus they use in cements.

However the doctors like it, there is very little satisfaction to an engineer in holding a post-mortem, but the result of this one on the defunct sidewalk in question might be stated in this form: Dissolution caused by excess of free lime contributed by basic slag adulteration, but concealed and true prognosis prevented by the presence of calcic sulphate, complicated with ferric oxide, various sulphides, phosphorus and other undiscovered components of blast furnace slag. It is no doubt a legitimate business to engage in the manufacture of slag cements; but to use the same as an adulterant is false and fraudulent and full of danger to the user in his work.

So far, the season has been too busy to afford much time to be spent on these matters; but a collection has been made of various samples, briquettes of different ages, etc., and we hope that much information may result from more thorough and leisurely examinations that will be of much benefit to the controllers of public works, and by developing methods for practical use will supplement the present standard of tests in the direction in which this standard now fails. But it will be, I believe, of greater benefit if this investigation be undertaken by a number of laboratories, totally disconnected from any manufacturing influences, whereby one may supplement another, errors be mutually corrected, and the increase of knowledge by the competition of mind with mind be fully obtained. Until this be done, I think we may all join in the sentiment of a cement expert, who remarked that the more he learned about cements, the less he was willing to swear to.

LITERARY NOTES.

The annual calendar of McGill College and University for 1899—1900, contains some 350 pages of information about this wonderful seat of learning—the greatest in Canada.

We have Volume IV., No. 5, of the Journal of the Western Society of Engineers, containing papers, discussions, abstracts, and the proceedings of the society. Published by the society in Chicago.

The American Sewage Disposal Company, of Boston, U.S., has issued a very neat pamphlet, which contains some details as to the works it has undertaken and a full statement of the qualifications of John M. McClintock, A.M.C.E., the president and resident manager of the company.

The Slide Valve, simply explained by W. J. Tennant, Asso. M.I. M.E., revised and enlarged by J. H. Kinealy, D.E., professor of mechanical engineering in Washington University, is a cloth bound volume of 75 pages, whose profuse illustrations give a very accurate idea of this difficult mechanism.

We have received a copy of the third edition, just issued, of Gas, Gasoline and Oil Vapor Engines. This is stated to be a new book on the subject, descriptive of their theory and power; illustrating their design, construction and operation for stationary, marine, vehicle, and motive power. This book is by Gardner D. Hiscox, M.E.

Up to date, the Canadian Engineer has received calendars for 1900 from the following companies and firms: Morton, Phillips & Co., manufacturing stationers and printers, Montreal; Royal Victoria Life Insurance Co., Montreal; National Assurance Co., of Ireland, Montreal and Toronto; the J. C. McLaren Belting Co., leather belting and mill supplies, Montreal and Toronto; Alex. Bremner, drain pipes, Portland cement, fire bricks, etc., Montreal; the Pope Manufacturing Co., bicycle manufacturers, Hartford, Conn.; Hamilton Times, Hamilton, Ont.; London Assurance Corporation, Montreal, P.Q.; Union Mutual Life Insurance Company, Toronto. These calendars are up to the former standard of excellence of the firms and companies issuing them, and we heartily thank the senders, reciprocating their good wishes for the new year.

The G. & C. Merriam Co., of Springfield, Mass., publishers of Webster's International Dictionary, now supply a need which is felt in most modern offices—that is, a dictionary, in handy form, and at a reasonable price, which gives the essence of the great International, with its definitions, synonyms, vocabularies of geographical, historical and proper names, tables of abbreviations, arbitrary signs, dictionary of mythology, etc. One of the special features of these appendixes is a very complete glossary of Scottish words and phrases, which will be generally appreciated in Canada. There is also a rhyming dictionary, and the definitions in the body of the book are elucidated by over 1,100 illustrations. The type is clear, the binding is unusually strong, and while, as its name, "Webster's Collegiate Dictionary," implies, it is specially adapted to the use of colleges and students, it is even better suited as a work for office reference. Although containing 1,016 pages, the work is not too bulky for convenient use, and we can endorse in the strongest terms the unqualified praise the new work has received from the highest educational authorities. It is published in three different bindings, cloth, sheep and half Morocco, with thumb indexes.

NEW CATALOGUES.

Interior Conduit is the name of No. 75 in the Sprague Electric Companies series of catalogues. These catalogues are, as we have said before, triumphs of the printers' art, and contain most valuable information for the electrician and the intending purchaser of electrical supplies.

The Smart-Eby Machine Co., Ltd., Hamilton, is sending out an attractive catalogue illustrating the "Webster" horizontal engine for gas, gasoline, or natural gas.

Innumerable illustrations enhance the interest of Steel Portland Cement, an artistic pamphlet sent out by the Illinois Steel Co., Chicago, to introduce its cement.

Industrial Notes.

Windsor Mills, Que., has voted $25,000 for a waterworks system.

A $10,000 Roman Catholic church will be built in Dublin, Perth county, Ont.

Meaford, Ont., voted a bonus of $56,000 to the G.T.R. and the proposed elevator.

The cheese factory at Bobcaygeon, Ont., will be changed into a butter factory.

Windsor, Que., is agitating for a waterworks system and an electric light plant.

An elevator to cost about $250,000, will be built in Quebec by the Great Northern Railway Co.

Lindsay, Ont., carried a by-law to buy the waterworks system from the company now operating it.

The Lamont Glass Works at Trenton, N.S., are to be put in operation by the Montreal Glass Co.

The sewage system in Pembroke, Ont., has been completed by the contractors, Russell & Fortin.

John Coughlan & Co., Victoria, B.C., have the contract for an hotel at New Westminster to cost $19,000.

The News-Record notes that Oelschlager Bros. are increasing their elevator building plant in Berlin, Ont.

The Cartwright, Man., Farmers' Elevator Company has been incorporated. The capital stock is $4,000.

R. B. Hanson, of Bocabec, N.B., proposes building a sawmill at the mouth of the Magaguadavic river.

Sarnia, Ont., will spend $25,000 on a trunk sewer, and $7,000 on waterworks in the present year.

St. Hyacinthe is to have a new shoe factory; the proprietors of it are A. Many, J. B. Hurteau and L. Baron.

J. Lawrence & Sons, Sarnia, Ont., have, it is said, made arrangements to erect a sawmill at Watford, Ont.

The Sutherland-Innis Cooperage Co. will build a stave, heading and hoop mill at Forest, Ont., this winter.

The Standard Chemical Company, of Toronto, is authorized to increase its capital from $80,000 to $150,000.

The Laprairie Brick Co., Montreal, has been incorporated with a capital stock of $150,000, to manufacture brick, etc.

Tottenham, Ont., has granted a loan of $15,000 to a Montreal man, who proposes to start a furniture factory there.

It is said that W. Chaplin, St. Catharines, will put up a veneer mill at Mansonville, Que., where he now has a handle factory.

A branch of the International Association of Machinists has been formed in Carleton Place, Ont., with Thos. Fraser as president.

The company proposing to make cement at Lake Medad, East Flamboro, Ont., are asking a bonus of $8,000, and speak of employing 75 hands.

The town of Durham, Ont., is asking legislative sanction for a loan of $10,000 to aid the Durham Furniture Co. in establishing a factory there.

It is said that C. H. Peters' Sons, whose tannery was recently burned at St. John, N.B., will establish their industry at Fredericton or in its suburbs.

The proposed sewage system for Bridgetown, N.S., has been postponed owing to the failure of the electors to come to an agreement. The voting resulted in a tie.

The Dodge Mnfg. Co., of Toronto, Ltd., has the contract for the shafting and hangers required for the large works of the Dominion Iron and Steel Co., Sydney, C.B.

The Acton Leather and Shoe Co., Ltd., has now completed the erection of its new tannery and factory at Actonvale, Que., and has begun operations in both places.

Arrangements are now being completed for the formation of a pork packing company in Simcoe, Ont. It will be the Simcoe Pork Packing Company, Ltd.; the proposed capital stock is $200,000.

The executive committee of the Brotherhood of Locomotive Engineers has decided to select a site in Cleveland for the permanent home of the Brotherhood. The land and building will cost $300,000.

C. Krug, W. Krug, J. Krug, C. Krug and H. Ankerman, Chesley, Ont., have been incorporated as the Chesley Rake and Novelty Co., Ltd. The capital is $20,000; chief place of business, Chesley, Ont.

Oshawa, Ont., will lend $50,000 without interest to the McLaughlin Carriage Co., in order to secure the firm's rebuilding its works, recently burned down. A three-story building, 700 x 50 feet, will be put up.

The Tracadie Lumber Company, whose mills are at Tracadie, in Gloucester county, N.B., is about to build a box factory to manufacture box shooks for the British market. The resident manager is B. H. Foster.

The works of the I. Matheson Co., New Glasgow, N.S., are being kept very busy on orders from the Dominion Iron and Steel Co., and in making up a large amount of mining machinery for the iron mines at Belle Isle, Nfld.

The Orangedale Brick and Trading Company, composed of Halifax men, are starting a large brick yard at Orangedale, C.B. They will manufacture with machinery on a large scale. Brick-making will commence in the early spring.

The municipality of St. Henri, Montreal, has decided to grant no more bonuses. This was their reply to an enquiry from the Phoenix Bridge & Iron Co., asking if a bonus would be granted in the event of the company's works being removed to St. Henri.

E. M. McDougall, Agnes H. McDougall, Jessie E. McDougall, spinsters; F. C. Henshaw, Montreal; Linda B. McDougall, Cobourg, Ont., and Robert Cowans, are being incorporated as the John McDougall Caledonian Iron Works Co., Ltd., Montreal.

T. Meyers, Bastard, Ont; L. S. Lewis, J. N. Knowlton, Newboro, Ont., and L. H. Kerr, J. B. Pinkerton, South Crosby, Ont., have been incorporated as the Ontario Milling and Manufacturing Co., Ltd.; chief place of business, Deloraine, Man.; capital, $40,000.

Failure to pay the promised bonus of $1,000 a year has caused the courts to give the J. D. King Boot and Shoe Co. a judgment against the town of Levis, Que., and under it the J. D. King Co. has seized the property of the municipality, including fire engines, etc.

L. W. Manchie, Newmarket, Pa., and W. G. Foster, of Foster & Co., Utica, N.Y., have leased part of the Toronto Carpet Co.'s buildings on Esplanade street, Toronto, from the Atlantic Refining Co., and will make iron beds, etc., under the name of the Toronto Bedding Co.

J. A. C. Madore, M.P.; Geo. Janin, C.E.; A. Stuart, C.E.; J. B. Lapointe and I. L. Lafleur, Montreal, are being incorporated as the La Compagnie d'Assainissement et d'Utilisation des eaux d'egout, to run a sewage farm; proposed capital, $50,000; chief place of business, Montreal.

J. Penman and J. B. Henderson, Paris, Ont.; T. Littlehales, Syracuse, N.Y.; W. D. Long and H. Long, Hamilton, have been incorporated as the Penman-Littlehales Chemical Co., of Hamilton, Ltd., to manufacture chemicals from gas tar; chief place of business, Hamilton, Ont.; capital, $50,000.

An engineer by the name of Lodian claims to have determined that steel rails begin to expand after a temperature of —50° F. is reached. We would be glad to hear experiences of C.P.R. engineers along the north shore, where it is cool also, if not so cool as in Siberia, where M. Lodian's observations were made.

The Ronald Fire Engine Works, Brussels, Ont., is sending out a circular, which contains some testimonials in the form of telegrams sent in answer to the enquiries of the mayor of St. John's, Que., by the fire chiefs of various towns where Ronald engines were in use. These telegrams are highly complimentary.

Canada Wood Specialty Co., Ltd., Orillia, Ont., organized by J. B. Tudhope, Wm. Tudhope, A. McPherson, J. H. Lavallee, Wm. Thomson and Geo. Thomson, is trying to secure from the town the following as a bonus: "Free light for office and factory purposes, water for drinking, 50-h.p. of electric energy, and exemption from taxation."

G. W. Grant and A. Dods, Toronto, Ont.; T. H. Hamilton, J. M. White, J. W. Gray, M.D., W. H. Hill and W. Irwin, Peterborough, Ont., have been incorporated as the Grant-Hamilton Oil Company, of Toronto, Ltd.; to manufacture and sell oils and petroleum products, varnishes, soaps and engineers' supplies; chief place of business, Toronto; capital, $40,000.

Instructions have been issued by the Customs Department at Ottawa cancelling instructions of July 1st, 1897, respecting duty on round steel in bars. The standard is advanced from 1-inch in diameter to 1½ inches, and on round steel in bars (polished) one and one-half inch in diameter and larger; the duty will be 30 per cent. ad valorem, instead of 35 per cent., as formerly.

The Dodge Mnfg. Co., of Toronto, Ltd., has enjoyed a most successful year's trade, the company's business being greater by 50 per cent. than for any previous year in its history. The Dodge Company makes a specialty of shafting, hangers and pulleys, as well as friction clutch pulleys and rope driving, and few large factories, it states, have been equipped recently which were not supplied in this line by the Dodge Co.

The United Correspondence Schools of New York city have a course of study in Mechanical Engineering especially designed to meet the needs of machinists, inventors, draughtsmen, tool-makers, machine shop laborers, pattern makers, boiler and engine builders, shop foremen, moulders and foundrymen, blacksmiths, engineers, builders and salesmen of machinery and others.

Chew Bros., Midland, Ont., have sold their sawmill property to Turner Bros., who will enlarge it. In the meantime Chew Bros. are at work upon another site in the east part of the town, where they will erect a new mill with all modern equipment. The Playfair Co. also has purchased a site, upon which it is about to erect a large timber mill It is expected that these two mills will employ about two hundred men.—Orillia Packet.

Some years ago a local company was floated in Perth, Ont., and a bonus was secured. The Perth Courier recently published the following paragraph, which might well have been part of the obituary column: "Pending the re-opening of the Facer Car Wheel factory, the C.P.R. has taken up the switch and the rail connection, and removed the semaphore. These can be replaced when the company begins operations."

The acetylene gas plant in the Fort Steele, B.C., post-office exploded recently, severely injuring postmaster Cann and his assistant, H. McVittie. The accident occurred through making an examination by candle light. This is an example of gross carelessness, and the accident cannot be attributed to the fact of its being acetylene gas; coal gas would explode under similar conditions.

M. J. Dodge, New York; A. R. Creelman, Q.C., and J. J. McNeil, Toronto; W. J. Sheppard, Waubashene; W. Irwin, Peterborough; A. McLeod, Bracebridge; T. H. Sheppard, G. McCormick, Orillia; J. Playfair, Midland; C. A. McCool, Ottawa, and W. D. Lummis, Spragge, Ont., have been incorporated as the Spanish River Pulp and Paper Company, Ltd., with a capital of $1,500,000.

The Laurentide Pulp Company, Ltd., has applied to the Quebec Government for an Act to amend the Act incorporating the village of Grand Mere, Que., in order to enable the officer of the said company appointed for that purpose by its board of directors, to vote in the name of the said company on all by-laws, which by-laws must be submitted to the proprietors of real estate in this village, and also to vote at the election of municipal councillors.

The Welland Press some little time ago made these sage observations about a bonus scheme: "The Hamilton iron works projectors ask a cash bonus of $25,000. Port Colborne can have them. Welland don't want them at that price; $25,000 to start other people in business is a little too thin. If they got it, they wouldn't be like other bonus-hunters if they didn't demand another $25,000 in a few years as the price for not moving away."

The Yale and Columbia Lumber Co., Ltd., which is the partial consummation of the effort to consolidate all the lumber mills of Yale and Kootenay, B.C., has been organized and includes the Genelle and Pupore mills, Nakusp, Robson and the Arrow Lakes, also the Blue mills of Rossland and Ymir, and Fisher's mills at Eholt, Phoenix and Rock Creek. The company is to be incorporated for half a million. The company has timber reserves estimated at 500,000,000 feet. Its head office will be at Greenwood, B.C.

The Gutta Percha and Rubber Manufacturing Company, of Toronto, recently finished an enormous driving belt. It was of rubber, and measured 3,529 feet in length. Its weight was nine tons This mammoth belt was made for the grain elevator of the Intercolonial Railway at St. John, N.B., and is now in use there. Another immense main drive belt, 58 inches wide and 338 feet long, with a weight of two and one-half tons, was recently completed for one of the Canadian Pacific Railway elevators at Fort William by the same company.

While British trade with Canada has largely increased, the Dominion drives a thriving commerce with the United States. The annual report of the Secretary of the United States Treasury shows Canada to rank fourth among the nations in respect of the bulk of the business done with the Republic. The total trade with the United States for the past twelve months was as follows: Great Britain, $630,266,922, Germany, $239,997,956; France, $122,742,955; Canada, $121,181,910; Netherlands, $93,763,618; Brazil, $70,114,783. No other nation reached the forty million dollar mark.

Various Ontario gas companies were represented recently at a meeting in Toronto at the Walker House. The high price of materials for making gas was discussed. Within the past two years gas oil has gone up 50 per cent. in price, and the duty of 2½ per cent. is said to be prohibitive A deputation will shortly wait upon the Dominion Government in this connection. The gas men declare it is hard to make both ends meet, which is a statement whose absurdity is so great as to cause laughter to all except those who are buyers of gas from these companies. A gas company which is not earning ten per cent. dividends is doing a poor business.

J. W. Tyrrell, C.E., Hamilton, Ont., has been chosen by the Dominion Government to explore the Keewatin district, to the east of Great Slave Lake in the Northwest Territories, as far as Chesterfield inlet. A few years ago Mr. Tyrrell explored the region north from Lake Athabasca to Chesterfield inlet, and the result of his labors was of great value to the Government. As far back as 1834 Sir George Back explored to the east end of the Great Slave lake, but stopped there on his march eastward. Mr. Tyrrell was expected to leave Edmonton about January 1, and expects to reach Fort Resolution late in March. He will be accompanied by the Rev. Archdeacon Lofthouse, of Fort Churchill. He will be away about ten months.

During the academic year 1898-99 Sir William C. McDonald has contributed to McGill University, Montreal, $7,650 to make up deficiencies in the income of the Faculty of Applied Science, and in addition to very many other generous gifts has given $30,000 to supplement the equipment of the electrical engineering laboratories; $55,000 to endow the department of mining and metallurgy, $90,000 additional endowment for the chemistry and mining building, $10,000 additional endowment for the chair of electrical engineering, $50,000 to found a chair of history associated with the name of the late Dr. William Kingsford, and has strengthened the auxiliary endowment fund, which he established in 1897, by the sum of $51,250, and a further sum of $62,500 to found and endow a "Dawson chair of geology."

Cities and towns which offer bonuses and other inducements to manufacturing concerns to locate within their borders have encouraged an evil which may recoil adversely on themselves, says the Montreal Daily Witness in a recent editorial paragraph. An instance of this sort of thing is given in the case of the Kingston Locomotive Works. It appears that the company has been offered a bonus of $75,000 to remove its plant to a town in another province, but it is said they will be content to remain in Kingston if that city will grant them the same amount. This opens a new way by which manufacturing companies may recruit their finances and gain other advantages. Any concern might manage so as to get an offer from another municipality than that in which it is situated to transfer its works for a bonus, and use the offer to compel its own town to pay a like amount under pain of removal. This is a dangerous game for municipalities to play with each other.

The announcement is made that the National Cycle and Automobile Company has decided to establish its plant in Hamilton, Ont. The company has leased temporary quarters in the old Wanzer building. James Dodge, of the Evans and Dodge Bicycle Works, Windsor, will superintend the installing of the plant in the factory It is altogether likely that with the removal of the E. and D bicycle works from Windsor, Ont., the Canadian Typograph Company's works, which has the same management, will also be removed there. The understanding arrived at with the company was that Hamilton men were to provide the money for the erection of the necessary factory buildings, which, with the site, were estimated to cost about $20,000. In addition to this, a bonus of $5,000 was to be raised by private subscription. In return the company agreed to provide employment for at least 300 men all the year round. The company speaks of doing a large export business.

The following were among the enquiries relating to Canadian trade received at the Canadian Government office in London, recently: Walnut boards of good quality, and wooden screws, are required in considerable quantities by a London firm. The names of Canadian makers of sporting ammunition, such as 22 calibre rim fire ball cartridges used for shooting gallery purposes, and any other cartridges for small bore sporting rifle, are enquired for. Enquiry is made for firms in Canada who would supply cheap wood mantel-pieces to be sent

over in a knock down condition. A large firm of manufacturers of enamelled, tinned, galvanized and japanned hollow-ware, sauce-pans, buckets, pails, etc., desire to do business with Canadian houses, and ask to be placed in communication with buyers. A Scotch firm largely interested in the export of Canadian goods, such as furniture, woodenware, hardware, provisions, etc., desire to extend their business in the export of Canadian goods to British India and the Cape, and are therefore open to hear from houses who may wish for their co-operation.

Plans submitted for protection to the piers of the Ottawa and New York Railway bridge, in course of construction over the St. Lawrence River at Cornwall, Ont., have been accepted by the Department of Railways. In the old structure the bottom was solid enough to hold the weight, but owing to the depth of water and the rapid current it was deemed advisable to reinforce the substructure. According to the plans submitted it is proposed to rip-rap the pier nearest the island with heavy stone blocks of half a ton or a ton each, piling up sufficient of them to protect the concrete from ice action. To secure the pier near the Cornwall canal an annular steel caisson will be built and sunk around the present crib several feet below the bottom of the river. This will be filled with concrete, and the new and old material knit together as far as may be to form one solid mass, the whole being tied with cables embedded in concrete. The pier at the canal bank appears to have been built on soft soil, being already a couple of inches at least out of plumb, and will be taken down and rebuilt, the foundation being made perfectly secure and means taken to prevent scouring.

Personal

J. W. Curtis, electrician for the Canada Paper Co., Windsor Mills, Que., is seriously ill.

Frank Duhamel, an engineer, and a native of New Brunswick, died in Vancouver, B.C., on November 15th, of consumption.

A. R. McVicar, Wardsville, Ont., has gone to Mexico, to superintend the construction of 100 miles of railway, for which his brother has the contract.

B. Laird, of the Robb Engineering Co., Amherst, N.S., is now in Cuba, installing some engines supplied by this company for street railway power purposes.

Maurice Bucke, mining engineer, was accidentally killed at Bear Gulch mines, near Jardine, Montana, last month. He was 31 years of age, and was a son of Dr. Bucke, of London, Ont.

William Mason, bursar and lecturer of the School of Mines, Kingston, Ont., died December 7th from acute tuberculosis. Deceased was a Scotchman, 56 years of age, and was with the British army in India.

P. L. Nasmith, who recently left the employ of the Dominion Coal Co., at Glace Bay, C.B., was presented by the employees of the company with a gold watch and chain, and Mrs. Nasmith with a silver tea service. H. Donkin, resident manager, made the presentation.

E. B. Wingate, city engineer, Hamilton, Ont., was naturalized as a Canadian citizen recently. At the time of his appointment, Mr. Wingate was a citizen of the United States.

Six miners at Sydney Mines, C.B., Z. Burchell, J. Edwards, D. Edwards, A. McDonald, R. Dixon, and N. McKenzie, fell a distance of 350 feet, and were badly crushed, a short time ago.

Francis Mill, C.E., died rather suddenly on 25th November last, aged 30 years, at the residence of his father, James Mill, J.P., Glenburnie, Maria, P.Q., from inflammation of the lungs. Mr. Mill had been in feeble health for the last four or five years. He was educated at Claremont College, Wallasey, England, and at the School of Practical Science, Toronto, and then became assistant engineer under Willis Chipman, Toronto, on the waterworks at Brockville, Ont. His friends will regret to learn of his death.

Baron Adolphe von Hugel died at the Royal Victoria Hospital, Montreal, December 20th, he having entered that institution on December 15th, suffering from an attack of paralysis. Upwards of thirty-five years ago Baron von Hugel came to Canada from Germany, and soon afterward became identified with the Midland Railway, of which he was president. At that time he lived in Port Hope, and served as Mayor of that municipality. During this time he built the Midland Railway, which eventually fell into the hands of Geo. A. Cox, and was sold by him to the Grand Trunk Railway, and became a part of that system.

James S. Taylor and Jos. Taylor, brothers of John M. Taylor, secretary-treasurer of the Dominion Radiator Co., Toronto, are now troopers in C Company, Bethune's Mounted Infantry, in South Africa. When the war broke out they were firmly established with head office in Johannesburg, and branches at Durban and Pretoria, having large mercantile interests there, holding large stocks of Canadian goods in South Africa, notably the Dominion Radiator Company, the James Morrison Brass Company, the Steel Clad Bath Co., of Toronto, and the Pedlar Roofing Company, of Oshawa. They were jointly contractors for the Johannesburg city hospital, and in October were offered protection if they would remain and look after the hospital building in case of necessity. Later, they were ordered to leave Johannesburg.

T. H. Browne, engineer in charge of the Havana Street Railway, died last month in Cuba, of yellow fever. Captain Browne was born in Montreal in 1870. He entered the Royal Military College, Kingston, from Lincoln College, Sorel. Graduating with honors in the electrical and mechanical branches of the R.M.C., he took up a position on the construction work of the Montreal and Ottawa Railway, a year later being appointed architect for the Dominion Government in the province of Quebec, having charge of all work on Government buildings, rifle ranges, etc. Taking up his residence in Montreal, he took a commission in the Royal Scots, attaining the rank of captain, and retiring retaining rank. In 1897, he left Montreal to take a position on the staff of the Boston Street Railway, and in December, 1898, resigned that post to join the engineering staff of the Metropolitan Street Railway, New York. He resigned that place in September last to take the appointment of engineer of the new street railway in Havana, Cuba.

Walter Shanly, C.E., ex-M.P., and one of the best known engineers in America, died December 17th at the St. Lawrence Hall, Montreal, where he made his home for a great number of years. Although 82 years of age, Mr. Shanly was able to be about up to a few days ago, when he became afflicted with extreme weakness, and, although his splendid intellect was bright to the end, he kept getting weaker, until he passed peacefully away. He was the fifth son of the late James Shanly, a member of the Irish bar, who came to Canada in 1836, and settled in Middlesex County, Ont. Deceased was born at "The Abbey," Queen's County, Ireland, October 11th, 1819; was educated by private tuition, and adopted the profession of civil engineer. In his younger days he was employed by the Canadian Government on the Beauharnois and Welland canals; was engaged on railways in the United States, and later, 1851—53, was engineer of the Ottawa and Prescott Railway. Between 1851 and 1862 he was successively engineer of the Western Division of the Grand Trunk, engineer of the Ottawa and French river navigation surveys, and general manager of the Grand Trunk Railway. His most important railway work was the construction of the Hoosac Mountain tunnel, in Massachusetts, in which he was associated with his brother, the late Frank Shanly, C.E. He was widely known as a consulting engineer. He sat in the old Parliament of Canada from 1863 till Confederation, and after the union sat in the first, fifth and sixth Parliaments. He gave an unyielding support to the late Sir John Macdonald, and was the contemporary, colleague and friend of Cartier, Galt, D'Arcy McGee and other brilliant men of the time. In 1864 Mr. Shanly was a delegate to the Detroit Trade Convention, along with the late Hon. Joseph Howe, Mr. John Young, and other representative men of the British provinces. He was for some years president of the Mechanics' Bank. The funeral took place in London, Ont.

Electric Flashes.

Sarnia, Ont., is granting a 30 years' franchise to the street railway.

L. Smith, Blenheim, Ont., proposes to put in an electric light plant at Little Current, Ont.

In Pembroke, Ont., a by-law for the purchase of the electric light plant was carried by over 200 majority.

The corporation of Picton, Ont., has awarded its meter and supply orders to the Canadian General Electric Co.

W H. Meldrum purchased the entire plant of the Paris Electric Light Co., and took possession on Dec. 12.

H. Corby, distiller, Belleville, Ont., has placed an order with the Royal Electric Co. for a 100-light direct current generator.

In Woodstock, Ont., a by-law was voted on, January 1st, for the purchase of the electric lighting plant, which was carried. All night lighting was decided on.

The Cataract Power Company, Hamilton, Ont., is building a brick addition to the transformer station at Victoria avenue, Hamilton, which will cost $8,000.

Gilmour & Co., Trenton, Ont., has lately installed in their mills a 100-light D.C. generator from the Royal Electric Co.

The Cataract Power Co., Hamilton, Ont., will provide free electric lighting to the township of Barton in return for a right of way.

The McCarthy Brewing Co., of Prescott, Ont., is installing a lighting system in its brewery at Prescott, using the Canadian General Electric Co.'s apparatus.

The Granby Consolidated Mining and Smelting Co., Grand Forks, B.C., has installed a 50-light direct current generator of the Royal Electric Co.'s manufacture.

The Ogilvie Milling Co., of Winnipeg, Man., has bought from the Canadian General Electric Co. a 30-k.w. direct current generator of its standard multipolar type.

The Drayton, Ont., Electric Light Co. is refitting its station equipment, and has placed an order for a 30-k.w. "S.K.C." twophase machine with the Royal Electric Co., Montreal.

The Dominion Iron and Steel Co., Sydney, C.B., has added another 40-h.p. 250 volt motor to the order already given for electric plant. The Canadian General Electric Co., has the entire contract.

The American Alkali Co., of Sault Ste. Marie, has placed an order for the switchboard necessary for its electrolytic plant, with the Canadian General Electric Co., which company is supplying the generator.

The Faculty of Applied Science, McGill University, Montreal, has received from a United States citizen, resident in New York, $10,000, to found a research scholarship at McGill in electrical engineering.

The Toronto Carpet Co. has increased its order for electric plant, and is now installing a 55-k.w. generator in place of the 30-k.w. originally ordered. The Canadian General Electric Co. has the work in hand.

Bothwell, Ont., is increasing its plant by the installation of two 20-k.w. generators to replace those originally purchased. The order, as in the first case, has been placed with the Canadian General Electric Co.

F. J. Davidson, Windsor, N.S., and H. McC. Hart, Halifax, N.S., are interested in the proposed calcium carbide works at Windsor, N.S., for which local capital, amounting to $100,000, has been subscribed.

According to the report of the Inspector of Weights and Measures for the year ending June 30th, 1899, there were doing business in Canada, 276 companies or individuals, supplying electric light, having a total of 630,732 lamps.

The Dodge Mnfg. Co., of Toronto, Ltd., has just installed a complete jack shaft equipment, consisting of floor stands, heavy shafting, iron pulleys, friction clutch pulleys, belt tightener, etc., in the new municipal electric plant of the city of Winnipeg.

The Kingsville, Ont., Electric Light Co. is increasing the capacity of its incandescent plant by the addition of a 75-k.w. alternator, the order for which has been placed with the Roy- Electric Co.

The Manhattan General Construction Co., Newark, N.J., has sold, through its Toronto office, a 35-lamp alternating current series arc lighting plant, including regulator, to the corporation of Campbellford, Ont.

J. M. Deagle, of Cataract, Ont., has ordered a complete electric light plant for the town of Erin, Ont., with the Royal Electric Co. The order includes a 30-k w. alternator, and 300 light capacity in transformers.

The St. Francois Xavier College, Antigonish, N. S., has placed an order with the Canadian General Electric Co. for a storage battery plant, consisting of a fifty-five cell battery, and one M.P.-4-17½-k.w. direct current generator.

A large number of motors taken in exchange are advertised for sale by the Jones & Moore Co., under the heading of Electric Bargains. Many of those offer exceptional values, as they are of standard voltages and makers, and have been but slightly used.

The Toronto Rubber Shoe Mnfg. Co. has purchased a 35-lamp alternating current series arc lighting plant, including regulator, for its factory, and the street illumination in Port Dalhousie. The Manhattan General Construction Co. is furnishing the equipment.

The Toronto Rubber Shoe Co., of Port Dalhousie, Ont., is installing in its new factory a 150-k.w. "S.K.C." twophase generator with switchboard, and one 30-h.p., and one 7-h.p. "S.K.C." twophase induction motors. The entire factory will be lighted and operated by electricity.

The St. Thomas Gas and Electric Co. is increasing its lighting capacity, and in doing so has decided to change its lighting system from singlephase to twophase, having ordered from the Royal Electric Co. a 150-k.w. "S.K.C." twophase machine with marble switchboard and instruments.

The Toronto and Hamilton Electric Co., Hamilton, Ont., is now in its new shop, a two-story building, 60 x 100 feet, in which some new machinery is being installed to meet the requirements of the increasing business of the company. All the machinery in the works is electrically driven.

The Pittsburg Reduction Company has awarded a contract to the Westinghouse Electric and Manufacturing Company for 11 electric generators, to cost $150,000, for installation in the great new aluminum works it will erect early next spring at Shawenegan Falls, on the St. Maurice River, Quebec.

The Coaticook Electric Light and Power Co. is increasing its lighting plant by the installation of another 2,000-light alternator with switchboard. It is also catering for electric power, for which purpose it has bought a 100-k.w. 550 volt direct current generator with switchboard complete. Both the above machines are of the Canadian General Electric Co.'s standard make.

The Dominion Electric Heating and Supply Co., Ottawa, has been out of business for the past year, owing to a dispute between the inventor of the process and the directors of the company. The creditors have received nothing, but efforts are being made to sell the second process of the company, and if this is done a dividend may be paid.

The St. Thomas Gas and Electric Co. is making changes and additions to its plant to meet increasing demands. For arc lighting purposes it is installing a Brush arc dynamo, with capacity for 125 lamps, manufactured by the Canadian General Electric Co. This company has also been operating the St. Thomas Street Railway for some time past from its power house, using two 100-k.w. generators of the General Electric standard type.

Greenwood, B.C., is putting in a lighting plant. G. C. Hinton & Co., Vancouver and Victoria, B.C., have the contract which calls for one 150-k.w. 2,000 volt, twophase "S.K.C." inductor type generator of 3,000-light capacity, complete with all equipments; and all material, insulators and supplies, the generator, switchboard, etc., being of the very latest and most approved pattern. The plant will cost in the neighborhood of $20,000.

As the result of a conference between Dr. Hoepfner, of the Hoepfner Refining Company, Hamilton, Ont.; John Patterson, of the Cataract Power Company, and an expert from the Krupp Gun Works, in Germany, it has been decided to enlarge the refinery premises in Hamilton by four times its present dimensions. The plant as it now stands consists of a main building, 236 x 55 feet, and three smaller buildings, and as soon as these are in operation the enlargement will be started, and the works when completed will cover six acres of land.

The Orangeville Electric Light and Power Co. is improving and extending its plant to meet a constantly increasing business, and a demand for an improved and economical street lighting circuit. For its incandescent requirement it has ordered another standard 60-k w alternator, with a complete new marble panel board for both machines For the street lighting the present open arc direct current plant will be abandoned and in place will be installed a constant current alternating system. This will consist of a 50-light series transformer with switchboard for same, together with 30 improved constant current lamps for operation from the same. This company has recently discarded the old 52 volt switchboard transformer system, substituting therefor large size type "H" transformers, feeding into a complete system of 3-wire secondary mains designed in accordance with modern practice. The single phase system will be adhered to. The Canadian General Electric Co. has the contract.

The Montreal Cotton Co., Valleyfield, Que., is pushing the extension to its new power house, and expect that by May 1st next, it will be completed, and the new 1,200-k.w. generator in operation. An interesting feature of this installation, which will be the largest industrial electric plant in the world, will be the switchboard arrangement. This will consist of a series of blue vermouth marble panels, 36 inches wide by 88 inches high, upon which will be mounted the necessary switches for controlling the motor circuits, and all instruments for controlling the generators and exciters. There will be used for present equipment twelve feeder panels and six generator panels. The entire board, as covered by present orders, will be 54 feet long, and when completed will present an imposing appearance, and will meet all requirements necessitated by the peculiar condition under which this plant operates, and the entire work will no doubt reflect credit upon the Canadian General Electric Co., to whom it has been awarded.

A good evidence of the progress of Montreal as an electrical centre may be afforded by a visit to the new premises of John Forman, 708 and 710 Craig street. To accommodate his increasing business in electrical supplies, Mr. Forman has appropriated the whole of one of the substantial new buildings erected in Craig street in 1899. The new premises are four stories high, beside basement, and are admirably lighted and fitted up. The different departments are well laid out, both for convenience for shipment and for attaining the best effect in the show of goods The basement is devoted to heavy goods, such as cables, heavy wires, conduits, insulators, etc., and is lighted by electric lights with double glass reflectors. A goods and passenger elevator connects the basement with the other flats. On the ground floor are the general offices, which are handsomely designed, and at the rear are supplies of various kinds. The first floor above this contains Mr. Forman's private office, and a new laboratory equipped with various instruments for testing incandescent lamps, etc., these instruments costing over $1,000. A noteworthy feature of this laboratory will be, that any person, no matter whether a customer of the firm or not, may have the benefit of these instruments, and no charge whatever will be made for testing lamps—beyond of course the cost of carriage from points outside the city. The privileges of this department will no doubt be appreciated by users of electricity. Portions of these two flats will be devoted to the display of electrical fixtures and supplies, and the two stories above these will be devoted to manufacturing. Mr. Forman has purchased the plant of the Canadian Bryant Electric Co., and will carry on the manufacture of all lines of supplies made by that company, including branch-blocks, mains, cut-outs, rosettes, switches, sockets, etc. The trade mark "Imperial" has been registered by Mr. Forman, and this striking emblem, which appears in his advertisement on another page, is sure to be a familiar one in the electrical field in future.

The McLachlan Electric and Gasoline Motor Co., Ltd., Toronto, has recently supplied the following: Duncan & McLennan, Campbelltown, N.B., two 50-light dynamos and one 3-h.p. gasoline engine; Hill & Rutherford, Victoria Glass Works, Toronto, one 15 and one 8-h.p. motor; Rodden Bros., Toronto, three 12-h.p. motors; Imperial Woolen Mills Co., Streetsville, 200-light, installation complete; Leitch & Turnbull, Hamilton, five 6-h.p. motors; Purdy, Mansell & Co., Toronto, two 6-h.p. motors; Douglas Ford, Toronto, one 8-h.p. motor; White, Allan Mnfg. Co., Toronto, two 3½-h.p. motors; T. Eaton & Co., Toronto, one 5-h.p. motor; E. B. Corlett, Toronto, one 2-h.p. motor; J. B. Kleinert Rubber Co., Toronto, one 3-h.p. motor; McKenzie, Snyder Co., Toronto, one 12-h.p. motor; Temple Building, Toronto, one 6-h.p. motor; Thompson Bros., Toronto, one 4-h.p. motor, A. E. Long, Toronto, one 2-h.p. motor; A. R. Williams & Co., Toronto, one 10-h.p. motor; O'Leary & Robillard, Ottawa, one 8 and one 15-h.p. motor; W. R. Robertson, Brantford, one 1-h.p. motor; Continental Costume Co., Toronto, one 6-h.p. motor; Capp & Co., Toronto, one 3-h.p. motor; H. W. Petrie, Toronto, one 2 and one 8-h.p. motor; Gold Medal Mnfg. Co., Toronto, one 25-light dynamo, full installation; Walter Dean, Toronto, one 6-h.p. motor; Mathew Bros., Toronto, one 30-light dynamo, full installation; Wm. Meek, Kingston, one 2-h.p. motor; John Henry & Sons, Ottawa, one 8-h.p. motor; Murray Printing Co., Toronto, one 12-h.p. motor; H. W. Petrie, Toronto, one 60-light dynamo and one 8-h.p. motor; Tarbox Bros., Toronto, one 3-h.p. motor; Mrs. Frero, Toronto, one ½-h.p. motor; Meteorological Office, Toronto, one 1½-h.p. motor; Dancyger Safety Pin Ticket Co., Toronto, one 3-h.p. motor; G. T. Pendrith & Co., Toronto, one 2-h.p. motor; Meyer & Shapro, Toronto, one 2-h.p. motor; Jas. Goldie, Guelph, one 5-h.p. motor.

Railway Matters.

The Grand Valley Railway, which proposes to build lines from Goderich to Port Dover and Stratford, Ont., has given notice of application for incorporation.

In Lindsay, Ont., a by-law was carried to grant a bonus of $25,000 to the proposed Lindsay, Bobcaygeon & Pontypool Railway. The township of Verulam voted $14,000, and the town of Bobcaygeon, $11,000.

The Pontiac, Pacific Junction Railway Company, will apply next session for right to construct a railway from Quyon or Shawville, Que., to Pembroke, Ont., and branches not exceeding thirty miles.

Logan, Jenks & Outheto, of Amherst, N.S., give notice of application for the incorporation of a company to build a line of railway from Pyramid Harbor by the Dalton trail to Fort Selkirk, and on to Dawson.

Prof. C. H. McLeod, C.E., and a party of fourth year students have surveyed a cut-off line at Hamilton, Ont., to relieve traffic on the "Y" for the use of the through traffic, near Waterdown station. The grades have been much improved.

The Canadian Pacific Railway will construct or acquire a railway from Morden on its Pembina Mountain branch, to Miami, and to Carman, Man.; and also a railway from a point between Hartney and Souris on the company's Souris branch, to a point between Boissevain and Ninga on the Manitoba and Southwestern Colonization Railway.

Application will be made for a charter to build a railway from the mouth of the French River, in the Parry Sound district, through the districts of Parry Sound and Nipissing and the county of Renfrew, Ontario, to Pembroke, thence through the county of Renfrew to a point at or near the village of Portage du Fort, Que., with power to erect bridges across the Ottawa River, etc..

A serious landslide occurred at Kas'o, B.C., last month. A strip of water front eighty to a hundred feet wide, and 250 feet long, at the Canadian Pacific Railway landing, sank. All the piling which the C.P.R. has been driving for the past season, on which to build its wharves, and which would have been completed in a short time, dropped out of sight without a moment's

notice. The two wharves were being built side by side, that of the C.P.R. having about 100 feet of work done upon it, while the Kaslo and Slocan Company's was about completed. The last pile was being driven when the collapse occurred.

M H Fitzpatrick has in conjunction with his brother, Hugh Fitzpatrick, Pictou, N.S., about completed the Midland Railway of Nova Scotia, the promoters of the line being W. Strachan, D. L. Lockerby, Peter Lyall, W. D. Reid and others of Montreal. If it were not for the heavy bridge over the Shubenacadie River, fifteen miles west of Truro, N.S., passenger trains could be run over most of the line, but the delay at the bridge will probably delay the opening of this railway till the early autumn of 1900. The New York Engineering Company has built the two abutments and two piers of this bridge, leaving three piers to be constructed next summer.

F H. McGuigan, general superintendent of the Grand Trunk Railway, recently said that the G.T.R. has laid, during 1899, 13 miles of double track and has the whole line doubled between Montreal and Hamilton, except 46 miles, from Port Union to Port Hope. If business is good, this link will be closed up in the near future. The double track from Hamilton to Niagara Falls is also laid out, and the work will be proceeded with next season It has likewise been decided to double the line from Port Huron to Chicago in the near future. No less than 315 miles have been relaid this year, with new 80 lb. steel rails, while 285 miles of these rails, replaced by the 80-lbs., have been laid down on the branch lines, the latter being from 72 to 79 lbs., and replacing in turn rails of from 56 to 60 lbs. So it will be seen that no less than 600 miles of the company's lines have been greatly improved. From Portland to Chicago there are now laid 720 miles of these standard 80-lb. rails, while the steel in the balance of the main line between those points average from 72 to 79 lbs. They have laid, during 1899, 1,826,857 ties, 1,344,374 being cedar, and purchased in Canada. The company put down last year 321 miles of gravel and 50 miles of cinder ballast, 123 miles of new fence and 63 miles of yards and sidings.

Marine News.

Over 40,000 tons of coal have been brought to Sarnia, Ont., this fall by vessels.

Water was turned into the Chicago Drainage Canal at 9 o'clock, January 2nd.

The St. John Sulphite Fibre Co. has bought barges to use in bringing pulp up from the mill at Mispec to St. John, N.B.

At a meeting of the shareholders of the Sydneys' Ferry Co., Ltd., held in December it was decided to buy two new steamers for their ferry business next season.

H. W. Kennedy, M. Brown, W. Ross, and G. C. Frisbie, Rat Portage, Ont., and A. R. Bartlet, Windsor, Ont., have been incorporated as the Commercial Dock Company of Rat Portage, Ltd.; capital, $10,000.

Steamer "J. L Nelson," built by W. H. Butler, of Yarmouth, for T. F. Smith & Co., of Newdy Quody, Halifax county, has been successfully launched. The new steamer is 68 feet long by 13½ feet beam and 7 feet deep. She is fitted with 7 x 14 x 12 compound surface condensing engine and a boiler 9 x 4 x 25 feet, carrying a working pressure of 140 pounds.

The United States project to place a dam across the mouth of Niagara River to permanently raise the level of Lake Erie some three feet is assuming a serious and tangible shape. It has been recommended by the Deep Waterways Commission, and Representative Corliss, of Detroit, is preparing a bill to bring before the United States Congress making an appropriation for construction. Of course the co-operation of the Canadian Government will have to be secured before the scheme can be gone on with.

—The Pratt & Letchworth Co., Buffalo, have bought the G.T.R. car works at Brantford, Ont., and will produce malleable iron for the Canadian trade.

FIRES OF THE MONTH.

Dec. 7th. The McLaughlin Carriage Co.'s works, Oshawa, Ont.——Dec. 10th. The Exeter, Ont., electric light station.——Dec. 11th. H. Kreig's woodworking shop, Hespeler, Ont.; engine house destroyed.——Dec. 12th. Owen Sound Iron Works pattern shop.——Dec. 14th. Machine shop of the Shore Line Railway, St. George, N.S.——Dec. 14th. Steamer belonging to G. F. Marsh, tug belonging to Shaw, Cassels & Co., at Huntsville, Ont., loss, $6,000——Dec. 18th. Shearer's lumber mills, Point St. Charles, Montreal, loss, $20,000.——Dec. 20th. Charite L. Patterson Mnfg. Co., makers of tar paper, Halifax, N.S., loss, $5,000.——Jan. 3rd. H. C. Rees' stave mill, Woodslee, Ont.; loss, $3,000.

—Inglis & Sons, engine and boiler makers, Toronto, are about to build refrigerating machinery on a large scale.

F Moore, of the Jones & Moore Electric Co., Ltd., Toronto has been for some weeks suffering from a severe attack of typhoid fever.

—Henry Aylmer, Melbourne, Que., intends to establish a large sash and door factory and sawmill. Electric power will be used, it is said.

—Sproatt & Rolph, architects, Toronto, have prepared plans for a glycerine refining plant to be installed in connection with Lever Bros., soap factory, Toronto.

—C.A.S.E. Toronto No. 1, at its regular meeting, January 3rd, elected A. M. Wickens and Chas. Moseley as representatives of the C.A.S.E. on the Board of the Technical School. At the open meeting on January 17th, J. Hunter will read an essay on "Refrigeration."

—The Hamilton Bridge Works Company, Ltd., has issued the following circular: "We beg to announce that W. H. Law has been appointed chief engineer and manager of this company. H. Szlapka will remain with the company, attached to the engineering staff." Mr. Law, who was formerly general manager of the Central Engineering Co., of Peterboro, has been heartily congratulated by his friends from many quarters on this return to his own special field.