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The Canadian Engineer

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CONTENTS OF THIS NUMBER:

TO INTENDING ADVERTISERS.

The following extract from a circular recently issued by the publishers may be of interest to intending advertisers:

In asking consideration for THE CANADIAN ENGINEER as an advertising medium, the most forcible argument we can use is a plain citation of its record. Since it was established in May, 1893, as a 28-page paper, it has been enlarged four times (being now 52 pages), and the fifth enlargement in contemplation will make it more than twice its original size. The first number contained 45 advertisements, covering 8¼ pages, including transient announcements, while at the date of this circular we have 153 advertisements covering 19¼ pages, without counting new orders in hand for the next ensuing numbers. The steady increase in our circulation has been one of the most remarkable, and to us and our advertisers, the most gratifying features of the record. The appended declaration from the company who have the contract for our printing shows the progress of the paper during the last nine months. To sum up, THE CANADIAN ENGINEER stands to-day UNRIVALLED among Canadian trade papers for the wide distribution and the character of its circulation. Its subscription list is entirely a bona-fide paid one (the only free copies being to advertisers and contributors), and it is the only paper which reaches both the men who own the industrial and engineering establishments of Canada, and the men who operate them.

To whom it may Concern:

TORONTO, Jan. 28, 1896.

This is to certify that the statement given below is a true account of the copies of THE CANADIAN ENGINEER we have printed and mailed for Biggar, Samuel & Co., beginning with May, 1895, issue, and ending with January, 1896, issue.

THE MONETARY TIMES PRINTING CO. OF CANADA, LTD.
Per A. W. LAW, Sec'y-Treasurer.

Date of Issue.	Copies Printed and Mailed.
Volume III., No. 1, May, 1895	2,000
" " 2, June, "	2,000
" " 3, July, "	2,100
" " 4, Aug., "	2,200
" " 5, Sept., "	2,400
" " 6, Oct., "	2,400
" " 7, Nov., "	2,500
" " 8, Dec., "	2,600
" " 9, Jan., 1896	3,500

WATERWAYS OF CANADA.

BY THOMAS MONRO, PRESIDENT CANADIAN SOCIETY OF CIVIL ENGINEERS; AN ADDRESS DELIVERED AT THE ANNUAL MEETING, 15TH JANUARY, 1896.

(Concluded.)

With these necessarily imperfect prefatory remarks, it is now proposed to make a few practical observations upon the leading principles which it is believed should govern the location of canals designed for the passage of large vessels, and in the position of those in progress or completed between Lake Erie and Montreal. Reference will chiefly be made, for illustration, to the works of the Soulanges Canal, because an attempt has been made to construct them in accordance with modern practice, the writer having been left a free choice in the design and arrangement of the structures, etc., etc. He was really limited only by the general dimensions of locks, etc., fixed by the Commission of 1870 for the St. Lawrence route.

1. The disadvantages attendant upon an abrupt change of direction, in a line of navigation of the dimensions of the St. Lawrence canals, are so great as to warrant a large outlay in order to preserve as straight a line as possible. Vessels weighing with their cargo about 3,500 tons, when under steam, even at canal speed of say four miles an hour, have to be guided with the utmost care to prevent accident. It is obviously easier to steer where the line is straight, and where objects can be seen some distance ahead, thus avoiding in many cases running on the banks, and preventing collisions which would otherwise be difficult to escape. The advantages of a straight line are very manifest at night, when a well-lighted canal can be almost as easily navigated, at moderate speed, as during the day. A gradual change of direction, effected by curves of large radius, is, however, by no means objectionable.

2. But not only ought sharp curves to be avoided—the dimensions of the prism should be uniformly preserved throughout as far as possible. At bridges the old practice was to place a pier in the middle of the canal, with a narrow opening on each side of it. This is a cardinal mistake, and can be easily avoided by the adoption of a light steel superstructure, one arm to swing over the whole bottom width of the canal (100 feet), leaving this free for navigation and the uninterrupted flow of the water. The pivot can be built on whichever side of the canal may be deemed desirable,

and the other arm made to swing partly over the land. Behind this pivot the prism can be enlarged, so as to give more than the full sectional area of the canal, and entirely obliterate cross currents at the bridges. In this way a double source of accident will be avoided. Vessels will have no tendency to sheer, and there will not be the same danger of collision with the bridges as when a narrow channel on either side of the pivot has to be passed through at such speed as will enable the vessel to be safely steered, especially in high winds. With this arrangement the eastbound and heavily laden craft need not slack up, neither the lighter ones coming west, so that there will be no detention whatever at the bridge crossings. In addition to the safety of this plan, it is by far the most economical. Some of the road bridges on the Welland Canal cost from $40,000 to $50,000. There is no reason why, under ordinary circumstances, a bridge, to serve the same purposes, if built according to the plan above described, should cost more than say from $25,000 to $30,000.

3. The reduction in the cost of masonry previously referred to, when discussing the question of the enlarged Welland Canal, is founded in the firm belief that for the purposes of lock walls, weirs, retaining walls, and other hydraulic structures, concrete made of sound and properly tested Portland cement, good clean broken stone and sharp silicious sand, is in all respects better than the expensive masonry hitherto in vogue. A monolithic water-tight mass is obtained of such shape as may be desired, and at a cost which will vary from about one-half to two-thirds of that of dressed stone, according to circumstances. Where, for example, the line of a canal passes through a rock formation, which, whilst not suitable for masonry, yields excellent material for concrete, what valid reason can be given for rejecting this mode of construction? Take, for example, the case of the new Welland Canal. Its line is in heavy rock cutting at the pitch of the Niagara Escarpment at Thorold, and close to where the bulk of the masonry is in the ladder of locks and weirs descending to Lake Ontario. Within a distance of about nine miles there are over 325,000 cubic yards of this masonry. And the rock excavation in the vicinity amounted in the solid to over 150,000 cubic yards. This, instead of being chiefly thrown to spoil, would, if broken to proper size, have made nearly 300,000 cubic yards of concrete. If the structures had been built (as might have been done in this particular case) of native cement, through a stratum of which the canal line passed—a vast mass of the work could have been executed at one-half or less than one-half of the masonry prices paid—which were from $10 to $12 per cubic yard. These are of course only approximate statements, but will serve to show the great saving which might have been effected by adopting the use of concrete under such favorable circumstances.

4. Recent experience in the use of properly made concrete places its economy and desirability for canal works in every respect beyond reasonable doubt. The Manchester Ship Canal examined by me in 1891, just previous to completion, afforded a convincing proof of this. The cost of this work even now is enormous. But what would it have been if the 1,250,000 cubic yards of masonry in its locks, quay walls, etc., etc., had been built of cut stone, instead of concrete?

Conclusive evidence of the durability of concrete in this climate, under the most trying conditions, is afforded by the present state of the breakwater at Buffalo harbor. This structure is exposed to the violent storms at the east end of Lake Erie, which entirely destroyed its old wooden superstructure. This was replaced by a solid mass of concrete—and the waves have dashed up against it for years, and masses of ice have clung to it for many rigorous winters, without effecting even the least degradation of its surface. It is, however, superfluous to multiply proofs of what is now a universally acknowledged fact. But it is also a fact that the reputation of concrete has suffered greatly by the use of cement in public works, which can only properly be described as "trash." There is nothing that requires so much care in testing as cement, although the duty is simple and easily performed, but without it there is no guarantee whatever of quality. The choice of cement should not be left to any contractor. Such a course is almost sure to result in failure; and it may here be observed *en passant* that there are several cases of this kind in canal works of recent construction.

5. There is another position in which concrete may, with advantage, be used as a substitute. Of recent years, the increasing cost of timber, its inferior quality, and comparatively short life, have directed attention to the plan of using concrete instead of it in the superstructure of entrance piers, dock walls, etc. On each side of both the upper and lower entrances to the Soulanges Canal, the cribs are finished to low water line, and along their inner faces concrete walls are built about 8 feet high and 6 feet wide at the base. These will be coped with cut stone and backed up by material of heavy class, well rammed in layers. The cribs are 25 feet wide. The wall is protected by oak fenders 18 x 9 inches. Its face is vertical. The cost of the crib superstructure is approximately about three-fifths of that of concrete, which is about $5.50 per cubic yard, with Portland cement at $2 per barrel of 400 pounds. The aggregate length of piers at both entrances is about 3,900 feet.

6. None of the other St. Lawrence canals is crossed by a stream of such size as the River Delisle, which intersects the Soulanges at Coteau du Lac. The flood measurement of this was found to be about 300,000 cubic feet per minute. The river is passed under the canal through four lines of cast iron tubes, each of 10 feet inside diameter, and having an aggregate area of 314.16 square feet. The length of the culvert is 290 feet. The banks of the river for some distance above it are flat, and then there is a rise of about 7 feet at what is known as "Sullivan's Falls." The spoil from the canal is used to raise these low flat banks, so that when the river at flood time rises to get the necessary head to pass such a large volume, the land on either side is not overflowed, and the effects of back water are not felt. The tubes are one inch in thickness, strengthened with fillets or bands three-eighth inches thick, and four inches wide at the centre and ends of each ring. The weight is about 1,300 pounds to the running foot. They are cast on end in lengths of five feet, and were laid on cradle pieces of white oak placed at five feet centres. They were butt-jointed and surrounded with about two feet of concrete.

At the Delisle they are laid in a rock trench 50 feet wide, and the whole trench is filled solidly up with concrete nearly to the level of canal bottom. The cost of this structure when completed will be about $85,000. At the River Rouge there has been a similar culvert built, but with only two lines of tubes. This is finished, and the stream now passes through it. Further down,

there is another at River a la Graisse, with only one line of tubes. One of the reasons why this plan has been adopted is, that under certain conditions which might occur, the culverts would be subjected to considerable bursting pressure. The tubes take the place of the centres, which would be required either for a stone or concrete arch; and, in brief, the plan seems to answer very well.

7. On the Beauharnois Canal the lift of 82½ feet between Lakes St. Louis and St. Francis is overcome by nine locks. The guard lock is always a lift lock. The lifts are generally nine feet. This suits the configuration of the ground on the south side of the river. But on the north side the land continues for a long distance eastward from the head of the canal, pretty much at the same level as Lake St. Francis, so the summit is about 10½ miles long. There is then a descent by one lock of variable lift, and about 2½ miles further down the land pitches off on the right bank of the Ottawa, so as to suggest the idea of concentrating the lockage there as much as possible. When the canal was first located, the rise of 70 feet was proposed to be distributed amongst five locks. This was subsequently changed to four, and, finally, upon full consideration, I recommended that the rise should be made by three locks, each of 23⅓ feet lift. In this view of the case I was supported by Walter Shanly, M. Can. Soc. C.E., and T. C. Keefer, Past President Can. Soc. C.E., who were consulted by the Government on this important point. The advantages of high lifts, when possible, are obvious. The number of locks is reduced. A considerable saving, both in first cost and subsequent maintenance, is effected, and the navigation of the canal rendered easier and quicker. But it must be remembered that it is entirely dependent upon the profile of the ground as to what lifts can be judiciously given to the locks. All the advantages claimed for the plan adopted in the particular case above referred to might disappear if the line adopted had to follow a long flat slope. Here, as elsewhere, judgment and experience are of course necessary in arriving at a proper conclusion.

8. As to the locks themselves, it may be stated that on the Soulanges Canal they will be faced with cut stone, but the mass of the wall will be of concrete. They will be filled from the sides through a number of short cast-iron pipes, leading from the culverts into the chamber. There will be no timber in the foundation as heretofore. One of the chief sources of accident is that through a wrong or mistaken signal, a vessel coming into the lock from below, may go ahead instead of reversing, and so run against the upper gates, if on the same level,—striking them about the mitre, and from behind, in which case they are jumped off the pivots by the force of the water, and are swept into the lock, damaging the canal and the vessels also. But when there is a heavy breast wall, upon which the upper gates are placed, it is the vessel that comes to grief, and the gates are left intact. There are a number of details in the construction of these locks, which have been thought out, and are believed to be improvements on the old style; but it is not considered necessary to refer further to them in this brief address.

It appears to me that on the Welland and St. Lawrence Canals, where the supply of water is practically unlimited, and for lifts of from 20 to 25 feet, there is no simpler or safer device for passing vessels from one level to another than the form of lock now in common use. If the gates are properly constructed and balanced, they can be operated quickly and with ease. An ordinary lock can be filled from the sides in four or five minutes. This avoids the surging of vessels, so much complained of when the water is admitted through valves in the gates—and, in short, there is no reason why a lockage cannot be made in from 12 to 15 minutes under ordinary circumstances.

9. It may, however, be well to draw attention to the facts concerning the proposed application of electrical power in opening the locks and bridges, and generally operating the Soulanges Canal. A power-house will be established about mid-way of the line, and where it nearly touches the St. Lawrence at River a la Graisse. Here the surface of the river is about 20 feet below that of the canal. The ordinary water cross section of the prism at mean level of Lake St. Francis is about 2,700 square feet. The fall in the summit level will, if necessary, give a current in the canal of, say, 100 feet per minute, or 270,000 cubic feet flow. Ten per cent. of this on a 20-foot fall would give 1,000 horse power gross, or, say, 750 effective. This would obviously cover all requirements as to locks, bridges, weirs, etc., and possibly provide power to haul the vessels into and out of the three lower locks without using their own steam at all. Experiments were made, under my direction, at Lock No. 9, Beauharnois Canal, on a simple plan for opening and shutting the gates by means of a rigid girder, worked by rack and pinion movement, and driven by an electric motor. The girder was attached to the top of the gate, and the machines were placed on the copings of the lock. The gates were easily opened or shut in less than one minute, and there is no reason why both the gates—filling and emptying sluices, etc., should not be operated from a single switch-board in a small wooden house or box, placed on whichever side of the lock may be considered necessary. The cables to the motors on the opposite side to be taken across in grooves in the foundations. It is intended that the weirs shall operate automatically, and advantage will be taken of all the improvements made by electrical engineers to render the working of the canal as efficacious and economical as possible. It is evident that the adoption of this plan will greatly reduce the present cost of operating the canals.

10. Incidental to this question of canal location, it may be said that much confusion has arisen in reference to the available depth of canals by the mistake of referring their draught to the *mean water* of the river or lake by which they are alimented. This should be carefully avoided. The depth on the mitre sills should be referred to the *lowest known stage* of such lake or river, and not to any deceptive mean derived from statistics. In such a case statistics won't do—it is *water* that is wanted, as the late Mr. John Page used to say. This lesson has been forcibly inculcated by the late unprecedentedly low water in Lake Ontario and the River St. Lawrence.

11. I had almost forgotten to say, before closing that, in my opinion, all canals, especially those taking their supply from lake or river subject to the effects of storms, or the unusual variations of surface due to heavy rainfall, should have a guard lock at or near the upper entrance.

If the summit or feeding level is very long, and the head of the canal is in such a position as that of the Welland at Port Colborne, where there is a funnel-shaped harbor leading out of the funnel-shaped end of Lake Erie, the effect of a violent storm upon the water

levels is, in its way, as remarkable as a Bay of Fundy tide. In October, 1886, and in January, 1889, westerly gales of this kind occurred. The guard lock had been left open and the water was rammed into the long offshoot represented by the summit level (about 18 miles long), where it was piled up and kept there by the force of the wind, so that, during the gale of 1886, the surface rose about four feet at Port Colborne, seven feet at the aqueduct, and a small quantity of water is said to have passed over the coping of the guard gates at Thorold, the level of which is about nine feet over Lake Erie, mean surface! Had a break occurred at this point, the damage which must have ensued to the country below can scarcely be imagined.

In this connection it may be asked what would have been the result on the 11th October, 1888, when a heavy breach occurred in the Cornwall Canal, had there been no guard lock at its head? In other words, if the canal had been open to the river at the time of the accident? I venture to say that instead of only the serious interruption so loudly complained of by forwarders, the canal would have been closed to navigation for the remainder of the season.

The safety which a guard lock gives under such circumstances (or modification of them) is sufficiently obvious. With guard gates only, the canal would not be navigable until the gale had subsided. If left open they would be useless; and if shut (as they should be), they could not be opened until the head against them disappeared. At the east end of Lake St. Francis the water will rise about 18 inches during a strong westerly gale. A guard lock is therefore indispensable at the head of the Soulanges Canal. With two pairs of gates, the passage of vessels need not cease during storms, and the canal below the lock (which is always liable to accidents) would be saved from the destruction which would ensue if it were left open to the lake, whilst a break occurred in the high banks, or at one of the culverts.

But I shall not trespass on your patience any longer. There are so many questions arising out of the study of this important subject that it would far exceed the time at my disposal to even touch upon the greater number of them.

In conclusion, I thank you for the honor you have done me by my election as President for 1895. I have endeavored during my term of office to absent myself as seldom as possible from the meetings; and I may now say that I do not mean, after leaving the chair, to take less interest than heretofore in the affairs of the society, knowing, as I do, full well, that no success can be achieved except by a long pull, a strong pull, and a pull all together.

THE MINERAL RESOURCES OF CANADA.*

BY FRANK D. ADAMS, M. AP. SC., PH. D., PROF. OF GEOLOGY, M'GILL UNIVERSITY.

(Concluded.)

Ores of silver and lead in nature usually occur together, and are found at a number of places in the Dominion. Only a few words, however, can be said concerning one district, which is at present especially prominent and promising, namely, the Kootenay district of British Columbia. This is bounded on north and west by the C.P.R., on the east by the interprovincial line, and on the south by the international boundary.

Here within the past few years a great number of important metalliferous deposits, chiefly rich silver and lead ores, have been discovered.

Many of these deposits have been taken up and are being worked. Little towns and mining centres are springing up. Roads and trails have been made in all directions. Lines of railway have been and are being built, both from the north and south, and several smelters have been erected. In fact, so far as the mining development of British Columbia is concerned, the centre of interest has for the time being, at least, been shifted from the old placer districts to this Kootenay country. Gold and copper have also been found in this district, which is believed to be one of exceptional promise, and which will in the near future largely increase the mineral production of the Dominion.

There are also among the products of Canadian mines, in addition to coal, many non-metallic minerals, that is to say, minerals which are not worked for any metal, but which are of the highest importance, such as asbestos, mica, gypsum, apatite, petroleum, salt, etc.; in fact the value of the non-metallic minerals produced by the Dominion far exceeds that of the metallic ores. Among these non-metallic minerals one of the most important and interesting is asbestos, a name given to the fibrous form of certain minerals, our Canadian asbestos being a fibrous form of the mineral, serpentine. The mineral derives its name from the Greek word signifying incombustible, on account of the fact that although this asbestos looks like the fibre of wool or cotton, unlike these, it cannot be burned or destroyed by fire. It is found in thin irregular veins, varying in width from the thickness of a sheet of paper to six inches or more, which veins traverse the great masses of serpentine rock found in the eastern townships of the Province of Quebec, but especially in the townships of Thetford and Coloraine. When first broken from its enclosing rock its distinctive character is not very clearly shown, but when crushed by striking with a heavy hammer or by passing between powerful rollers, it falls into a mass of fine, soft, flexible fibre of so-called mineral cotton or asbestos. This fibre, although not possessing the strength of many vegetable fibres, can be spun and woven. String, rope, wall paper, or millboard, or even clothing of asbestos, can thus be made, and the material being incombustible, serves many purposes for which vegetable fibres are unfitted. It is especially useful in packing steam joints, etc., and in Paris and elsewhere firemen are clothed in suits of asbestos cloth, and thus protected to a certain extent from the dangers incident to their heroic calling. The asbestos industry is comparatively a new one in the Dominion, the first mining having been done in 1878, when 50 tons were taken out; last year 7,630 tons were raised, having a value of $420,825.

"Phosphate" or Apatite was until the last year or two mined extensively in the Ottawa district. The discovery of the very extensive phosphate deposits of Florida, however, has so lowered the price of this mineral—a fall in price of about one-half having recently taken place—that the mineral cannot be profitably mined at present prices in Canada. With the phosphate a number of other minerals are found, and among these is mica, which occurs in large amount in the form of crystals, often of large size, and while the phosphate has so greatly declined in value, a corresponding demand for this mica has sprung up, and the Canadian "amber mica" is now largely exported, and has now a well

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

established place in the markets of the world. This demand is due to the great strides which have recently been made in the applications of electricity, the mineral being used for insulating purposes in the construction of dynamos and other electrical machines. Many phosphate properties which were thus believed to have become valueless have proved to be capable of yielding good returns when worked for the mica, which had formerly been disregarded as a refuse product.

The output of gypsum is steadily increasing. It is largely worked in Nova Scotia, New Brunswick and Ontario. The deposits in these provinces are very large, while others not yet opened up are known to occur in Manitoba and the North-West Territory. The mineral when ground finely is used under the name of "land plaster" as a fertilizer, or dressing for land, and when calcined is converted into "plaster of Paris," which is employed very largely for the production of casts, mouldings, etc., as well as for the interior finishing of houses. Alabastine and other similar products are also made from it. The gypsum beds of the Maritime Provinces are of great thickness, and occur in association with the limestones of the carboniferous system. In the quarry at Hillsborough, N.B., a cliff of gypsum rock 100 feet in height is to be seen, while cliffs of snowy white gypsum 200 feet in height are found in Nova Scotia. The transparent, crystallized variety of this mineral, known from its moon-like lustre as selenite, is found in New Brunswick as great veins cutting the massive deposits. The name plaster of Paris, which is given to gypsum when calcined, is derived from the fact that at Montmartre, near Paris, in France, where there are very extensive deposits, the gypsum was first calcined on a large scale and the so-called plaster of Paris thus obtained. The production of plaster of Paris depends on the fact that the gypsum contains about 20 per cent. of water, which is driven off when the mineral is heated. The anhydrous plaster of Paris so produced, and which looks like flour, has, however, when mixed with water to a pasty mass, the power of taking up this water again, and thus becoming converted into a solid rock-like mass. It is this property which enables the plaster of Paris to be used for the various purposes to which it is put. Last year the Dominion produced 223,601 tons of gypsum, valued at $202,031, as may be seen from the report of the Geological Survey on the Mineral Production of Canada in 1894, published in the July issue of THE CANADIAN ENGINEER.

Canada is also a large producer of petroleum. And here it may be mentioned that the name coal oil is a misnomer, seeing that petroleum is not in any way connected with coal, neither originating from coal, nor being found associated with coal, nor in coal-bearing districts. It occurs in rocks, sometimes older and sometimes newer than the coal measures, and is derived chiefly from bituminous shales or limestones.

Formerly, oil, known as kerosene, was manufactured from these bituminous shales by a process of distillation, but when petroleum was discovered in the great oil wells of Pennsylvania and Russia, the price of oil fell so greatly that the production of kerosene in this manner was no longer profitable, except in a few of the most favorably situated localities, and petroleum or rock oil thus became the great source from which the various illuminating and lubricating oils, as well as a host of other products, paraffine, vaseline, tars, etc., were obtained. It will be remembered that by the discovery of oil on their farms, many poor men were suddenly raised to great wealth, and many remarkable incidents are related as showing the variety of ways in which this wealth, so easily acquired, was as readily squandered. The largest oil-producing districts in Canada are in the County of Lambton, Ontario, and in the vicinity of the town of Petrolia. These oil fields yield, practically, all the oil produced in the Dominion. The oil is met with at a depth of from 370 to 470 feet. The first flowing well was struck on the 19th of February, 1862, and before October in the same year, there were no less than thirty-five flowing wells. As there was no accommodation at that time for the storage of the large quantities of oil flowing from these bore holes, much of it went to waste, and it is calculated that between the dates above mentioned no less than 5,000,000 barrels of oil floated off upon the water of a neighboring creek. This district now produces about a million of barrels of oil annually. The "wells" or holes from which the oil is obtained are about four and a half inches in diameter, and as above mentioned, from 370 to 470 feet deep. The Petrolia drillers are very expert and are in demand all over the world, and much work is done by them even in Asia and Australia. The holes are drilled by means of jump drills in about five or six days, and when completed each is fitted with a pump and a whole series of them are pumped by one engine. The good old days of flowing wells have gone by, all the wells now requiring to be pumped, each yielding an average of about half a barrel per diem. Old wells are constantly abandoned and new ones drilled, and the supply being in this manner kept up. The various oils contained in this crude petroleum are separated from one another by a somewhat complicated process of distillation, known as fractional distillation, the crude oil being heated and the several oils passing off at different temperatures as the heat is raised, and being thus collected separately. The heavy tarry products are further treated and worked up into a variety of useful products, while the coke remaining in the retort at the completion of the process is utilized as fuel.

A volatilization of all the lighter constituents of petroleum in a way similar to that which takes place during its distillation as above described, is observed in certain localities where rocks holding petroleum have for long ages been exposed directly to the air. Heavy black tars are thus produced, and a most remarkable occurrence of this kind is found in the Athabaska region of our North-west territory. The tar here occurs impregnating a soft sandstone of cretaceous age which rests on an older limestone formation. The latter contained immense quantities of petroleum which have escaped into the overlaying sands, and these being exposed to the air, have hardened into tar. These so-called "tar sands" have an area of at least 1,000 square miles, and are from 150 to 225 feet thick, the area being estimated by Mr. McConnell, of the Geological Survey, to contain six and a-half cubic miles of tar of bitumen. The commercial value of this tar sand, owing to its remoteness, is not at present great, but the abundance of the material, and the high percentage of tar which it contains, makes it probable that in the future it may be profitably utilized for many purposes. Its existence proves a flow of petroleum to the surface in this Athabaska region, in times past, unequalled elsewhere in the world, but as above mentioned, the valuable constituents have long since disappeared, and the supply in the

rocks from which it issued is probably long since exhausted. These sands are, however, in an adjacent part of the country covered by shales, and a boring, already 1,700 feet deep, is now being put down by the Geological Survey, under instructions from the Government, at Athabaska Landing, in order to ascertain whether supplies of petroleum do not exist below this protective covering. If they do another great oil field is assured to the Dominion.

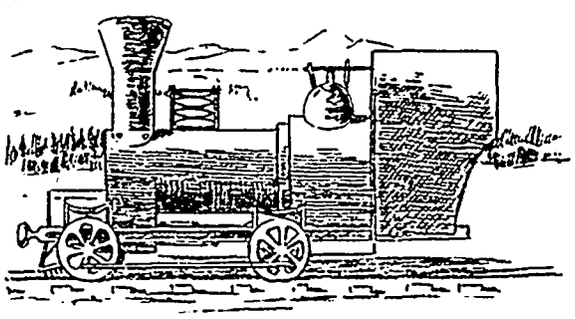
Another mineral with which the Dominion is abundantly supplied and which is extensively worked is salt, somewhat over 57,000 tons having been produced last year. This salt comes principally from Ontario and New Brunswick, although it is known to occur elsewhere in the Dominion, especially in Manitoba and the North-West Territory, where brine springs abound. In Ontario, which is our principal salt-producing province, the salt is derived from beds at or near the base of the Onandaga formation, where it occurs interstratified with marls, dolomites and shales. The salt is brought to the surface in solution in form of saturated brines, formed by the surface water percolating down through the rock and dissolving the solid salt of the above-mentioned beds. These brines being tapped by bore holes or wells, are pumped to the surface and then evaporated. In 1876 a boring by means of a diamond drill was made at Goderich, Ont., in order to ascertain the thickness of these salt beds and their distance below the surface. As a result of this boring it was ascertained that the first salt bed lay 1,006 feet below the surface and was 31 feet thick. In the following 520 feet five additional beds of salt were penetrated, the total thickness of salt discovered amounting to no less than 126 feet. This section may be taken as an index of the general character of the formation traversed by the Ontario brine wells, which are usually from 1,000 to 1,500 feet deep. It shows that under this part of Ontario there lies an inexhaustible supply of salt, which has been proved by analysis to be very pure and of excellent quality. The brine springs of Manitoba and the North-West Territory, which, as mentioned above, are very numerous and very saline, are as yet worked only to supply local requirements.

In addition to the various minerals above referred to, a number of others also occur in the Dominion, and are more or less extensively worked. Among these are iron pyrites, chromic iron ore, arsenic and antimony ores, manganese ore, iron ochres, graphite, soapstone, whiting, lithograph stone, grindstone, moulding sand, etc. Large supplies of natural gas are also found at certain localities, as well as many deposits of other minerals, which as yet are of little or no commercial value, but which will undoubtedly be worked with profit as the country becomes opened up and more thickly settled. The Dominion also possesses immense supplies of excellent structural material—granites, sandstones, limestones and other building stones, slates, sands and gravels, brick clays, materials for the manufacture of cements, pottery, terra cotta, tiles, etc. The annual output of these has already a value of over $5,000,000.

The mineral deposits of the Dominion will, moreover, be a permanent and continued source of wealth to the people of Canada. While the fur trade has greatly diminished in value, and the timber supplies of the Dominion, being rapidly destroyed, must follow, (unless some steps can be taken, as in older countries, to grow forests as well as to cut them down), the mines and quarries of the Dominion will year by year become more numerous, better developed, and more productive, and will always constitute one of the chief sources of our national wealth and prosperity.

REMINISCENCES OF CANADA'S FIRST RAILWAY.

A representative of THE CANADIAN ENGINEER recently had an opportunity of gathering some interesting facts about early locomotive engineering in Canada, from Geo. Ostrout, late of Montreal, who drove the first engine on the Laprairie and St. John Railway, and who, at the age of 70, could sit down, and with a steady hand, prompted by a perfectly clear technical memory, draw his first love, the "Dorchester," so well that the sketch needed only to be brought up to the requirements of modern illustration for reproduction here. Mr. Ostrout was born in Montreal, on February 28th, 1826, and records as his first recollection the building of the island wharf for Bronson & Spiers, in 1830 1831. In 1832, during the cholera epidemic, young Ostrout and his mother boarded a steam ferry. Near them sat an old lady who, like many others at that time, had a superstitious horror of any powerful agent whose pedigree she did not know. She informed the Ostrouts that nought but unavoidable circumstances could have forced her into such a wicked contrivance, and that the devil himself must be aiding the engine driver. Young Ostrout replied that he meant to learn how to start an engine, devil or no devil, and a few years afterwards, when the lad had attained the advanced age of 12 years, he was actually running an engine on a three-mile journey, while the responsible driver lolled in a shed playing checkers. Previous to this, the cars had been drawn by horses driven tandem. Most of these cars were made in Troy, N.Y., were mounted on four wheels, and had a high seat and a brake, acting on one pair of wheels, at each end. They were divided into three compartments, each having its own door, and with two leather-cushioned seats running athwart the car. The conductor had to travel on the step-rail which ran round the outside, unless he too got inside to play checkers.



This was the state of things when the first locomotive—the "Dorchester"—arrived. She was built by Stephenson & Son, of Newcastle-upon-Tyne, of the type known as the "inside connection." The wheels were four in number, having felloes and spokes of English oak, with iron hubs and tires. She had two safety valves. That over the steam chest had a rod running back to the engineer, with a spring balance attached to the end by a screw, which could be shifted at will. The other valve was placed forward, as shown. It was pressed down by a number of elliptic springs, placed back to back between two little pillars, with cross-bar and nuts. The valve motion in the steam chest was produced by one eccentric for each cylinder, the back and forward motion being caused by raising

or lowering what is called a double gab. The lever on the rock shaft being double-ended, the lowering of the gab caused the lips of the lever to thrust the pin into the gab, and thus the forward movement was produced. The backward movement was produced by raising the gab, which caused the upper lips to strike the upper pin, and this shifted it to go backwards.

The smoke-stack was funnel-shaped with a heavy wire screen, having a piece of boiler plate about 12 inches diameter in the centre, stretched across the opening. The frame was made of boiler iron filled in with oak. The protection of the driver seems not to have been thought of, for the "Dorchester" had no cab. A frame of iron was bent over the steam chest, and by stretching canvas over this some protection was obtained. The "Dorchester" was considered a grand engine in her day, but she was no light undertaking for her driver. For instance, the heat of the boiler at the bottom of the smoke-stack was often so intense as to burn up the packing in the cylinders, and he had to pack the bottom of the smoke-box with clay.

The rails were of wood, with an iron strip running along the top about $\frac{5}{8}$ inch thick and $2\frac{3}{4}$ inches wide. These served every purpose until the "Jason C. Pierce" appeared on the scene in 1837. This engine was built at the Norris works, Philadelphia, and was gigantic for her time. She had outside connections, a rather high boiler, cylinder on the incline, and four driving wheels —one set fore and the other aft of the fire-box. "She had the oddest rig I ever saw for valve motion," says Mr. Ostrout. "She had four eccentrics, four hooks or gabs, all disengaged at once, and tripped by small rock shaft with four short levers with friction rollers. To move ahead, two of the rollers were lowered to drop on pins; but the pins would not engage with hooks until the valve rods were manipulated by the engineer, who shifted the valve rods by levers on a slewed rocking shaft connected with the valves, and put the pins under the hooks. To back, it was necessary to reverse the small rock shaft to its full extent. This engine was much too heavy for the primitive wooden track, and would twist the iron strap into all imaginable shapes. On one occasion the strap rail curled up just behind the driving wheel, struck under the tender forward of the flange connection of the feed hose, running up through the bottom and top sheet of the tender and through the tool chest."

Mr. Ostrout remembers with amusement the first cut-off. It was a common throttle on which they set a band shaft with the lugs of two half hoops. As each lug revolved it would thrust a valve connected to a hinged post by an iron rod, rubbing on the shaft valve and closed or bumped out the opening valve. Some steam, he says, was saved, but the later introduction of the drop valve with dash pots was a great improvement. Mr. Ostrout is continually recalling, while he talks, little events which mark advances in both railway and marine engineering, and was recently engaged in writing his experiences when a calamity befel him like that which happened to Sir Isaac Newton—a little dog captured and tore into fragments his technical, though lucid descriptions.

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THE PUBLISHERS.

For THE CANADIAN ENGINEER.

CRIBWORK RETAINING-WALLS.

BY WILLIAM B. MACKENZIE, ASST. ENG. I.C.R., MONCTON.

Mr. P. E. Nostrand's description of the present state of the Riker's Island cribwork, near New York, published in *The Engineering News* of January 6, 1896, is very interesting and valuable. This crib has turned over backwards and slid out on the soft mud from 25 to 35 feet.

Mr. Nostrand was employed to make an expert examination, and his excellent suggestions for the building of cribwork are as follows:—

1st. Dredge for a level and firm foundation.

2nd. Build returns or anchors as part of the cribwork, at frequent intervals.

3rd. Begin to fill at the crib, so as to drive the mud wave towards the shore.

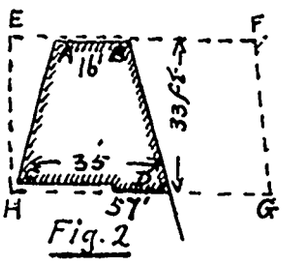


Fig. 2

Referring to Fig. 2 for the actual cross-section of the Riker's Island cribwork *A BCD* as built, it is doubtful whether it could have been made to stand and retain earth level with its top, on any but a hard and level foundation.

For a quick method of finding the approximate pressure against a retaining-wall of any kind, when the natural slope of the backing is $1\frac{1}{2}$ to 1, I have constructed and used diagram 1, and for finding the proper width of cribwork filled with stone, acting as retaining-walls on soft bottom, I have constructed diagram 2.

These diagrams will explain themselves.

It will be seen that for a factor of safety of $1\frac{1}{2}$, diagram 2 calls for a bottom width of 57 feet for the Riker's Island cribwork, instead of 35 feet as built; see dotted lines *E*, *F*, *G*, *H*, Fig. 2: the character of the bottom, etc., being assumed the same in both cases.

Diagram 1 is intended to save the trouble of calculating the pressure against any wall, and diagram 2 is simply a straight line drawn between two points, one corresponding to the width for a low crib, and the other that for a high crib, intermediate widths varying directly as the heights.

After finding the earth pressure against the crib by diagrams, the estimated weight of the crib in sea-water, multiplied by a co-efficient of friction of 0.20, for wood on soft mud, was used to find the width of the crib, which width was increased or diminished until a factor of safety of $1\frac{1}{2}$ was reached.

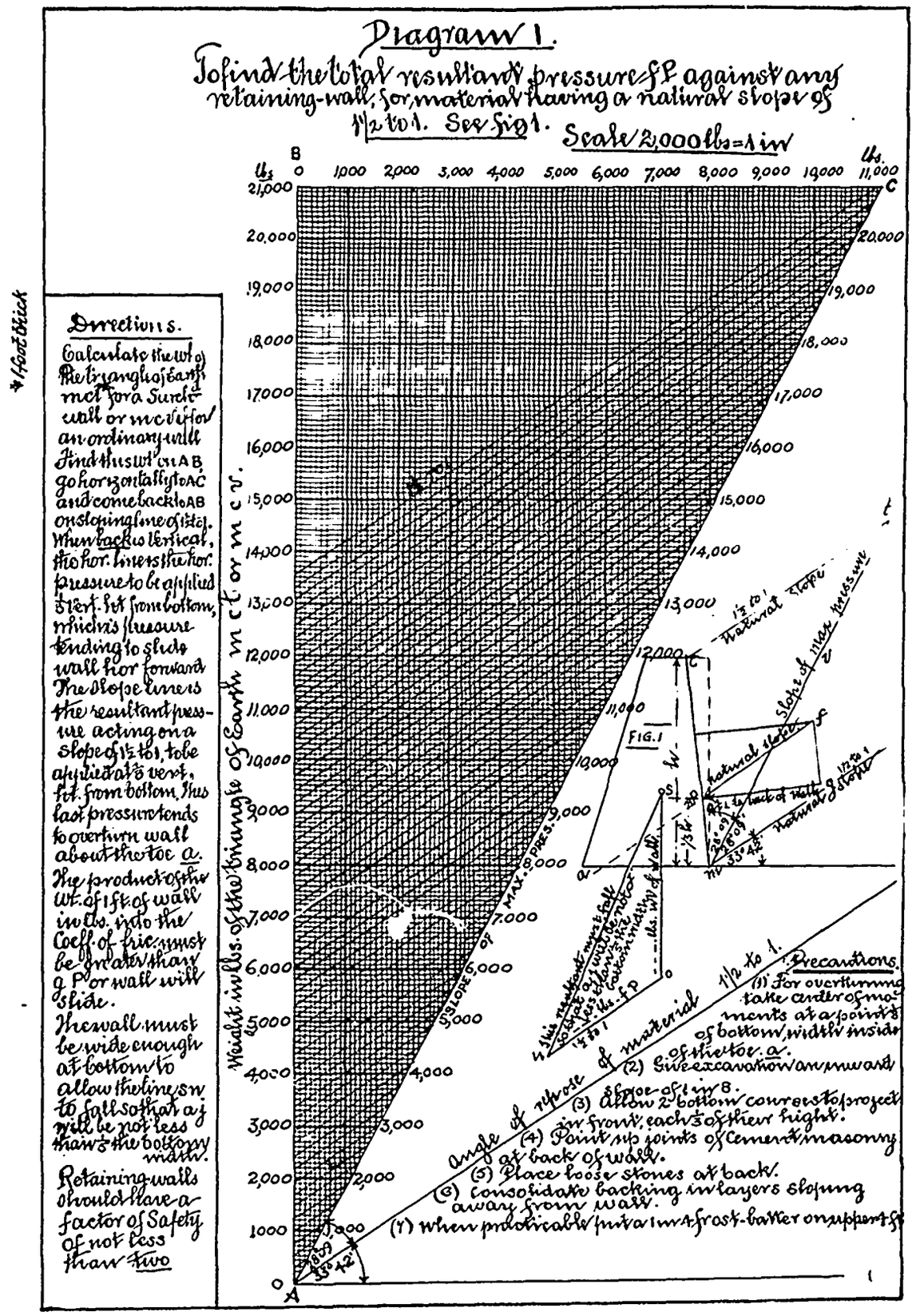
The part of the crib above high water was taken as weighing 84.98 lbs. per cubic foot, the part between high and low water at 90.74 lbs. per cubic foot *in air*, and 48·97 lbs. per cubic foot *in water*, and the part below low water at 41 lbs. per cubic foot *in the water*. For the filling of earth at the back, the part above high water was taken as weighing 117 lbs. per cubic foot, the part between high and low water at 65 lbs. per cubic foot at high tide, and 123 lbs. per cubic foot at low tide, and the part below low water at 65 lbs. per cubic foot. No assistance was counted on from the mud in front.

In the summer of 1895 a crib 800 feet long was built at Halifax, Nova Scotia, having widths as per diagram No. 2, the heights varying from 24 feet to $32\frac{1}{2}$ feet from mud line to top of crib. It was filled with stones, and built on a bottom so soft that it has sunk from 4 to 15 feet down into the mud. The ballast-floor was

placed so as to be as near as possible on the surface of the mud when settlement had ceased. High-water line is 7·7 feet below the top of the crib, and the fall of tide is 6 feet.

crib, before the stone ballast is put in, or through holes left for the purpose, stones afterwards being packed solidly around them.

Following is a table of weights of materials and



Although the backing is not completed along the whole length, the work is now in good line laterally. Mr. Nostrand's suggestion No. 3—that "return cribs should be built at frequent intervals"—is, I think, the best of the whole, and I may add that in the Halifax crib the remains of several old worm-eaten pile wharves lend some assistance in this way.

In places where piles could reach hard bottom at a reasonable distance, I think it would be economy to drive a number inside, in the centre and through the

co-efficients of friction, which I have compiled in a convenient form for use, with the diagrams:

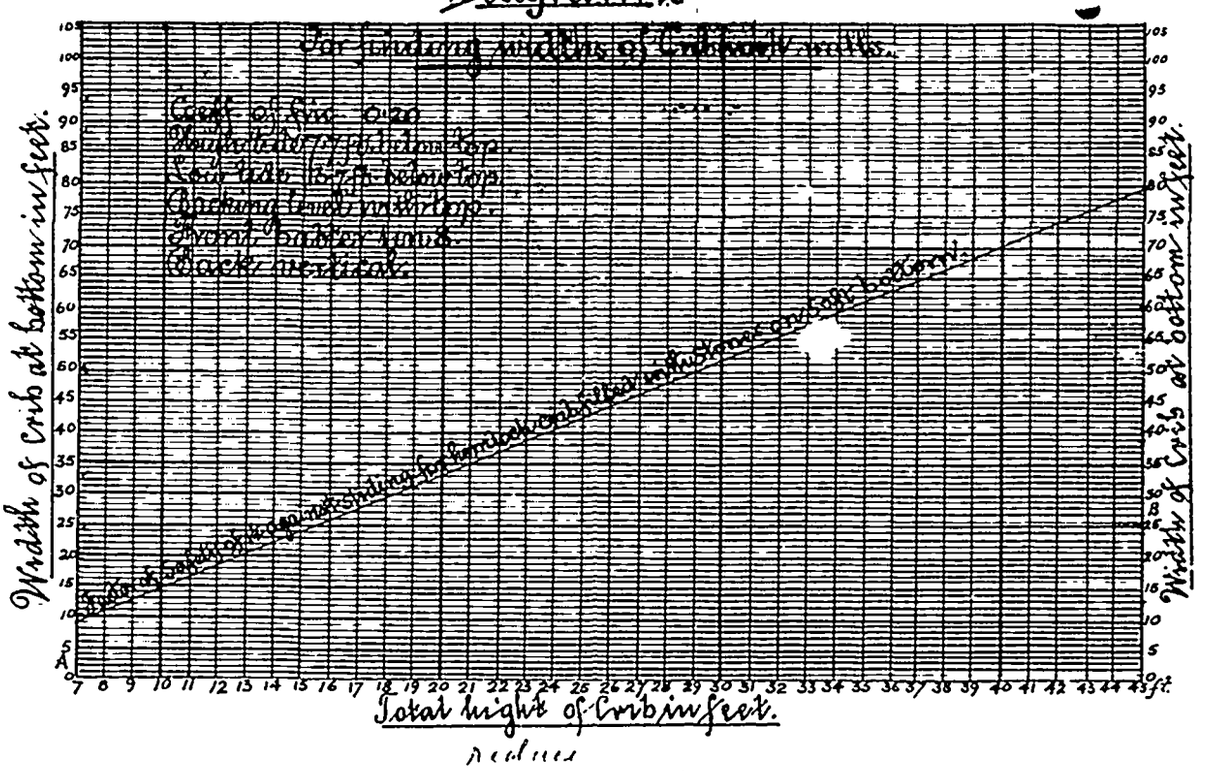
WEIGHTS OF MATERIALS.

	Lbs. per C. Ft.
Earth, common	124
" loamy	126
" clay	121
" clay with gravel	160
Sand, common	1.?
" quartz	172
" wet	140
Gravel and sand	110

Gravel, moist		135
Brickwork, common		111
" pressed		140
Sandstone masonry		144
Granite masonry		165
Limestone masonry		165
Granite or limestone	Mortar rubble	150
	Dry rubble, scabbled	138
	Dry rubble, rough	125*
Concrete (best)		160
" (porous)		125
Hemlock (seasoned)		30
" between high and low W.		41
" (water-soaked)		60
Iron		485
Solid stone		169
Loose stone ballast		96½

*To 135 lbs. for large stones.

Diagram 2



CO-EFFICIENTS OF FRICTON.

Masonry on moist clay	*0.20 to 0.33*
" on sand	0.40
" on dry clay	0.50
" on dry earth	0.50 to 0.66
" on gravel	0.60 to 0.75
" on wooden platform (dry to wet)	0.60 to 0.75
" and brickwork (dry) on the same	0.65
" " with wet mortar on the same	0.47
" " with slightly damp mortar on the same	0.74
Brick masonry, with wet mortar on the same	0.50
Limestone dry and hard on the same	0.38
" soft and dry on the same	0.64
Brick on soft dressed limestone (dry)	0.65
" on hard dressed limestone (dry)	0.60
Concrete on concrete (dry)	0.65

STUDENTS' COURSE AT THE CANADIAN GENERAL ELECTRIC COMPANY'S SHOPS.

An electrical education cannot be found between the covers of books, though such a theory has its supporters, nor is the other extreme true, that it is to be gained by the use of an oily rag and a pair of plyers. The electrical engineer can only be qualified for his work by a thorough grounding in both the practical and theoretical sides of the subject. When a man's knowledge is confined to theory, and he takes charge of a plant, the result is a burnt out dynamo or something else equally practical or expensive. On the other hand, the man who is without theoretical knowledge gets on well while he confines himself to the work to which he is accustomed; he is at sea when anything new turns up. A question which would be solved in a moment by a well read man presents insurmountable difficulties to the exclusively practical man.

The opportunities for practical work in Canada are not so great as in the United States; aside from the Royal Electric Company, Montreal, the Canadian General Electric Co., Peterboro', is the only place where students are given a practical course. When students were first admitted to the workshops of the C.G.E. Co., some three or four years ago, no entrance fee was charged, and they were paid for their work after the first six months. At present an entrance fee of $500 is required, and the wages which are paid after the first six months for piece-work are very often all taken up by the charges for spoiled material, as the students quite properly pay for any damages they cause.

There is a short and a long course, of eighteen months and three years, but nearly all the students take the long course. There are two exams., one at the middle and the other at the end of the course, conducted by the works engineer, who is in charge of the students. At present there are about 24 students in attendance, and most of them are taking the three-year course. The first department which the student enters is usually the machine shop, where he is expected to become familiar with the different kinds of work, such as drilling, tapping, lathe and vise work, building up of armature bodies, erecting dynamos and motors, and winding magnets and transformers.

The next department entered is the armature room, where the student assists in the manufacture of armatures, and learns how to insulate, wind, bind and connect. Eight months to a year is spent in passing through these two departments.

Next usually comes the wire department, where the different processes of covering are gone through. After the wrapping and braiding are complete, the wire is taken to the compound room, where it is rendered

"weatherproof" by the application of various compounds. In the wire department cables are also made. The process of applying a solid rubber covering to wire and cable, which was introduced into the C.G.E. Co. not very long ago, is also carried on here. The rubber is forced through a steam-heated cylinder on to the wire as it passes through a die, whose size depends on the thickness of the rubber coating desired. As it leaves the die the wire, with its covering of soft rubber, passes through a cold water bath and coils in trays containing fine chalk to prevent adhesion. The trays are then put in the vulcanizer, a steam-heated oven, which hardens the rubber coating. To determine whether the insulation is perfect, the rubber-coated wire is immersed in a tank and tested by means of a galvanometer. If the insulation is sound, the wire is then ready for use, unless it is desired to put a braiding outside the rubber. The construction of arc lamps is next taken up. This comprises the putting together of the different parts already made and the testing of the completed lamps. To the test room is the next move, where all the dynamos, motors, transformers, and other apparatus manufactured in the shops are subjected to a series of severe tests in order to discover any defects, however slight, which might exist in any of the parts. The student usually spends some time in the power house at this point in his course. Here the hours are longer and some of the work decidedly disagreeable, as boiler cleaning and firing.

As the shafting in the shops is run by motors supplied from the power-house dynamos, the student has to look after these machines and see that they are started in time and kept in proper running order. Five or six weeks is the usual time spent at this work.

Road or construction work offers more variety and gives the student opportunities of seeing the various apparatus manufactured in the shops in actual use. Here he usually works under a foreman, but is sometimes sent on a job alone. The work done includes street car equipping, installing light and power plants, and occasional repairs and alterations.

After putting in his time on road work the student is ordered back to the shop, where he has to pass his final examination before receiving the certificate which is granted to students who satisfactorily complete the course with the C.G.E. Co. W. P. R.

THE FINANCIAL ASPECT OF MINING.*

BY J. H. CHEWETT, B.A. SC., ASSOC. MEM. CAN. SOC. C.E.

That such a great country as Canada, so admittedly rich in all kinds of minerals, with its well-developed transport facilities, its enormous food-producing areas, its magnificent timber, and practically unlimited water supply and power, should be so backward in the important industrial branch of mining, is cause for surprise and enquiry. The reasons for this state of affairs, and anything that may explain and remedy the lack of development in this direction, are subjects that must commend themselves to every good citizen, and, above all, to members of the Ontario Mining Institute, for consideration.

It has been stated that in proportion to the capital invested, mining has been less remunerative in Ontario than almost anywhere else. I do not believe, nor do I think our Institute is willing to admit, that workable ore deposits are so few and far between that it is unwise to attempt development. The causes of failure may be looked for very often in other directions, and we may examine a little certain of these which have, among others, attracted my attention. They may be broadly set down under five divisions: (1) Highly capitalized promotion schemes floated on surface indications; (2) Application of treatments not suited to the ores; (3) Untrained and incompetent management; (4) Premature surface equipment and buildings; (5) Bad roads.

Under the first heading the following points suggest themselves as directly bearing on the legitimate capitalization of a mine. "The cash value of a mine is that which will net a given annuity to the investors; the amount of this dividend should increase with the risks run."† This can only be determined by actual development, which means the expenditure of a certain amount of money. The quantity of ore revealed, its grade and cost of treatment, should then determine the estimated value. The proper (or justifiable) capitalization will be dependent upon this cash value, and the equipment necessary for production commensurate with the prospective annuity. But as no mine is inexhaustible, its life being calculable, a sinking fund must be provided in order to create a new capital within the period of its life. On account of the greater risk run in mining investments as against investments, say in Government bonds, or first mortgages on choice lands, a much higher rate of interest is required, ranging from 10 per cent. to 50 per cent., according as the risk is considered great or small.

The Banket beds of the Transvaal afford examples of companies with enormous capitals, in many cases from $5,000,000 to $10,000,000, organized on a basis to yield the moderate return of about 10 per cent. This was possible on account of the wonderful continuity in grade and character of the ore beds now ascertained by extensive workings and deep borings. At the same time it is evident the equipment of a gold mine working on a $7 to $10 per ton milling ore, capitalized at $10,000,000, with the object of paying 10 per cent., should not cost, even in the Transvaal, over $250,000 to $300,000, or say three per cent. of the total capital. And just here comes the vital question: Is the cash value of the workable deposit $9,700,000? To authorize such a capital we see the mine must have a life of 15 years at least to repay the investors, which seems a long period to anticipate a uniformity of all the present conditions. Many things may happen in that time. It is probable the price of labor and supplies will rise, one cause being the immense production of gold going on all over the world. At present between 30,000 and 40,000 Kaffirs, employed in the Rand mines, are satisfied to work for an average wage of $15 a month —50 cents a day. It is unlikely such wages will continue indefinitely to satisfy these workers, and any increase must affect prejudicially the value of the mines as an investment.

Again, until recently a gambling spirit has pervaded mining. Attractive prospectuses giving glowing accounts of mountains of ore, based perhaps on Indian legends of pure gold and silver almost in bulk, have been put forth, rather than the results of honest development, careful tests and examination. Money put into such ventures is speculation pure and simple, and though in rare cases successful results may have been realized, in the majority of instances the capital has been lost and mining discredited, the only person benefited being the unscrupulous promoter. The result may be put in the words of a Liverpool gentleman to

*A Paper read before the Ontario Mining Institute.

†Hilseng.

me recently, "Canadian mines stink to heaven"; and we have ourselves to blame, and not our imperfectly examined mineral field for this state of things.

Secondly, the application of inappropriate treatments is another potent source of failure. Mining men know of many places where rotting timbers and rusting mills form melancholy monuments of misdirected capital. Such failures have been due both to inexperience and to lack of technical knowledge. It has too often happened in mining that the man in charge has gained the wisdom of experience at the cost of his confiding employers. But it must also be allowed that one of the main elements of successful treatment lies in the uniform composition of the ore, and many cases are known of sudden changes, such as galena to bornite, lixiviating ore to lead-zinc ore, free milling to smelting ore, etc. These must be guarded against, as far as possible, by cautious preliminary exploitation. As an example of judicious development before erecting a plant, the Hall mines, at Nelson, B.C., may be cited. This company has quietly carried on its work of opening up, for two or three years, and now, with sufficient ore of known composition in sight to keep their smelter going for five years, they are in a position to operate on a most satisfactory and economical basis.

Thirdly, incompetent management has been, perhaps still is, the greatest cause of loss in mining investments. Influential directors have been too ready to translate some friend or relative from an office desk to the control of a mine. Untrained and out of sympathy with his surroundings, what is to be expected other than failure?

Fourthly, undue haste in erecting machinery, almost before a drill has been struck, has led to much waste of money, where judicious work expended on a shaft, or careful tests with a diamond drill, would have revealed the pockety nature of the deposit, or the barren quality of the ore as depth was gained. It is well to remember that all veins do not widen, or become richer with depth. Neither is it necessary to build a palatial residence for the manager, nor to construct permanent houses for the miners, and schools for their children, before the mine has afforded some pretty satisfactory evidence that it will become reasonably profitable.

Lastly, bad roads have played a greater part in many failures than is commonly supposed. I am aware of a mine in Ontario, the road giving access to which is so bad that three barrels of concentrates form a load for two powerful horses; in fact, more than once the third barrel has had to be thrown off in mid journey to lighten the draught. In another case, it took about five weeks to take in a 60-horse power boiler about 40 miles. How can profit be realized when every ton of material brought in or taken out must be handled under such very unfavorable conditions? In connection with the transport of ore and supplies, I do not think enough attention has been paid to light tramways, upon which a single horse can draw comparatively large loads with ease. Wire cable-ways, particularly over short stretches of difficult ground, also deserve more consideration, their cost of operation comparing favorably with that of light rail and tramways, while the first cost is less.

Above all and by way of summing up the whole matter: When the plans are being laid, the educated mining engineer who possesses the business perception required for the successful conduct of any other manufacturing enterprise, will adopt tried and true processes, even though, as innovations, not having the seal of local usage, they may be looked upon with suspicion and resisted by "men of the camp." To such careful, observant management, however, the many mines of Europe owe their continued prosperity after three hundred years of working. By actual and costly experience the "practical man" learns what the "theoretical man" has been taught—to profit by the experience of others. System will replace obsolete hand-to-mouth methods, and thus many an idle mine may, by one keenly alive to improvement in mining appliances, be converted into a prosperous property. A compromise between, or a union of theory and practice, in such a manner as to inculcate the principles of technical knowledge, will enable the engineer to bring the rosy anticipations of enterprise to the level of the facts of experience.

PNEUMATIC HAMMERS.

Within the last few years the pneumatic hammer has entered into broad fields with telling effect. The prehistoric hand hammer has given way in many instances, and to-day we are calking boilers, ships, carving stone, riveting, driving nails, and in fact doing a variety of work much faster and more perfectly than ever was possible by hand.

The King Valveless Pneumatic Tools shown here are the result of careful study. It has been the aim of the makers to produce a simple tool, eliminate the small parts, and have as a result something that could be placed in the hands of the most unskilled mechanic. The wear and tear on this tool have been similarly studied, and that satisfactory results have been reached is proven by the large number in daily use, and the large number that have been running more than a year without repairs. These tools are composed of but five pieces, and have but one moving part, the piston (or hammer). Every movement of the piston from one end of the cylinder to the other changes the ports in such a way that an alternate supply and exhaust take place from each end of the cylinder. As no auxiliary valve is used with these tools a much higher speed is possible, as an appreciable amount of time would be lost in the travel of the auxiliary valve, and as the piston is its own valve, the speed runs up to 10,000 single strokes per minute. The tool when removed from the work is automatically stopped, thus saving the wasteful use of compressed air, and saving the wear and tear which would be necessarily brought upon the tool. The back pressure from the exhaust is used to close the small piston shut-off valve when the pressure of the operator is withdrawn from the tool. The tools are made in numerous sizes to suit the general work of the user. In chipping cast iron, steel, and cleaning steel castings, each tool will do the work of about three men. In the boiler shop and ship yard the tool operates much

faster, and does the work of five and six men. A view of a boiler shop in Pittsburg is shown here.

The calkers are at work on the Allegheny City pipe conduit, and each man calks 600 feet of half-inch plate in nine hours. With extra exertion these men have accomplished eight and nine hundred lineal feet of calking on this pipe in the same time. A number of the largest steamers on the great lakes have been calked with these tools, the well-known steamer "Zenith City" being one of the number. Another view shows men at work chipping steel billets at a prominent steel works in Pittsburg. A large air plant was installed especially for this purpose, and the firm is highly pleased with the results. These tools are manufactured by Chas. B. King, 110 Antoine street, Detroit, Mich.

☞ T. Hope, a subscriber, complains of irregular delivery of his ENGINEER. As the place from which he writes is not given on his post card, and the postmark is obscure, we are sorry we cannot attend to the complaint till we hear from him further. This only illustrates the necessity of subscribers giving both old and new addresses when removing. It is impossible to remember the names and addresses of 3,500 subscribers.

THE RIGHTS OF AN ENGINEER.

A civil engineer is engaged by a city to perform certain services requiring special education and skill which are not possessed by his employers. In everything calling for the exercise of these qualifications he is the sole judge, and his advice cannot properly be set aside without consultation with other and presumably better qualified members of the profession. Much less can those who engage him themselves decide upon a course of action contrary to that which he believes to be correct, and compel the engineer to carry it out on pain of dismissal. The physician is not told that unless the patient approves of the treatment he will be dismissed. Nor would a surgeon be ordered from a patient's bedside because he declined to amputate a limb at the request of the relatives. If the matter of the amputation had been one which by a written contract was left to the decision of the surgeon, the impropriety of such a dismissal would become more evident. That such views of the duties of professional men are not everywhere held is shown in the recent outrageous dismissal by the City Council of Victoria, B.C., of G. E. Jorgensen, C.E., on the 12th February, because he refused to sign a letter which the mayor had written to Walkey, King & Casey, contractors for water works improvements at Beaver Lake. This letter laid down conditions as to the extension of the time for the completion of the works, which were contrary to an agreement already made between the contractors and the city engineer, and were considered unreasonable by him. In addition to this fact the matter of extension was one placed at the discretion of the engineer by the contract between the city and Walkey, King & Casey. Upon the very proper refusal of Mr. Jorgensen to sign this letter, he was suspended by the mayor under his power "to inspect and order the conduct of the officers and employees of the corporation, and to suspend them for negligence or carelessness or violation of duty." One of the councillors was of the opinion that it was a serious matter for the Council "to blast this young man's reputation as an engineer by acting too harshly." He need not have wasted time on that view of the case; the action of the Victoria City Council is a testimonial of the highest character, and will undoubtedly do more to advance Mr. Jorgensen in his profession than many years' engagement with a body of men who possibly believe that a city engineer is an official whose sole duty is to aid his employers in taking advantage of those who are so unfortunate as to be brought into business relations with them.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

We have been asked by several correspondents to give some information regarding the summer convention of the Canadian Society of Civil Engineers, which it is proposed to hold in Toronto in June. So far as our enquiries extend, the matter seems to be dropping out of sight. A meeting of members resident in Toronto and district was held on the 20th of last month, but nothing was done, as the council has taken no action in the matter. It will be a great pity if this convention fails to meet. Criticism is frequently directed against the exclusiveness of Montreal as the place of meeting. An opportunity is afforded the members of meeting in another centre, and they should all unite in making the Toronto convention a success.

CLOSE CORPORATION.

The Legislature of Manitoba has passed the bill adopted by the Canadian Society of Civil Engineers at its last annual meeting. To the Prairie Province belongs the honor of leading the van in this important movement. The Ontario committee have interviewed the Provincial Cabinet. The bill could not be introduced into the House this session for want of sufficient notice, but it will be brought in next session.

WITH this issue Volume III. of THE CANADIAN ENGINEER is completed. Those who wish to have their volume bound at this office may do so by sending us the back numbers, express paid, with $1 to cover cost of binding and return expressage. An index for the year will be found in this number for the convenience of those who may prefer to do their own binding. Only a limited number of ready-bound copies can be supplied from this office.

RE PIPE DISTRIBUTION.

Editor CANADIAN ENGINEER:

SIR,—Please correct an error which I find in "Pipe Distribution and Water Supply for Fire Service," in your March number. The table of number of streams from different sized pipes should read as follows:

Diam. of pipe in inches	6"	8"	10"	12"	14"	16"	18"
Number of streams from 1¼" nozzles said pipes will supply	2	3	5	8	12	16	22

If the pipe is supplied from both ends the number of streams can be doubled

Yours very truly,

WILLIAM PERRY, H.E.

Montreal, March 28th, 1896.

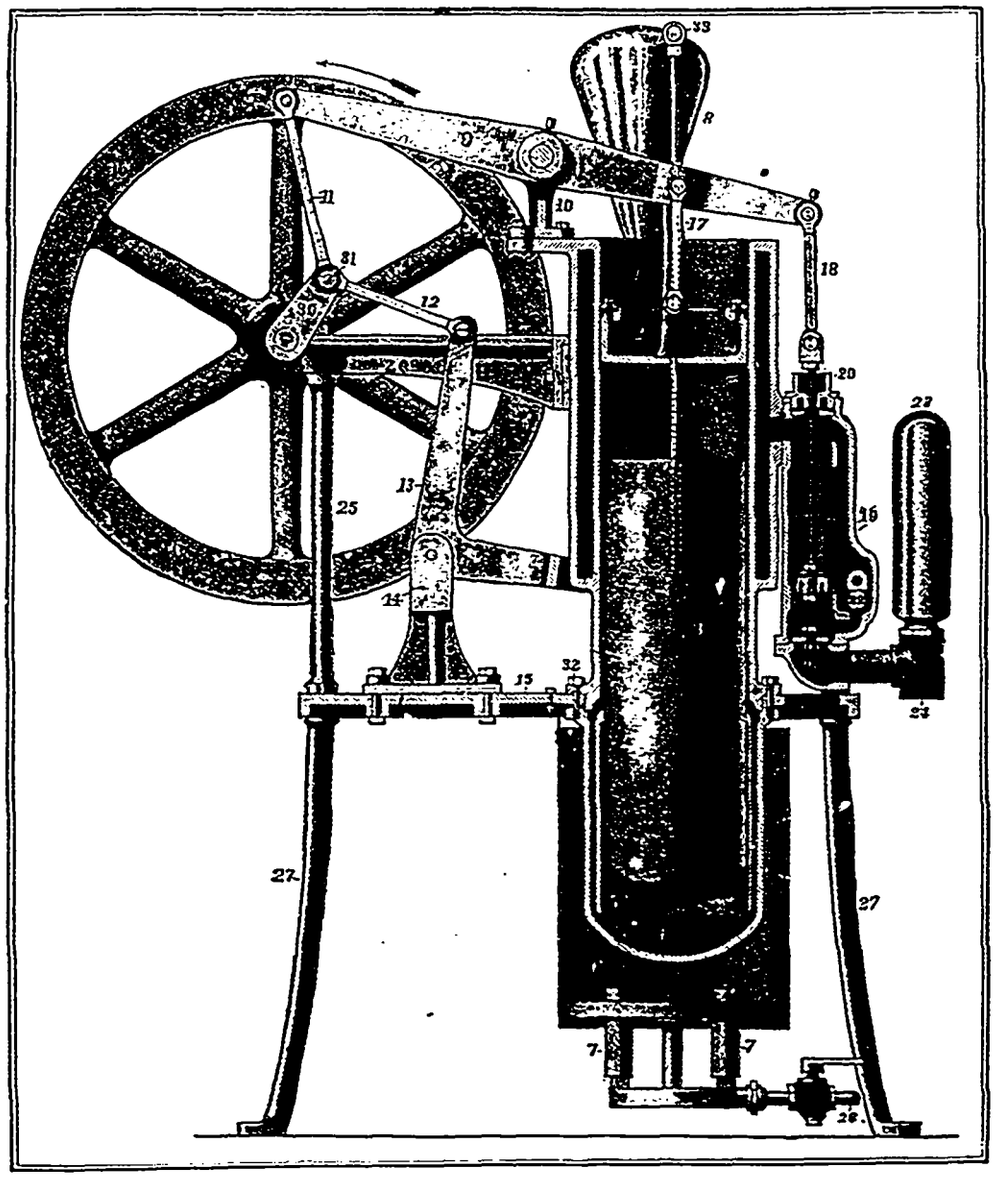
RAINY RIVER GOLD REGION.

The Rainy River gold mining districts in the "New Ontario," which Arch. Blue in his last report of the Bureau of Mines, describes as "a land of innumerable lakes and interlacing streams, of ancient rocks, stored with the richest minerals," is attracting a good deal of attention just now.

J. H Chewett, the Toronto mining expert, returned last month from an inspection of properties in this region, and his report has been so favorable that a strong company of Hamilton capitalists has been formed, and will go on with development work. The principal shareholders are J. H. Tilden, Wm. Southam, John Hoodless, T. M. Lester, F. C. Bruce, H. N. Kittson, Geo. Lynch-Staunton, and H Beckett, of Hamilton; with F. S. and H. A. Wiley, and Mayor G T Marks, of Port Arthur; and W H Plummer, of Sault Ste. Marie, the company being known as the Saw Bill Lake Gold Mining Co., with a capital of $100,000. The prospects of the new company are exciting a good deal of interest in Hamilton. Mr. Chewett's report is a very instructive one, and shows that there is a strip of country 150 miles long by about 50 wide, between the main line of the C. P. R. and Rainy Lake, that is rich in gold, and when it is opened up—as it will be within a few years—it will prove to be a second Cripple Creek or Witwatersrand. A good deal of quiet investing is being done, but the principal operators so far have been Americans. At present there are a number of mines in operation, each of which has proved richer the deeper the shafts have been sunk. The principal mines in actual operation are the Foley, the Lake Harold, the Ferguson, the Wiegand, the Lucky Coon, Sultana and Regina, in the last named of which $4,000 was obtained in 96 hours with ten stamps, or an average of $40 per ton. The Saw Bill property is accessible from Bonneur Station of the C P R., about 120 miles west of Port Arthur, the route to the mine being by water. Mr. Chewett calculates the cost of mining there at $4 a ton, and says the average of all the assays gives $16 a ton, leaving a margin of $12 per ton. They propose to put in a plant which will enable them to handle 7,500 tons a year.

THE DE LAMATER-ERICSSON HOT-AIR PUMPING ENGINE.

The "De Lamater-Ericsson" Hot-Air Pumping Engine is a single-cylinder engine, in which are two pistons, one called the main or air-piston, which receives and transmits the power, and the other called the transfer-piston, the office of which is to transfer the air contained in the machine alternately and at the proper time from one end of the cylinder to the other. The cylinder is provided at its upper end with a water jacket, through which all the water passes on its way from the well to the tank. This keeps the upper end of the cylinder cool, while the lower end is exposed to the fire and becomes as hot as it is practicable to make it. By the peculiar arrangement of connections between the air and transfer pistons, the proper relative motions between these pistons are obtained.

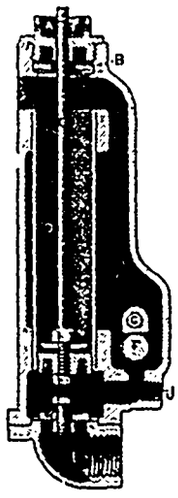


1. Cylinder.
2. Air Piston.
3. Transfer Piston.
4. Heater
5. Telescope.
6. Furnace.
7. Gas Burners.
8. Air Chamber.
9. Main Beam.
10. Beam Centre Bearing.
11. Connecting Rod.
12. Bell-Crank Link.
13. Bell Crank.
14. Bell-Crank Bracket.
15. Bed Plate.
16. Fly-Wheel.
17. Air Piston Links.
18. Pump Link.
19. Pump Chamber.
20. Pump Gland.
21. Foot Valve.
22. Discharge Valve.
23. Vacuum Chamber.
24. Suction Pipe.
25. Stanchion.
26. Foot-valve Chamber.
27. Legs.
28. Gas Cock.
29. Crank-Shaft Bracket.
30. Crank.
31. Crank Pin.
32. Heater Bolts.
33. Transfer Piston-Rod Cross-head.

The operation is as follows: After the lower end of the cylinder has been sufficiently heated, which usually takes only a very few minutes, the engine must be started by hand by giving it one or two

revolutions. The air contained in the machine is first compressed in the cold part of the cylinder; it is then transferred to the lower end, where it is instantly heated and expanded, thus furnishing the power. This engine, like all other hot-air engines, is only single acting. The momentum of the fly-wheel continues the revolution until it receives an additional impulse by the repetition of the above-mentioned conditions, which occur once in every revolution. The same air is used continuously, and is cooled, compressed, heated and expanded in the regular order, and without noise.

The accompanying sectional view shows the working parts of this engine.



The pump most generally used on these engines consists, as will be seen from the cut, of a cast-iron chamber, in which is securely fastened the brass lining *D*, which forms the working barrel. In this working barrel is the piston *E*, which is packed with a cup leather. *A* is a brass gland, through which the pump rod passes and which holds in place the pump rod packing *B*, which is also a cup-leather packing. *H* is the foot valve, which is a round disc of India rubber, secured, as shown, by a brass bolt. *I* is the suction chamber. *F* is the discharge valve, which is a cylindric piece of India rubber.

This pump is extremely simple, has no delicate parts, and is arranged so as to present the smallest possible resistance to the water passing through it It is constructed on scientific principles and will draw water as far as is possible to do with any fast-running pump.

The general agents for these engines and pumps in Canada are R H. Buchanan & Co., Craig street, Montreal.

THE PRODUCTION OF CALCIUM CARBIDE AND ACETYLENE GAS.

Editor CANADIAN ENGINEER:

SIR,—The manufacture of calcium carbide and acetylene gas on a commercial scale has for sometime past occupied the attention of those interested in the manufacture of artificial light for general purposes.

So far nothing has been published to show that it is in successful operation as an illuminant outside of laboratory experiments or for show on a small scale by those having a pecuniary interest in it. A very large amount of space in newspapers and technical journals has been given to describing what they have called its wonderful and far-reaching properties; yet it does not appear to have come to the front in competition with gas, electricity, or coal oil.

Its promoters are now actively engaged in selling territorial and other rights for its use before they have given any authentic proof that more light can be brought into action from it than the same quantity of electricity used in the furnaces to produce the carbide would give, if used on lamps in the usual way.

It has been claimed by those interested that the carbide can be made at various prices, ranging from $7 to $25 per ton, while writers in Europe and the United States state that it cannot be made by water power for less than from $80 to $160 per ton.

A calcium carbide manufacturing works on a large scale have recently been put into operation at the Falls of Neuhausen, Switzerland, where a water privilege equal to 60,000 horse power is available, the water and electric machinery of the very latest design there developing 5,000 horse power and operating 30 Morsan electric furnaces. Careful experiments were made on the carbide produced there, under the direction of continental scientists, to determine the amount of acetylene gas from a given quantity of carbide, as also the average production per ton: the amount of gas produced from 1 lb. of carbide averaged 4.40 cubic feet, giving a light with a one cubic foot per hour burner, equal to five cubic feet per hour of ordinary good coal gas. Some of the European authorities claimed that the light was equal to a gas light burning six cubic feet per hour. The cost of the carbide at these works in large quantities of five tons and upwards packed ready for delivery, is $106 per ton. In quantities under five tons and down to one ton, $117 per ton, in quantities under one ton, $129.50 per ton; for the lowest quotation, about 5 cents per lb and the highest 6 cents.

The Canada General Electric Company, of Peterboro', charges twenty-five cents per pound for it, in small quantities of one pound and upwards, and for 100 pounds and upwards fifteen cents per pound, $500 and $300 per ton, respectively. With the carbide at five cents per pound, corresponding to $106 per ton, the gas would cost, allowing for the difference in its favor, at the rate of $1.90 per 1,000 feet for coal gas. This is without allowing for the freight to the point of distribution, warehouse and office attendance, and profit on purchase. The fact that capital has been freely put into to develop what was believed would be a profitable business, shows that the capitalist had no lack of faith in its future. It is also evident from the number of sales made in the States and Europe of territorial rights, that the promoters, before the successful development of the gas, are now making a good thing for themselves out of it. The claim has been freely made in the States and Canada that the carbide can be made at $20 per ton, while the fact is that in Switzerland, with its cheap water-power and labor, it is sold for five times this amount. It has also been claimed that it can be used as an enricher of coal and water gas instead of kerosene, gasoline and benzine. It has been shown that this is not possible, as the cost of the kerosene for this purpose is far under that of acetylene.

Acetylene gas, it is stated, has been compressed into a liquid at a pressure of 600 to 700 lbs. per square inch; this pressure may be more or less depending on the outside temperature. The iron vessels in which this gas is contained will have to be made with a large margin of safety, as explosions brought about by the mixture of the gas with the atmosphere are of great violence, as was shown by a recent explosion in St. Louis that blew down a three-storey machine shop with loss of life, and that in Quebec last month. The gas, however, to a limited extent, may be used as an illuminant in places where gas or electric lights are not available. It may be found suitable to run gas engines and motor vehicles, as experiments are now being made with this in view, but no report of the experiments has yet been published.

It may, however, in the future be possible to make changes in its manufacture, reducing its cost so that it may become useful and profitable.

It is often asked how does it happen that this wonderful acetylene gas, of which so much has been written and said, is not put into use on the scale expected; there surely has been sufficient time to demonstrate its usefulness since it was first brought into notice. It also appears strange that those who have it in hand are so anxious to dispose of it before its great value as claimed by them is made evident by a successful installation in actual practice. It may yet be found that those who have invested their means in it have made a mistake, and were dazzled as much by the scheme as by the intensity of the few lights shown to them.

J. H. KILLEY.

RAILWAY DESIGNING.*

BY HENRY K. WICKSTEED, B.A. SC., M. CAN. SOC. C.E., CHIEF ENGINEER C.N. AND P.R.R., COBOURG, ONT.

This is of all engineering subjects that of which there has been least written and said And further, for some time to come, it will probably be in building railways to develop the great central plain of Canada, now generally referred to as the North-West, that most of the engineering work of the next quarter or half century will consist of, and to which a great many of our present and future engineers will turn for a living and a career. I have said that there is very little literature on the subject, and let me state here just what I mean by this, and what my subject really is. Pages and volumes have been written upon the designing and building of bridges and culverts, trestles, retaining walls, station buildings, locomotives and locomotive shops, etc., but none of these are the railroad; they are only details, the integral parts of which it is made up.

My subject, and the one on which, I repeat, scarcely anything has been written, but little said, and which to the best of my knowledge is hardly taught in our technical schools at all—to myself it was never mentioned—is the, to my mind, far more important one of the design of the railway as a whole in its relation to commerce, connecting roads, termini, branches, and more especially to the topographical features of the country passed through. It is the "location" as it is generally called, of the railway—the scheming of routes—and the balancing of them one against the other, as to cost of construction, cost of operation, earning powers, local aid, etc., and last, but not least the political and personal idiosyncrasies and preferences of that bane of the locating engineer, the Board of "Directors."

It is my object to discuss the methods and processes by which a decision and final selection of route is made.

And in partial explanation of the statement I before made as

* A paper read before App. Sc. Grad. Soc. of McGill University, March 6th, 1896, and published exclusively in THE CANADIAN ENGINEER.

to the paucity of the literature upon the subject, I may say that besides that there are no mathematical rules by which a comparison may be made, there are generally a number of solutions to each problem in location, and we can never definitely say until after the road is built which is the best, sometimes not even then. The problem is indeterminate in every case, and hence has little attraction for the master minds who wrote our text books. It is a matter of judgment, common sense and diplomacy, rather than mathematics, and you may infer if you like, but remember that I am not saying so, that common sense and judgment are less common among the writers of technical literature than dexterity in the manipulation of mathematical formulas and symbols.

While the problems are indeterminate, there is no reason why we should not study them, and approximate to the true solution, and in doing this mathematical and instrumental skill will help us a very great deal, and there is still less reason why paramount importance of the study should not be pointed out. Perhaps another reason that engineers have paid so little attention to it is that the board of its directors in general considers itself far better qualified to deal with matters of common sense, judgment and tact than the engineer whom they employ, and I regret to say that in a considerable number of cases they are not very far wrong. This august board then arrogates to itself all the judgment part of the business, and requires the engineer to collect and submit the facts and data and it will decide upon them.

Even under these circumstances the task of the engineer is no easy one, and the mere fitting of a line to the topography of the country, the estimation and computation of quantity, and the balancing of these one against another, and the compilation of a brief, pithy report embodying the result, is a piece of work which might well engross the attention and interest of first-class men much more than it has in the past. As a matter of fact, the average director, intelligent, clever man of business though he be, is very seldom capable of appreciating the value, for instance, of reducing the maximum grade by, say, one-tenth of one per cent., or the flattening of the standard of curvature by, say, one degree. He will say: "Well, they have one per cent. grades on the A. B. & C. road, have they not?" The engineer answers that they have. "Well, I think what's good enough for them ought to do for us," and that is often the end of the argument. On the other hand, the engineer is often far too ready to put the directors to unnecessary expense by running a bold, careless line, and presenting it as the best that can be had in the neighborhood. Often have I seen a line run close alongside another equal to it in respect of alignment and gradients, and affecting a saving of thousands of cubic yards of excavation in a single afternoon's work, yet we constantly see the anomaly of an engineer hurrying over his location and then devoting himself with great zeal to scrimping the material in his structures, reducing the widths of his banks to the very least amount consistent with safety, and to setting contractors bidding against one another, with a net saving very often of less than could have been effected in two or three days' work of a competent and painstaking field party. There is a reason for this, too, in that the difference in cost between good location which might have been had and the bad one which is built upon, is known to very few, if to any one. Few, even among railway men, pay much attention to the location of a railway after it is once built, and it is very rarely indeed any subsequent attempts at improvement are made. But the engineer who can grind the contractor down a half cent per cubic yard and induce him to be satisfied with very scanty measurements at that, is looked upon as a very clever man, indeed "just the man we wanted." Here the fault is with the directors—their ignorance of the technical work of the engineer, and their familiarity with the financial side of it. On the other hand, the location engineer is a-field all the time, often in bad weather, and perhaps under canvas, he is subjected to much discomfort and perhaps hardship and suffering. Can we wonder that he often hurries over his work and neglects it more or less in order that he may return to civilization and commence construction, during the progress of which he will have a comfortable office and a warm lodging, especially when he knows that the chances are that if he does take extra time and study over a knotty piece of country his work will not only not be understood or appreciated, but he may even be cross-examined as to why he could only run an average of one mile per day while Johnston or Blake were doing one and a quarter.

Again, in the past, at any rate, location work has often been poorly paid for, and construction work highly so. The man who really plans the work and decides how much money is to be spent on it, who has the saving or wasting of tens of thousands in his hands at almost any point of his work, is, or was, considered to be of less importance than the one who merely supervises the paying out of the money to the best advantage. The work of the latter can generally be understood and appreciated by any moderately intelligent man, while of the former it takes an engineer, and an experienced one, to judge. All the above has for its text the saving of money, and of money at first cost as well as in operation, and here let me say a word as to the true definition of an engineer in general, and a railway engineer in particular. The definition given by the Canadian Society Civil Engineers is that he is one who directs the great forces of nature to the use and convenience of man. I think that is not all, but it is enough, in all conscience. Another definition I have heard—I was credited with being the originator of it but I am not—is that a civil engineer is a man who can do anything except earn a living for his family. This is better in some ways, but not universally applicable. There are a few, at any rate, very competent engineers who do manage to more than support a family. But I think the best and most concise definition of a railway engineer, at any rate, is that of the western man:—"A civil engineer is one who can do at a reasonable cost what any blank fool can do with unlimited money." To my mind this hits the nail on the head very fairly. Any one can locate, and almost anyone can build a railway, provided he has sufficient means at his disposal, but it takes a competent engineer to design and lay out a workable railway, whose cost shall come within the amount which is usually available. The modern railway engineer is an economist. I say railway engineer advisedly, for in the case of many engineering works, bridges, public buildings, etc., it is permissible, even advisable, to spend money on decorative or other work, to use for the sake of appearance, or other reason, expensive materials and plenty of them, but railways are in ninety-nine cases out of a hundred business enterprises, pure and simple. And with the public constantly crying out for cheaper rates and competition, the most rigid economy in construction, maintenance and operation, is the only basis upon which they can be expected to pay. By rigid economy I do not mean that anything about them should be cheap and nasty. That is merely saving in the first cost at the price of a constant drain in after years for repairs and maintenance. I mean rather that nothing can be spared in a majority of cases for æsthetic adornment, and still less can any chance of saving by more judicious and careful survey at the cost of a few dollars be thrown away.

Having decided that a railway between two points is desirable, and that if a favorable location can be found, it is probable that sufficient funds can be raised to build it, the first step is the acquirement of a charter for the building. This being done, a provisional board of directors is appointed, and these generally, as a first step, select an engineer to examine the country, and report upon the best route or routes and their probable cost, and their relative advantages and disadvantages in operation and earning powers. He will probably be asked what such an examination will cost, and if he is wise, he will be very careful about putting the figure at so much per total, or at so much per mile of distance—at any rate, not until he has driven or walked over the country between the two termini and obtained some familiarity with it. In the first place, the number of possible routes is often very great, and no engineer is justified in reporting on which is the best until he has, at any rate, a superficial knowledge of all. In the second place, the existence of much heavy timber will often greatly enhance the cost, both on account of the difficulty of vision and that of obtaining instrumental measurements, and in the third place, the cost of a survey does not, as a rule, vary with the distance, but more nearly as the square of this last. If we assume the air line between A and B, the two terminal points, to be twenty miles, we can without unduly lengthening the line, diverge from this air line for a distance of three miles or more on either side, and consequently what we are to examine is not a line, but a lenticular area, having a length of twenty miles, a maximum width of six miles, and an area of about eighty square miles. We should be familiar with every square mile of this area before we start to run even a tentative or trial location through it, or, at any rate, with every valley and watercourse. Now similar figures are to one another in area as the squares of their similar parts, hence the statement I have just made, but the ratios in a majority of cases, for many reasons, are hardly as high as this, prominent among which are that the expense and delay of organization before any work at all is done is nearly constant, and that the expense of mapping, drawing, and estimating vary nearly with the distance itself. Local conditions and arbitrary points often make a great difference. During the summer just passed, for instance, I was employed to locate forty miles of line between two cities. For a great portion of the distance there was an important railway upon one side and the shore

of one of the great lakes upon the other, and it is a *sine qua non* that the location should for the greater part of the route be made upon the intervening strip often less than a mile wide By lessening the choice of route the cost of survey was, of course, greatly reduced, but I would like again to impress upon the younger members of this audience that our examination is to be of an area, and not of a line. It is a line which we want to place upon it, but for a long time, at any rate, we should not commit ourselves, even in thought, to the idea of a line I want to impress this upon you because it is such a common mistake, perhaps the commonest mistake of all in doing this class of work to run the line first An engineer drives over the travelled road; he notices within the range of his vision on either hand that a practicable line can be obtained, and without seeking further he proceeds to run his preliminary. He lays on grades to fit, establishes a standard of curvature which will allow of moderate cost, and proceeds to make his location and estimate, and the latter being deemed reasonable, it is built upon. Years after, it may be, another railway comes through the same country, finds an easier route at less cost. I have an instance of this very thing in my mind's eye at this moment, where an important railway was located and built at heavy cost, and years after one nearly parallel, possessing great operative value at one-half the cost, was located between two common points.

The examination of the area referred to is called in common parlance a reconnaissance, and may, according to circumstances, be made in a variety of ways In ordinary settled country a great deal of work may be done by the engineer alone, preferably on horseback, with an aneroid barometer The best maps extant should be obtained at any expense of money or trouble, and brought down to a reasonable scale. I found forty chains, or half a mile to an inch, about right on most work, and fortunately a great number of Crown Land maps are published on or about this scale. Every possible line should be sketched or traced by the eye upon this plan, and more especially the direction of the drainage and water courses, the position and elevation of the low places on the divides or water sheds, and each one of the routes should be examined in more or less detail; but none should be examined in any considerable detail before a good general idea is had of the country as a whole, else we shall be very apt, in spite of ourselves, to become prejudiced in favor of some one route to the exclusion of others The temptation to jump at conclusions in this way is often very strong, and often leads to final selection of the wrong line, or, not quite so bad, in our spending a lot of valuable time on the examination in detail of some one line, which after being followed for many miles, proves for one reason or another to be quite impracticable.

Having decided upon all possible routes, the engineer will then proceed to examine each one in more detail, and to this end it is often, I have found, well to supplement the barometer, which is at best a somewhat fickle and unreliable instrument, by a leveller and rodman with a light portable instrument. Levels can be carried along the main roads, and bench marks left every half mile or so at the rate of seven or eight miles a day, by a smart leveller, and by checking on these from time to time the elevations of points on either hand can be established with the barometer with tolerable precision. This work done, the engineer will be able to draw approximate contours upon his map, which will greatly aid him in his work. After the more detailed examination is made it will generally be found that several of the possible routes, because they lead one too far from centres of trade, or because they involve the use of excessive curvature or gradients or other reasons, are obviously either impracticable or greatly inferior. I would advise caution in coming to this decision, but in a majority of cases the conclusion will be rapidly forced upon one that the choice is narrowed down to two or three routes. We can now start a survey, or, as it is generally termed, "run a line" This is a preliminary line or traverse, and is carried forward as rapidly as may be, keeping near, but not necessarily upon, the ground we think will be followed by the location. I say not necessarily upon, for various reasons, among which are that before we get through we are apt to change our ideas very much as to where the located line should be. Secondly, we may also save much time by taking a road or lane for a short distance, and by offsetting to avoid heavy choppings in the bush, and lastly, the object of this line is to obtain as much information as possible of a miscellaneous nature, and the transit man or compass man is better employed in taking notes and bearings to surrounding objects, etc., than in trying to pick out the best ground to run upon. In fact the line should be looked upon as a traverse from which bearings and distances may be taken, and a large scale plan worked up, rather than as an approximation to the true location. Levels are taken upon it, but not necessarily at every hundred feet. The profile to be plotted from them is rather for the purpose of determining the rate of gradients than the quantity of work, but the depths and widths of river valleys, gulleys, etc., may well be taken with some accuracy, and a few offsets levelled off on either side at distances varying with the nature of the ground. Opinion is somewhat divided as to the best instrument to use, transit or compass. Both on account of the extra scope of the instrument and the greater precision in laying down the line on paper, my personal preference is for the transit, but the choice will be largely governed by the nature of the ground and by the character of the assistants. Some men seem never to learn to set up and handle a transit instrument quickly, as well as accurately, and as the measure of the progress of the party as a whole is that of the transit instrument, one is often forced against one's will to take the compass. For distances, the ordinary steel link chain is still unsurpassed for accuracy and rapidity in ordinary country, but often there are cases in which the use of stadia wires or of a micrometer will save much time and give quite sufficient accuracy. When shorthanded not very long ago, the writer threw a chain of triangles along the line of his work with great rapidity and with excellent results. In fact, while the ordinary locating engineer, like the ordinary whist player, is the one who understands thoroughly the common methods of work or play, the good one is he who is constantly watching for chances to get on quicker with less work, and breaking away from the ordinary rules to meet the conditions obtaining in exceptional cases. I have spoken of the micrometer; no doubt you are all acquainted with its use and cosstruction; as also with the stadia wires. I doubt if you are so well acquainted with a simple little attachment often put on transit instruments nowadays, by which small angles of elevation and depression may be measured, and which is called the gradienter, and is, I believe, the invention of Messrs. Gurley, the well-known instrument makers. I fear that many will think I am talking heresy when I say that, speaking generally, the American designs and methods of graduation, etc., are vastly superior to the English. The workmanship of the latter may be better—it used to be at any rate—but I doubt much whether it is now; but for engineering work some of the patterns are crude and cumbrous in the extreme. For instance, a young man came to me last summer, and a McGill man at that, with the intention of running in curves with an instrument graduated from 0 to 360. When the curve was to the right he got along all right, but when to the left he had to perform a subtraction for every different station. Life is too short and axe men's wages too high to wait while this is being done. This young man also had a method which I had been taught myself of keeping his bearings on the vernier, and checking them by the magnetic. If you are running around a block a half mile square, or even three or four miles square, and closing on your own work at the end, this may work well enough, but if you have forty or fifty or a hundred miles of traverse on end with no closure to count on, and you want to have some satisfaction when you are laying down your location upon your preliminary plan, then I strongly advise you to have an instrument reading from 0 to 180 each way, with a double vernier, and book your angles as to right or left of the last line produced, and more than that, to repeat them. I know I shall be told that it is very easy to put down R for L and L for R, and so it is, but if you do so your compass bearings will enable you to locate the error without delay, and you have the angles themselves when you want them, and are not obliged to subtract one bearing from another, or add them together and subtract from 180, or any humbug of that sort. And it is the angle we want, and not the bearings. If I want to know about what curve would fit into a bay in a hill side, or around the nose of a mountain in a hurry, I get the distance from the chain stakes, and ask the transit man for the total deflection, and if tells me that it is the difference between N. 70° 32 feet E. and N. 25° 18 feet W., I shall, being short-tempered, be very liable to say something which is not considered quite the thing to say in polite society. But this is somewhat of a digression. As a general rule, for the guidance of young transit men especially, I would reverse the old proverb which tells us to take care of the pennies and the pounds will take care of themselves, which is a very silly and misleading proverb indeed, and say, take care of your degrees and your tens of degrees and the errors in minutes will balance one another out. . . I don't want to discourage nice and precise work; nothing is pleasanter and more satisfying at the end of the week, when you take an observation for azimuth, than to find your bearings corresponding to a minute or two, but it is a fact, nevertheless, that it is large errors of degrees

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which get the oftenest into the work, and play the very mischief with it, and I would say be accurate and careful first, and if your chief and your picket men will give you time, be as precise as you like afterwards, but let neither of these bully you into neglecting to repeat or double your angles, and in doubling to reverse the instrument, for in this way we can eliminate almost all the sources of error in collimation, in centreing, and above all, in reading the wrong degree or the wrong ten degrees, or the right hand vernier or the left. And if you keep your vernier set to the bearing, you can't double your angles, and if you can run two or three hundreds of courses without making a mistake, and finding it hard to locate the position of that mistake, then you are the best transit man I have ever come across, and I have had to do with a good many.

Having run our preliminary line or lines, we have got ahead a long way with our work. We are now in a position to decide which is the shortest line, and its length, within a very small percentage. We can lay down a standard of gradients and curvatures within very small limits, and with experience we can make a very tolerable estimate of the cost of the different routes. Often this will be as far as we need go for a time at any rate, it being only required in many cases to determine the best route, its approximate cost, and whether we can at moderate expense obtain such gradients and curves as will permit of the line being a financial success. This operation of traversing, in fact, completes the survey properly so called, and we will do well in any case to take a few days in the office, and lay the information we have obtained down on paper on a larger scale than we have hitherto used, say, 1,000 feet to an inch, and on this information the engineer will write his preliminary report and consult with his employers upon the choice of route. And let him not write this in a hurry, or jump at conclusions. He will find, if he is conscientious, food for thought and study for many days, and possibly sleepless nights He will have to take into account the character of the traffic, and its probable volume, the conditions imposed by competing and connecting roads, by municipalities granting subsidies, the nature of material on the one practicable line or the other, the position and accessibility of ballast pits, stone quarries, etc.; he will have to choose between a possible short and direct route with heavy gradients, and another longer and more crooked one admitting of easier ones, and his choice must be largely governed by the conditions of future traffic, and none of these things, be it observed, are capable of an exact valuation in dollars and cents. Roughly, you will find it estimated in some of the text books that a foot of distance saved is worth a certain sum, and a degree of curvature saved a certain other sum, and I have seen elaborate tables made up balancing the values of two alternative lines. Make up your tables by all means, they are worth studying; but don't forget that these values for degree of curvature and foot of distance vary with every road, and even at different periods on the same road. I have seen, too, values for every foot of rise and fall irrespective of pitch or angle of gradient. I can show you such tables and equations given as examples in a large work which was for a long time a standard one. Can anything be more ridiculous, when we come to think over it, than giving the same value to four feet of rise and fall on the open road—to a slight undulation which has no effect except upon the speed of a train—to that of adding four feet to the summit of a long grade up which the freight train can barely crawl, and which four feet may have the effect of stalling it altogether? And if so, is it not the attaching of the same importance to four feet upon a light easy grade, and to four feet upon a maximum or ruling grade? The pitch of this ruling or maximum grade is on a majority of roads of the most supreme importance, and generally the first thing to be considered, and to be borne in mind to the end of the chapter. The standard on Canadian roads may be said to be one per cent., but I think the tendency among railway men—men who operate and manage railways—is towards reducing it. The standard on the Grand Trunk was rather higher, and it has been reduced at considerable expense at 100 points. The Great Western had this standard, and it is felt as a terrible drawback, especially of late years, when it has had to compete with the Canada Southern, with its almost unexampled grades of three-tenths per cent. Mr. Sandford Fleming, twenty-five years ago, was so impressed with the importance of easy maximum grades that he had the whole of that portion of the C.P R. between Winnipeg and Lake Superior located to a standard of one per cent. going west and one-half per cent. going east, so as to favor the heavier east-bound trains. Assistant engineers kicked and grumbled and declared the thing impossible, but Mr. Fleming was firm, and not only was it found to be possible to obtain such grades through a broken country, but in few places has the cost of the road been very much increased. All that was needed was patience and care in making the surveys and location, and subsequent years of operation have demonstrated the wisdom of Mr. Fleming's decision. The reason why the ruling grade is of such paramount importance is not hard to understand, and yet I think that even to-day it is not fully understood even among engineers. To put it simply, an engine which will haul twenty-two cars on a gradient of one per cent. will haul about thirty-seven, or nearly double, on one of one-half per cent. And on the principle that the chain is no stronger than its weakest link, what it can haul on the steepest grade is all that it can haul over the whole road or division It is the maximum train load in fact, and railway operating expenses can be gauged and are gauged pretty much by the cost per train per mile. Now if we can haul thirty-seven cars at the same cost that somebody else hauls twenty-two, it requires no very elaborate calculation to show that we have reduced hauling expenses by nearly forty per cent., and a little reflection will show that even a poor concern can afford to spend a very considerable sum in the present to effect such a very large saving in the future.

To attempt even a general discussion of these questions would consume much time, and even should I attempt it, I should probably merely say over again what has been better said elsewhere. I must content myself with pointing out the paramount importance of the study of location, and perhaps with saying a few things which have not, to my knowledge, been said before.

Having plotted his plan, spent some hours or days in poring over it, and covered a good many sheets of scribble paper with figures and sketches, the engineer is in a position to make his choice, and, what is perhaps more difficult, to lay it before the board of directors, and intelligently explain his reasons for it, and in writing his report he should remember, first of all, for whom and to whom he is writing. He will put it in plain terse language, and eschew the use of mathematical and technical terms; he will be brief and concise; and, above all, he will be careful, no matter what his personal preferences and convictions, to conceal nothing. He will remember that he is called in as adviser and counsel, and not as judge, and that his judgment may be in error; but let him be sure that his facts are right. To write a good report to a board of directors, he must try to acquire the faculty of looking at things through the director's glasses, and then he will find less difficulty in picking right words and phrases in which to set his arguments, and, as I have already said, the director's point of view is pretty much the financial one. He will generally find one or two men who want nothing but the cheapest; perhaps one or two more who believe in nothing but the shortest; but generally a leaven of sensible and clear-sighted ones, who understand something of the subject, and who are willing to be taught more, provided the teaching is done in a respectful and diplomatic way.

The report being read and adopted, the engineer will probably be asked sooner or later to locate his line upon the ground, an operation altogether different from what he has been previously doing. His first operation is the running of the trial location. Most men start this at one end, and work straight through to the other. I may be erratic, but this is not my idea of the best plan, for reasons which will presently appear. I believe that long ruling gradients should be almost invariably run downwards from the summit, and hence the best point at which to start is the summit of the longest gradient. We are assuming, remember, that he has already fixed the pitch of the maximum grade, and consequently the height to which he can rise depends upon the distance. Now, if he starts from the bottom he cannot tell from his previous work just how long his line will be, and he may easily find the summit cutting five, ten or fifteen feet heavier than he intended, and his trial line, while not necessarily useless, much more difficult and expensive to work from. There are cases of course where the bottom of the grade is fixed by some heavy stream crossing, but as a general thing it is the summits which are the governing points, and it is from the governing points we should work. Further, it is the almost universal practice, I believe, to run the trial location through before commencing location. I think this is bad practice also, and that it is better to carry the location along simultaneously, a mile or two of trial location, and then a mile or two of location alongside of it. By so doing we have a better chance of retaining that personal knowledge of the ground obtained by working laboriously over it, which no amount of elaborate contouring or topographical sketching will replace. I know an engineer who sends a party out into the field to make a contour plan, and does all the scheming of his location in the office on that plan, sometimes without any personal knowledge of the ground at all. I have not over much respect for that man, or for his work, and I fear he has very little respect for the pockets of his employers; at all events his employers are beginning to think so. I may say that he is not a McGill man.

The trial line, then, is a line run as near as the eye and the

knowledge gained on the preliminary survey will admit to the position of the centre line of the proposed railway. It is usually staked out every hundred feet at least, and levels taken at every station, and these levels must be reduced on the spot, and on maximum gradients the grade elevation carried out alongside the reduced, so that the engineer may see at a glance whether his line is on too high or too low ground. And in this levelling let me insist again that it is rapidity and accuracy which is wanted rather than precision. One of the first engineers I worked for after leaving these classic halls was a Frenchman, and he conveyed to me this idea very forcibly thus: "My dear fellow, you take too much pains; the railway is not like the canal. Suppose you make a mistake, five, ten feet on the railway, that will give you no trouble, you fix your grade, that is, make him all right, but suppose you make mistake of ten feet on canal, that is play hell!" I think he told me that he had tried it and spoke from experience, but I can't remember now. Without going as far as this, and saying that an error of five or ten feet is of no consequence, I do say that errors of a few hundredths, or even a tenth or two, while they are apt to give annoyance, are not worth spending time and money to correct. Here again I would counsel you, take care of the feet and the tens of feet and the hundredths won't give you much trouble. If a man wants extreme accuracy it is cheaper to send a special little levelling party over the line after it is located, than to detain the location party while they are at work. I have known trial lines to be run by compass, but I believe it is unusual, and in my own practice I have always been opposed to it. A smart transit man would take little more time with the transit, and the increased precision is of great value in enabling us to block out and run in, directly from notes taken off the plotted plan, curve after curve, without having recourse to that tedious and exasperating process which is known as running to intersection, that is, producing two tangents until they meet, and then putting in the curve between them. In other words, the time saved in running trial line is more than lost on location. The plan of trial line should be plotted up every evening to date, on a scale of two hundred or four hundred feet to the inch, depending upon the intricacy of the work. Cross sections are taken at varying intervals according to the nature of the ground, and some engineers believe in very elaborate contour plans made up from the cross section notes. Much depends upon the character of the surface, but my own view is that the best location work is done by a system of trial and error work, a series of closer and closer approximations to the true line than by an attempt to lay down at once upon any plan, however minutely accurate, a final line, and that contouring is of more value upon the smaller scale plan obtained from the preliminary work and blocking out the general route than in fixing the exact centre line. Every man will have his own particular plan, and will be able to work quicker and better in his own grooves than in those of others. The trial line being run and laid down upon the plan, we proceed to locate, first upon the plan and then upon the ground. Methods of plotting vary. Some work out a traverse table and plot from it. Others rule up a meridian at every angle and plot from the bearings. Much of this work if not all, will be done, in camp, or on the kitchen table in some farmer's house; in either case the facilities for carrying forward parallel lines are not of the best, and my own preference is for plotting the work exactly as it is done in the field, both for speed and accuracy. I simply produce the line, and turn off the angle to right or left with a protractor, if I wish to be particularly nice, by calculating the natural tangent deflection. Curves are best schemed by having them scratched upon celluloid or horn, and they can generally be drawn in with a pair of pencil dividers. If the centres are marked, and the initial and termini radii drawn, there will be some trouble and time saved in calculating sub-tangents.

The scheming of the location on the plan is largely a matter of judgment, and the methods those of individual preference, and nothing much occurs to me to say about it except that the inexperienced are apt to consider the location of a railway as a series of straight lines connected by curves. On the paper plan, in projecting it, I think it is always or nearly always the reverse—a series of curves connected by tangents, that is to say, the position and radii of curves govern the position of the tangent, and the former should be drawn in first; but this is at best merely a general rule, and not a universal one, and the outcome of the increasing tendency of late years to increase the number of curves, and decrease the length of tangent in order to save work, or reduce the maximum gradient. Another reason for it is that the most crooked portions of the line are usually on the most difficult ground and require the most careful fitting. I remember a long piece of located line where the adopted minimum radius of curvature was considered to be too short, and the engineer was required to lengthen it. He did so by leaving the tangents in their original position and merely flattening the curves between them. The result was a botched piece of work. The proper procedure would have been to re-plan the whole line, keeping it as nearly as possible in its original position. The running of the location on the ground is a matter which is treated of at some length in many of the text and pocket books, and on which little need be said by me. It presents a constant series of very interesting problems, to which there are a great number of solutions. In running curves in heavily wooded country, for instance, it is common practice to run a series of long chords to avoid the chopping or frequent setting up entailed by the shorter and more numerous ones, and a table of these long chords is almost always given in the pocket books. The objection to the method is, that after having cleared and chained the chord, the end of it often falls in a hole or other awkward place to set up the instrument. The better method to my mind is to run a series of short tangents. It will be found that this method involves a lesser number of instrument points, and permits of a much greater range in the choice of them, and further, the short tangents will be found to lie more nearly on the line of the curve, and the corresponding chords, often a matter of some consequence. A number of rules will be found for the running in of reversed curves. I trust it is unnecessary for me to remark that reversed curves are considered bad practice, and that it is almost invariably better to shorten the radius, and to leave some tangent between two curves of contrary flexure. I, and others of the Canadian Society of Civil Engineers, have written of and discussed at considerable length the best methods of designing and laying down transition curves, and there is neither time nor necessity to go into the matter here. Suffice it to say that the great interest shown in the matter by numerous correspondents, both in Canada and the United States, proves that many practical railway men feel the crying need for something of the sort.

The location finished, there comes the preparation of right of way or expropriation plans, the calculation of quantities, and design of structure—not in detail; this belongs more properly to the construction stage, but as to their general type and material, whether of stone, iron, steel or timber, and whether temporary or permanent, for these questions, and especially the last, affect very considerably the best location of the road and the position of the grade line upon the profile. With the disposition to use temporary structures liberally, the latter will almost invariably be kept rather higher, to the reduction of cuttings and earthwork. There is rather a prejudice against the use of timber in modern times, partly on account of the increasing relative cheapness of steel, partly on account of the accidents which have in many cases attended the use of wood. My own view is that the accidents have in a majority of cases been due to poor design and insufficient care, and that because they are cheap, and sometimes insignificant, thinking men have not devoted the same attention to their design and construction as has been bestowed upon structures of steel and masonry. Certain it is that upon pioneer roads, through unsettled districts at any rate, it will be long ere the use of timber is discontinued, or ceases to play an important part in the design and construction of railways. I would conclude with a few general remarks and bits of advice. Don't trust your eyes when looking over a piece of ground and estimating elevations and depressions, distances, etc. Use them freely, but be cautious about accepting as final the information they give you. There are a number of optical illusions which are understood and can be guarded against. There are others which seem to have no explanation, and to be peculiar to some particular locality. Test every important point with the instruments. If you cannot trust your eyes, still less can you believe your ears. The amount of worthless information which a farmer can communicate to you in a great many words is extraordinary, and this not because the farmer is unintelligent or prejudiced, but simply because he has no experience whatever in looking at things from your point of view. The old Indian is better, but intensely misleading at times; but, on the other hand, do not suppose that because their voluntarily communicated information is of no use that there is no sense in talking to them. In the first place, you hurt their feelings and destroy their interest in the enterprise you represent, which is often of great value, and, in the second place, if you keep them closely to the points upon which they *are* well informed, you can gather indirectly a great deal that is of value. Either can generally tell you the direction of the drainage, and the approximate position of the watersheds and divides, and what portions are heavily wooded, and what the character of the timber is. The old Indian has no sense of distance, the farmer none of altitude, and both are prone to exaggerate the value of even ground, and the difficulty of rough and broken country.

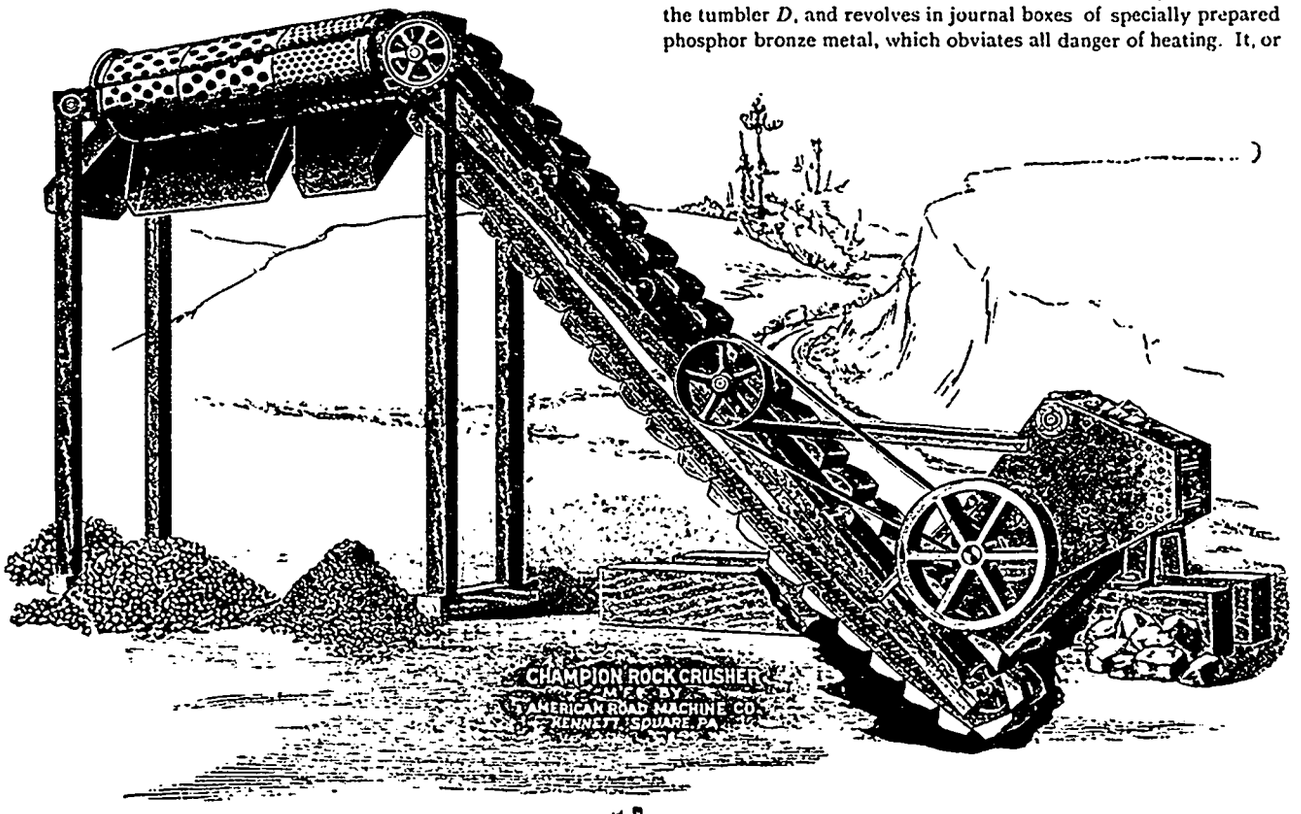
Then as to the point I have already touched upon, the "cui bono" of painstaking surveys and location, does it pay? If it does not I think it is largely the fault of engineers themselves in allowing themselves so often to be proved slipshod and careless in their own work and methods. If they do not themselves show by their reports and work that they can and have saved large amounts of money for their clients, how can they expect the latter to believe in them and to pay them liberally? It rests with the engineer to educate the public into a belief in the value of his own services, and he can do so best by showing that he has reasons for what he thinks and does, and by discussing these frankly and plainly and setting them forth in his plans and reports. And let me say further that the man who thinks less of his work than of the pay he is getting for it, is not much of an acquisition to the engineering or to any other profession, nor does he represent a very lofty type of manhood. The pleasure in cashing a big cheque with the treasurer's signature beneath it, is tempered by the reflection that a large portion of it is already owing for the necessities of life and th rest will soon follow, but the satisfaction of wrestling, and wresti successfully, with a knotty problem in location, and of successfull tting a line around the base of a forbidding looking bluff when all the indications were that you must tunnel through it· is something which "cannot be taken away from you," and it is to be classed among the greatest of luxuries. It is a luxury which has many a time more than repaid me for days and weeks of fatigue and privation, hunger and cold.

THE CHAMPION STEEL ROCK CRUSHER.

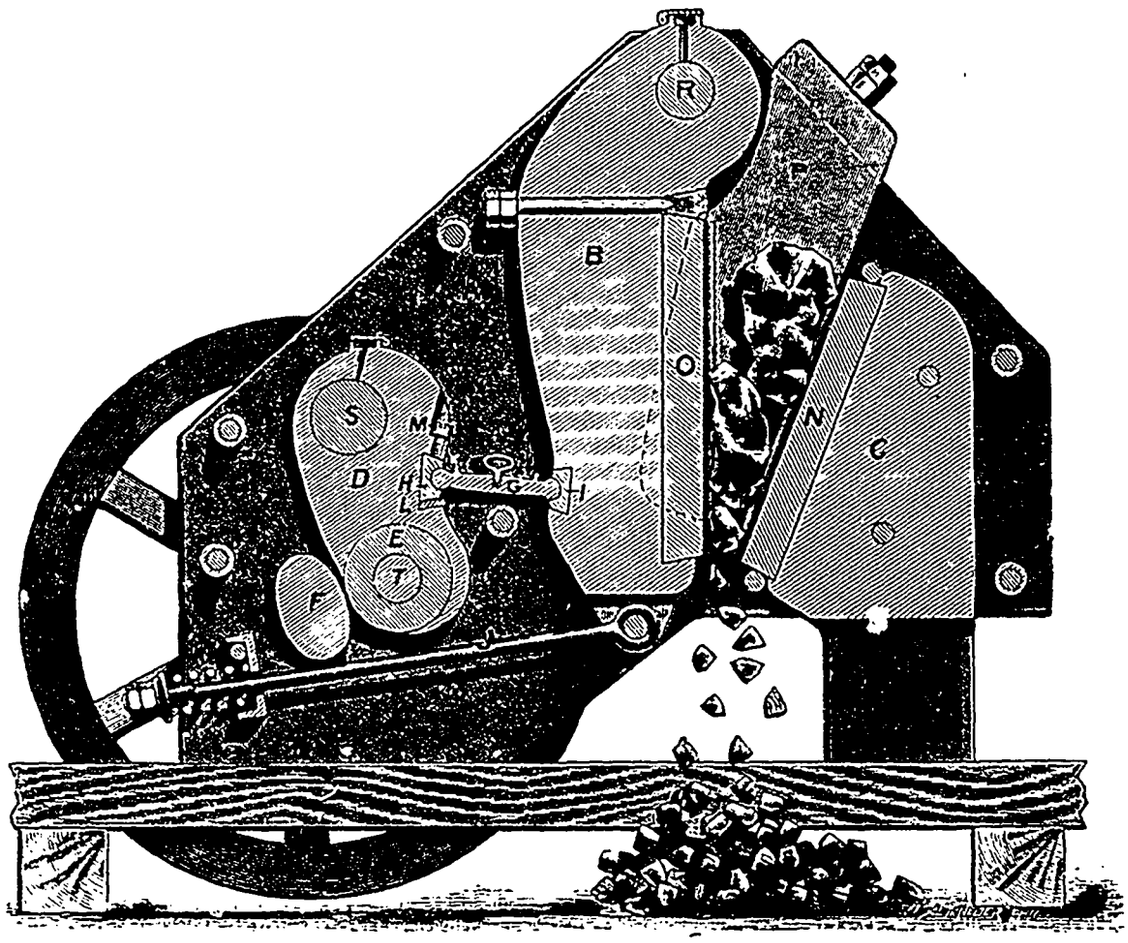
The Champion Steel Rock Crusher is now in use by road-makers, contractors, quarry owners, ballast makers, etc., as one of the lightest, strongest, most durable, and most thoroughly convenient and reliable rock crushers on the market.

Prior to the past season but two sizes of this crusher, known as the No. 3 and the No 4, have been built. The degree of success attained by these two machines, attested by their large and increasing sales, and the demand by quarry owners, contractors, cities and large towns for a machine of larger receiving and producing capacity, has influenced the Copp Bros. Co., Hamilton, to perfect a machine of larger size, and for the coming season they offer, in addition to the No. 3 and No. 4 sizes, the No. 5 Champion Steel Rock Crusher. This machine, although differing in some essentials, is built on the same general plan as the No. 3 and No. 4 machines, except that it is not portable on account of increased weight. It has a receiving capacity 11 x 26 inches, and is designed to have double the producing capacity of the No. 4 machine, or about thirty tons per hour to a two inch opening. In the Champion Crusher the main shaft is elliptical in shape, and one revolution of the fly-wheel produces two movements of the jaw; thus in comparing the Champion with other jaw crushers the makers claim it will be only necessary for us to make one-half as many revolutions of the main shaft or of the fly-wheels to obtain the same number of movements or grips of the jaw. The advantage of this feature should not be underestimated, ... reduces the amount of friction just one half, and consequently secures a great saving of power and less wear of working parts. In the Champion Crusher the fly-wheels perform a very important part, as they serve the triple purpose of balance wheels, belt wheels and of travelling wheels when the machine is in motion on the road. A wooden pulley or belt wheel is supplied with each crusher, which can be attached to either fly-wheel. This wooden belt wheel is usually 44 inches in diameter for the No. 3 crusher, and 50 inches in diameter for the No. 4, and is furnished because, as the regular fly-wheels serve the purpose of rear travelling wheels for the crusher, they will become too much roughened for belt wheels, and moreover, wood always makes the best belt wheel. The size of the product is regulated by toggles of different sizes, four of which are supplied with each machine. These toggles are a special casting, with a chilled surface. The four toggles admit of a range of work from three-fourths of an inch to two and one-half inches, all that will ordinarily be required. The change of toggles can be affected in a few minutes.

In the Champion Crusher, as shown in the sectional view herein, the power is exerted upon the moving jaw *B*, through the rolling action of the double cam shaft *F*, anti-friction roller *E*, tumbler *D*, and toggle *G*, thus giving two grips to each revolution of the shaft. This shaft is located near the base of the machine, and has on either end a heavy wide-rimmed wheel of 800 pounds each on the No. 3 size and 1,000 pounds each on the No. 4 size. *A*. Main frame. The main frame or sides of the crusher is of two pieces of homogeneous steel of great strength, which insures against the breakage of any heavy or expensive parts. *B*. Moving jaw. The moving or swinging jaw is a heavy casting, having a short pendulum motion. *C*. Stationary jaw. The stationary jaw is also a heavy casting, forming the front end of machine. *D*. Tumbler. The tumbler is a heavy casting, having a pendulum motion on the shaft *S*. *E*. Anti-friction roller. The steel roller is journalled to the tumbler *D*, and revolves in journal boxes of specially prepared phosphor bronze metal, which obviates all danger of heating. It, or its bronze boxes, are easily replaced when worn. *F*. Main cam shaft. The main cam shaft is a steel forging, elliptical in shape at its centre, and revolves in babbitt metal boxes, which are provided with liberal oil cavities covered with a lid. It is of ample strength and holds upon either end the heavy fly-wheels. *G*. The toggle. Is a special casting with chilled surface, and its purpose is to regulate the size of the product. Each machine is furnished with four of these toggles of the following sizes: seven, seven and one-half, eight, and eight and one-half inches, and under ordinary circumstances, by changing them, the size of the product is varied from three-quarters to two and one-half inches.



Under certain circumstances, however, when it may be desired to crush very coarse or very fine, it will be found necessary to use smaller or larger size toggles, and the makers are prepared to furnish toggles from five to ten and one-half inches in sizes, which will admit of the widest possible range of work. *H* and *I*. Steel seats for toggle These are steel forgings seated in the castings *D* and *B*, respectively, and held by set-screws, and into which the toggle fits *K* and *J* Tension spring and spring rod. The office of this spring and spring rod is to assist the jaw *B* and tumbler *D* in their backward vibration, thus holding the toggle *G* in its seats and keeping the anti friction roller in contact with the surface of the elliptical cam shaft. The spring should be compressed just enough to hold the roller *E* in such contact, thus preventing a knocking or pounding of the cam shaft on the roller. *L*. Steel-backing. Its functions are to facilitate the removal of a worn-out toggle seat, *H* or *I*, both being supplied with this backing and



screws. By loosening the set-screws *M* and shifting the steel backing *L* to the upper side of the toggle seat *H*, the movement of the jaw is increased. This is only advisable in crushing soft rock or slag. *N*. Chilled stationary die. This die is of chilled charcoal iron; it can be reversed, end for end, when worn, and is easily taken out. *O*. Chilled moving die. This die is also of chilled charcoal iron, and is reversible, same as *N*. *P* Cheek plates or lining. These are of hard open-hearth steel, and are intended to prevent wear of the sides of crusher. They are rectangular and reversible. *Q*. Fly wheels. Two of these are supplied with each machine. They should make 180 revolutions per minute on the No. 3 crusher, and 160 revolutions per minute on the No. 4. When the crusher is at work, these wheels should revolve backward, *i.e.*, the opposite way to that when drawn on the road. *R*. Shaft for moving jaw. This is a steel shaft upon which the moving jaw swings. *S*. Tumbler shaft. This is a steel shaft upon which the tumbler swings.

TABLE OF SIZES, PRODUCT, ETC.

	Size or receiving capacity of jaws.	Product per hour in tons when closed to 2 inches.	Weight approximated.	Rev. per min	Pulleys, diameter and face.	Horse-power required.
	Inches.	Tons.				
No 3..	7x13	7 to 13	5,000	180	44x8	10 to 12
No. 4	9x15	12 to 18	8,000	160	50x8	12 to 15
No 5 .	11x26	24 to 36	16,000	150	60x10	15 to 25

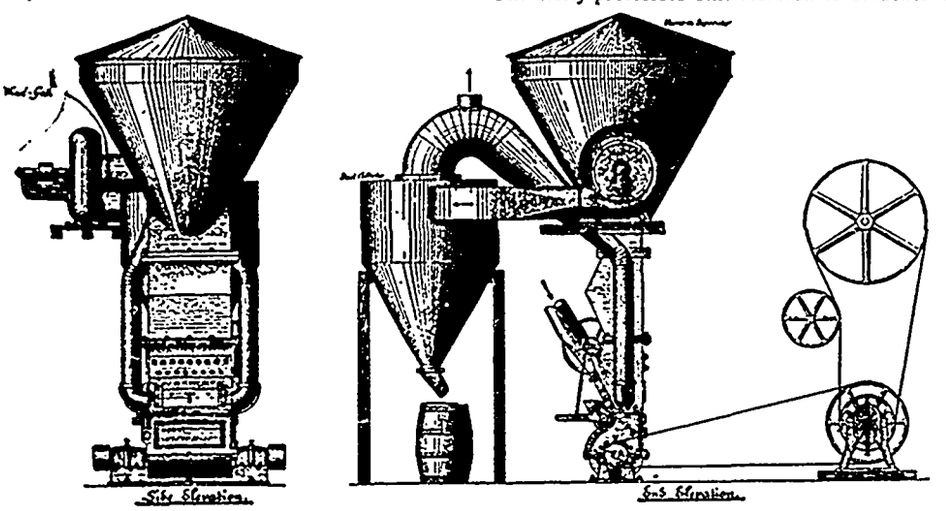
BOILER EXPLOSION AT WATERDOWN.

A steam boiler explosion of an unusual character, with destructive results, took place on the 18th March, at Curtiss' saw-mill recently put in near Waterdown, Ont, about four and one-half miles from Hamilton The boiler was a second-hand one of the locomotive type, with an oval shell sheet around the furnace. The furnace followed the shape of this shell, with a flat top supported by bridges and stays to the top of the shell. It had an open front with cast iron frame, with furnace and ash-pit doors, and was reckoned at about 25 h p, but, like most of saw-mill boilers, had occasionally to exceed this power. Before the explosion the pressure on the boiler varied from 75 to 100 lbs. to the square inch. At the time of its rupture the mill had been closed down for from ten minutes to a quarter of an hour, some repairs being required on the machinery, at which Mr. Curtiss and the mill hands were working. Mr. Smiley, the mill teamster, was sitting near the boiler at the time of the explosion, taking his dinner. He was found by the mill hands after the rupture about 40 feet from the position he occupied before, with one leg broken in four places, and the other leg in two places. He was also internally injured, and scalded with the steam and water. The rest of the hands were not injured, but escaped almost miraculously. Had they been in their usual places, some of them would have been killed or injured. When the hands recovered from the shock and looked around they saw a wreck such as has been seldom recorded. The mill building and boiler house, a frame one, was blown down, the debris being scattered around. The remains of the boiler were scattered around the mill site in various directions, and the parts widely separated. In one place at a distance from the mill, lay the outside shell of the fire-box, in circular instead of its oval form, all the stay bolts being drawn out of it. The under shell of the furnace was found nearest the mill, nearly all the screw stays that attached it to the outside shell being in place in it. In another place, widely separated from this, were the nest of tubes partly attached to the head, the tubes being clean, with no scale on them, as appeared to be the case with all the internal parts of the boiler. In another place was the flattened out barrel of the boiler, with detached smaller pieces in various directions. Some of the parts were buried in the deep snow, and will not be recovered until it melts off the ground. The tall iron smoke-stack fell all flattened out, near the head of the boiler,

and the engine was also struck, and its girder-framed bed broken and rendered useless. The scene was such a one as an engine-builder, boiler-maker or second hand machinery man seldom sees, but it should be seen by them and by stationary engineers, as it would no doubt make them all more cautious in their dealings and work. It proves the great necessity of all steam boilers being legally examined and tested by competent engineers both before and after use, and placed in the hands of competent men. There is no reason why this should not be so in land engines and boilers, as it is in steamboats Many efforts have been made to get Government authority to do so, but without avail, so that the destruction of life and property goes on apace. The makers and the dealers in machinery are not nearly as much to blame in this as the laws that allow this to go on continuously. No person would be injured by laws that would render explosion nearly impossible, and both dealers in, and users of, machinery would be permanently benefited by it. As the matter of this explosion may come before the courts and become a legal question, it would be injudicious to give any opinion here as to the cause of it. This has been investigated and reported on to the owner of the mill, by J. H. Killey, consulting engineer, of Hamilton. Further particulars as to the cause of this explosion may be given in our next number.

PULVERIZING AND SEPARATING PLANT.

The accompanying illustration shows a plant for an improved process of reduction and vacuum separation, just completed by Bannerman & Findlater, machinists and boiler makers, Ottawa. This plant has been made for the British American Graphite Mining Co., of Buckingham, Que., this being the second ordered by this company It is known as the Raymond process, and will reduce all hard or fibrous materials to an almost impalpable powder. It is entirely dustless in operation, and has no friction contact of grinding parts It will make different grades of separation at the same time, if desired, or the entire product can be made impalpable simply by the adjustment of the air valves.



It will reduce the following articles: Phosphate rock, iron ores for mineral paints, lime stone, marble, iron slag, drugs of all kinds, coal, coke, plumbago, mica, talc, gypsum, fire clay and shale, slate, sawdust, paper, straw, hay, oat hulls, oil cake, cereals of all kinds, corn stalks, corn cobs, or corn in the ear, old leather, old rags, oyster shells and shells of all kinds, bone, borax, salt, sugar, cotton seed hulls, etc. The vacuum separator is not used when required to reduce straw, hay, corn stalks or similar materials. For this purpose it has a perforated steel screen surrounding the pulverizing chamber, through which the material is discharged when reduced fine enough.

ANOTHER PRINCELY GIFT FOR McGILL UNIVERSITY.

A. T. Taylor, architect, Montreal, under instructions from W. C. McDonald, is preparing the plans for another new building in connection with McGill University, to be devoted to Chemistry and Mining. The idea has been under consideration for several years, and was so far advanced a couple of years ago that plans were drawn—which, however, owing to the advance recently made in these branches of knowledge, have been laid aside and new ones drawn to meet the requirements of the day. Mr. McDonald, already a most generous benefactor of McGill, proposes to erect, equip and endow this new building with a fund sufficient for its support, such as the expenses connected with lighting, heating, insurance, caretaking, etc., and to make two endowments of $50,000 each, one for a chair in Mineralogy and Metallurgy, and another for Architecture. Mr. McDonald has also made an additional endowment of $150,000 for maintenance of the Engineering and Physics Buildings which he erected recently. This latest evidence of Mr. McDonald's generosity will amount to over half a million dollars, and put old McGill away and beyond all other universities in this Dominion so far as its applied science branches are concerned. Indeed, the benefactions already made by Mr. McDonald have placed it in such a position that some of the best authorities pronounce the applied science departments of McGill to be unsurpassed by any university in the world.

SCHOOL OF PRACTICAL SCIENCE.

At a recent meeting of the School of Practical Science Engineering Society, Prof. Galbraith, principal of the school, gave his annual address to the society. He began with a history of the school, with its origin in the School of Technology—vulgarly known as "Tech" (or "Tek")—which occupied the building now the Public Library, Toronto. Dr. Ellis was head of this institution, being at the same time engaged in his duties as public analyst. Prof. Galbraith recalled several interesting incidents of the days when he used "to go over to 'Tech' to have a smoke with Ellis."

The school took a fresh start in 1878, when an Act of the Ontario Legislature was passed establishing a School of Applied Science. The old "Tech" was sold and a new building put up, which is the northern wing of the present building. The faculty, when this building was opened, consisted of H. H. Croft, Professor of Chemist y; Chapman, Professor of Mineralogy; J. Loudon, Professor of Mathematics and Physics, Ramsay Wright, Professor of Geology, and Dr. Ellis, assistant in all departments, and soon afterwards J. G. Galbraith was appointed as Professor of Engineering. The staff formed the council of the school, which was practically a part of University College. This regime continued until 1889, when the school was established in its present position. The University professors still lectured to students of the school, but were no longer members of the council. The department of Architecture was introduced. It will be remembered that at this time the University of Toronto became a teaching body, taking up only such subjects as entailed laboratory work, leaving purely academic subjects to University College. The Act under which these changes were made provided for the attendance at lectures at the University of Toronto, and the use of laboratories by students of the School of Practical Science. It also established the degree of B.A.Sc., to be granted by the University on the completion of a four years' course at the school. Men who have taken this degree have exactly the same relation to the University as graduates in Arts. The former was a three years' course, for which a diploma was granted by the school, and this was still continued.

The three years' course gives the student a general education in the department in which he has entered, and the different departments overlap each other to a great extent, since all branches of technical education have much in common. In the fourth year the student specializes in the subjects led up to in the previous course. The work is largely practical, the idea being to have the practical work uninterrupted by lectures. With the same object in view, the few lectures are arranged at the beginning and end of the day's work.

Professor Galbraith considered this somewhat unique plan of course within course as on the whole advantageous.

Men who had obtained the degree of B.A.Sc. naturally wished to proceed to a higher degree. The University considered the matter, and several degrees, such as Master of Engineering or Dr. of Applied Science, were discussed, but in the end the degrees of C.E., M.E. (Mining Engineer) and E.E. (Electrical Engineer) were decided upon as being of greater value to the man obtaining them, since they designate his special qualifications. The degree of C.E., as formerly granted, had no connection with that of B.A.Sc. It has now been made, with the others mentioned, the superior degree, and is consequently of much greater value. Referring to finances, Prof. Galbraith said that the education of S.P.S. students cost $300 a head per annum, a much larger sum than that of students in arts.

The purse of the school is independent of that of the University, and is in the hands of the council.

ACETYLENE AND CALCIC CARBIDE.

Editor CANADIAN ENGINEER.

SIR,—I think it is my duty to warn the Canadian public, through THE CANADIAN ENGINEER, of the operations of those who are in the ring in the promotion of the calcium carbide "industry" in the United States. I am satisfied that all the money put into it outside of this ring will be lost to the public, and that they are working it "for all it is worth" to make their money out of it before the true character of the scheme is discovered. At present calcium carbide and acetylene gas are not honest commercial articles.

Yours truly,

CANADA FIRST.

[We can inform our correspondent that, fortunately for Canadians, no sub-company, like those which have been organized in the States with large capital, to operate under the calcium carbide patents, has been formed in Canada. The Canadian General Electric Company have been licensed to manufacture calcic carbide and acetylene gas in the Dominion, and under their license sub-companies could be formed. That company, however, have so far only manufactured the article experimentally, and sold it at prices which would not bring it into common commercial use. So far as we know they have wisely refrained from inducing any sub-company in Canada to build a plant for its commercial manufacture or use. Thos. L. Willson, the discoverer of this remarkable substance, is a native of Canada, as our readers have already been informed, and is entitled to all the credit this journal has given him in this connection. If in the experimental plants he has put up, he has not got at the actual cost of this product, we feel sure it is a matter of miscalculation, and not of misrepresentation. There is no need for Canadians to suffer any great loss by this invention except such as is incident to small experiments, for the actual commercial cost will soon be determined by the large works which are now being erected at Niagara Falls, N.Y., by the Philadelphia company who have taken this huge task in hand. If they fail to produce it cheap enough to compete with gas and electric light, their loss will be a heavy one. But even this should not finally settle the question, as acetylene is yet in its infancy.—Ed. C. E.]

METAL IMPORTS FROM GREAT BRITAIN.

The following are the values in sterling money of the shipments of metals, etc., from Great Britain to Canada, for February, and the two months ending February of this year and last:

	Month of Feb.		2 mos. ending Feb.	
	1895	1896.	1895.	1896.
Hardware and cutlery	£4,301	£4,322	£7,547	£10,094
Pig iron.....	209	1,260	209	3,033
Bar, etc.....	989	791	2,291	2,422
Railroad	....	852	.. ..	852
Hoops, sheets, etc.....	1,244	631	2,865	2,372
Galvanized sheets	1,377	2,942	2,872	4,021
Tin plates.....	5,357	11,860	15,946	22,969
Cast, wrought, etc., iron ..	1,482	2,601	3,478	5,924
Old (for re-manufacture)..	....	.. .	.. ..	.. ..
Steel	3,117	5,777	5,650	12,085
Lead	502	1,122	871	2,168
Tin, unwrought	904	936	3,760	2,087
Alkali.....	1,739	1,402	2,930	4,398
Cement	.. ..	128	30	430

DO NOT NEGLECT THIS!

"Canadian Engineer" subscribers are reminded to notify the publishers of any alteration in their address, made necessary by removals, etc. Please give the old as well as the new address.

PAPERS FOR THE TORONTO CONVENTION OF CIVIL ENGINEERS.

Editor CANADIAN ENGINEER:

SIR,—Will you permit me to use your valuable columns to call upon the members of the Canadian Society of Civil Engineers to exhibit a practical interest in the work of the society by keeping up the supply of papers. We have not been supplied as we should have been during the past few months, and in view of the summer convention to be held in Toronto in June, the Committee on Papers desire to announce there are no papers on hand, and they are most anxious to secure some.

Respectfully,

ALAN MACDOUGALL,
Chairman Committee on Papers.

Toronto, 25th March, 1896.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

An ordinary meeting of this society was held on March 12th, the president, Herbert Wallis, in the chair.

The following were elected into the society:—Associate members, Walter Jos. Francis, of Deer Park, Ont.; John W. Harris, of Winnipeg, Man. Students, William I. Bishop, of Montreal; Hamilton Lindsay, Kingston, Ont.

The following were transferred from the class of student to the class of associate member:—John Edward Schwitzer, of Ottawa; Alex. W. Spence, of Ottawa; Alfred J. Stevens, of Moncton, N.B.

At this meeting, the discussion on W. Bell Dawson's paper on "A New Method for the Design of Retaining Walls," was continued, and a paper on "The Effects of Engineering Works on Water Currents," by Cyrus Carroll M. Can. Soc. C. E., was read.

At the ordinary meeting of the society, held on the 26th of March, the President occupied the chair. The evening was taken up in the discussion of the resolution: "That engineering works shall be constructed by day's work, under the immediate direction of a civil engineer, instead of being done through a contractor."

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

LIBRARY FOR TORONTO NO. 1.

We are requested to publish the following circular issued by Toronto No. 1, and trust it may be the means of inducing many to contribute books: Toronto No. 1 of the above association is now entering upon its tenth year, and having procured a new and suitable hall, propose commemorating the event by starting a mechanical library, and fitting the meeting room up with models and drawings. Should you feel disposed to assist in any way this very laudable object, an intimation to any member of the committee to that effect will be thankfully received and promptly attended to. Thanking you in advance for any favor you may grant us, yours respectfully, John Fox, chairman of committee, 79 Edward street, Toronto; W. G. Blackgrove, sec.-treas., 22 Esther street, Toronto; G. C. Mooring, Thos. Eversfield, W. Lewis, A. M. Wickens.

Hamilton Branch, C.A.S.E., held their annual dinner on the 2nd inst.

Toronto Branch contemplate holding an excursion early this summer.

LITERARY NOTICES.

"Picturesque Cottages." The fourth edition of this work contains fifty new and original designs for surburban houses and summer homes, costing from $300 to $2,500. It gives prospectives, accurately drawn, of houses which will be pleasing and restful to the eye. A little cottage should be home-like and inviting looking, and these designs are certainly that. Floor plans are given with complete descriptions and estimates, the latter will, of course, vary somewhat according to location. Prices are given for plans with details and specifications. The publisher makes a specialty of getting up artistic designs for small houses at a moderate cost. E. E. Holman, architect, 1,020 Chestnut street, Philadelphia, Pa. Price by mail 50 cents.

"Astronomical and Physical Society of Toronto, Annual Report for 1895." This makes an instructive volume of 181 pages, with a fine drawing of Saturn and his rings as a frontispiece. Among the contributions is the paper on "Electrical Radiation," by Prof. Chant, which recently appeared in this journal.

"Transactions of the Association of Civil Engineers of Cornell University for 1895": Ithaca, N.Y. Among other valuable papers are: "Construction and Maintenance of Waterworks in Small Towns"; "Decimal System of Measurements"; Masonry Dams";

"The Sanitary District of Chicago"; "The City and the Engineer"; "Measuring the Flow of Water by the Pilot Tube"; "The Chicago Canal," with illustrations.

"The 80th Meridian"; a paper by Willis Chipman, C.E., Toronto. This gives a valuable table of average temperatures from points in Canada north of Toronto, reaching beyond the Arctic Circle—a table which appears to be the most complete yet compiled.

Vol. I., No. 1, of the *Journal of the Western Society of Engineers* (1737 Monadnock Block, Chicago), is creditable to the enterprise and public spirit of the civil engineers of the Western States. The first issue of this journal, which is published bimonthly in book form, makes a volume of 144 pages, plentifully illustrated with engravings and diagrams, and having a supplement containing four folding plates with profiles of the water routes from Chicago to the sea, by the St. Lawrence and the Champlain-Hudson Valley. This is the most comprehensive contribution yet made to the cartography of the lake levels, which is now so important both to the engineer and navigator in these regions.

It is generally believed that a man cannot live on air; but the first number of *Compressed Air*, a new monthly journal, wholly devoted to the subject indicated by its title, shows that editors can easily do the impossible. This interesting little paper is published by W. L. Saunders, 26 Cortlandt street, New York, and the March number shows the promoters have raised the wind very successfully among New York advertisers.

Industrial Notes.

A. DOBSON, Beaverton, Ont., will put in a new engine and boiler.

E. A. GOODWIN, St. John, N.B., contemplates putting in a cold storage plant.

SOME enterprising people in Arnprior, Ont., will build a large tannery, it is said.

HIRAM WALKER & SONS, Walkerville, Ont., are about to build a large hotel in Chatham, Ont.

THE council at Nanaimo, B.C., call for tenders for a bridge to connect that town with Newcastle.

THE Collins Inlet Lumber Co. is going to have a saw mill at Little Current, Manitoulin Island, this summer.

THE proposed iron bridge at Thamesford, Ont., will not be built—a wooden structure has been decided on for part of the distance, and filling in for the rest.

W. P. YORSTON, C.E., recently consulted with J. J. Taylor, engineer to the municipality, as to the erection of the reservoir to be built at Truro, N.S., this summer.

EXPERIMENTS are being made with the clay at Kamloops, B.C., to determine its value for brick and terra cotta manufacture. If successful, a plant will be installed.

SYLVESTER BROS.' factory, Lindsay, Ont., has been working overtime of late to keep up with the orders coming in for machinery from the North-west and elsewhere.

A WRIT has been issued by the Trinidad Asphalt Company, in Toronto, against Michael Connolly, contractor, of Montreal, claiming about $10,000 for stock and plant sold.

THE Ottawa council is willing to spend $5,000 to put in a steam plant to melt anchor ice at the waterworks pump house. About $12,000 will be spent in new water mains.

WATERVILLE, QUE., is to have a new furniture factory. The stock is nearly all taken, and a meeting is to be held at once to organize. They intend to buy machinery of the latest patterns.

THE Essex county council has declined the offer of the Walkers of $50,000, with free site, if the county buildings were removed to Walkerville. Instead of moving, $19,000 will be spent in repairing the old buildings.

THE Stratford, Ont., city council has decided to join with Perth county council in building a house of refuge. They will contribute 13 per cent. of the first cost. The Idington farm of 93 acres has been purchased as a site at $64 an acre.

AT a recent meeting of the council of Brockville, Ont., it was discovered that $10,000 which had been voted to the Canada Carriage Company had been illegally diverted. Three thousand dollars have already been paid twice over, and the remaining $7,000 will also have to be repaid.

ORILLIA is preparing a by-law for a $5,000 fire hall.

OX CHURCH, Woodstock, Ont., will cost $35,000.

WORK has been begun on the new cheese factory at Sydenham, Ont.

THE Canada Carriage Company, Brockville, Ont., has received orders from Australia for a car-load of vehicles.

W. H. LAWRENCE will build a tannery and shoe factory on the C.P.R. at Burt's Corners, Keswick, N.B., it is said.

SAMUEL ROGERS & Co., manufacturers of lubricating oils, are supplying the G.T.R. with cylinder and engine oils.

THE Galt bicycle factory will be in operation shortly, says the Galt, Ont., *Reformer*, under the management of H. Tolton.

THE Sissiboo Falls Pulp Company, N.S., are now making regular shipments of pulp from Port Gilbert to New England.

A COMPANY has been formed in Annapolis, N.S. to engage in the manufacture of hardwood barrels for apple and fish packing.

WATSON & FOSTER, Montreal, will build an addition, 325 x 106 feet, to their wall paper factory, and will have another warehouse.

THE company that undertook to build waterworks in Perth, Ont., say they will begin operations as soon as the snow is off the ground.

FEATHERSTONHAUGH & Co., patent barristers, solicitors and experts, Toronto, are opening a branch office in Montreal, with W. J. Withrow in charge.

D. L. COCKLEY, of the Shelby Steel Tube Company, Shelby, Ohio, U.S.A., says the firm would establish a branch in Hamilton if a bonus is forthcoming.

NOTICE is given that the Guelich Silica Barytic Stone Company of Ontario, Ltd., intends to change its name to The Silica Barytic Stone Company of Ontario, Ltd.

DAVIS & SONS have commenced building the piers for the new swing bridge across the Cornwall canal at Mille Roches, which is to connect the mainland with Sheik's Island.

THE Metallic Monument Co., Ltd., are applying for an Ontario charter; J. Bowden, R. Drury and J. W. Reid, provisional directors; capital, $45,000. Headquarters in Toronto.

THE city of Montreal has inscribed an appeal against the judgment condemning it to pay $3,487 to Adolphe Davis for wrongful dismissal from his position as waterworks superintendent.

AN Ontario charter is asked for by the Scribner Organ and Manufacturing Co., Ltd., of London, Ont.; capital, $50,000; provisional directors, F. G. Rumball, W. McIntosh and others.

IN addition to the Oneida chain works now being built at Niagara Falls Centre, the contract is let to build a frame addition to the building, 70 x 40 feet, to be used for plating purposes.

THE Moncton, N.B., *Times* calls attention to the large deposits of high grade coal recently discovered at Loch Lomond, Cape Breton. One estimate is that there is 222,000,000 tons in the basin.

THE Anglo-American Canning Co., Ltd., Vancouver, B.C., applies for a British Columbia charter; capital $30,000. Provisional directors—F. G. Bell, W. S. Westcott, J. S. Crowder and E. E. Penzer.

THE potters who are making sanitary ware in St. Johns, Que., the St. Johns Stone Chinaware Co., the Dominion Sanitary Co., Campbell & Purvis, and T. B. Dakin & Co., have established a uniform basis of prices.

VROOM BROS., St. Stephen, N.B., have decided to discontinue the manufacture of furniture and to devote their attention to retail. It is probable that N. E. Sederquest, foreman of the factory, will continue it on a smaller scale.

THE new Normal and Collegiate building in Hamilton, Ont., will cost about $115,000. George Webb, Hamilton, will have the masonry contract at $52,000, and the carpentering contract will probably also go to a local firm at about $25,000.

A JOINT STOCK company has been formed at Indian Head, N.W.T., to build a creamery. The provisional directors are Tindale, Braithwait, A. Dixon, Worden, Stewart, Luithwait, Quigley, Hannah, McKay, Wm. Dickson, Stephens, and Sherwood.

PREVENTION is better than cure, and proper plumbing, drainage and ventilation are better than disinfection. Where premises are so situated that the former cannot be secured then a good disinfectant is a necessity. Among the best and most economical yet on the Canadian market is Phenyle, a powder of the carbolic order, which has testimonials in its favor from the highest authorities. The manufacturer for the Dominion is A. W. Spooner, Port Hope, who reports a rapidly increasing sale for this article.

NEWCASTLE, ONT., wishes to buy a fire engine.

GEO. S. TICKELL & SON have started a casket factory in Belleville, Ont

A NEW creamery is being built at Avonmore, Ont., by McCullough & Croyle.

WM. SMITH & BROS. will build a butter factory at Chantry, near Harlem, Ont.

J. T. ROWE, Aylmer, Ont., is about to enlarge his organ factory and add pianos to his output.

HINTONBURGH, a suburb of Ottawa, is to be the site of a new planing mill; N. Bevan, proprietor.

JOSEPH BOURQUE, of Hull, Que., has signed the contract for building the reformatory at Alexandria, Ont.

A T. BALL contemplates starting a butter factory at Otterville Ont., in the spring.—*Port Dover Maple Leaf.*

THE Armstrong Flour Mill Association, Vernon, B.C., has decided to build an elevator of a capacity of 20,000 bushels.

THE Chaudiere lumbermen are clubbing together to build a $40,000 dam above the Chaudiere to improve the water supply.

THE new boilers have been set in position in Hilyard Brothers' mill, St. John, N.B. The masons are now working on the new patent furnace, which is near completion. The mill will then be ready for operations.

GILMOUR, HUGHSON & Co, Ottawa and Trenton, Ont., will, it is said, build a saw mill on the O., A. & P. S. Railway, west of Whitney, Ont, to cut thirty million feet a season.

LETTERS patent have been issued incorporating A. Zimmerman, P. D. Crerar, M. A. Hunting, Hon. J. M. Gibson, F. J. Muir, A. Campbell, Hamilton, as the Doherty Process Company of Hamilton (Ltd.) with a capital of $120,000, to do a smelting and iron founding business.

THE new foundry of G. Gale & Co., in Waterville, Que., is nearing completion, and is to be equipped with machinery from Great Britain. The principal part of the work in this foundry will be the manufacture of iron bedsteads, which have hitherto been imported from England.

THE town of Richmond, Que., has won its suit against the local waterworks company, who may now be called on to take up its plant within 90 days. It is probable a settlement will be arrived at, if the company will agree to put the works in proper condition for fire and domestic purposes.

A MANITOBA firm are turning out machines for extinguishing prairie fires, by burning a strip bare ahead of the fire. The machines now in use will burn a strip eight feet wide, 30 miles long, in a day, at a cost of 50 cents per mile. Battleford, N.W.T., will purchase eight of these machines.

THE Parmenter & Bulloch Company, Gananoque, Ont., are applying for incorporation as brass founders, wire and nail makers, and metal workers generally. W. Bulloch, W. V. Bulloch and Wilfrid Bulloch are to be the first directors. The capital is $100,000.

THE directors of the E. B. Eddy Co., of Hull, Que., elected at the annual meeting, are: E. B. Eddy, president and managing director; S. S. Cushman, vice-president; George H. Millen, general mechanical superintendent; J. J. Gormully, Q.C., solicitor; W. H Rowley, secretary-treasurer. J. T. Shirreff, assistant secretary-treasurer.

THE terms upon which Strathroy, Ont., may secure a furniture factory are that the town give $10,000 as soon as the building is completed and in working order; the company to put up a building and plant worth $25,000, pay out in wages $300 per week; pay taxes on an assessment of $5,000; and protect the town by insurance for twenty years.

THE plans submitted by Gordon & Taylor, of Montreal, for the new Jeffrey Hale Hospital in Quebec have been accepted by the governors upon the decision of Mr. Fuller, chief architect of the Public Works Department, Ottawa. They provide for a structure on the pavilion system. The cost will be about $40,000, and ground will be broken in the spring.

THE dyking operations long anticipated are now proceeding on a large scale in the Fraser River valley, B C Assisted by the Government guarantee of interest, valley farmers are still anticipating joint aid from the federal and local governments in thoroughly surveying the Fraser with a view of improving the river channel, and preventing floods by dredging About 68,000 acres will be dyked.

BAKER BROS., Casselman, Ont., are starting a brick works.

THE furniture factory at Goderich is now in course of erection.

THE Roman Catholics of Merritton, Ont., will build a new church this summer.

THE Coleman Fare Box Company is preparing to do a manufacturing business in Tottenham, Ont.

A NEW boiler is being put into Wm Allan's saw-mill, Perth, Ont., by Goldie & McCulloch, Galt, Ont.

G. W. WILKINSON and E. Massey (the Granby Iron Works, Granby, Que.) have dissolved partnership.

THE Maritime Nail Company will build a new wharf on their property in St. John, N.B. Tenders are called for.

THE new wood-working factory at Hartland, N.B., is almost ready for the machinery. W. R. Richardson is proprietor.

ARRANGEMENTS have been completed whereby Duncan Weir, of Thedford, Ont., will build a flax mill at Forest, Ont., this summer.

THE machinery in what is known as McCuan's mill, situated at the confluence of the Waba and Madawaska rivers, has been removed to Ottawa.

THE Thorold *Post* reports that Jones' bicycle factory is growing. John Bertram & Sons, Dundas, recently put in a lathe of the most improved style

THE Hudson's Bay Company has subscribed $5,000 towards the new traffic bridge about to be constructed across the Saskatchewan river at Edmonton.

OTTAWA, ONT., will have a paper box factory. Thoburn & Co., Elgin st., have leased a large building and are fitting it up with the most improved machinery.

IT is said that Stehlin Bros. will build a tramway from New France, Digby Co., N.S., twelves miles to Gates' Mills, to haul lumber to the Sissibou River.

THE city council of Sherbrooke, Que., have requested G. K. Addie, P.L.S., to survey a route for the water supply from Key Pond to the present reservoir.

THE proprietors of the asbestos mine at Asbestos, Que., are building an iron foundry, to be run chiefly for their own work. The works have been running night and day for some time.

THERE appears to be every prospect of a paper and two pulp mills being built at the mouth of the River Rouge on the Ottawa River, Que., this summer. No names are yet mentioned.

THE problem of sewage disposal is now pressing on the people of Hamilton. The pollution of the air and water at the outlets of the main sewers in Hamilton and Toronto is becoming a serious question for both cities.

RHODES, CURRY & Co., Ltd., Amherst, N.S., are now turning out freight and passenger cars for the Quebec Central, I.C.R., General Mining Association, Sydney Mines, Halifax Electric Company and the Coal Railway Company.

A NEW tannery will be built at Boca de Quadra, about twenty miles from Mary Island, Alaska. The principal party interested is M. B. Magneson, a San Francisco capitalist, but a number of Victorians will also have shares in the company.

THERE will be a Baptist church built at Mactnaquac, N.B., this summer—$2,000; and a Methodist church at Moose Jaw, N.W.T.—brick The rebuilding of the college of the Freres de Ste. Marie de la Beauce, Que., is under discussion.

THE Master Plumbers' and Steam Fitters' Association, of Toronto, had their annual dinner on the 26th ult. W. J. Burroughes, president, occupied the chair, and J. B. Fitzsimmons, vice-president, the vice-chair. About seventy guests sat down to dinner. W. F. Maclean, M.P., was present and replied to the toast of the "Queen."

A. E. JUKES, St. Catharines, Ont., claims to have invented a bottle which cannot be refilled, thus making it certain that the contents are the original contents as indicated by the label. A prize of $100,000 has been offered for the invention of such a bottle (which would be cheap enough to be available) by the Distillers' Association of the United States.

PORT ARTHUR has voted to let a contract to the Port Arthur Light and Power Company for putting in waterworks, a new electric lighting plant, building a pulp mill, and furnishing power for the electric street railway for twenty years. The scheme includes the development of the Current River and McVicar Creek waterpowers, and will provide about 3,000 horse-power, available for all sorts of industries.

CORNWALL, ONT., is to have a new hospital.

THE Montreal Lighterage Company, with a capital stock of $50,000, has been incorporated.

THE Goold Bicycle Co., Brantford, recently sold a car load of bicycles for export to South Africa.

THE Small and Fisher Company, Woodstock, N.B., has made three shipments of shingle machinery to British Columbia recently.

BOWMANVILLE, ONT., is negotiating for a Rubber Manufacturing Co., which will employ 50 hands. A bonus of $8,000 and exemption from taxes for 15 years is asked.

THE contract for the construction of six iron bridges over the Raleigh Plains drain has been awarded to the Hamilton Bridge Company at $6,590. The spans run from 50 to 65 feet.

ROBT. ROTHWELL, the employee of the Bertram Engine Works, Toronto, who was knocked on the head by the crank of a crane while raising a heavy tank, has since died of his injuries.

THE firm of Wilson & Baines, machinists and founders, Victoria, no longer exists, Wilson having left for Alaska, and Baines now being employed by the mortgagees, who have taken the business.

THE London Street Railway Company have let the contract for a bridge across the river at Wellington street, to the Central Bridge Company, of Peterboro', the work to be finished this spring.

MERRITTON, Ont., believes itself on the road to a boom, as all the idle water powers have been bought up recently. Geo. Wilson, of St Catharines, has bought the Phelps saw mill for $3,200 and will convert it into a box factory. The Disher & Haight power and the vacant powers at Locks 9 and 10 have been bought and paid for by some United States capitalists who will, it is said, produce calcium carbide.

THE McClary Mfg. Co. of London, Ont., have gone into the manufacture of enameled steel ware, enameled white ware, and enameled iron signs. The latter named have been in extensive use in Great Britain and in Europe for advertising purposes, and are destined for general adoption in Canada. Hitherto these signs have had to be imported, but the McClary Mfg. Co. are now making them, and have turned out some excellent samples of both plain and ornamental signs.

PETROLEA is to see one of the busiest summers ever known in her history this summer Three new churches, at an average cost of $10,000 each, will be erected; the waterworks at a cost of $172,000; a large brick hotel at a cost of $20,000; also a number of private residences will be built. The new railroad, tapping the C.P.R., is considered to be a sure thing, and it is also said that an English syndicate will bond oil property there to the extent of about $12,000,000.

IN December, 1893, William Wilson, engineer of the Montreal Rolling Mills Co., was found dead—or rather the scattered parts of his mutilated body were collected about the engine-room—he having been caught in the fly-wheel. Action was brought for $10,000 by Mrs. Wilson, and judgment in her favor was given for $3,000 on the ground that the belt and fly-wheel were not properly protected. The company appealed against the judgment, but the Court of Appeal has now maintained the widow's action.

THE Lachine Rapids will soon be doing work for Montreal besides carrying steamers down stream, says the *Witness*. The Lachine Rapids Hydraulic and Land Company's work has been pushed on with vigor. They have ascertained how to maintain twelve feet head of water during the winter months in the rapids, which will yield 20,000 horse power. Some 200 or 300 men have been kept at work all winter, and this force will be greatly increased in May. Arrangements have been made with the contractors whereby power will certainly be delivered in Montreal not later than next November. The contract for water wheels was let to a Dayton, Ohio, firm. The electrical machinery contract will be awarded in a few days.

THE water works pumping engine for Toronto Island, for which the Northey Manufacturing Company have the contract, is of one million gallons capacity, and is of the duplex compound condensing type. They also supply a boiler of 60 h.p., and feed pump and heater, and the whole work, when completed, will be model in every way. This company are busy on large pumping engines, one of which is for the T. Eaton Co., of Toronto, and has a capacity of 2,000 gallons per minute. A fire test was made recently at the cotton mills in Cornwall of one of their underwriter pumps, having a capacity of 1,000 gallons per minute. The test was conducted by the inspector of the Associated Factory Mutual Insurance Co., who made a very flattering report on this pump.

THE Northey Manufacturing Co. have shipped to the Dominion Coal Co. two large compound mine pumps having a capacity of 800 and 500 gallons each per minute, discharging against a vertical head of 600 feet.

THE Engineering Society of the School of Practical Science, Toronto, held their annual elections on the 27th March with the following results: President, Frank King; Vice-president, H. S. Carpenter; corresponding secretary, H. L. Vercoe; recording secretary, H. R. Stovel; treasurer, A. G. Piper; librarian, W. A. Hicks; fourth year representative, J. A. DeCew; third year representative, M. B. Weekes; second year representative, J. Shaw; 'Varsity Editorial Board, C. W. MacBeth, J. A. Bow, and J. F. Little; 'Varsity Business Board, L. Burwash and E. Richards.

A BOILER in the mill of H. B. Palmerton, near Elmwood, exploded on the 18th March, instantly killing a young man named Lewis Cole. About 11 o'clock the engineer notified Mr. Palmerton, proprietor of the mill, that the governor balls were not running smoothly. While Mr. Palmerton and the engineer were trying to fix the governor the boiler exploded. Lewis Cole, who was standing in front of the boiler, was hurled twenty feet, and jammed feet foremost between two logs. His head was badly cut, and he must have been killed instantly. Cole was unmarried, and was not a regular employee. He was taking the place of a log-turner, who was off for the day. Michael Absden, a married man, had his head severely cut, and he was scalded badly. Norman Weaver, also married, had his ankle twisted, a leg bone broken and head cut. Mr. Palmerton escaped with a slight abrasion of the nose. There were seven men in all near the boiler, but the others escaped. There was 100 pounds of steam on and the boiler was full of water. A piece of the boiler head was blown out, but the rest was found intact 300 feet from the mill. It was driven backward against a pile of logs, the logs in turn being driven back twice their length. The boiler then bounded 100 feet further, landing on another pile of logs, splitting them into rails. It turned again, lighting over the fence on to the far side of the road, where it landed on some more logs

Railway and Marine News.

CAPT. J. MCNABB will again command the Beatty Line steamer "United Empire."

THE work of repairing the steamer "Lansdowne" has been given to G. H. Waring, St. John.

THE Kingston, Smith's Falls and Ottawa Ry. Co. applies for an extension of time in which to build.

THE steam barge "Dominion" was sold the other day at Owen Sound to Alex. Fraser, of Toronto, for $1,200.

THE new swing bridge across the Hamilton Beach Canal is to be finished in time for the opening of navigation.

THE steamer "J. G. Nichols," lying at Kingston, has had her main deck raised a foot. Her captain is Gus. Hinckley.

THE Dominion Atlantic Railway of N.S. may soon establish a steamship service of their own between Yarmouth and Boston.

A NEW private car, 50 feet long, is being built at the C.A.R. workshops, Ottawa, for J. R. Booth, of the O.A. & P.S. Railway.

THE officers of the steamer "Telegram" are: James Ganley, captain; Jas. Payne, chief engineer; Thos. McMurray, assistant engineer.

THE Dominion Parliament has decided not to give any further aid to the Chignecto Ship Railway. The scheme seems to be completely discredited.

THE proposal has been made to build a dry dock and marine railway at Sandwich, Ont., and the Federal Government will be asked to make a large contribution.

HUGH SULLIVAN, engineer last year on the tugs "Minnehaha" and "Geraldine," is assistant engineer of the steamer "City of Toronto," and is fitting up the steamer for the coming season at Collingwood.

CAPT. CLARK, in company with McCormick and McCloud, have purchased the well-known steamer "Maganetawan." They intend using the steamer in her present condition this summer, but next winter will build a new hull for her.

AN influential deputation from Almonte, Ont., waited on the Ontario Government last month to urge the claims of the Carp, Almonte and Lanark Railway. The first link of the proposed line is only ten miles long and would be sure of a heavy traffic.

THE Toronto Island steamer "Clark Bros." is being rebuilt.

THE Dominion Government have not favorably entertained the project to build a canal from Montreal to St. John's.

THE Dominion Government will not send an expedition to Hudson Bay this year to determine to what extent the waters are navigable.

IT is reported that the Baie des Chaleurs Railway Company has offered to sell the road to the Government to make a feeder to the Intercolonial.

THE city engineer of Hamilton, Ont., has notified the G.T.R. that a bridge must be built the full width of Barton street over the Northern track.

AFTER being stuck in the ice five weeks, the car-ferry boat "Shenango No. 1" has been relieved by her sister steamer and towed to Conneaut.

TWO new steamboats are being built at Phillips' shipyard, Selkirk, one for Messrs. Short and the other for the Reed Fish Company.—*Winnipeg Free Press.*

THE new steamer "Grand Duchess" is to ply between Halifax and Boston this spring. She has accommodation for 300 first class and 400 second class passengers.

THERE is a movement on foot at Fort Saskatchewan, N.W.T., to form a municipality, and offer a cash bonus for an extension of the Calgary and Edmonton Railway to that point.

CAPT. SCOTT will command the steamer "Persia" this season; Capt. Towers, the "Ocean," and Capt. Chestnut, the "Cuba" Alex. Ramsay will be engineer of the "Ocean."

THE Ontario Legislature has granted the Grand Valley Railway Co. power to change its proposed course from Brantford to Galt, and thence to Copetown on the T., H. and B.

THE people of Manitoulin Island are promised immediate railway connection by Peter Ryan, in a letter to the electors, if they assist in securing a charter for the new company.

CAPT. COONEY will command the steamer "Garden City," which has been sold to the Crystal Beach Steamboat Company of Buffalo (of which John A Miller is president) for $60,000

THE Montreal and Ottawa Railway bill provides that the company may complete the road in four years, and it must build as far as the village of Alfred inside twelve months, and spend $100,000 in that time.

IT is reported that an agreement has been signed by which the G T R will allow the C P R. running privileges over the road from Toronto to Hamilton, thus saving the construction of a new line to give the C.P.R its connection with the T., H. & B

THE officers of the Great Northern Transit Co., Collingwood, Ont , this season are Steamers—"Majestic," Capt. P. M. Campbell, Engineer W. Lewis , "Pacific," Capt. R. D. Foote, Engineer J B. Aston; "Atlantic," Capt James Wilson, Engineer J. Aston , "Northern Belle," Capt. C. Jacques, Engineer S. Wilson.

CAPT A. CLARK and Geo. McCormick, Sydney, C.B., have purchased from the Emery Lumber Co., Windsor, N.S., the steam tug "Evelene," which measures 80 feet in length, is 17 feet wide and draws 12 feet of water. She was built for the French River Boom Company about two years ago. The price paid was $10,000.

ENGINEER STEPHENS is taking the engines out of the old "Kootenai." They are to be used in the new boat, the boiler for which is expected down by next boat, from Arrowhead. Work on the new steamer under construction for the C. & K. S. N Co., is being pushed along rapidly by Mr. Bulger and his staff of men. She will be 170 feet long, 33 feet beam, and is intended for freight more than passenger traffic.—*Nakusp Ledge.*

THE *Whig* states that the Kingston and Montreal forwarding company will form a new line of lake barges to ply on the upper lakes, and will fit out the barges "Thrush," "Lapwing" and "Hiawatha" for the line, which will be commanded by Capts. Simmons, Patterson and Smith. The tug "Relief" will be brought from Quebec and will be used to tow the barges during the early half of the season. During the latter part an iron steamer will take the place of the "Relief," and will, it is expected, arrive in July.

THE fleet of the Playfair Barge and Tug Line will make Midland their headquarters during the ensuing season. The officers of the company's barges are: "St. Andrew," W. H. Featherstonehaugh, captain; John McRae, engineer. "C W Chamberlain," Jas. Foote, captain. "Metamora," R. H Gilbertson, captain; A. E. House, engineer. "Shawanaga," Jas Tindall, captain; J Norton, engineer. The company is establishing a wrecking outfit, which will be stationed at Midland.—*Collingwood Bulletin.*

THE Albert Southern Railway was sold by auction in St. John, recently, to Judge Wells, for $600, subject to certain liens and mortgages.

WORK on the Newfoundland Railway is to be resumed this spring, and it is expected that 100 miles to Bay St. George will be finished this year.

THE barge which has for some years been known as the "City of Owen Sound," will hereafter bear the name of "Saturn."—*Collingwood Bulletin.*

BOARDS OF TRADE in different towns of British Columbia are urging on the legislature a grant of $2,500 a year to a company to navigate the Upper Yukon.

THE Woodstock and Centreville Railway, N.B., which is going to push construction this summer, is bonding the road to a New York loan company for $510,000.

THE Montreal, Portland and Boston Railway, which has been in the hands of a receiver for some time, was sold recently to J. N. Greenshields, Montreal, who represented the bondholders, for $1,625.

THE C. P. R. has adopted a new system of discipline. Each man enters the company's employ with a clean sheet, and bad marks are entered for misconduct. When 60 marks are entered the man is discharged.

THE *Collingwood Bulletin* reports the following officers on the D.G.S. line: "Petrel," E. Dunn, captain; A. J. Brown, chief engineer; W. H. Linter, second engineer. "D.G.S. Dolphin," G. W. Pearson, captain; Mr. Cornish, engineer.

THE St. Lawrence & Chicago Steam Navigation Company, Ltd., John H. G. Hagarty, manager, Toronto, Ont., will have the following officers this year: Steamers—"Algonquin," Capt. James McMaugh, Engineer James H. Ellis; "Rosedale," Capt. James Ewart, Engineer Richard Childs.

THE annual report of the Minister of Railways and Canals shows there are 15,977 miles of railways in operation, an increase of 350 They earned $45,785,000 and the working expenses $32,749,000, leaving net earnings of $14,035,000. There were 13,987,000 passengers carried, of whom nine were killed. Of freight 21,524,000 tons were carried.

AN engineering party of fourteen that has been at work for the Canadian Pacific between the Columbia River and Rossland have been ordered to make preliminary surveys for a road from the Nakusp and Slocan at Rosebery, south along the east shore of the lake to Slocan Crossing on the Colombia and Kootenay.

THE appointment of General Manager Hays, of the G.T.R., and Mr. Smith, of the Vermont Central, as receivers of the latter road, is a distinct triumph for Mr. Hays, as the magnates of the New York Central system had intended to take possession of the V.C. The V C. management will be merged in the G.T.R. at Montreal.

THE following officers have been appointed for the season of 1896 on the Can. Pacific S.S. line: "Manitoba," E B Anderson, captain; R Kenny, chief engineer; R. Chalmers, second engineer. "Athabasca," G. McDougall, captain; Wm. Lockerbie, chief engineer; J. Davey, second engineer. "Alberta," J. McAllister, captain; A. J Cameron, chief engineer; J. Donaldson, second engineer.

THE officers of the Niagara Navigation Company for this season are as follows: "Chippewa," Capt John McGiffin, 1st engineer, Robt. McCaul. "Chicora," Captain James Harbottle; 1st engineer, Harry Parker "Ongiara," Capt. H. McIntyre. Capt. W. H. Solmes is commander, and W Walsh first engineer of the new boat now building to take the place of the "Cibola." Her name has not yet been decided on, but it is expected she will be ready for the lake early in July This company will commence to run its boats about the middle of May.

THE Huron and Ontario Ry Co. has received a charter to run from (*a*) Port Perry to Kincardine, touching at Mount Albert, New Market, Bradford, Beeton, Shelburne, Priceville, Durham and Walkerton; (*b*) from Priceville, through Meaford, Owen Sound, Southampton, Port Elgin and Tiverton to Kincardine; (*c*) from Walkerton, through Mildmay, Teeswater and Lucknow to Goderich, with a connection between Lucknow and Kinloss. The bill said "at or near" these places, but this term was taken out. The bonding power was limited to $10,000 per mile for single and $16,000 a mile for double track. The proposed incorporators are: A. M. Cameron, Meaford, J. W. Curts, Port Perry; A. E. Scanlon, Bradford, H J. Robton, Shelburne, Wm. Laidlaw, Durham; H. H. Miller, Hanover; M. McNamara, Walkerton, and others.

T. SIMMONS has been appointed chief engineer on the steamer "James Swift" for the coming season.

THE new barge to consort with the new steamer "Rosamond" will soon be finished at Kingston.

CAPT. J. DIX will sail the steamer "Valena" this season. She will ply between Gananoque and Clayton.

CAPT. JAMES B. SYMES will be master, and Samuel Gillespie engineer, of the steamer "Seguin," this season.

DIRECTORS of the Hamilton and Barton Incline Railway Company have decided to increase the capital stock from $40,000 to $61,500.

THE officers of the Mathews' Line, Toronto, are: Steamers—"Niagara," Capt. James Morgan, Engineer James Tetro; "Clinton," Capt. W. R. Maitland, Engineer Thos. J. Rolfe.

THE following are the officers of the steamers of the North-West Transportation Co., Sarnia, Ont.: Steamers—"Monarch," Capt. E. Robertson, Engineer E. W. McKean; "United Empire," Capt. Jno. McNab, Engineer S. Brisbane.

AT Kingston the steamers "Hero," "Islander," and "Naiad," are being overhauled for the opening of navigation, and the fleets of the Kingston and Montreal Forwarding Co. and the Montreal Transportation Co. are being prepared for the season's work.

SOME time ago we mentioned that the United States battle ship "Texas" had been damaged by an attempted dry-docking. The injuries have proved quite serious, and $150,000 will be needed to put it right. Query: If it takes $150,000 to repair a United States battle ship after being dry-docked, what would it cost to refit one after a scuffle?

THE following is a list of the officers of the Ottawa River Navigation Co.: Steamer "Sovereign," H. W. Shepherd, captain; T. F. Marchand, engineer. Steamer "Empress," Alex. Bowie, captain; George Menish, engineer. Steamer "Duchess of York," John McGowan, jr., captain; Alphonse Fredette, engineer. Steamer "Princess," Peter McGowan, captain, A. Menish, engineer. Steamer "Maude," E. Gauthier, captain; N. Fugere, engineer. Carillon and Grenville Railway, R W. Shepherd, manager, John McGowan, superintendent, John Halsey, engineer.

RANDOLPH CLARK, assistant engineer of the G.T.R. at Stratford, has been dismissed. Mr. Clark entered the service of the Grand Trunk in Montreal in 1861, when he was about seventeen years of age, and rose steadily, occupying various positions of importance. Three years ago the territory under his charge was enlarged to take in all the G.T.R. west from Port Hope, including north to Midland. The only other officer on the Grand Trunk holding a position similar to Mr. Clark's, is Mr. Hollinshead of Montreal, whose territory extends from Port Hope to Portland.

THE engineer of St. John, N.B., recently submitted a plan for extensive harbor improvements there. It included the extension of Sand Point slip wharf up to Union street, a wharf along Union street to north Rodney wharf, a wharf to replace south Rodney wharf, and one at right angles to the latter down to the harbor front. The cost would be about $1,725,000; if it is found necessary for the city to provide further facilities at once, a short extension will be made, which would cost $60,000. The whole plan admits of the making of a wet basin with lock gates. The entire plan will not be carried out at present.

THE new steel steamer that is being built on the Tyne for the Montreal Transportation Company is to be called the "Rosemont." She will have a length of 245 feet between perpendiculars, 253 feet over all, 41 feet beam, and 24¼ feet moulded depth. Her engine is to be triple expansion and surface-condensing, with cylinders 21½, 34 and 57 inches diameter and 39 inches stroke. Two Scotch type boilers 13¾ feet in diameter and 9¾ feet long will furnish steam. The carrying capacity of the "Rosemont" is placed at 72,000 bushels of wheat on 14 feet draft. She is to have three spars and a partial outfit of canvas.

THE appointments to the steamers of the Richelieu & Ontario Navigation Company are not yet complete, but will appear in next issue The various boats are now being got ready for the season. The "Corsican," lying at Kingston, is having new paddle wheels put in, and part of her bulwarks are being renewed. The "Spartan" is having her dining saloon remodeled, and the shaft of the "Hamilton" is being lowered seven inches to enable her screw to get a better hold in the water. The "Berthier" is having new boilers, and her bottom has been renewed, and the Montreal ferry steamers "Longueuil," "Hochelaga," and "Laprairie" have been overhauled. The "Bohemian" is being overhauled and modernized. Capt. L. H Roy, one of the old commanders in this fleet, died last month from grippe at the age of 70. He was for 15 years in command of the "Montreal," and was widely known and esteemed.

THE suit of McKay Bros., of Hamilton, against the Dominion Government, to recover damages for the sinking of the steamer "Acadia" in the Morrisburg canal, last summer, has begun in Montreal. If the plaintiffs win the case, other suits will be brought.

THERE is every possibility of the Rideau Canal from Kingston Mills to its confluence with the St. Lawrence being dredged early in the summer. This is badly needed, and will aid navigation very materially. At present, there are about 90 men working at Newboro' cut.—*Whig.*

IN support of the Squire bill, to which reference was made in last issue of THE CANADIAN ENGINEER, which will exclude Canadian engineers from United States vessels, a curious petition has been forwarded to Congress from Cleveland, O., that sets out the dangers to the great Republic which arise from trusting steam boilers to the care of subjects of an alien and possibly hostile power.

THE Case Perfected Outward Thrust Propeller Wheel is meeting with pronounced success, and there now seems to be no question as to its merits. Hitherto, Mr. Case has given his attention wholly to fast yachts but is now having calls for wheels suitable for larger boats. The Bertram Engine Co., Toronto, manufacture these wheels for the Canadian trade, and already have a number of orders in hand for the coming season.

THE G.T.R. is remodelling and bringing up to date the whole of its sleeping car stock, and ten or eleven new Pullman cars will be put on the through lines, making a very decided improvement in the whole of the Grand Trunk sleeping and parlor car service. The cars will all be lighted with gas under the Pintsch patents, will be provided with hot and cold water service under air pressure, with combination vertical plane couplers, train whistle signal, and will be arranged for being warmed by steam from the locomotive.

THE vessels of the Collins' Bay Rafting and Forwarding Company will all be engaged in the timber business until end of August, principally from Lake Superior and Georgian Bay ports to Collins' Bay, from whence they raft the timber and forward to Quebec. After August they will be in the grain trade from Fort William and Duluth to Kingston and Georgian Bay ports The masters and engineers Collins' Bay Rafting and Forwarding Company are: "Orion," captain, Alexander Milligat, engineer, John Huff. "Saturn," captain, Alexander Anderson; engineer, Wm. Kennedy; "Petrel," captain, John Houston; engineer, —— Barlow. "Rival," captain, J A McDonald: engineer, A McBride, barge "Muskoka," captain, Patrick Gallagher; barge "Waubaushene," captain, Henry Milligan; schooner "S. Neelon," captain, Charles Beaupre.

THE shareholders of the Brockville and New York Bridge Company, which holds the charter from the Dominion Government for the bridge across the St. Lawrence at Brockville, met on the 23rd ult., when the agreement for amalgamation with the St. Lawrence Railway Company of New York, which holds the American charter, was ratified. The capital stock of the two companies is $2,600,000 in all, of which $214,000 has been subscribed, and $21,400 paid up. Chas. McDonald, Joseph S. Decker, Wayne Griswald, and Clarke R. Greggs, of New York, and Chas. J. Pusey, Wilmot P. Cole, Daniel W. Downey, G. A. Weatherhold, and L. B. Howland, of Brockville, constitute the first Board of Directors of the new company. Several abutments for the bridge were built last season on the Sister islands midway between Brockville and Morristown, N. Y. The amalgamated companies intend pushing the construction of the bridge during the approaching summer.

THE following are the officers of the Deseronto Navigation Co. for the ensuing season.—Steamer "Resolute," Deseronto to Oswego, tri-weekly, John Gowan, captain, Louis Ostrander, mate: John Harrison, 1st engineer; John Toppin, 2nd engineer; J. Gowan, purser. Steamer "Reliance," from Deseronto to Oswego, tri-weekly; James Dougherty, captain: Albert Barnhart, mate; George Boyd, 1st engineer; James Noble, 2nd engineer, J. Dougherty, purser. Steamer "Ella Ross," between Picton and Trenton, daily, D. B. Christie, captain, T. Farrington, mate; John McFaul, 1st engineer; Thomas Toppins, 2nd engineer; George Butler, purser. Steamer "Deseronto," between Napanee, Picton and Deseronto, daily; William Skillen, captain, Gilbert Arthurs, mate; John Rice, 1st engineer, John Hart, 2nd engineer; W. Skillen, purser. Steamer "Armenia" (charter boat); Samuel Anderson, captain, Ben. Bowen, mate, Thos. Toppins, 1st engineer; Chas. Rayburn, 2nd engineer; S. Anderson, purser. Steamer "Rescue" (charter boat); John Rowe, captain; Dan. McVicker, mate; Michael McFaul, 1st engineer; Martin Maloney, 2nd engineer. Steamer "Nile," from Deseronto to Ottawa (freight); W. J. Daly, captain; Jas. Smith, mate; James Quigley, 1st engineer.

A BARQUE and two schooners are being built at Port Greville N.S., and are to be launched in June.

IT is said that James Corry, of Ottawa, is the successful tenderer for the Peterboro'-Lakefield section of the Trent canal.

THE engineering questions between the G T.R. and the City of Toronto respecting the Queen street subway have been settled, and the only question remaining to be settled before a start is made at the work is that of damages to owners of adjacent property.

GEORGE PHILLIPS, shipbuilder, of Rat Portage, has been appointed inspector of steamships and hulls for Manitoba, Northwest Territories and Keewatin, *vice* Robertson, who has been dismissed. The inspection of steamships has been very lax in the districts named, hence the change.

REGARDING the scheme for a railway over the Detroit river, the railway men now offer a compromise in the way of one pier in the centre of the channel and 1,100-foot spans, but the vesselmen object to any artificial obstruction being placed in the river while the Government is spending millions of dollars to remove artificial obstructions. They say there is more commerce on Detroit river than on any other stream in the world, and that it is increasing rapidly They argue, too, that a tunnel will answer the purpose of the railway companies just as well as a bridge, and they have produced a firm of contractors who offer to build a two-track tunnel, 3,400 feet long, for $3,500,000, and give a bond for $1,000,000 to keep the same in order without expense to the railway companies for a period of three years, while the cost of a bridge is estimated from $5,000,000 to $8,000,000. The vesselmen cannot understand why the railroads insist upon spending so much money to obstruct navigation, when they can accomplish the same purpose for half the expense without affecting any other interests.

Electric Flashes.

THE Hon. P. Mitchell got $1,000 damages in his suit against the Montreal Street Railway Co.

R. R. CASEMENT, Madoc, Ont., has put in a new engine and boiler for his electric light plant.

A COMPANY has been formed at Brantford to manufacture the Callender automatic telephone.

THE *Beeton World* promises success to the proposed incandescent light installation in Beeton, Ont.

HEWSON BROS., Durham, Ont., are making arrangements for installing an incandescent plant to supply the town.

THE village of Westport, Ont., will apply for incorporation, a system of electric lighting being in contemplation, as well as other improvements.

THE St. Catharines Street Railway Company is making a number of improvements, new rails and new overhead cables and brackets are being put on.

THE J. G. Brill Co., electric car builders, of Philadelphia, talk of having a branch in Canada, and E. A. C. Pew is trying to induce the Hamilton city council to give them the Wanzer factory and a bonus.

HOOPER & STARR, contractors for the Cornwall Street Railway, have ordered a 250 horse power cross compound Robb-Armstrong engine, and two 125-horse power Monarch Economic Boilers from the Robb Engineering Co.

A MEETING of the directors of the Brockville Electric Street Railway Company took place the other day, when the agreement with the town was formally ratified. According to the agreement, work is to be commenced on the construction of the railway not later than May, 1897, one mile to be completed and in operation a year from that date.

THE Spokane and Columbia Telephone Co. has been incorporated to connect British Columbia mining districts with Spokane, Wash. The capital stock of the company is $75,000, held by Nathan R. Stone, L. T. Gordon, I. H. Adams and J. D. Farrell, of Spokane, and Angus McNish, of Rossland, B.C.

THE telegraph lines to Langley and Chilliwack, B.C., have been transferred by the C P R Telegraph Company to the Westminster and Burrard Inlet Telephone Company. There will now be direct communication by telephone between Vancouver, Westminster, Langley, Chilliwack, Eburne, Steveston, Ladner's, Clover Valley, South Westminster, Delta, Port Moody, Blaine, Whatcom, Seattle, Tacoma, and other points.

SUDBURY, Ont., will spend $10,000 on electric light and sewage.

UNDER Joseph McVey, the extension of the St. Stephen and Milltown Railway is making good progress.

E. A. C. PEW says electric lights would only cost one cent a night in Hamilton, if his power scheme were working.

THE South Essex Electric Railway Company applies for an Ontario charter to build from Amherstburg to Harrow, Ont.

STRATFORD, ONT., wants an electric fire alarm system, embracing fourteen boxes, to be placed in different parts of the city.

A NEW incandescent light company, of which Mr. Noble, Macnab street, is manager, is getting into shape for business in Hamilton.

THE Campbellton, N.B., Electric and Telephone Company are enlarging their plant and are contemplating an extension to Dalhousie.

FRED. NEILSON is about to introduce electric light into Portneuf, Que., and he expects to have it in working order by the month of June.

JOHN NISKIVELL, who attempted to shoot Superintendent Glenwright of the Street Railway Co., Winnipeg, has been sentenced to life imprisonment.

THE Niagara Falls Park and River Electric Railway carried last year 499,015 passengers, which is a large increase over 1894 The receipts were $65,784, and cost of operation $40,630.

THE Citizens' Light, Heat and Power Company of St. Catharines, Ltd., applies for an Ontario charter. Capital, $40,000. The provisional directors are: W. Cooke, Annie Cooke, and W. H. Phillips.

J. E. FLOOD and J. W. Burke, of New York, were in Sherbrooke, Que., recently, to make final arrangements with the city council and R. W. Heneker for the commencement of the electric street railway in that city.

THE Brantford, Ont., Operating and Agency Co., Ltd., applies for leave to increase its capital to $150,000, to purchase the Brantford Electric and Power Co., and to change its name to the Brantford Electric and Operating Co., Ltd.

CROOKES' tubes and barium-platino cyanide, in one gramme bottles, may now be had of the Packard Electric Co., St. Catharines, Ont. Much interest is taken in these commodities at present, as they are indispensable to the Roentgen photography.

JOHN N. LAKE, M. W. Hopkins, C.E., and the other gentlemen who started, intending to make a four days trip over the country to be traversed by the proposed new electric railway, have got back, having gone as far as Cayuga. Owing to the severe storm they did not make the full trip; but as far as they went all were satisfied with the outlook. The work of getting stock subscribed will be undertaken soon.—*Hamilton Times.*

THE Canadian Electric Railway and Power Co., which proposed to build an electric line from Montreal to Windsor, has had its application refused by the Railway Committee of the Dominion Parliament. Efforts are being made to restore the bill to the order paper The promoters, who are chiefly Toronto capitalists, are George W. Beardmore and W. H. Cawthra, Toronto; James K. Osborne and Lyman M. Jones, Winnipeg.

UNDER the new arrangement by which the Toronto Electric Company and the Incandescent Electric Light Company, of Toronto, are consolidated it is proposed to make a considerable extension in city lighting and power The central portion of the city will be supplied by the old incandescent plant, and by cutting off the "suckers" which ramify in different directions, the quality of the light will be improved Parts not reached by the old plant will be supplied from the Toronto Electric poles and wires. It is also the intention of the company to go more extensively into supplying power, and in the future heat will also be supplied. The company's plant at the foot of Scott street will be extended.

MESSRS. HOOPER & STARR—the latter the well-known electrical engineer of Montreal—have commenced work on the construction of an electric railway for freight and passenger service at Cornwall. The contract for the electric apparatus, including a 200 kilowatt generator and ten C.G.E. 800 motors, has been awarded to the Canadian General Electric Company. The same company will also furnish two closed motor cars of their standard type, the balance of the cars being supplied by the Rathbun Company of Deseronto. A freight locomotive, on which the motive power will consist of four C.G.E. 800 motors with special controllers, will handle the freight business between the mills and the Grand Trunk Railway.

THE organization meeting of the Moncton Street Railway, Heat and Power Company was called for the 3rd instant.

THE committee of the St. Catharines City Council appointed to enquire into street lighting, reports in favor of a municipal plant to cost $9,125.

A PROJECT is on foot in Montreal for substituting electricity for steam at the waterworks pumping station, the electric power to be supplied by the Lachine Rapids Power Company.

THE Riverside school, Montreal, has been fitted with the Warner system of electric time, by the Canada Electric Company This system is also working in the Aberdeen, Victoria and Dufferin schools, giving great satisfaction.

S. G. CHAMBERS, J. A. Leaman, P. McG. Archibald, F. A. Laurence, W. Craig and M. Dickie, Truro, N.S., have held a street railway charter since 1889. It has now been extended to 1897, and they are expected to make progress with the undertaking.

A REPORT has been current that a company was about to start in St. Catharines, Ont., in the manufacture of electrical appliances. The report, we understand, originated in the preparations being made by Thos. L. Willson's company for the manufacture of calcium carbide, a water power privilege at Thorold having been bought for that purpose.

CAPITALISTS from the United States, including J. N. S. Brown, Baltimore, president of the Maryland Trust Company; J. Shear and W. J. McCracken, New York; and F. O. Blackwell, C.E., are interested in the Quebec Electric Street Railway scheme. The absorption of the Electric Light Co.'s plant, and the Quebec, Montmorenci and Charlevoix Railway, is contemplated.

THE increase of trade with J. H. Farr & Co., Toronto, manufacturers of insulating compounds, during the past year, has again necessitated the enlarging of their already commodious and well equipped works. In view of the general depression of business, this speaks well for the firm, and demonstrates that their goods are giving the highest satisfaction.

ELECTRIC railway building will be brisk this summer on the Island of Montreal. Over 30 miles of track is to be laid by the Montreal Park and Island Railway Company. A syndicate has agreed to take that company's bonds and build the road, and furnish rolling stock and everything necessary to the complete equipment of the line. The system will comprise seven miles of double track to Lachine, seven miles to St. Laurent, and four miles to St. Vincent de Paul, including a bridge over the Black River to cost $20,000. Mr. Reid is at the head of the syndicate.

THE promoters of the Hamilton Radial Electric Railway have secured the right of way over the Beach, crossing the canal by the new Government bridge, and the great expense of crossing the Desjardins Canal on the other side of Hamilton Bay is thus saved. It is the intention of the company to start building early in the spring, and to have the line completed as far as Burlington in June. The officers of the company are: Alex. Turner, president; Thos. Leather, vice-president. W. W. Osborne, Secretary. W. A. Wood, treasurer. Directors—A. Zimmerman, Geo. Lynch Staunton and John Moodie.

THE building of the Lanark-Perth electric road, for which Lanark some time ago voted a bonus, is causing much discussion in the county of Lanark. Other towns are anxious for connection with Lanark as well, and a road from Carleton Place to Lanark is spoken of. Almonte wants connection with the O. A. &. P. S. railway, and bonuses have been voted by the different municipalities through which the line would pass. The easiest solution of the problem, a correspondent thinks, would be an electric road running up the valley of the Mississippi river from Fitzroy harbor on the Ottawa river, where one of the largest and most cheaply available water powers in Canada is lying idle, through the towns of Galetta, Pakenham, Blakeney, Almonte, Appleton, Carleton Place and Innisville, thence to Lanark All of these towns mentioned possess undeveloped water power, and all now manufacture extensively, indeed millions of dollars' worth of woolen goods and cheese are shipped from these points every year. This line would give the towns named outlets by the C.P.R., the O.A. & P.S. railway, and the Ottawa river. A branch from Carleton Place to Smith's Falls, through Franktown, would do a good local traffic and would connect the system with the Rideau canal. Our correspondent points out the advantages of lower freight rates to the towns on the C.P.R., as he says that road has been known to charge nearly as much for hauling goods sixty miles from the point where competition stopped as had been required to bring the goods to that point from Great Britain.

Mining Matters.

THE Antler Creek Mining Co., Ltd., has been incorporated to mine in the Cariboo district, B.C.

THE Crown Point is working 20 men and has nearly 1,000 tons ready for shipment.—*Rossland Miner.*

THE Torbrook iron mines, Annapolis, are being pumped out, and work will be resumed in a short time.

IT is said that McConnell's gold mine on Lake Wahnapitæ, Ont., is under option to some Montana mining men at $150,000.

I. MATHESON & Co., of New Glasgow, have turned out $10,000 worth of machinery for the Fifteen Mile gold mine, N.S.

THE city council of Vancouver, B.C., has granted $500 towards getting information regarding the establishment of a smelter and refinery there.

HIRAM WALKER, Walkerville, Ont., has leased the farms of P. Macdonald, J. Murray and A. Marquis, of Bothwell, Ont, and will bore for oil.

R. A. THOMPSON, while drilling for water to run his mill, at Lynden, Ont., last month, struck natural gas, which throws a blaze five feet in the air, out of a four-inch pipe.

WELSH coke is being brought into the British Columbia smelters. It is hoped that the Dunsmuirs will be successful in producing a workable coke on Vancouver Island.

THE report given some time ago of the discovery of gold in the Birch Hills, Prince Albert, N.W.T., appears to have had something in it. Claims are being staked out at a rapid rate.

FROM the Cariboo claim at Camp McKinney from $8,000 to $12,000 per month is being taken out in gold, besides a large quantity of rich concentrates, which are shipped to Tacoma for treatment.

FEARS are expressed that hydraulic gold mining in the upper benches of the Fraser river may, as is the case of the Sacramento river, result in silting up and flooding. Extensive dredging is proposed as a safeguard.

RETURNS from 12 tons of pyritic dry ore shipped from the Howard Fraction and Exchange claims, on Springer Creek, New Denver, were 163 ounces of silver and $17.50 in gold to the ton.—*Victoria Times.*

H. A. WILEY, G. T. Marks, F. S. Wiley, Port Arthur; W. Southam, J. H. Tilden, J. Hoodless, T. W. Lester, H. N. Kittson, H. Beckett, and F. C. Bruce, Hamilton, are the provisional directors of "The Saw Bill Lake (Ont.) Gold Mining Company (Ltd.)' Capital is $100,000.

MR. M. RYAN, township clerk of Bagot and Blythfield, Renfrew Co., Ont., says an asbestos mine is being opened up about six miles from Calabogie station, by Jas. Carswell, of Renfrew, Ont., and others. About 800 acres of land have been purchased.

IN the first week in March the Hall mines smelter shipped its first matte to the refinery. The matte shipped ran 50 per cent. copper, and carried 280 ounces of silver to the ton. This, reckoned at 64 cents an ounce for silver and 7 cents a pound for copper, makes the matte worth $249.20 in Nelson, B.C.

FOUR cars of plumbago from the Calabogie, Renfrew Co., Ont., mines, of the Ottawa Graphite Company, were sent down recently over the O. A. & P. S. Railway. This is the first shipment from these mines. The plumbago will be prepared for market at Ottawa, and preparations are being made to handle nine tons a day.

THE *Ottawa Journal* says that the gold and iron ores recently discovered on the farm of Thos. G Armstrong, situated about a mile from Carp, have been tested and found to be of good quality. It was estimated that the iron will yield 95 per cent. of magnetic ore, while the gold mine yields $18 to the ton.

AT Harrison Corey's nitro-glycerine factory, Petrolea, Ont., a dreadful accident occurred on March 23rd, by which John Owen and William Huggard were instantly killed. It is probable they were thawing out some material, but no evidence of the cause can even be discovered, owing to the awful destruction caused by the explosion.

THE strike at the Joggins Mines ended on March 21st, by the leaders of the riot submitting to arrest, and the announcement of the retirement of the manager. The strike, which had lasted for two months, was caused by a ten per cent. reduction in salaries. During the last week of the strike a riot took place, in which a number of miners were seriously injured, and armed resistance was offered to the police.

THE Silver King smelter put through 120 tons in the first 24 hours working.

THE ore now being brought up from the bottom levels of Le Roi mine, Rossland, B.C., is worth $300 per ton.

THOMPSON & ABELL have disposed of their oil property, west of Marthaville, to Calvert & Cameron.—*Petrolea Topic.*

THE Petrolea Electric Light Co. are putting down a few wells on their Tank street property. Recently the second one was finished, and proved an excellent well, starting off with a production of three or four barrels a day.

IT is understood that efforts will be made to develop the coal find at Lutz Mountain, about nine miles from Moncton, N.B. Several prominent business men of this city have ascertained that the deposit gives evidence of turning out excellent if worked.

IT is said that the dispute as to ownership has been decided, and the Revelstoke Smelting Company will make another start with the Revelstoke smelter. A. H. Holdich, formerly of Revelstoke, now of the Hall mines smelter at Nelson, has received instructions to investigate the condition of affairs, and will probably manage the smelter.

A KINGSVILLE, ONT., despatch of 27th March, says: "While boring for gas on Pelee Island on the 9th inst., the Kingsville and Pelee Oil and Gas Company struck a flowing oil well at the depth of 800 feet. Oil spurted 35 feet in the air, and the well was quickly capped, and the stockholders are bound to secrecy. The Standard Oil Company, who have leases on 3,000 acres on the island, got wind of it, however, and great rivalry is now going on for new leases. Fabulous prices are being offered. The oil tested 40 per cent. specific gravity. Great excitement prevails. The truth leaked out only this morning."

Personal.

SAUNDERS & WIGGINS, civil engineers, Brockville, Ont., have dissolved partnership.

THE death of Wm. Masson, since 1853 a shipbuilder in Newcastle, N.B., occurred on March 2nd.

J. DUVAL, of Chicago, succeeds W. G. King, for a number of years superintendent of the car shops, Perth, Ont.

JOHN O'BRIEN, foreman of the boiler department of the Burrell-Johnson Iron Company, Yarmouth, N.S., died on Feb. 28th.

E. M. STACY is succeeded as superintendent of the St. Stephen, N.B., water works, by Mayor Roy, of Milltown, N.B.

A. J. PARKER, car foreman in the C.P.R. shops at Carleton Place, Ont., goes to North Bay, Ont., in a similar capacity.

J. BRIGNELL, formerly general manager of the Western Counties Railway, N.S., is to be the manager of the Central Railway, Nova Scotia.

SAMUEL LAMBERT, Kingston, Ont., has been appointed inspector of bridges and carpentering on the G.T.R., between Brockville and Toronto, including the Midland division.

SAMUEL RISLEY, formerly chairman of the Dominion board, boiler and steamboat inspectors, died in Toronto in February, aged 74. Mr. Risley designed for the Great Western Railway of Canada the first ferries to carry trains across the Detroit River.

WM. BREAK, formerly of the city engineer's office, Toronto, and latterly superintendent of street railways in London, Ont., and Detroit, is going to South Africa as a missionary, according to a Toronto paper.

F. W. WARREN, superintendent of the street railway, St. John, N.B., is leaving this road, but will it is said be given a most responsible position in the management of the different street railway systems in which Mr. Ross, of Montreal, is interested. Mr. Neilson, assistant superintendent, assumes control in St. John.

J. MCCREDIE, of Shawville, Que., received what are probably fatal injuries by being caught in the shafting of his planing mill recently.

JAMES MACDOUGALL, engineer of York county, Ont., has been elected an associate member of the Institution of Civil Engineers of England.

ARTHUR W. WHITE, London, Ont., who was umpire on the Duryea motor, which won the moto-cycle race at Chicago, has been appointed one of the umpires on the *Cosmopolitan* moto-cycle race in New York, to be held on the 30th May next.

BRIDGE Inspector C. F. Hanson had a narrow escape on the Kettle Creek bridge, the L. E. & D. Railway, on the 20th ult. In attempting to jump on to a moving train, he would have fallen from the bridge but for one of the employees catching him as he was falling.

D. A. COSTE, Bridgeburg, Ont., has removed to Buffalo, where he takes the place of his brother, Eugene Coste, as manager of the Provincial Natural Gas Company. Eugene Coste left his position to take the management of an oil company in Ohio.

J. F. HILL, comptroller of the Montreal Street Railway, has resigned, and has taken a position in Chicago in a railway company. Mr. Hill in the last ten years has been successively accountant in the Canadian Pacific Railway, the Toronto Street Railway, and the Montreal Street Railway.

JOHN GOLDIE, of the Goldie & McCulloch Company, died at his residence, Galt, on the 26th March, after an illness of several months, from blood poisoning. Mr. Goldie was in his 75th year, and has been a resident of Galt for over 40 years. He was a most exemplary citizen and held in the very highest esteem by all classes of the community. A widow, one son (Alex. R. Goldie) and two daughters survive. The deceased was a brother of Jas. Goldie, of Guelph, and the late David Goldie, of Ayr.

THERE is a family residing in Burlington whose home is far from a happy one at present. A dark cloud hovers over it, and they at least cannot see the proverbial silver lining. Some months ago R. C Stewart, then employed as a draughtsman in the chief engineer's office, had the misfortune to lose his right leg while passing from one car to another on his way to his home in the above-mentioned village. Shortly after this Mr. Hobson, his chief, was called to take charge in Montreal, and Mr. Stewart was among those who were left without employment. Only the other day the doctor who amputated Mr. Stewart's injured member sued and obtained judgment for some $85. Mr. Stewart bears up under all these disasters like a man. His friends hope that some kind influence will replace Mr. Stewart on the G.T.R. at Hamilton, with which district he is thoroughly acquainted, and has proved a useful man.—*Hamilton Herald.*

NAT. W. PRATT, treasurer of the Babcock & Wilcox Co., died last month at the age of 44. He was born in Baltimore, of old American stock. Young Pratt entered the employ of the firm of Babcock & Wilcox in 1870. His energy, engineering ability and remarkable business qualifications won the confidence of his employers. In 1881 the Babcock & Wilcox Co. was organized as a corporation. He became treasurer and manager of the new company, retaining the position until at the death of Geo. H. Babcock in 1893, he was elected president. He combined engineering knowledge and inventive genius with extraordinary business qualifications. As illustrating his versatility: In 1884 he became consulting engineer to the Dynamite Gun Co. Under his designs and patents the first successful dynamite gun was built. It was with this gun, 8-inch calibre and 60 feet long, that the experiments of throwing aerial torpedoes were conducted at Fort Lafayette, N.Y Mr. Pratt was noted not only for his sound business judgment and remarkable energy, but also for his generosity and kindness of heart. Even his business opponents admired him for his singular aggressiveness as applied to business, and by all with whom he came in contact, both at home and in trade, he was universally loved and admired.