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RECENT DEVELOPMENT OF MINING IN ONTARIO.

THE GOLD FIELDS.

Dr. A. P. Coleman, geologist and mineralogist of the Ontario Bureau of Mines, has prepared a preliminary report of his work during the past summer in the gold fields of Western Ontario. The details will be published in the next Report of the Bureau of Mines. Gold is found in Ontario, Dr. Coleman reports, in a territory nine hundred miles in extent, stretching from Hastings county in the east to the Manitoba boundary in the west. The gold of the eastern section, as at Deloro, has been known for thirty years, but could not be profitably worked under the old processes. The successful working of the Empress mine on the south shore of Lake Superior, in a series of bedded or lenticular quartz veins enclosed in green Huronian schist, near an outcrop of granite, is described. A very complete ten-stamp mill has been at work here for some months, and several bricks of gold have been obtained. The ore is not high in gold and is rather refractory, so that not more than 40 or 45 per cent. is extracted by the stamps.

"Attention is, however, specially directed at present to the main gold region of Ontario, which extends for more than two hundred and fifty miles from Moss Township westward, the preliminary report says, and has been proved to be at least one hundred and thirty miles wide, between the Little America mine, just south of the international boundary in Minnesota, and Lake Minnietakie, twenty miles north of the Canadian Pacific Railway. Here the number of locations, usually of forty acres each, taken up for gold mining purposes within the last four years, runs into the hundreds. Many of these will, of course, not prove workable mines; but, on the other hand, new finds are constantly being made, sometimes in quite new localities, sometimes in regions supposed to have been well explored years ago. In general the gold-bearing veins occur in green chloritic and hornblendic schist, probably of Huronian (Keewatin) age, and are of a bedded or lenticular kind; but sometimes they are found in masses of eruptive granite or gneiss which have pushed their way up through the Huronian schists. In the latter case the veins are commonly true fissures, and may be followed for considerable distances. In either case the contact of an eruptive rock with schist seems of importance, since the best veins are found within a mile or two of such a contact. In addition to gold-bearing veins there are deposits of other kinds which are worthy of attention, such as fahlbands, wide bands of schist heavily charged with sulphides, and showing a considerable amount of free gold; and dykes of felsite or quartz porphyry containing pyrites and gold; though up to the present none of these have been mined sufficiently to prove their value."

From Savanne, on the C.P.R., to Rat Portage the party traveled seven hundred miles by canoe and examined a large number of properties.

On Reserve Island, Seine River, H. B. Proudfoot was opening up a number of veins, but at the time of the visit development was not sufficiently advanced to admit of estimating the value of the location.

The Sawbill Lake mine occurs in a formation mapped by the Geological Survey as biotite-granite gneiss of the Laurentian, so that gold appears in satisfactory amounts in a rock hitherto looked on as barren.

The Harold Lake mine, on the Seine below Steep Rock Lake, owned by Wiley & Gibbs, has several veins, of which one small one is exceedingly rich. The country rock here is quite varied, granite of the greenish altered kind, often called protogine, piercing green and yellowish rocks of the Huronion.

"Shoal Lake may be looked on as the focal point of the Seine River and Rainy Lake gold region, hundreds of locations having been taken up during the last three years within a radius of ten miles of this small lake, and a very considerable amount of work has been done on several of the properties. Up to the present the most important mines have been found in an area of protogine granite about six miles in length from northeast to southwest and about a mile in width, lying between Shoal Lake and Bad Vermilion Lake. The whole granite area has been located, and scores of veins have been found, varying greatly in gold contents, but generally true fissure veins, with well-defined walls of slickensided talc or sericite schist."

In this district there are a number of very fine properties. The Ontario Gold Mine Co. owns the Foley mine. On one of their veins, the Bonanza, one shaft had been sunk to 210 feet and another 1,200 feet away to a depth of 113 feet, and more than 300 feet of drifting had been done at various levels at the time of our visit, July 17. The vein proves very uniform in

width, running from 2½ to about 4 feet, and the ore, which contains a considerable amount of visible gold, is said to average $20 in free milling gold and $5 in concentrates per ton. The Ferguson mine, belonging to the Seine River Gold Mines Co., and the Lucky Coon or Hillier mine, which has been taken hold of by Edinburgh capitalists, promises well.

"Many locations have been taken up in the Keewatin schists east of Shoal Lake, and also along Little Turtle River and Lake, north of Bad Vermilion Lake. These deposits are mainly bedded veins or fahlbands, and have been very little developed, though rich specimens of free gold come from them. On Rainy Lake itself gold has been found at a number of points; but the only mines worked are two in Minnesota. North of Rainy Lake and south of the Canadian Pacific Railway, at Wabigoon, is a very promising region on the shores of Lake Manitou, and smaller bodies of water near by. Ore deposits of varying kinds and of all degrees of richness occur here, and brilliant specimens are found, but nothing that can be dignified with the name of mining has yet been attempted. Gold has been found at various points north of the railway, *e.g.*, on Minnietakie and Sturgeon Lakes; but locations are yet only in the prospecting stage."

The Regina Gold Mining Co.'s property on the Lake of the Woods was visited next. The vein on which most work has been done begins in a mass of protogine granite near the shore, and runs into a weathered diabase (trap) toward the south. There is a rich shoot of ore running down through the granite into the diabase. The gold is fine and difficult to save by the present concentrators. The mill is of ten stamps, and the number of men employed about fifty. "Many locations have been taken up near the Regina and farther north-west on Yellow Girl, and other bays, but none have been worked seriously. Nearer Rat Portage, however, especially along the contact of Laurentian and Huronian, running north-west from Andrew Bay to Black Sturgeon Lake, a number of shafts have been sunk, generally to a depth of fifty feet. At the time of our visit only two mines were producing gold, the Golden Gate, whose ore was being crushed at the mill of the adjoining Gold Hill mine, and the Triumph, which was having its ore tested with a two-stamp Tremaine mill." The Sultana mine, owned by J. F. Caldwell, Winnipeg, is situated on an island seven miles south-east of Rat Portage; it is the most famous in the district, having, the report says, "a great body of rich quartz, in places forty feet wide, and already followed more than three hundred feet in depth. Nearly a thousand feet of drifting has been done, and there is ore enough in sight to keep the well-equipped ten-stamp mill, or one double its size, running for years. The ore bodies appear to be lenticular, the lower one of immense size, and are enclosed in the sheared and schistose edge of an area of coarse porphyritic granitoid gneiss, mapped by the Geological Survey as Laurentian, but adjoining green Huronian rocks. The ore is somewhat quartzitic looking, contains one or two per cent. of iron pyrites, and is free milling, to the extent of 75 or 80 per cent. A recently finished chlorination plant extracts the gold carried by the sulphides very satisfactorily."

The Mikado mine on Western Shoal Lake is owned by an English syndicate, of which W. T. Engledue is chairman. It has been worked enough to show that the ore is very rich, though not enough sinking has been done to prove the extent of the deposit. The quartz contains a variety of sulphides, including a sulphide of bismuth new to the Lake of the Woods region, and a considerable part of the gold is carried by these refractory minerals. But probably two-thirds of the gold contents are free milling, the gold occurring as thin plates rather than nuggets. The ore treated is the richest found in large quantities in Ontario, and the ore now on the dump, after only a few months' work by a small force, contains values sufficient to pay for the mine and a simple equipment. Several other finds of very rich ore have been made in the vicinity of the Mikado, and next summer will probably see the development of an important mining camp in that district.

"At a number of other points on Lake of the Woods and its bays promising finds of gold have been made, *e.g.* at Camp Bay, to the southeast, but none of them have been worked sufficiently to make sure of their value. Looking at our gold mining region as a whole, one is struck by the wide extent over which gold has been found, the variety of deposits that occur, the ease with which they may be reached, the free milling character of most of the ores, all points in its favor as compared with most gold regions.

"No part of the region is more than forty miles from a railway or steamboat, and most of the mines are within a few miles of them. In winter a road sufficient to take heavy machinery may be made without difficulty to any point in the region, and the Ontario Government has shown itself liberal in granting assistance to such roads. All parts are readily reached by canoes in summer. Plenty of water of good quality is found everywhere, and wood for fuel, building or mine timbering almost everywhere." Dr. Coleman says, in conclusion, "The region is not an inaccessible desert, nor covered with malarious swamps, nor cut off from civilization by precipitous mountains. Supplies of all sorts are cheap; efficient labor can be obtained on easy terms, the labor of white men, not of negroes or Indians, and life and property are as safe as anywhere on the globe."

ANTHRACITE, ANTHRAXOLITE, WHICH?

Since the building of the Grand Trunk Railway nothing so full of promise for the development of Ontario industries has occurred as the reported discovery of anthracite near Sudbury, Ont. At the time of writing, the genuineness of the discovery is a point about which discussion rages, and until the report of Dr. A. P. Coleman on the mineral is made public the question which heads this paragraph cannot be definitely answered. We hope before the last of these pages goes to press that the report may be handed out, so that we may present the decision of the Ontario Bureau of Mines to our readers. In the event of the deposit not proving true anthracite, if it is sufficiently extensive it may be applied to great advantage in the reduction of the various ores with which the northern part of Ontario is so rich. Much turns, then, on the report of the nature of the mineral, but much also depends upon the amount available.

GAUGING THE RIVER ST. LAWRENCE.

During the latter part of October, the third year students in civil and mining engineering at McGill University, under the direction of Prof. McLeod, assisted by Profs. Kerry and Smith, made a three-day trip down the St. Lawrence, about 45 miles, to Lanoraie. The yacht "Wild Rose," belonging to Mr. Drummond, and under the supervision of Mr. Frank Redpath, was placed at the disposal of the party.

At this point the river is straight, deep, and of uniform cross section for a mile or so, and has been measured previously by the staff of the Harbor Commissioners, and last year by the college party under the same direction, and at about the same time of year. This year pole floats, and also Amsler electric current meter observations, were both taken; a cross section of the river taken again, and levels of water, etc. It is hoped these records may not only be of present, but of permanent, future value, as determining the volume and velocity of flow of the St. Lawrence in years of low water.

GAS VERSUS ELECTRICITY DIRECT FROM COAL.*

BY D. M. DUNNING.

For a number of years we have heard of the great things that were to happen when science achieved the production of "electricity direct from coal;" yet it does not seem to have occurred to many that ordinary illuminating gas is, and always has been, produced "direct from coal." The purpose of this paper will be to show in a practical way that, with the modern gas works, handled in an up-to-date manner, an efficiency can be attained which is about all that could be produced, even should science succeed in the production of "electricity direct from coal." In doing this it will be desirable first to briefly describe the modern gas works and some of the essential advantages to be derived from it, in comparison with the works in use until the past few years.

In the way of the utilization of residuals, and illumination through incandescent lamps, it has, through the aid of science, made most rapid advances, and still presents, in these and other lines, the broadest fields for scientific research and investigation. At various times it has, in the minds of many, been threatened with serious, if not fatal, competition from electricity; yet the gas industry is probably to-day in a healthier and more prosperous condition than it would have been if electricity had never been a competitor, because the electric light has created a demand for more light and a stronger light, which, together with its competition, has stimulated the gas industry to improvement, and to advance and extend its business; and on these lines, and with the aid of lower prices, the future manager seems to have an almost unlimited field.

In the evolution of the modern gas works one of the first and most important steps was the construction of the "regenerative furnace." Only a few years ago, with the old-style furnace then in use, it was the common thing to consume fully one-half the coke produced in the furnace itself; and, with no special effort made to find a market for the other half, it often became a cumbrous thing about the works, and was disposed of in liberal measure and at nominal prices, which practically destroyed its market value. We now have in common use the "regenerative furnace," which, with its essential features of primary and secondary combustion, is a remarkably economical generator of heat. By secondary combustion I mean the combustion of the unconsumed products of the first combustion, which is brought about by a secondary supply of air at a point just above the furnace proper. In this manner, together with an ingenious arrangement of flues for heating the air-supply with the otherwise waste heat of the furnace, the efficiency of the furnace has become fully doubled, so that we are now able to carbonize our coal with about one-fourth of the coke produced. Another important advantage of the modern furnace is the transfer of the coke without quenching, whereas, with the old furnace, it was necessary to quench the coke, and then fire it up again. This furnace also affords a very marked saving in depreciation and labor, especially if run with moderate heat, as it should be; and the large amount of coke saved, if properly stored and marketed among people educated to its use, becomes a very important by-product, and, in such works as are in proximity to the bituminous coal fields, nearly, if not entirely, liquidates the coal bill.

And, with the great saving in this by-product, there has been achieved a still greater in the two other by-products—namely, tar and ammonia. Within the memory of the writer, coal-tar was a serious annoyance to the gas manager, because it had to be disposed of in some way other than as ordinary sewage; and it was not an uncommon occurrence to be obliged to haul the major portion of it out into the country and there burn it, hoping to sell the remainder for local use for enough to defray such expense. To-day it can probably be safely said that in no branch of chemistry has science delved so deeply as in that which deals with the black and sticky mass of coal-tar, and certainly from none has it produced more brilliant results, the productions being already numbered among the thousands, comprising nearly all of our most beautiful colors, such as the aniline series, and the most important of our medical remedies, one of which—phenacetine, of the anti-febrin class—has acquired a world-wide reputation; altogether, the list seems as limitless as the starry heavens, and as yet about as unexplored. Saccharin, a thousand times sweeter than sugar, suggests that, if we have sufficient faith, and work, we may yet live on tar. Coal-tar products have acquired so important a place in the arts, sciences and manufactures that this by-product has become a well-established article of commerce, and undoubtedly pays, for the average gas works, about twenty-five per cent. of the coal bill.

Not until a recent period did gas companies—in this country at least—make much of an effort to save their third important by-product, ammonia; and it is an interesting feature of this saving that the necessary treatment of the gas in process of manufacture, in connection with such saving, has been so material an improvement over the old treatment as to more than compensate for any added expense caused thereby, leaving the ammonia saved out of the qustion. Formerly the gas was often washed in a shower-bath of cold water, and many of its illuminants were washed away with the ammonia into the sewer. Now only an exceedingly small quantity of water (which has great affinity for ammonia) is allowed to come in contact with the gas, and this contact, by ingenious mechanical contrivances, is continued over a long and sinuous course, entirely removing the ammonia without disturbing the illuminants, and producing a valuable article of commerce. The storage and concentration of ammoniacal liquor requires careful and skillful handling, as it is an extremely fugitive substance, always anxious to escape to the clouds, and return thence to the farmer in his fields. Five to seven pounds per ton of coal is a fair production of this by-product, and between thirty and fifty cents per ton of coal the average revenue.

This summary of the state of the gas industry at the present time, in respect to the saving of residuals,

* Published in the *Engineering Magazine*.

brief as it is, warrants the statement that the dividends of to-day are declared from the wastes of yesterday; and the knowledge of it seems to touch, in the mind of the gas engineer, whenever by chance he happens to gaze at the chimney of an electric lighting company, a sort of sympathetic chord in harmony with the feelings of the stockholders thereof, in the shape of a vision of dividends vanishing in smoke, worse than wasted, because an intolerable nuisance.

Important as the mechanical evolution of the industry has been, it fairly sinks into insignificance in comparison with what has been accomplished and with the possibilities in view, in the evolution of the business end of the industry, following the line of enlarged output at lower prices.

Progress seems to be the watchword in all the lines of industry in the present age, and our electrical friends just at present are unusually active. Among the many startling announcements of recent date in reference to progress in electric lighting probably none seems so tangible, and has attracted so widespread attention in the scientific press, as the discovery of Dr. W. W. Jacques, of Newton, Mass., of a chemical process by which electricity can be generated direct from coal. So radical are the changes in the production of electricity by this method that a writer proclaims that "dynamos will be sent to the attics, and it will be cheaper to heat and work by electricity than by fires." And similarly we find in other magazines page after page of interesting scientific enthusiasm pertaining to this particular invention, until we are constrained to give it a careful and impartial examination. The process may be briefly described as follows: Iron retorts are set up on end in a furnace. The retorts are partially filled with caustic soda. They also contain a piece of carbon suspended from the top, and are provided with an air supply at the bottom. The furnace and contents are to be brought up to a temperature of 400 to 500° Centigrade, and a supply of air forced up through the fused mass of soda, the oxygen from which attacks the carbon and forms electrical energy, with which arc and incandescent lights can be immediately maintained. The efficiency is said to be such that thirty 16-candle incandescent lights were maintained for nearly nineteen hours with a consumption of only eight pounds of carbon in the retort; and this is pronounced an efficiency of about ninety per cent., for the eight pounds of carbon consumed in the retort. But what about the perhaps eighty pounds of carbon consumed outside of the retort to maintain this temperature of 800 to 900 degrees Fahrenheit and the air-blast for the nineteen hours? So disposed are enthusiasts in science to exalt any new thing that this, probably the real source of the energy, is passed over in comparative silence. If we call an enthusiast's attention to this, we are told that they are on the track, and the next step will be to accomplish all of this without the aid of outside heat; which brings up the suggestion: suppose you could do this without the aid of outside heat, or, what is more probable, suppose a small portion of the energy generated—say not to exceed ten per cent. of it—could be diverted to maintain this heat and pump the air. "Then," the enthusiast exclaims, "we would move the earth, we would certainly revolutionize all existing things." "But what about the carbon consumed in the retort?" suggests the practical man. Could you not manage in some way to furnish this, or a large portion of it, without cost? And, if you could, suppose we compare the efficiency which you would then attain with the efficiency of the modern gas works. They have the retorts set in the furnace. They are charged with carbon in the form of coal. According to scientific authorities, something more than twenty per cent. of the energy is driven off in the form of carburetted hydrogen, called gas, which can be safely and easily stored without loss or deterioration for any length of time; and the practical man claims that the other eighty per cent. is retained as follows: forty per cent. in the form of coke, twenty-five per cent. in the form of tar, and fifteen per cent. in the form of ammonia.

One-fourth of the coke, or ten per cent. of the entire amount of energy, suffices to do all the work of heating the furnaces, and the balance of these residuals, in many cases, sells for enough to pay for all the coal, and on an average, should pay for about eighty per cent. of it.* But the scientist comes forward with an array of heat units and standard candles to prove that eighty per cent. of the energy does not remain in form of the above-named residuals, and the practical man waves him aside with the exclamation that they pay eighty per cent. of the coal bill, and that the energy which pays the bills is the right kind of energy for him; and he claims that, if he can eliminate eighty per cent. of the raw material by the sale of residuals, then he has a right to consider the entire production of the original article sought as the production of the remaining twenty per cent. of the raw material, which would show an efficiency of the full one hundred per cent. of energy. And then he calls attention to the wonderfully efficient character of this energy when utilized with the oxygen of the atmosphere through bunsen burners, incandescent lamps, and gas engines for heating, illuminating, and power purposes.

The gas engineer calls on nature twice during the carbonizing of his coal for assistance from the oxygen of the atmosphere, as has been shown under the description of the regenerative furnace; he calls again for assistance in the distribution of his product under the weight of the atmosphere, which does it quietly and effectively, unseen and unknown to most of us; and he calls again at the utilization of the product for a supply of oxygen to support its combustion, for all its various purposes of light, heat, and power, calling twice in the use of the Welsbach lamp, or for a double service, and producing at once the most economical and efficient artificial illumination yet known to man, and which may well be called "one of the great inventions of the nineteenth century." And thus he goes hand in hand with nature in all the ways of his profession, so differently from his friend, the electrical engineer, who seems at all points to be endeavoring to thwart her, and, with his lamp, depends for his success upon his ability to oppose her. For nature abhors a vacuum.

And now comes the philanthropist, and desires to know why, under all of these advantages, the price of the product does not fall. Why are not companies formed to give it away, so that the people may rise up and call them blessed? The reply might be made that, in common with other corporations that deal with the public, they are always sure of the blessing. Perhaps a better reply would be that water is free, free as the air, and stored in inexhaustible quantities at the very doors of many of our cities; and yet it costs the people of most cities more than gas. Suppose it were

* At the gas works in charge of the writer, four hundred miles from the coal mines, the residuals sold pay more than eighty per cent. of the coal bill.

possible to store daylight and distribute it by night through "vacuum tubes," does any one imagine that it could be done for nothing? It is not the first cost of the raw material that counts in a service of this nature. It is the long train of contingent expenses that rises up to swamp the enthusiast, when he attempts to move the world too rapidly. But the world is bound to move, and we are glad of it, and we hope to see the Jacques furnace improved so that it will become self-sustaining —perhaps float off into perpetual motion. And, when this is accomplished, then we think that, in point of efficiency, it will just about begin to get into comfortable competition with the modern gas works.

HYDRO-GEOLOGY AND HYGIENE.

BY C. E. DE RANCE, OF H.M. GEOLOGICAL SURVEY.

(Continued from last issue.)

In selecting the site for a well it must be always remembered that if faults occur in porous rocks, the fissures of the fault will be filled with porous material. They not only will be found to offer a water-tight barrier if an impermeable deposit be on the other side of the fault, but the same result is obtained if there was at a former geological period at the point in question, impermeable material on one or both sides of the fault, which has since been destroyed by denudation, as well as the upward prolongation of the fault which traversed it. This latter acted as a duct or pipe, to fill the fissure of the fault, as at present preserved, with impermeable material, which has had the effect of converting it into a natural puddle trench. A very good example of this occurs at Bootle, near Liverpool. A north and south fault runs parallel th the coast and dock line. All wells west of the fault are heavily polluted from percolation from tidal waters of the Mersey, including some close to the fault, which has been puddled by Keuper marls, since denuded; while the Bootle pumping station of the Liverpool Water Works still supplies a water of equal purity to that it did in 1851, though it is immediately east of the fault in question.

Through increase of population and manufacturing requirements, the quantity of water annually consumed in England is steadily increasing, while the number of available sources of supply being necessarily limited, the competition for the possession of suitable water-bearing areas, especially those adjoining the more densely crowded centres, becomes keener and keener, and the parliamentary and other preliminary expenses larger and larger.

Rival townships, after severe competition, obtain the whole of the water rights of a district, to the exclusion of those who, from apathy, ignorance, or want of funds, neglected to claim a portion of the natural watershed due to them.

The Local Government Board and parliamentary inquiries, at the best, only endeavor to ascertain whether any proposed water scheme laid before them is likely to fulfil the purpose desired for that particular district, and have no machinery to see whether it is the best scheme, or whether it will interfere with the interests of other districts, who, through ignorance, are not represented.

These are actively influenced by the action of existing local authorities, who, though for the most part they ignore setting in action the Rivers Pollution Act of 1876, jealously watch every proposal to abstract water from underground sources. Thus during the present session the opposition of the Nottinghamshire County Council has prevented the Nottingham Corporation obtaining the water from wells in the new red sandstone they so much required, on the mistaken notion that it must necessarily be at the expense of the streams which are only running off a small quantity of water altogether out of proportion to the quantity percolating, which is running to waste down the dip planes of the strata; and, similarly, the opposition of the Hertfordshire County Council has caused the House of Commons Hybrid Committee on the London Water Bills to reject the proposal of the New River Company to sink additional wells in the chalk north of Hertford, to obtain water which is now running to waste under the Essex tertiaries and the bed of the River Thames in that county, but have sanctioned the retrograde step of impounding gravitation water at Staines, for the use of the New River and the requirements of other London companies. Such reservoirs are retrograde, since they impound surface water, always more or less suspicious, if not absolutely dangerous; they occupy flat meadow tracts of large extent suitable for providing foodstuff for cattle; they are also an interference to transit and other purposes, when placed in well inhabited districts, and even to those near sites where the land is in a good state of cultivation.

It is worthy of note that whenever parliamentary committees have to choose between a gravitation scheme and an underground scheme for public supply, their sympathy is invariably in favor of the former, with the result that valuable land is precluded for good from exercising its natural functions of yielding crops or forming sites of towns, to store indifferent waters, while the rocks beneath, or within reasonable distance, could yield the same quantity of water at a tithe of the expense, and of a thoroughly pure quality after passing through the pores of the rock.

Thus the new red sandstone is described by the Royal Commission as the most effective filtering medium known, every trace of organic matter being converted into innocuous compounds. Its value can be realized when its extent in England and Wales is found to be no less than 10,000 square miles, and it is remembered that one inch of rainfall gives 22,427 gallons per acre, or 14,353,280 gallons per square mile, which, spread over a year, yields a daily average of 40,000 gallons per square mile, and experience in South Lancashire and elsewhere has shown that 10 inches out of a 30-inch rainfall can be pumped up, probably a larger quantity generally percolating. At Liverpool, four public wells yield an unvarying quantity of 6,000,000 gallons of water daily, of a quality which has remained uniform since it was examined in 1851 by Mr. Phillips, for the late Mr. George Stephenson, C.E. At Nottingham and at Wolverhampton waterworks individual wells have yielded more than 3,000,000 gallons daily for a long period, but it is probable that in these cases part of the supply was what the late Mr. Thos. Hawksley, C.E., F.R.S., called "water of cistonage"—*i.e.*, the supply was partly drawn from "old storage," and the amount permanently obtainable naturally fell off until the quantity annually pumped balanced the quantity of water annually absorbed. At Gainsborough a very eminent engineer advised the water committee that the well the writer had recommended them to sink through the Keuper marls was pumping "water of cistonage," and would decrease in yield, and that they should revert to pumping the River Trent; but experience has since

proved that this is not the case, and that the ample supply the town now obtains is derived from the rainfall of an area eight or nine miles distant, which previously to these artesian wells being sunk was passing beneath the town to waste on its way to the sea bed. This fact has four important bearings, viz.:

1. That a large number of towns situated on suprapervious strata can be supplied with pure water which was running to waste.

2. That the water so running to waste can be directly obtained by sinking wells in the area of absorption without affecting that proportion of the rainfall that maintains the dry-weather flow of the streams, providing always that the quantity artificially abstracted does not exceed the quantity that would have naturally run to waste.

3. That any water authority, or even private owner of land in a "suprapervious area," can by sinking, under the common law of the country, not only obtain the quantity of water that would naturally pass to waste under the site, but might by artificial pumping obtain water that would naturally otherwise have passed down the stream in the area where the rainfall was absorbed, and this abstraction will be practically without limit as regards the distance between the point of the rainfall and the point at which the well is situated.

4. The abstraction of water on a large scale by a public authority from under a suprapervious stratum may materially affect the riparian rights, advantages, and water supply derived from a distant stream without the owners and users of the same either knowing the cause of the depletion, or, if they did, having any mode of redress either from the law courts or from Parliament, or from the Local Government Board.

By common law* underground water, like game, is free to all who have a legal right to hold it. It is not like water flowing in a defined channel which must be passed on, after the rights of using it have been exercised. With the one proviso, that though you may use every gallon you can get, if you do not use it you must not spoil it,† for those around you can draw upon what you do not require; but though you may not spoil the water under your neighbor's house, you may pump it all out, and let his foundations down, destroy his house, or subside an adjacent railway, there being no right "of support in water." ‡ All these matters, though the law of the land, appear to be contrary to equity, and to demand careful consideration with the other points to which attention has been drawn as regards future legislation. Equity demands that changes should be made in the common law, as again and again thoughtful and important schemes of water supply for the public good are thrown out because it is thought that if damage should occur no legal remedy exists for the damage done. For the most part such would not have occurred, and the public health would have benefited by the scheme being carried out.

The legal decision referred to restrains objectionable matter being conveyed to a well for the purpose of disposal, as it will necessarily pollute the water of those who have to use it, but no law exists to prevent a well being made, or works to be constructed over porous rocks, to allow sewage to either flow or percolate into the same; this should be rendered impossible by Parliament. Instances of such works are known to the writer—of county council lunatic asylums and of city and county borough corporations. These are operations that might well come before a water board of the district of damage from pollution, for the complexity of the conditions point to the necessity of the possibilities of damage from all these causes being prevented by giving greater powers to the Local Government Board. It is obviously impossible that that department, already heavily overworked, can send inspectors on roving commissions all over the country to find out dangerous proposals, many of which can be carried out without recourse to the board or to parliament. But if each district had its own water board, it could communicate direct to the department, formulate its wishes, and point out the necessity of their advice or of a local enquiry.

If the common law should be altered, the matter of subsidence for the removal of material in chemical solution by pumping should obtain attention. As regards brine pumping, in which the contact of an imperial gallon of water causes it to take and hold in solution over 3 lbs. of common salt, special legislation has been recently passed overriding "the common law" as regards underground water, but unfortunately has absolutely failed to discriminate between the damage caused by "natural brine," *i.e.*, artesian water resting on the upper surface of the top bed of rock salt in the Cheshire district—to that caused by the abstraction of "mined brine"—*i.e.*, water derived from streams that flow through old shafts, from time to time silted up, into the large excavations in the lower rock salt bed, in which the principal mines occur, and which at the present time is alone mined. This injustice is a matter which requires further legislation.

In the Burton-on-Trent Brewery district, water impregnated with gypsum extracts from the area around 250 lbs. of sulphate of lime for each 1,000 barrels of ale brewed. Very large quantities of gypsum are thus removed from beneath the Needwood Forest district.

In the chalk area, every million gallons of water pumped abstracts from the chalk 1¼ tons of that material through which it has percolated, giving an additional storage for 110 gallons of water.

In the case of water rising at artesian pressure to the surface, and overflowing into a water-tight receptacle, there is no possibility of surface contamination, no matter how dangerous the surroundings, provided always that no pumping takes place allowing a cone of exhaustion to take place. Supposing the strata to be thoroughly porous from the surface to the point at which water enters the tubed portion of the borehole, and the tubes are carried up to the surface, or above it, on the principle that a gallon jar, when full, cannot hold more than that quantity, but if half-a-gallon be removed a similar quantity can be replaced, then if a void be produced in the surface rock and the artesian water removed, a conical space is left for the percolation of surface water with any impurity in solution that may be present. In many cases the borehole pipe terminates in the bottom of a well, which should always be made thoroughly water-tight by iron cylinders securely connected, and the bottom of the well should be carefully cemented, and annular space at the back of the cylinders made thoroughly water-tight. Cases are known to the writer where the well is simply excavated in the rock, the artesian water allowed to rise into it, and is pumped down below surface level, and percolation from the surface is left to its course. This points to the necessity, from a health point of view, of every waterworks,

* Chasemore v. Richards.
† Ballard v. Tomlinson.
‡ Popplewell v. Hodkinson, vol. iv., Exchequer Cases; and Acton v. Blundell, and Elliott v. the North-Eastern Railway.

belonging either to local authorities or private companies giving a public supply from a pumping station, being inspected by a competent expert; and it appears more desirable that he should be an official of the Local Government Board than of a local water authority, as the knowledge requisite for a sound judgment in such matters requires a wider experience than can be, as a rule, locally acquired. Considerable danger also often accrues, in cases where no wells occur and borehole pumps are used, by the annular space at the back of borehole tubes not being filled up with cement, allowing surface water to trickle down the back of the tubes to the water plane, which thus becomes polluted. Similar induced artificial passage of water-effects are met with in laying sewer pipes. A trench is made, and surface water is pumped up to allow the work to proceed, and the local wells are dried up. Then the pipes are laid and made thoroughly water-tight; but the water-level is forever afterwards lowered to that of the pipes, the ground water following their line in the annular space. Thus millions of gallons of good chalk water are lost in more than one county.

The absolute impermeability of the rocks, or their entire perviousness, as well as intermediate degrees of porosity, can be recognized, without a visit to the ground or the possession of a geological map, by inspection of a good topographical map. This is at once apparent if a square mile of a 1-inch Ordnance map be compared, say, in the Sherwood Forest, north of Nottingham, or of the chalk (where not overlaid by drift) in Kent, with a similar area of gault or weald clays in the latter county, where it will be found, as pointed out to the writer by the late Mr. H. E. Martin, M.I.C.E., that the linear mileage of streams varies in the one case and in the other from five miles to one mile, or even from five miles to even less, and in some cases no stream being indicated over the whole area in question. Porous rooks being absorbent, streams are but little liable to floods, consequently the sectional archway of the bridges over them is exceedingly small in relation to the sectional area of those over streams draining similar areas of impermeable rocks. This fact was some years ago well brought out in a series of drawings made by the instructions of the late Mr. C. Homersham, M.I.C.E., F.G.S.

The evidence lately adduced in the London Water Bills before the House of Commons clearly brings out that the bed of a stream may be naturally puddled by clays occurring higher up the stream, though flowing over a porous rock, and that the saturation level of that rock may be a good deal lower than the stream; in this case pumping will not affect the stream, unless the area of the cone of exhaustion extended up stream so as to cut off the springs supplying the same.

On the other hand, the late Mr. Taunton, M.I.C.E., of the Thames and Severn Canal, clearly showed that where a stream passes across porous rocks between impermeable layers, as does the Thames above Oxford, which have not sufficient surface area on either side of the stream to be charged with water derived from rainfall, they absorb direct from the river and deplete it to a very serious extent for certain lengths, but the porous rocks in the Thames case are cut off on the dip by faults, with impermeable material on the upcast side; these return the waters so abstracted to the river at a point lower down in its course; it is obvious that did no faults occur the water would be lost to the Thames for good.

Should a water Act be passed consolidating the various existing laws, and the Local Government Board staff be strengthened as to allow more constant inspection, and water boards in each catchment basin be called into existence, the supervision of canal waters must necessarily follow. In many cases they are a fruitful source of evil from pollution received from streams, which is rendered doubly dangerous from the slow speed at which canal waters travel. And in other areas where the water is comparatively pure, or perfectly so, there is a grave danger that may account for the sporadic appearance of cholera, typhoid, and diphtheria at unexpected points—that is, the milk supply being poisoned by cows drinking canal water on the margin of the fields, which water had just been contaminated by the barge population suffering from diseases they have acquired in passing through the great centres of population. The relation of the path of progress of the various cholera visitations to that of the course of canalized rivers and canals is a most important one, and points to it being made an offence to allow cows to drink canal water.

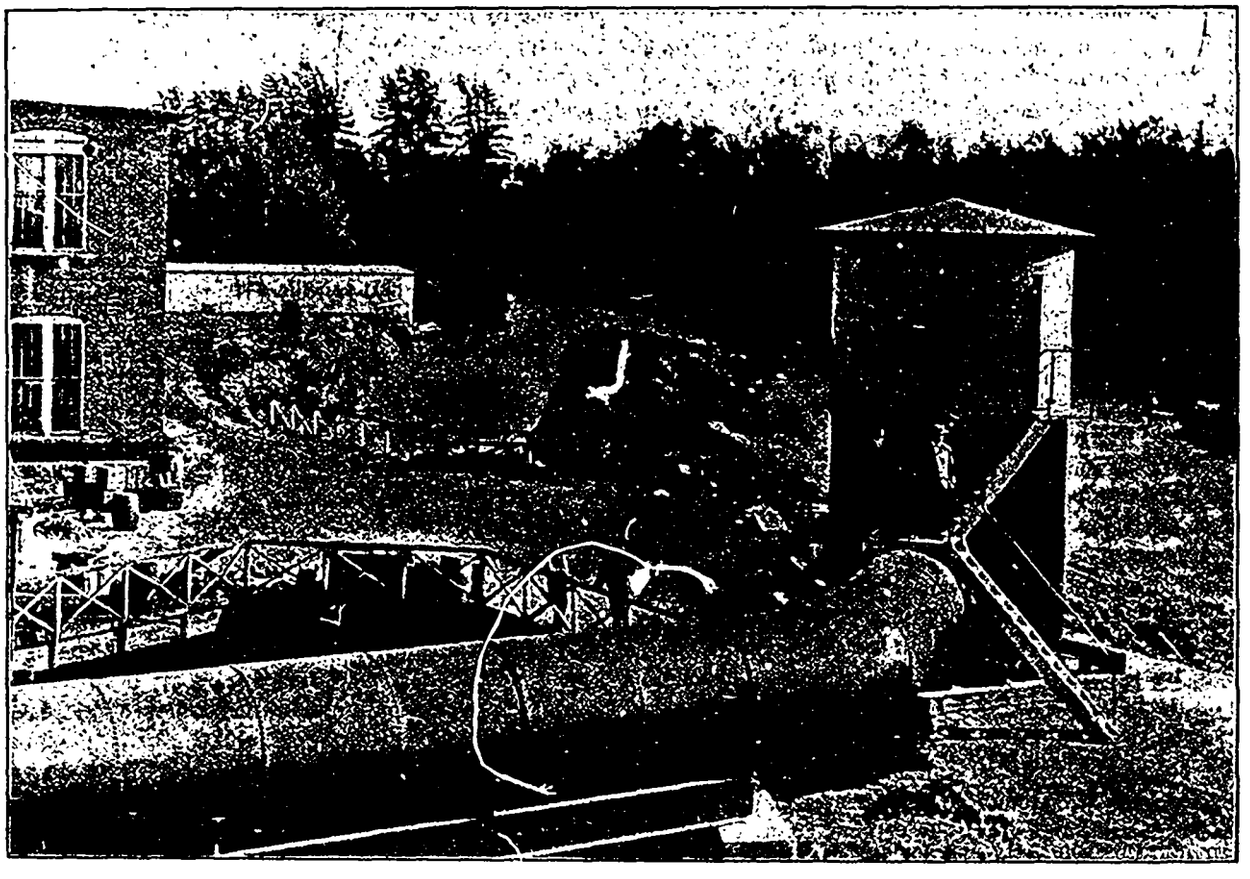
The writer wishes to state, in conclusion, that he is aware a "Floods Prevention Act" is now before Parliament, but looking to the complexity of the existing law, he ventures to suggest successive stages of modification and unification of the complex Acts of Parliament affecting water rights in so many diverse modes of application for the public good and public requirements; and ventures to make the following suggestions, as the outcome of close and serious attention to the questions involved since 1866-7, when he assisted the late Mr. R. W. Mylne, C.E.,F.R.S., then hydraulic engineer to the War Office, in his investigations that led to the successful sinking below the sea bed of artesian wells, for the supply of the Spithead forts. Between 1868 and the present time, as an officer of the Geological Survey of England and Wales, his attention has been always more or less drawn to the subject by the course of official duties, but more especially as secretary to the Underground Water Committee of the British Association for the Advancement of Science from 1874 to 1895, and having drawn up the 22 printed reports, he is of opinion that, looking to the complexity of the existing water law, vested interests in the parliamentary costs of obtaining the existing powers, and the far larger capital expended in carrying out works so sanctioned for various purposes affecting water on the one hand, and the necessity of dealing with the same for the public good on the other, that decisive, but progressive, steps in legislation are absolutely requisite, and is of opinion that the varied, and often antagonistic, requirements, and the necessary funds to deal with various interests, cannot be incorporated in any general Act of Parliament, and he ventures to suggest that it is advisable that (1) county councils, or groups of the same, be given powers by Parliament to form "Water Boards;" (2) that such boards have power of control of all water within their area in three stages: (*a*) direct; (*b*) with Local Government Board sanction, after local inquiry at suggestion of the local authority; (*c*) after parliamentary enquiry and approval of the modification of existing rights and previous Acts, subject to monetary compensation when rights, exercised under parliamentary powers, were affected.

THE TAYLOR SYSTEM OF AIR COMPRESSION.

The utilization of compressed air for mechanical purposes has long attracted the attention of scientific engineers; but compression by steam or hydraulic power has never been perfectly successful, on account of the loss of power caused by the heating of the air in mechanical compression, and the cooling of it in transmission. These difficulties have been overcome by the Taylor system, the air from which is, by the tests, six times drier than the normal atmosphere, and of the same temperature as the water fall. This system, the invention of a native Canadian, C. H. Taylor, of Montreal, was fully described and illustrated in THE CANADIAN ENGINEER, in April, 1895, the article having attracted much attention at the time. It remained, however, to be put to the test in an actual working plant, which has been done at Magog, Que. Here a plant of 150-horse power has, after many initial difficulties, which proved the faith of the projectors in their system, been installed for the Dominion Cotton Mills Co., Ltd., and which for the past two months has been operating their calico printing machines with perfect satisfaction, and a great saving of expense, their former power being steam. Mechanical air compressors were tried, and failed to operate these very machines.

The plant consists of a shaft sunk to a depth sufficient to obtain the pressure required, ending in a receiving tank, for the air and water.

It will be of interest to our readers to repeat briefly the claims made on behalf of the Taylor air compressing system when its description appeared in this journal. These are chiefly as follows: It can be successfully applied to any waterfall where there is a head of three feet and upwards, thereby bringing into use many low waterfalls at present not considered available for power. By this system air can be compressed to any pressure and transmitted by ordinary pipes any distance required, with little loss of energy, and with practically no wear or tear. The air can be supplied to any style of engine, taking the place of steam. Being perfectly automatic, there is no cost for operating after the plant is installed. It completely overcomes the smoke nuisance, and the exhaust serves as a perfect ventilator for mines, factories, etc., and can also be used for refrigerating purposes. It can be applied to mining, pumping, drilling, elevating, ventilating, transmission of power, and street railway and other power development. According to Prof. McLeod's report, the Dominion Cotton Company's plant at Magog shows an efficiency of 62 per cent. of the actual power of the water used, transmitted in compressed air, with a waste of 20 per cent. of the air taken down. In the installation of any future plant, this surplus of air is to be utilized by increasing the size of the air chamber, and consequently the efficiency will be increased by not less than 10 per cent.



TAYLOR AIR COMPRESSING PLANT AT MAGOG.

The following is the report of Prof. McLeod, of the Faculty of Applied Sciences, McGill University, Montreal, October 27th, 1896:

The Taylor Hydraulic Air-Compressing Company:

DEAR SIRS,—At your request I have examined the Tayor Hydraulic Air Compressor recently completed at Magog, Que., and beg to hand you my report thereupon. This installation is, I am informed, the first on Mr. C. H. Taylor's system of supplying power by compressing air in a falling water column. The general features of the method are clearly shown by the annexed drawing. [See page 345, vol. 2, CANADIAN ENGINEER.] The water in the downflow pipe *A* entraps air bubbles from the small air pipes at the upper surface, and compressing them as it falls, delivers them into an air chamber at the bottom of the shaft. The air is conveyed from this reservoir or air chamber by the small

pipe marked *D*, and the depleted water rises to the surface through the main shaft to the tail race. The pressure of the air in the chamber is measured by the difference of level between the surface of the water in the chamber and that in the tail race. In the Magog compressor the average water column measures 120.5 feet, which is equivalent to a gauge pressure of 52 lbs. The diameter of the water supply pipe is 5 feet 6 inches. The diameter of the tank at the inflow is 12 feet. The diameter of the headpiece carrying the air-tubes is 4 feet 8 inches. The internal diameter of the downflow pipe is 3 feet 8½ inches The air-compressing chambe has a diameter of 17 feet, and an average height of 6 feet from the base of the downflow pipe. The compressor was constructed to drive six double engines, the cylinders of which measure 12 in. x 8 in. diameter.

METHODS OF TESTING.

The following methods were employed in testing the efficiency of the compressor: The quantity of water which passed through the compressor was measured in the tail-race by means of an electrical recording current meter, which has been carefully rated. The section of the tail race where the measurements were made was nearly rectangular, and had a width of 12 feet. The depth of the water, which, of course, varied with the discharge, ranged from three to nearly four feet. The measurements were made in four equally spaced vertical sections and at three points in each section. The air delivered was measured by anemometers placed in a discharge pipe, the area of which was gradually enlarged to about one square foot, at which area the velocities were sufficiently reduced to admit of measurement. Measurements were made at points uniformly distributed throughout the section, and each series of readings extended over one hour. For each trial the measurements of water discharge and air delivered were made simultaneously. The anemometer employed has been very carefully calibrated for these trials. Two of the driven engines were indicated, but it was found that they were so wasteful and leaked so badly that no idea of the efficiency of the whole plant could be formed by comparing the indicated horse-power with the available power of the waterfall.

The results of the tests are presented in the annexed tabular form. Column I. gives the number of the trial, for convenience of reference. The trials 1 to 3 were made on August 7th, and 4 to 6 on August 13th, 1896, after some minor changes had been made in the details of the compressor. Column IV. gives the horse-power actually expended by the falling water on the air compressor, and Column VII. the horse-power of the compressor. The efficiency (Col. VIII.) is the ratio of the actual compressor horse-power to the horse-power available in the water fall. It will be seen that the efficiency varied from trial to trial, and that where the quantity of water used was small, the efficiency was large. It will also be observed by comparison of trials 1 and 5—in which cases the quantities of water used were nearly the same—that the efficiency was greater in the latter case. This was owing to the fact that improvements were made in the details of the compressor in the interval. By reference to Columns IX., X. and XI., it will be seen that the air was isothermally compressed, which is a very marked advantage of this compressor, as the best mechanical compressors now in the market lose a large percentage by heating the air during compression, such heat being afterwards totally wasted if transmitted to any considerable distance through a pipe line.

Taking the most favorable conditions of working in this experimental installation as being the fairest estimate for probable future plants, the efficiency is seen to be 62 per cent. The very marked increase of efficiency with the use of a relatively small quantity of water points clearly to the possibility of an increased efficiency in future installations. It ought also to be mentioned that in a comparison which was made, when the compressor was working at nearly its full capacity, of the amount of air taken into the compressor at the air inlets with that discharged from it, it was found that there was a loss of about 20 per cent. This accounts for the smaller efficiencies obtained when larger quantities of water were used, and shows that if this loss can be made good, an efficiency of at least 60 per cent. will be obtained under all conditions of working.

C. H. McLEOD, M.E.

RESULTS OF TRIALS OF THE TAYOR HYDRAULIC AIR COMPRESSOR AT MAGOG, P.Q., ON AUGUST 7TH AND 13TH, 1896.

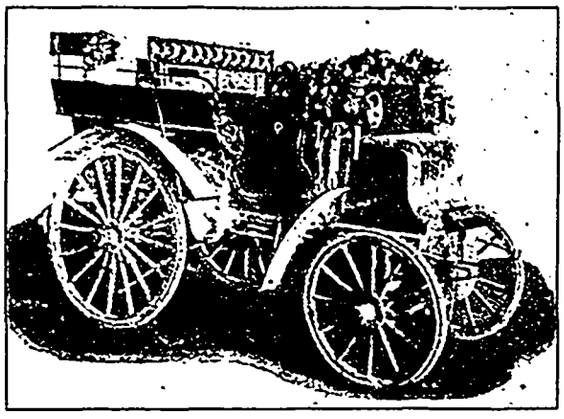
No. of trial.	Quantity of water discharged in cubic feet per minute.	Available head in feet.	Available horse-power.	Quantity of air delivered in cubic feet per minute at atmospheric pressure.	Pressure of air in compressor.	Actual horse-power of compressor.	Efficiency of compressor.	Temperatures. External air.	Temperatures. Water.	Temperatures. Compressed air.
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
1	6,122	21.4	247.7	1,377	52	132.5	53.5	79	75.2	75.2
2	5,504	21.9	228.0	1,363	52	131.0	57.5	83	75.5	75.5
3	4.005	22.3	168.9	1,095	52	105.3	62.4	80	75.6	75.6
4	7,662	21 1	305 9	1,616	52	155.4	50.8	75	80.0	80.0
5	6,312	21 7	260.0	1,506	52	144.8	55.7	77	80.0	80.0
6	7,494	21.2	299.8	1,560	52	150.2	50.1	75	80.0	80.0

(Signed) C. H. McLEOD.

THE HORSELESS VEHICLE.

THE CANADIAN ENGINEER, since its first enthusiastic advocacy of the horseless vehicle, has lost none of its faith in that invention, but further investigation has modified its opinion of what has been accomplished and what actually remains to be done to make the horseless vehicle the same success in highway transportation as the electric car has been in rail traffic. At the beginning of the year this journal proposed a moto-cycle competition in Canada, and a combination of enterprising citizens in Hamilton were prepared to encourage a race in that city with a substantial bonus. On looking further into the question, however, we were convinced that a race held this year would be disappointing to the promoters. Since then a representative of THE CANADIAN ENGINEER went to England, and after examining those on view at the Imperial Institute and the Crystal Palace, in London, and in other places in England—where not only English, but French and German types of "autocars" and "automobiles" are in use—he felt bound to endorse the opinion of the leading English engineering papers, that a good deal yet remains to be done before the horseless vehicle can be considered a universal road carriage. We may hope, however, that the problem will soon be solved, especially since the new Act has been passed in England, giving the liberty of the road to mechanically propelled vehicles. Seeing that such vehicles were never prohibited on the highways of the United States or Canada, it is a wonder that our boasted mechanical skill has not achieved greater things in this

line than this continent has yet been able to show. One reason of this dearth of result in America probably is that experiments are expensive, and the hundreds of small experimenters have been independently going over the same ground, while in England, the evolution of the horseless carriage is in the hands of a few syndicates with large capital, who control a great number of patents, and who can thoroughly work out each problem.



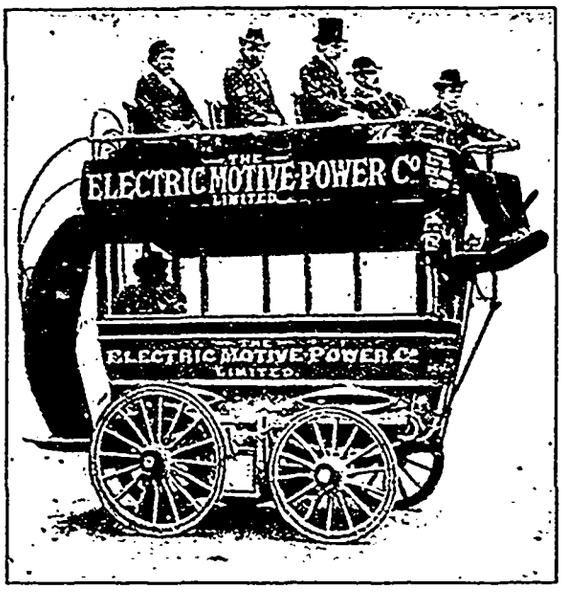
Panhard & Levassor Vehicle, Second Prize in Paris-Marseilles Race.

The question of a regulating gear for speed, and the question of accumulating and applying power for an emergency, are among the problems yet unsolved. Although a horse-power means a force that will lift 33,000 lbs. one foot high in one minute, a man who begins to study the horseless vehicle question soon realizes that a real horse in his work can, in an emergency, such as climbing a hill or pulling a load through a mud hole, exert ten or even fifteen horse-power for a short time, but your mechanically propelled vehicle cannot so adapt itself to an emergency. Furthermore, it is found that the strength of a horse pulling a wagon is exerted with greater effect than the same power exerted from and on the vehicle itself, especially when working through heavy roads. What we want is a source of power which does not in itself impose too heavy a weight on the wagon, and some means also of accumulating power for a sudden and heavy strain. There are other questions also, and although they are of minor importance, prospective manufacturers of horseless vehicles in Canada have, after all perhaps, lost nothing up to the present stage by waiting and following rather than leading.

Most of the machines on exhibition in England are crude in mechanism and clumsy in appearance; but thousands of brains are at work on this problem, and great advances must necessarily be made in the coming year. The last great contest held in France, in September, shows a decided advance this year in appearance and efficiency of vehicles, although, as a matter of fact, the number of manufacturers of vehicles in that country has not increased since 1891. There were 52 carriages actually started in that race—which was from Paris to Marseilles and back, a distance of 1,728 kilometers, or about 1,080 miles—and out of these 13 were timed as arriving back in Paris. Considering the extraordinary vicissitudes of weather, etc., this was a very good showing. During the race a tempest came on, followed by a gale, so that in the course of the race there was mud, dust, head winds, fallen trees, and fragments of fences, not to speak of ferocious dogs and bulls, to contend against. Fifteen dogs lost their lives from the mistaken notion that their duty called them to stop these strange invaders at all risks. One driver, to avoid collision with a dog, ran up against a tree, and so knocked himself out of the race, while M. Levassor, the winner, was capsized and delayed two hours by a dog. The bulls evidently viewed the horseless vehicles as a particularly objectionable innovation, for one of them charged the Bollee carriage with a force more disastrous to the carriage than the bull; while another dashed into the Rochet & Schneider carriage, both being knocked out. The first, second and third prizes were won by carriages made by Panhard & Levassor, the fourth place being taken by a Delahaye carriage.

In the class for vehicles with more than four seats the winners were Peugeot & Cie, and in the motor cycle class, for bicycles, tricycles, etc., a Dion tricycle won the chief prizes.

The time of the first Panhard & Levassor was 67 hrs., 42 min. and 58 secs., or an average of about 16 miles per hour. The Panhard & Levassor vehicles are fitted with a motor of their own design, the motor being a two-cylinder vertical one, and placed in the fore part of the carriage. The Peugeot & Cie carriage has a two-cylinder horizontal motor placed under the front of the vehicle and geared to the driving axle by three cog-wheels. These winners all had oil motors, and the chief difficulty in the operation of nearly all the carriages was the blowing out of the burners. It was the general opinion, after this contest, that the firing tube was not nearly so satisfactory, all things considered, as the electrical battery for ignition. Both steam and electricity have been rather discredited as a motive power in this contest. Considering the rain in one part of the race, the blinding dust storm in the other, and the variety of grades -some of them being more than one in ten—and condition of the road, with other hindrances, the time was very good and the test a very exacting one. A very comprehensive report



English Storage Battery Omnibus

of the contest is given in our interesting contemporary *Autocar*, of London, to which we are indebted for our illustration of one of the winning carriages. The illustration of the horseless bus, from the same paper, is from a photograph of an omnibus now being tested on the streets of London, and which can be operated with its load at a cost of 2d. or four cents per mile. The power is an Epstein storage battery weighing 15 cwt.,

and the total weight of bus is 2 tons and 4 cwt.; speed from one to ten miles per hour.

Speaking of cost of running, A. R. Sennett, C.E., recently gave some valuable comparisons of the cost of operating horse and horseless vehicles in England. With regard to the first cost of the outfit, the result was slightly in favor of steam motor vehicles. As to running cost, the consumption of fuel scarcely exeeeded a halfpenny per mile, per ton of the goods carried. For petroleum the cost would be about 2¾d. On the other hand, the cost of horse keep was notoriously high. With respect to the allowance for depreciation, the depreciation of an English-made vehicle might be put at 15 per cent. only. Depreciation in a tradesman's horse-drawn vehicle was exceedingly high; the average life of that type of draught horse was very short; and the loss through sickness and premature death of the animal was far more serious than the casual breakdown of motors. Then as to stabling, the space occupied by the motor-car was about half that occupied by the horse and plant, and there were sanitary and hygienic considerations of importance in the change. No doubt, driving a motor vehicle called for greater skill than driving a horse, but there could be established some system of granting certificates to drivers.

For THE CANADIAN ENGINEER.

CREOSOTING TIMBER.

BY WILLIAM B. M'KENZIE, MEM. CAN. SOC. C.E.; MEM. AM. SOC. C.E.; ASST. ENG. INTERCOLONIAL RAILWAY.

Timber.—It is of the utmost importance that only the species of timber best adapted for receiving the creosote should be used. Of the thirty-five different kinds of pine found in the United States and the ten kinds which grow in Canada, besides the Douglas fir or Oregon pine, as far as known at present, only the short leaf *Pinus mitis*, Michx., and the Loblolly-pine, *Pinus toeda*, Linn., are suited for creosoting as a protection against marine insects.

The Short-leaf pine is found in great perfection in the light sandy soil of Virginia and the northern part of North Carolina, while the Loblolly flourishes on the lower ground near the coast of both States. All the other pines, as well as the Douglas fir (Oregon-pine), spruce and hemlock, have too little sap wood for successful creosoting. They are also variable in texture, and require such a high and long-continued heat, that the wood is checked in the cylinders and the fibre injured.

These two species of pine are known by several different local or common names in different places, for instance: *Pinus mitis*, Michx., or *Pinus echinata*, Mil'er, commonly known as Short-leaf pine, North Carolina-pine, Yellow-pine, Spruce-pine, Bull-pine, Rosemary-pine, Frankincense-pine, Sweet-pine, Sap-pine, Lol lolly-pine, Oldfield pine, Slash-pine. Color, yellowish red. Sapwood, commonly over four inches of the radius. Section variable. Rings wide near the heart, followed by zone of narrow rings, not less than four, mostly eleven or twelve rings to the inch. A moderate amount of resin. This tree prefers a well-drained, light, sandy or gravelly soil, or warm light loam. Foliage short and scant. Cones small. Bark reddish, in long plates. Crown pyramid-shaped.

Specific gravity	0 6104
Percentage of ash	0.2900
Weight per cubic foot (lbs.)	38.04 at 212 Fah.
Compressive strength with grain	5,900 lbs per sq. inch
Compressive strength across grain	940 " "
Bending strength	9,230 " "
Tensile strength	13,400 " "
Shearing strength	688 " "

Pinus toeda (Linn.) commonly known as Loblolly-pine, Virginia-pine, Short-leaf pine, Rosemary-pine, Frankincense-pine, Indian-pine, Oldfield pine, Bastard-pine, Slash-pine, Black-pine, Swamp-pine, Meadow-pine, Sap-pine, Cornstalk-pine, Foxtail-pine.

Height of mature trees, 125 to 150 feet. Foliage thin. Color of foliage, sea-green. Coarse grain, 3 to 12 rings per inch, generally wider than in *Pinus mitis*. Color whitish to brownish yellow, the dark bands of summer wood being proportionately narrow. Sap wood variable, one-third to one-half of the radius. Resin abundant about midway between short-leaf and long-leaf. Bark grayish, in deeply fissured plates.

Specific gravity	0.6343
Weight per cubic foot (lbs.)	39.23 at 212° Fah.
Compressive strength with grain	6,500 lbs per sq. inch.
Compressive strength across grain	990 " "
Bending strength	10,100 " "
Tensile strength	14,400 " "
Shearing strength	690 " "

GENERAL INFORMATION ON PINES.

The annual rings are closer together at the top of the tree.

Logs cut from the foot of the tree are 7 per cent. stronger, and two pounds per cubic foot heavier.

The greater the weight, the greater the strength.

The strongest wood is at one-third the distance from the heart, and the strength decreases from the heart to the periphery 15 per cent. to 25 per cent.

Large beams are from 10 per cent. to 40 per cent. weaker than small beams of the same material.

Green timber beams fail first on the compression side.

Seasoned wood is 50 per cent. to 100 per cent. stronger than green wood.

Short-leaf pine is one-third weaker than long-leaf pine.

Wood seasoned out of doors under shelter, retains about 15 per cent. of moisture, computed on the dry weight.

Wood used in doors retains about 10 per cent. of its moisture, computed on the dry weight.

The faster the drying, the greater the checking and warping.

Boxed or tapped long-leaf pine timber is slightly stronger than untapped timber, and is in no respect inferior. The tapping extends over a period of four years. A large proportion of the long-leaf pine lumber is from tapped trees, and it is never kept apart or distinguished from the untapped by either the millers or the dealers. No available criteria exist by which to distinguish the two kinds of long-leaf timber—tapped and untapped—after manufacture. Some of the most resinous long-leaf timber comes from tapped forests and some of the driest from untapped forests.

Age or use does not destroy the strength of timber, unless decay or season-checking takes place.

The heaviest wood shrinks most in drying.

Top-logs shrink 15 per cent. to 20 per cent. less than butt-logs.

Short-leaf pine shrinks one-quarter less than long-leaf pine.

The amount of water in the wood does not rule the shrinkage.

Wood is composed of carbon, 52.4 parts; hydrogen,

5.7 parts, and oxygen, 41.9 parts, and its specific gravity is about 1.5.

The bark forms 10 per cent. to 15 per cent of the volume.

It is only owing to the looseness of texture that most timbers are lighter than water.

Immersion in fresh water soon after felling makes timber more durable, and one year in salt water doubles the life of timber.

Sap freshly drawn from a tree begins to putrefy in 24 hours.

The time of felling has no effect upon the strength of pines.

Green sap wood contains about 50 per cent. water computed on the dry weight.

Sap wood is heavier than heart wood, and the part formed in the summer is twice as heavy as that formed in the spring.

Sap wood contains 1 per cent. to 4 per cent. of resin and about 1-6th of the resin is composed of turpentine.

It is from the sap wood of the long-leaf pine only that resin is obtained by tapping.

Sap wood shrinks one-quarter more than heart wood.

In trees 100 years old sap wood changes to heart wood in 30 to 60 years. In trees 25 years old sap wood changes to heart wood in 70 to 80 years.

In trees between the age of 80 and 100 years the sap wood is the strongest.

The sap wood in short-leaf and Loblolly pines forms about 60 per cent. of the volume.

Unseasoned heart wood contains about 20 per cent. water computed on the dry weight.

Heart wood of long-leaf pine contains 5 per cent. to 24 per cent. of resin, and about 1-6th of it is composed of turpentine. This resin is thick, and will not flow when the tree is tapped.

The cells of the heart wood are dead and contain only water or air.

At the top of the tree the heart wood is the strongest.

Excessive steaming or heat over 250° Fah., destroys the elasticity of timber. Creosoted timber is less liable to burn than untreated timber.

Creosoting with dead oil of coal-tar increases the resistance to bending 15 per cent., and the resistance to compression 22 per cent.

Piles driven after the 15th of June are seldom attacked by the *teredo* until the following spring.

PREPARATION OF PILES.

The sap is more fluid in timber cut in the first months of the year, and if the piles are floated direct from the forest to the creosoting works, water will enter the cells, drive out part of the air and act as a solvent to liquefy the gummy parts of the wood; so that when they are hauled out of the water, barked and laid on skids to dry, they will season better and more quickly than piles treated in any other way.

STEAMING.

The creosoting cylinders are usually 6 feet diameter by 100 feet long, of $\frac{5}{8}$-inch steel, fitted with cast-iron heads weighing three tons each, securely bolted on the ends of the cylinders. When the piles for treatment have been run into these cylinders on trolley cars, the doors are closed and bolted. Steam is then admitted to the cylinders and its heat increased by steam-heated pipes in the bottom. When the temperature in the wood reaches 187° Fah., the albumen in the sap (about one per cent.) solidifies. The heat enters slowly from the surface towards the interior and the sap is made more fluid. The air expands and part leaves the cells and, as the temperature rises above 212° Fah., the water therein is gradually transformed into steam. The extractive ingredients of the sap are driven from the wood, and, together with the water of condensation, collects at the bottom of the cylinder. The time required is directly proportional to the diameter and density of the timber, and varies from 8 to 10 hours. The temperature of the steam should not be allowed to rise over 250° Fah., as higher temperatures or long-continued steaming softens and separates the fibres of the wood, and thus reduces its strength.

VACUUM.

After the steam has been on a sufficient length of time, say from 8 to 10 hours, it is allowed to flow out of the cylinders by its own pressure, and this is followed by the vacuum pump exhausting the air and vapor from the cylinders and the wood, removing at the same time the extractive ingredients of the sap from the cylinders. A vacuum of from 22 to 25 inches is continued for from three to five hours, and until the discharge has neither odor nor taste of turpentine. In order that as much as possible of the water in the cells towards the centre of the timber be volatilized and removed as steam by the vacuum pump, it is necessary that while the pump is working the heat be kept above the condensing point, which varies from a temperature of 212° F. under one atmosphere, down to 135° F. under a 25-inch vacuum. The heat must not be so high as to cause checking of the timber. Short-leaf pine withstands this ordeal better than any other kind of wood. While the vacuum is on, and when timber is green, steam is usually admitted to the coils within the cylinders at about 250° to 300° F., and when the wood is very wet, at a maximum of 350° F.

(To be continued.)

For THE CANADIAN ENGINEER.

BRIDGE BUILDING.

J. A. Waddell, of Kansas City, is paying a visit to McGill (where he graduated in 1882), and is giving a series of lectures on bridges to the graduates of Applied Science. He was for four years professor of civil engineering at the Imperial University, Tokio, Japan, and in recognition of his services was made a Knight Commander of the Rising Sun by the Emperor. He is now consulting engineer of the Kansas City, Pittsburg and Gulf Railway, and permanent chief engineer of the Omaha Bridge and Tramway Co. He has works of an aggregate value of several million dollars under his charge in Chicago, and is just finishing the Esquimalt and Nanaimo trestle and arch bridge for the E. & N. Railway, B.C. This last is the only work Mr. Waddell has had the opportunity of doing for his native country.

In the lectures already given, two great aims are apparent, viz., greater attention to artistic effect, and a better method of teaching civil engineering. In the lecture on "Architectural Effect," Mr. Waddell points out that nearly all the metal bridges built during the last twenty or thirty years in the United States seriously violate the principles of æsthetics. The reasons for this are that many technical schools provide no instruction in architecture, that the amount of money at the disposal of the designer is usually small, that most

American engineers seem to regard with contempt any effort to engraft architectural ideas upon engineering construction, and the custom of letting bridges upon competitive designs, and awarding the contract to the lowest bidder.

Henry Van Brunt, in a letter to Mr. Waddell, confesses that the bridges of the present day are far in advance of those built ten years ago from a mere engineering point of view; but this creditable progress has not carried with it a corresponding progress in grace and beauty of design. In fact, these qualities seem to appear in inverse proportion to the development of the structural scheme towards the practical ideal of strength, stability, and economy. The modern steel girder or cantilever bridge, while perfectly adapted to its uses according to present knowledge, is, nevertheless, in nearly every case, an offence to the landscape in which it appears Its lines, since they have ceased to be structural curves, have become hard mathematical expressions, and have not been brought into any sympathy whatever with the natural lines of the stream which it crosses, of the opposite banks which it connects, of the meadows, forests and mountains among which it is placed. All sylvan effects of harmony are shocked by its discordant intrusion. Even a factory, a gasometer, a railway shed, an elevator, need not challenge the architect in vain to produce effects of fitness not entirely inconsistent with the requirements of art. Indeed, the engineer himself, with maxims of art, has in the evolution of the roof truss, the locomotive, and many industrial machines, succeeded in satisfying ideals of beauty in the very process of making them powerful, compact and economical of material and space.

In concluding some very instructive direct hints on decoration, the lecturer said that true economy, engineering excellence of construction, and the best architectural effects will almost invariably be found to accompany each other, and that any bridge built with the due consideration for, first, efficiency, second, appearance, and, third, economy, will be satisfactory and pleasing. He divided the architectural treatment of bridges into four parts: 1st. The laying out of spans, piers, and approaches. 2nd. The outlining of each span. 3rd. The decoration of each span. 4th. The ornamentation of the entire structure by elaborately artistic approaches.

These were treated of in detail, and exemplified by many views of bridges designed by Mr. Waddell. Amongst them were the Sioux City bridge, East Omaha bridge, Halstead Street lift bridge, Buda Pesth bridge, St. Louis train shed, ornamental elevated bridge at Chicago, Jefferson City bridge, St. Louis bridge, and the Esquimalt and Nanaimo trestle and arch bridge. This lecture forms a chapter of a book on the subject of bridge building, which Mr. Waddell will ultimately publish.

The Goldstream Trestle is on a tangent throughout, and consists of four thirty-foot spans and three sixty-foot spans, with two braced towers and two solitary bents. The spans are deck plate girders six feet deep and spaced ten feet centres. The towers are braced on all four faces with rigid, double cancellation bracing, and the diagonally opposite posts are connected at the panel points by horizontal, adjustable rods. The greatest height of grade above pedestals is one hundred and six feet. The structure is to be on a grade of seven-tenths per cent. The batter of columns in transverse planes is one and a half inches to the foot.

The Trent River Trestle is on a tangent, excepting only two short spans at one end that will be on a ten-degree curve; will consist of ten thirty-foot spans, four sixty-foot spans, and one one hundred and thirty-three-foot span. With the exception of this long span, all the details of this structure are similar to those of the Goldstream Crossing. The greatest height of grade above pedestals is about seventy-five feet. The entire structure is on a level grade.

The Arbutus Ravine Trestle is on a ten-degree curve throughout, except for about one span length at one end that will be on a tangent; consists of five thirty-foot spans and five sixty-foot spans. The greatest height of grade above pedestals is about one hundred and sixty-three feet. The structure is all on a grade of seventy-five hundredths to the foot. The batter of the columns in transverse planes is two inches to the foot. With the exception of the curvature and its resultant effects, the detailing of this structure is similar to that for the two trestles previously described. One important feature of this trestle is the parallelism of the two transverse faces of each tower, thus making the latter rectangular just as if it were on a tangent.

The Niagara Ravine Arch and Trestle.—This structure, which is mainly on tangent, but has a short piece of ten-degree curves at each end, consists of one thirty-foot span, three sixty-foot spans, and an arch which will measure two hundred and sixty feet between centres of end pins. The trestle portion of the structure is similar to that described for the other crossings, the batter being two inches to the foot. This arch spans a gorge over two hundred feet deep. It is a three-hinged arch, with riveted joints, rigid upper lateral bracing, and adjustable lower lateral and inclined sway bracing. The structure is on a grade of one and a-half per cent.

All anchor bolts are of soft steel, with cold, pressed threads. These give fully fifty per cent. excess of strength over ordinary cut-thread bolts. The four pedestals forming the skew-backs of the arch are of cast steel of the best obtainable quality. No imperfect casting was accepted. The end stiffeners of the girders were made one-half-inch thick to provide for planing down to three-eighths of an inch to secure perfect contact.

The trestle work was erected by an overhanging traveller reaching far enough to build a tower thirty feet long and seventy-five feet from its vertical axis to the bent last erected. The two halves of the arch were erected and riveted up in a nearly vertical position, then lowered gradually by blocks and tackle till the upper ends met at mid span, when the two pins were driven.

Mr. Waddell will give more lectures in Montreal on technical engineering subjects. He is well provided with material for lectures of a more popular character, but whether any of these will be delivered depends on the time at his disposal.

For THE CANADIAN ENGINEER.

SAND CEMENT.

BY PROF. CECIL B. SMITH, MONTREAL.

The engineering public is always interested in the improvement of cement. One of the most likely directions for such improvement at present seems to be the use of sand cement. Concrete is a mass of coarse stone or gravel whose interstices are filled with sand, which in turn has its interstices filled with cement. The finer we grind the cement the more completely is the surface of each sand grain covered with it, and the stronger the resulting mass. Now let us go one step further and

we have sand cement. Let us take a mixture of say 1 to 1 of Portland cement and pure sand (silica sand), and re-grind this mixture into an impalpable powder, in which the cement gets ground very fine and the sand itself is as fine as ordinary cement. If we mix this sand cement in the proportion of say 1 sand cement to 3 ordinary sand, we obtain a mortar nearly as strong, and indeed some claim fully as strong, as an ordinary mixture of 1 cement, 3 sand.

This process enables us to use less cement, and expend more on grinding. The relative costs are appreciably in favor of sand cement. A special application would be to haul a grinding mill to the site of large public works, where cement costs high by reason of freight; but where sand is plentiful, a large saving could be thus effected. Whether sand cement can be made and shipped in competition with ordinary cement remains yet to be demonstrated. In Denmark it has been made for two years, and cement works in Germany, Russia, Italy and the United States have commenced its manufacture.

The following tests were made on "Iron Clad" brand, and on a mixture of 1 to 1 "Iron Clad" and silica sand ground into a sand cement. Both were received from Glen Falls, N.Y:

COMPARATIVE TESTS OF "IRON CLAD" PORTLAND AND SAND CEMENT MADE BY GRINDING ONE PART "IRON CLAD" AND ONE PART SILICA SAND.

	Residue on No. 100 sieve.	Blowing test.	Tensile strength: 1 dys. neat.	1 wk. neat.	4 wks neat.	3 to 1 1 wk.	3 to 1 4 wks.	3 to 1 1 wk	3 to 1 4 wks.
"Iron Clad"	3.5 per cent.	Good	340	775	790	98	187	199	224
"Sand cement"	1.5 per cent	Good	3*6	475	602	*3	105	*	202

	Residue on No. 100 sieve.	Blowing test.	Compressive strength. 1 week. neat.	4 weeks. neat.	1 week. 3 to 1.	4 weeks. 3 to 1
"Iron Clad".....	3.5 per cent.	Good	6,500	6,560	1,375	1,6*8
"Sand cement".....	1.5 per cent.	Good	3,380	4,650	1,6*0	1,123

* 3 to 1 sand tests made with standard sand.
4th and 5th columns in tension, 20 per cent: water, 20 lbs. per sq. in. moulding.
6th and 7th " " 12 " " rammed.
3rd and 4th " compression 12 " " "

CALCIUM CARBIDE IN CANADA.

A detailed account of the discovery of calcium carbide and acetylene gas, together with a sketch of the discoverer's life and a portrait, appeared in THE CANADIAN ENGINEER for January, 1896. Since then we have from time to time noted the progress of the new illuminant. As our readers are aware, a plant has been established by T. L. Willson at Merritton, Ont., for the manufacture on a large scale of carbide. The following description of the works is condensed from the Report of the Bureau of Mines (Ont.):—

At Merritton, on the route of the old canal, T. L. Willson has acquired the power as locks Nos. 10, 9 and 8, giving a fall of 12 feet 8 inches, 12 feet 6 inches and 12 feet 2 inches respectively, and yielding a total of 1,650 horse power. Works have been completed for the manufacture of calcium carbide. A flour mill, which stood for many years at lock No. 10, was purchased and part of the milling machinery adapted for the preliminary processes of treating the lime and coke. Both materials are required to be reduced to a fine powder, but the coke must be ground finer even than the lime. For the lime a "pot" crusher gives the first reduction, and about one-third of the material is brought by this operation at once to the necessary fineness, the remainder being sent on to a pair of millstones, where it is also ground sufficiently small. The coke is reduced by successive pairs of corrugated rolls of graduated fineness, from each of which the product passes through a "scalper" or "grader," which sifts out the particles brought down to the required size, and returns the coarser ones to the next pair of rolls, the final operation being performed by a pair of smooth rolls. The whole process of grinding the coke answers almost exactly to that of making flour by the roller method, and is performed on machinery designed for this work. The lime and coke, when sufficiently crushed, are elevated to bins, whence they are emptied into a weighing hopper, and mixed in the proportions of about 100 lbs of lime (anhydrous) to 60 lbs of coke Below the weighing hopper is a revolving cylinder in which the materials are thoroughly and intimately mingled, after which the mixture is stored in bins ready to be conveyed to the furnace room Here is a series of electric furnaces, constructed in pairs Each furnace requires about 250 horse-power for its operation. It has been found advantageous to run only one furnace of each pair at a time, so that when 250 horse-power is being used a pair of furnaces can be in constant operation alternately, time being required to withdraw a fused charge and introduce a new one. The furnaces are the same in principle as those at Spray, North Carolina, but with improvements in detail, and capable of reducing a greater proportion of the charge to calcium carbide. When the aggregate power of the three falls is utilized, there will be six sets of furnaces, requiring 1,500 horse-power, and capable of producing 7½ tons of calcium carbide in 24 hours.

The power plant consists of two Leffel twin horizontal turbine water wheels of the type known as the "Samson," at each fall, each wheel capable of generating 275 horse-power under 12 feet head, with full gate, and running at 120 revolutions per minute. The turbines are immersed in a substantial wooden penstock behind massive masonry, built to ensure the safety of the canal bank pierced for the water flumes, which are 18 feet wide, and contain a depth of 7½ feet of water. The wheels are run separately, not in tandem. Each is connected by a belt 28 inches wide with a dynamo having a capacity of 75 volts and 2,500 amperes; consequently, when the plant is complete, there will be six water wheels, each driving a dynamo, and furnishing a total of, say, 1,500 electrical horse-power.

The current generated by the falls at locks number 9 and 8 will be conducted by wire to the furnaces in the present building, and by connecting the terminals the whole of the electric power can be evenly and automatically distributed among the furnaces just as it is required. The belts connecting the water wheels with the dynamos are made of laced rawhide tanned to resist the action of water They are manufactured in St. Catharines under the patents of Mr. Ellis, superintendent of the Riordan paper mill.

A spur of the Niagara Central Railway runs to the door of the factory, giving good facilities for bringing in the raw materials and shipping the finished product

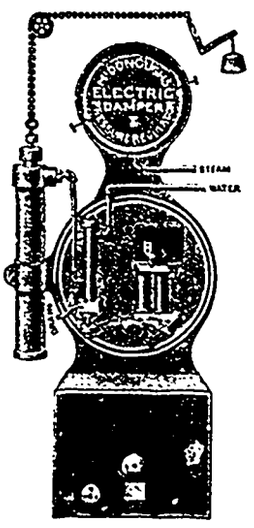
In discussing the lack of suitable carbon in Ontario for the manufacture of calcium carbide, the report says: "The vast amount of material annually going to waste in the sawmilling and other wooden industries of Ontario ought to afford an ample opportunity for the production of charcoal on an economic scale, especially by the distillation method, by means of which the bye-products, such as wood alcohol, tar, etc., are saved, and greatly reduce the cost of the process. The Rathbun Company of Deseronto has shown that it is both practical and profitable to do this, and other large manufacturers and sawmillers might with advantage take a leaf from their book."

Mr. Willson claims that a pound of the carbide will yield about 5 cubic feet of acetylene; consequently a ton will give off 10,000 feet. The illuminating power of acetylene being say 14 times as great as that of ordinary illuminating gas, the product of a ton of the carbide is equal to 140,000 cubic feet of the gas produced in either of these cities. In Toronto the price of gas is now 90 cents per 1,000 feet, so that calcium carbide at $80 per ton is equal to gas at 50 cents per 1,000 feet But Mr. Willson contends that the diffusive power of acetylene is much greater than is shown by the photometer, and that in practice a much less quantity is required than the theoretical equivalent, consequently the actual cost of the acetylene would be still smaller in comparison with that of gas. Arrangements are being made for a practical test of the merits of acetylene as an "enricher" of coal gas in the city mains of St. Catharines.

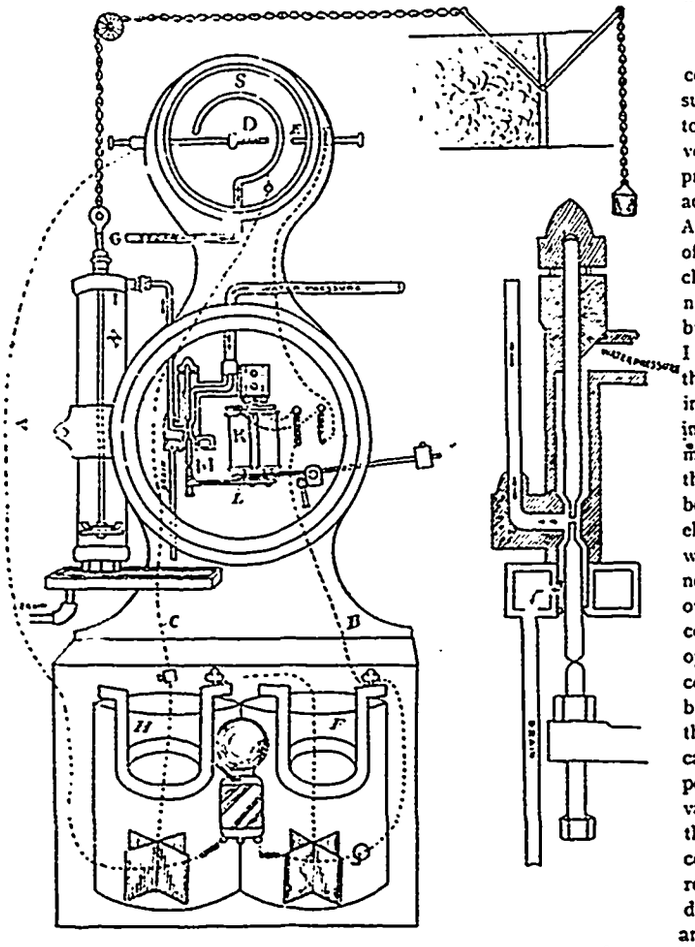
At the present stage of its development the illuminating properties of acetylene gas are engaging the attention of those interested in it almost exclusively, but the possibilities of its employment in synthetic chemistry in a commercial way will receive closer investigation when it has been a little longer in the market. Mr. Willson is advertising the carbide for sale at present for $80 a ton, ready barrelled for shipment, and at this figure he believes it absolutely certain to have a large local demand. The export trade to Europe will be a considerable feature of his business, and large contracts are offered him from Belgium and elsewhere. He confidently expects to be able to sell the carbide profitably in Europe at a lower cost than that at which the manufacturers there can produce it. Mr. Willson's faith in the future of calcium carbide, and his faith in the advantages offered by Canada, especially by Ontario, for its manufacture are alike great But it must be admitted that he is proving his faith by his works. He has undertaken the expenditure of a large sum of money in order to put his ideas into

effect, and professes his willingness to extend his works and build new ones in order to keep abreast or even in advance of the demand. He asks no bonus, exemption from taxes, or special privileges of any kind. He believes his business is a legitimate one, and one that will pay. A man who will invest his capital in developing the natural resources of the country is entitled to consideration, and the public in general will hope that Mr. Willson's reward will be commensurate with his energy and his pluck.

M'DONOUGH'S ELECTRIC DAMPER AND PRESSURE REGULATOR.



Among the advantages claimed for this machine over other damper regulators, is that being electrical it is more sensitive, and responds more quickly to any variation of steam pressure, changing the position of the damper for one-tenth of a pound variation of steam pressure. It rings an alarm bell when steam becomes low, and is a "regulator which does not have to be regulated." The machine is set by moving the pin *E* to or from gauge spring for any pressure desired. Steam from the boiler enters the pipe *G* to gauge, and as pressure increases the springs expand, until a contact is formed with pin *E*, thereby completing an electric circuit from batteries *H* and *J*. An electric current now goes out on wire *C*, returning on wire *B*, passing through magnets *K*, lifting armature *L*, on the arm of which rests valves *M*, which are opened, allowing water pressure to pass to cylinder *N*, forcing the piston down. The chain to which the damper is attached from the piston closes it. When the steam falls the contact between spring and pin *E* is broken; the armature falls from the magnets allowing the valves to close, shutting off water pressure, the damper is counterbalanced by weight, which now opens



and draws the piston up. When the steam becomes low the spring recedes, until a contact is formed with the pin *D*, closing the circuit, to which is attached a bell, which continues ringing while steam is low, thereby attracting the fireman's attention. The bell may be placed in any part of the building, separate from the machine, and is thus indispensable to caretakers, watchmen, or firemen, whose other duties compel them to be away from the boiler. This regulator is used by Toronto Street Railway Company, Consumers' Gas Company, Provincial and Dominion Governments, and O'Keefe Brewing Company. Manufactured by A. J. McDonough, 31 Hayter street, Toronto.

FIELD TESTING OF MINERALS.*

BY W. HAMILTON MERRITT, ASSOC. R.S.M., M.E., TORONTO.

At the present moment, when the mining interests of Canada promise to become the most important source of our future progress and development, much interest is naturally taken in everything which pertains to the prospector's art, and in this connection we present the following paper:

We all recognize the province in which we live is an extremely large one, and I generally emphasize the fact when I wish to impress outsiders by inviting them to recollect that Ontario stretches past parts of the great States of New York, Pennsylvania, Ohio, Michigan, a small portion of Illinois, Wisconsin and Minnesota, and when they realize that fact they begin to believe that Ontario is something. But unfortunately I think we must also recognize that Ontario is in a very partially prospected condition, and in a very partially surveyed condition too. Now, how many mines are actually operated to-day in that enormous expanse of country? We can really count the mines that are operating I think almost on the fingers of one hand. Therefore, it certainly should impress anyone that the amount of mineral development to the south of us in those States which bound Ontario is out of all proportion to the natural mineral possibilities of the two areas; that, considering the gigantic mineral development that is going on there, there is certainly a field in Ontario for more than the number of mines that you can count on one or two hands or a very great number of bands. And this partial development is in a country which is really nothing short of a kingdom in itself, full of immense possibilities. There is no need of mentioning that to you, gentlemen, who have come in personal contact with this great field in many places, where you have seen indications of a diversity and richness in mineral products which some day must form the largest proportion of the wealth of this province.

To-day we are only commencing to prospect.

It is a well-known fact that no class of men in the country come in such close contact with the prospector as the Ontario land surveyor (in this province), and there is no one who is in a position to assist him so materially, and without doubt he does assist him very greatly. Oftentimes the land surveyor himself might be a prospector. We know that it is not always the persons who are actually prospecting for certain minerals that are the discoverers. As a rule "chance" plays a very important part in the discovery of minerals. Most finds in the very first case are discoveries by chance. For instance, close at hand you will remember that the nickel-copper deposits were discovered entirely by chance, through building the Canadian Pacific Railway. And it is not long ago that I met in the Kootenay one of the Hall Brothers, who in hunting for their horses were the first men that discovered any mineral of value in the West Kootenay—"The Silver King," and from that date intelligent prospecting has brought about an enormous development. It is at present, I may say, enormous, but it is a very trifling thing to what it will be. So that a land surveyor may by chance be just as likely to come across a new mineral district as anyone else. While "chance" governs the discovery of many new fields, we do not know how many misses are made for every hit. We are not aware how many deposits of one kind and another may be passed over without their value being recognized. We well know the copper-nickel deposits in Sudbury were in the first place merely opened up for copper, and that nickel was not recognized. Of course that ore was not a usual thing for a prospector to discover, but at all events want of experience in that class of ore prevented the discoverer from recognizing its value in the first place. So there can be no doubt that it is advisable to have as much information as possible of all classes of minerals. Another very old story about the value of an ore not being recognized, most of you will remember in the case of the great Comstock lode in Nevada. The men who discovered it were only panning for gold in the first place, and did not recognize that there was silver in the ore (which was a good deal decomposed at the surface). They were throwing it away in heaps and continued to do so for a long time, while a very little prospecting knowledge and a very small outfit would have enabled them to have tested for silver, which is an advisable thing to do in almost

* Reprinted from the Proceedings of the Association of Ontario Land Surveyors, 1896.

any kind of stuff, because silver may frequently be present in a decomposed condition as silver chloride, and look like so much mud in the outcrop or oxydized portions of any veins

While it cannot be denied that a knowledge of common minerals, and the means of testing them in the field, is desirable, yet it is possible to go to the other extreme, and think we can rely on very imperfect tests under disadvantageous surroundings, to take the place of the chemist and the assayer. That is essentially a mistake. Where it is possible to bring any samples to be assayed or tested by the chemist and the assayer, it is always desirable to do so. I may say that, with one exception, the assayer's tests, as usually made, are naturally superior to those you can make in the field, while both tests are extremely desirable The one exception is the test for gold. The reason being that in an assayer's fire-test he gets all the contents of the ore without discriminating between the free milling gold and gold which is not extracted by mercury, but which requires some more expensive operations, such as smelting, chlorination, cyanide treatmen. etc , while you can make a field test which will give you practically just the same test as a mill test, if you do it carefully. "Old timers" are generally satisfied with the pan test They do not bother with the refractory portion of the ore at all If they cannot get a good showing with their pan they probably drop the prospect and go on to something else

Now, as an example of a field test of gold, applicable to either alluvial or quartz, we will take an auriferous quartz. Sampling is the first consideration Nowhere have so many mistakes and regrets arisen as through improper sampling. Fair sampling of any deposit, not only of gold but any other deposit, is a fundamental preliminary of immense importance Bringing in little pieces, and getting an assay (of course, the assay will show you what the specimen contains), will give no clue as to whether you can get hundreds or thousands of tons of it, which is the ultimate object of mining. This will remain distinctly to be proved, and therefore unless there is a certain amount of sampling done on the spot there will be difficulty in obtaining a proper result Especially is that the case in gold ores, which being of such high value a very little piece will throw an assay one way or the other tremendously It is always better to get as much as one can and make a heap on a level place and divide it up by quartering it down, or making channels through it and taking some out of the four remaining segments It does not require much discrimination to get a fair sample, and then break the pieces to somewhat similar size and get another sample, and again break smaller and get another, until it is quartered down to a reasonable bulk. Now, in the case of the gold ore, we will take two pounds of it, when we have got a fair sample in the manner indicated.

For this test we use an ordinary miner's pan kept for that purpose. The pan you use for panning for free gold never should have any mercury put into it. Then we must have a balance We are supposed to be in the field of course. It is very difficult now to get one of these cheap spring balances, because they are prohibited by law. Still if you can get hold of one it will be serviceable. These could weigh two pounds of quartz If you cannot get anything better, you certainly need not be at a loss while you can get one of these book or paper balances that cost about 30 cents, and which weigh up to 12 ounces. With that balance you can easily weigh out a couple of pounds, and it will also weigh out your ounce of mercury. After you have weighed out your rock in the first place, the two pounds, you pound it up to pulp in a mortar I am describing an outfit with which you can carry on this test, and arrive at the result that I am coming to, and which you can take away anywhere. The mortar costs about 90 cents to a dollar, a small mortar. Larger mortars are naturally preferable, but weight, as you well know, is a matter of consideration when you have to "pack" your outfit. Then you get the sieve for 50 cents to sieve the pulp with. In sieving it you should be very careful to notice whether there is any free gold left on your sieve After you have sieved the pulp you put the final part on a piece of paper, and with your magnet you take out the iron, and then with your glass you can easily see the free gold. If there is any free gold you probably will put it in a little porcelain thimble, with a little nitric acid to clean it. You then throw it in with the rest of your pulp When you have sieved your pulp and got your two pounds in the pan you then weigh out one ounce of mercury with your little scales.

The cheapest and best carrier of any kind of liquid is made by the "Patent lightest weight United States Mail Case Company" These cases are lined with cork and are very light and convenient You can put any liquid in them and can even throw them about without danger of breaking. The mercury can be carried in one of these cases. You weigh out your ounce of mercury, and then you throw it in with the pulp, or, what is still better, you put a little metallic sodium (which is a good thing to have with you in panning when you want to collect the globules afterwards if they are at all scattered, or even if the mercury is somewhat floured), to the amount of a small pea, in the mercury After you have heated the mercury in a porcelain dish you throw the resulting sodium amalgam into the pulp in your pan and then stir the pulp around with the mercury for about an hour, preferably with a wooden pestle The use of a porcelain mortar and pestle is sometimes advocated, but that is awkward for taking in the field, and at all events it gives a grinding effect, whereas we have already ground and sieved the pulp and really have it as fine as a mill would get it. All you want to arrive at in a test is about what you would get in the mill, so after you have stirred the pulp around for about an hour with a wooden pestle you pan off the pulp into another pan, because you want to get the concentrates in order to know what amount of concentrates there is in the ore as well as the free milling property of the ore You therefore pan off the concentrates and tailings and get all the mercury back, pan it a couple of times to make sure you have got all your mercury, then you pan for the concentrates and get your concentrates. So you have got the concentrates in one pan and the mercury in the other, and the pulp or tailings has been panned away. Then comes the question of retorting the mercury. Of course, cheapness is the main thing for a prospector's method, so the outfit must not cost more than is absolutely necessary. You may therefore use ordinary Russian sheet-iron and get it bent up into a little cup, which you can get for about ten cents, and you can unbend it open again afterwards if you like If you are anxious to save your mercury in the field you can do so if you take a good sized potato and hollow it out and use it to cover the little retort; all the mercury will then be caught in the potato and you get your little gold button, or gold sponge, left in the bottom of the retort. With your penknife you very easily scrape it loose, and you empty it out. Then you take a little assay lead and melt it with the gold sponge on charcoal. A little clay-holder, which costs 25 cents, can be used with prepared charcoal buttons. The other side of the holder is for scorifying capsules. A charging spoon is a handy thing to have The gold and lead are mixed together in the spoon, and then you carefully pour into the charcoal cavity and fuse together the gold and the lead. Now you have got the bullion in with the lead button, by means of your blowpipe and candle. You then mix some borax and a little soda, and fuse them with the lead button to purify it. Next you put a little bone ash in the other side of the clay holder, or in a clay pipe, shape it with the head of an iron bolt, and then you cupel the lead button and get your gold bead The great point is in the cost. Balances costing $130 and all that sort of thing simply makes a prospector sick when you mention it. It fairly paralyzes him; he loses heart and hope of anything in the future. But where you have got a $3 balance, it makes a good deal of difference. Every one of those beads I am exhibiting has been weighed on this $3 balance, which weighs to five grains, and is divided into a tenth of a grain. If two pounds of ore is taken, every grain of gold we get gives a result of approximately two ounces of bullion to the ton of ore. A tenth of a grain is two-tenths, or one-fifth, of an ounce to a ton. If the bullion is $18 bullion, one grain means $36 to the ton. One little division is a tenth of that, that is $3 60. With this balance you can quite easily weigh to half of that Therefore you can with no difficulty get the result of a gold ore running $1.50 to $2 a ton free milling with this balance, by using the two pounds of ore, and it is far better to use two pounds for a result than to use an assay ton (29.16 grammes) Therefore, in many respects, this field test is superior in its result to a fire assay When you can get an ore down to $1.50 to $2 a ton, and up as high as you like, of course it is very satisfactory. Take the case of a large button from an ore that showed $174 50 in free gold, a very rich ore which nearly exhausted the balance in weighing 4 3/10 grains in the balance. You have got the concentrates, you weigh them easily on the letter-weight balance. Having ascertained the number of ounces, or the decimal of an ounce, which they weigh, divide that amount into thirty-two (number of ounces in two pounds), and thus you get the proportion of the concentrates to the ore. Therefore you see how many tons of ore it takes to make a ton of concentrates. So that finally you have your free gold, and you know how many tons of rock you have got to mill to get a ton of concentrates, which is about all a prospector is very keen to know.

As regards the value of the concentrates. Roughly in the field you may say you can roast the concentrates, and either pan them directly, or, if you have two pounds, you can treat them as above described for free gold Or take two to three grains of raw ore, roast, then mix with litharge, soda and borax, cupel the resulting lead button, and if you get any gold at all, which you can see, it is worth making an assay of. But you can do still better. You can go a step further and use a little outfit which is very portable,

namely, a Fletcher's furnace, and a little crucible. The furnace has got a hole on the side, and you blow in and smelt anything in it, and then use a capsule for your scorification, if you prefer to reduce the lead button in that way before cupellation. Take the case of some concentrates for illustration. They are roasted, and three grains taken and smelted in the little furnace. Then you get it in the form of a lead button which is cupelled down, and you obtain a little button of gold, which you measure on the Plattner's scale. You will see it better as a rule if you use a glass. Suppose it opposite the figure 6 on the scale. A table in Fletcher's little book gives you the number of grains of gold there are in the concentrates to the ton of ore, so that finally now you have got the free gold and the gold in the concentrates, and you have got the number of tons of ore to make a ton of concentrates. Therefore, you see, in this case we have got $163.40, or something like that, per ton from the ore, free milling; then there is $38 to the ton of concentrates, and by the amount of concentrates we get, it shows that it takes 42 tons of ore to make a ton of concentrates. Therefore, a ton of ore yields about 90 cents to the ton in concentrates and $163.40 in free gold. You find all that out with this outfit, which is quite portable. It weighs only some 19 or 20 pounds, including 11 or 12 pounds for mortar and pestle.

Naturally, the more refractory the gold ore is the more valuable this test is. An assayer may give $50 a ton to a ton of ore. When you come to mill it, perhaps it is all refractory, and you cannot get out anything at all. If you had made this test in the field, for instance, and you find out it is all refractory, and you cannot get the gold by mercury, it entirely alters your whole base of calculation about the ore. It costs quite a different sum to treat.

Silver ore is very much easier to test by the blow-pipe. Any galena that is found should be tested for silver, because you may say the only value there is in the lead is in the silver associated with it. At least you get the lead to the good, as it were, and it is safer not to reckon on any value except the silver.

Now, we mix fluxes according to the class of ore. There are different charges given in the little manual by Fletcher. The book costs about $1.30, and is a very excellent work.

As an example, take an argentiferous galena. We mix three grains with a certain amount of nitre and carbonate of soda, and then fuse them in the little furnace. It gets to white heat and readily fuses all down, and then the next thing after we have got it reduced is to take out the bead by breaking the little crucible. You lose less silver in scorifying than you do in cupellation. So that next we scorify the lead button down smaller. All you need do is to put one of the little capsules in the clay holder, blow on the lead, and gradually it oxidizes down. The little silver-lead button breaks out perfectly clean. The lead button is then cupelled in the bowl of a clay-pipe on some bone ash.

A small silver button is obtained as the result. Place the silver button on the Plattner's scale, and see how many ounces to the ton it goes. By a table in Fletcher's book we see the button gives a result of 54.26 ounces to the ton of galena.

COST AND DETAILED DESCRIPTION OF APPARATUS.

The *panning* outfit catalogued below, including sufficient supplies of reagents, etc., for any ordinary prospecting trip, will cost about $7.50: 1. Glass stoppered bottle, containing strong nitric acid. (This can be carried in a "patent lightest-weight liquid-mailing case.") 2 Two gold-pans; one to be used for mercury only. 3. Mercury, about one pound. 4. "Travellers' letter and parcel-balance" hand-scale, weighing 0.25 to 12 ounces, for weighing mercury and pulp; cost, 30 cents. 5. Balance, hand-scale with sliding weight, very sensitive, from 0.1 to 5 grains; cost, $3 6. Small Russia sheet-iron retort, and sheet of Russia iron one foot square (with hole for retort in the centre), for supporting the retort. 7. Small porcelain dish or thimble. 8. Iron mortar and pestle; cost, 90 cents. 9. Brass wire 60-mesh sieve; cost, 50 cents. 10. A little sodium carried in naphtha, in a wide-mouthed bottle, in a "patent lightest weight liquid-mailing case." 11. Wooden pestle. 12. Sheet or shot-lead (pure, if possible). 13. Borax. 14. Soda. 15. Blowpipe; cost, 25 cents. 16. Bone-ash. 17. Clay pipe for cupelling. 18. Charcoal. 19. Candles. For *quantitative* determination of value of concentrates by measurement with Plattner's ivory scale (cost $3), a sufficient outfit, including the scale, can be obtained for $5, if the prospector makes his own little anvil, pestle and guard and pincers, and gets a small cheap hammer. He will need in addition (included in the $5) only a Fletcher blowpipe furnace, clay crucibles and capsules, a spirit-lamp and some litharge.

For *qualitative* work a prospector's simple blowpipe outfit might comprise: 1. Knife. 2. Magnifying-glass. 3. Blowpipe. 4. Charcoal. 5. Candle. 6. Old scissors. 7. Pincers. 8. Steel anvil, ½ by 1½ by 2 inches. 9. Pestle and guard. 10. Small hammer. 11. Magnet. 12. Borax. 13. Soda, 14. Litharge. 15. Bone-ash. 16. Clay pipe for cupel. 17. Round-headed bolt for making cupels. To which may be added platinum-wire, spirit-lamp, microcosmic salt, cobalt nitrate, three-cornered file and glass tubing. The total cost need not greatly exceed $1. Therefore for the entire panning, qualitative and quantitative field-outfit for purposes above indicated, the cost need not exceed $14, and with it the prospector, or indeed the mining engineer, can with practice obtain in most cases valuable information in the field concerning the ores of the precious metals.

Weight of Apparatus.—The weight of complete outfit, including the panning, qualitative and quantitative outfits (avoiding duplications in above lists), may be about:

	Pounds.	Ounces.
Two pans	3	12
Mortar and pestle	11	..
Remaining articles, including mercury and other ingredients	5	4
Total weight	20 pounds	

I shall not dwell on tests for other ores. There are certain field tests for some sorts of ore that are carried on very simply. Take two ores that sometimes look so very much alike that you can hardly tell one from the other. One is the usual ore of mercury and the other common red oxide of iron, hematite. If you use a simple little test on the blowpipe you can easily distinguish one from the other. The weight will roughly tell the value of an iron ore. Between the ores of iron which look very much alike you well know one scratches red, being hematite, and the other black, being magnetite. It is a good thing to make no mistake about having a magnet, because sometimes magnetic ores of a lean quality puzzle people. I have seen prospectors and assayers about to assay some lean magnetic ore for silver It may not look like magnetite, but the minute you take the magnet it attracts it and you can tell at once what it is. For native copper or galena you would pan. For the presence of copper dissolve in nitric acid, then add ammonia in excess and you get a marked blue color.

There are numerous little tests like that. One of the most difficult things to test is where a mineral occurs in very small quantities, such as nickel, but I have found by using the magnet and taking away most of the pyrrhotite some of the nickel minerals remain behind in a more concentrated condition. Then with a small borax bead you can get the reddish hue nickel color. There are a number of tests of different minerals that can be done in the field, but I did not intend at all to turn this into a class of testing ores, but just to show what can be done in some directions with a very cheap and portable outfit, because that is the main object. Expensive balances and heavy things to carry are an absolute impossibility. You have got to make your testing workable so that it can be done in the field.

With regard to the consideration of the educational part of the subject, it must be granted that the facility of making simple field tests of minerals is advisable, yet it will also be conceded without doubt that it may be very valuable to have a knowledge of chemistry and mineralogy, and an acquaintance with all the common rocks and ores that may be met with in this country. It might be said it would take a very long time to acquire this knowledge, but when I tell you that an effort has been made to implant the rudiments of these subjects in the prospector's mind in two weeks, it will be recognized that, for the purpose of prospecting, it is not deemed necessary to go very deeply into science. Yet when we come to the actual facts of the case in the field, we do not want to go into the minute divisions of controversy, but we wish to know roughly what we see. There are very few minerals that are common in rocks, and there are not many ores that are common. Rocks puzzle people, yet when you recognize that in a little more than a dozen specimens we have all the common rocks in Ontario, you will imagine it is not a hopeless thing to acquire a knowledge of them in a reasonably short time. Of course the three great divisions of rocks are the ordinary sedimentary rocks, the metamorphic rocks and the igneous rocks, which include the volcanic rocks. The only common ones we have in the mineral districts of the metamorphic class are crystalline limestone, gneiss, talc schists, what are called hydro-mica schists, mica schists, chloritic schists, and quartzite. And then the common igneous rocks are granite, syenite, and the green-stones, diorite and diabase. A very marked form of diabase is a rock which you are quite familiar with, viz., gabbro. There are not a great many minerals that compose these few rocks, and you can soon learn their characteristics.

With this elementary knowledge you will be able to tell all the common rocks you are likely to meet with in the field in Ontario.

We attempt to give this information in the prospectors' classes in mining centres in two weeks. A course, however, of two months has been carried on for the last three years at the School of Mining at Kingston, especially designed to give prospectors, mine foremen, and mining men generally, a mixed theoretical and practical course, which will fit them better for work in the field, in the study, and in the laboratory. It is merely designed to lay a foundation from which a man attending the class can proceed for himself, on whichever line or lines he may find desirable. It has been found possible in this course to give a foundation in chemistry. It fits the student to study mineralogy and to understand what a mineral is, chemically speaking. Mineralogy in a particularly practical form is fully dealt with to fit a man for field geology and prospecting. Geology, ore deposits, prospecting and mining, are all given attention, and the practical work of panning, blow-pipe, assaying and assisting at the running of the mill, etc., are part of a course made as practical as possible to assist a man in the field. It has occurred to me that this two months' course would be exactly the thing that many land surveyors would gladly have taken up, especially before they entered upon the active operation of their profession, after which I well know it is often difficult to get away for two months at a time.

The course is held in the winter at Kingston, during January and February. I do not know of another School of Mining anywhere that is holding a similar course of instruction, and perhaps you would add to the usefulness of your indispensable association if you made it obligatory for a man to hold a certificate of having attended this two months' course before he could put O.L.S. after his name.

In conclusion, I would like to draw your attention somewhat away from the immediate subject of my paper, and would ask the question, are there any causes, besides the lack of capital and the lack of mining experience, which act as retarders on mineral development in our great province? It appears to me that there are at least two causes besides the deficiencies alluded to. One is that large blocks of unexplored land are held by individuals and companies which should be made impossible in the future, so far as the mineral is concerned. The other serious defect is that the prospector or discoverer, who, above all men, is deserving of consideration, does not receive the same liberal treatment as in British Columbia, Nova Scotia or the United States. Instead of being able to stake out his find and hold it for some years, subject to development work, he has to find the money for a survey and pay a dollar an acre in rent besides his development work. This may seem a small thing to men with money, but it is an insurmountable difficulty in the path of a man who has been "grub-staked" by a partner nearly as "dead broke" as himself.

If the Government did more surveying half of the difficulty might thereby be overcome I believe it is generally conceded that the Government should do much more surveying, and that a very much too small proportion of the province has been surveyed. The present situation appears to me to be a hardship to the surveyor I would like to know how many cases are known to my hearers where the necessity of this law has induced men to deceive them in connection with remuneration for surveys, on which never a cent has been paid to this day A very small proportion of surveyed claims ever amount to anything. In British Columbia the surveying comes after the development work has been done, and after the claim has been proved to be some good. With us the cart is before the horse.

DISCUSSION.

Mr. Butler—I would like to ask one question, whether Mr. Merritt thinks there is any probability of finding the clay shales through the Trenton or Laurentian formation suitable for clinker brick or that class. It is a clay shale from which paving brick is made

Mr. Merritt—You find clay shales through almost any formation. But in the Laurentian, in the older rocks, these are generally metamorphosed into gneisses, and as you find them there they would not be in a workable condition. You should find them in the Huronian and Cambrian. There are lots of clay shales in the Silurian, but the Trenton is carbonate of lime. Near Toronto, at the Humber, there are clay shales.

If the Ontario Government grants the Queen Victoria Niagara Falls Park and River Railway the right of selling its surplus electric power, it will serve the very desirable end of breaking the monopoly of the Cataract Construction Co., which holds the right at present and makes no use of it, thus preventing the development of the Canadian shore.

SPEED OF MACHINE TOOLS.*

The following speeds of cutting tools may be taken to represent average practice.

TURNING.

Material dealt with	Surface speed in feet per minute.	Materials dealt with.	Surface speed in feet per minute.
Chilled iron rollers.....	3	Hard brass	45
Ordinary cast-iron	18	Soft "	120
Steel	25	Screw cutting steel	8
Wrought iron	30	" " wrought iron	13
Gun metal	35	" " gun metal	30
Boring cast-iron	9	Boring brass	35

To enable the correct speed of a lathe, spindle or boring bar to be ascertained, the following formula can be used:

Let d = diameter of shaft to be turned, or cylinder to be bored in inches

Let m = constant number as below.

Let r = number of revolutions of spindle or boring bar per minute.

The value of m is as follows:

FOR TURNING.

$m = 45.8$ for steel.
$m = 57\,3$ " cast-iron.
$m = 76.0$ " wrought iron.
$m = 172.0$ " brass.

FOR BORING.

$m = 23.0$ for steel.
$m = 28.68$ " cast-iron.
$m = 38.0$ " wrought iron.
$m = 86.0$ " brass.

Then $r = \frac{m}{d}$ which will enable the speed to be easily worked out.

The time taken to finish a job depends naturally upon the traverse of the tool along the work, and can be calculated as follows.

Let T = time taken in minutes.

Let t = traverse per minute.

Let n = pitch of traverse, or number of movements per inch.

Let l = length of job in inches.

Then $T = \frac{l\,n}{r}$ or $= \frac{l}{t}$.

For the various kinds of work the traverse varies in accordance with the material treated and the cut taken. For most classes of work the following will be correct, but the range of speed is very great:

For light work up to 4 in. diameter ....30 to 40 per inch.
" heavier work up to 12 in. diameter..25 to 35 "
" all work over 12 in. diameter ..... 6 to 15 "

PLANING MACHINES.

Planing machines run at from 15 to 20 feet per minute, lineal speed, and the cuts taken depend on the work, as does also the traverse of the tool For heavy work the traverse can be from $\frac{1}{8}$ to $\frac{1}{10}$ of an inch; for finishing light cuts with a broad tool, from $\frac{1}{8}$ to $\frac{1}{12}$ of an inch. Very light work can be dealt with at discretion.

SLOTTING MACHINES

Slotting machines, except when constructed for exceptionally heavy work, have three or four speeds, and the tool will move from 10 to 50 feet per minute, and the traverse will depend on the work.

SHAPING MACHINES.

Shaping machines run at a tool speed of from 12 to 18 feet per minute.

MILLING MACHINES

Milling machines are very largely employed, and in consequence of the great improvement in their construction, are now run at greatly increased speeds. For cast-iron the peripheral speed is as high as 60 feet per minute, but this is determined by the character of the metal With an average depth of cut, say $\frac{1}{8}$ inch, the forward traverse should be about $1\frac{1}{2}$ inch. Wrought iron and steel respectively require a speed of $\frac{3}{4}$ and $\frac{2}{3}$ that used for cast-iron, the traverse being correspondingly reduced, while brass can be worked at double the velocity and traverse. All the above traverses can be changed with advantage in accordance with the weight of the cut

CIRCULAR SAWS.

Circular saws run at a speed of 8,000 to 9,000 feet per minute when cutting woods; band saws at 3,500 to 4,000 feet; and moulding cutter 4,000 to 5,000 feet.

* From Calvert's "Mechanic's Handbook."

EMERY WHEELS.

Emery wheels have a speed of about 5,000 feet per minute on their periphery, and grindstones about 800 feet.

ORDINARY DRILLS.

Ordinary drills can be worked at a peripheral speed of about 8½ feet per minute for cast-iron, and 12½ feet for wrought-iron, but twist drills are run at higher speeds. Messrs. Brown and Sharpe give the following speeds for twist drills :—

Dia. of Drill. Inches	Annealed Steel. Revolutions.	Feet per min.	Dia. of Drill. Inches.	Cast-Iron Revolutions.	Feet per min.
1/8	750	39	1/8	900	47
1/4	600	39	1/4	750	49
1/2	200	26	1/2	320	42
3/4	130	26	3/4	170	33
1	100	26	1	140	36

Up to 2 inches the following speeds are a fair average: Steel, 18·5 feet; cast-iron, 22 feet; wrought-iron, 26 feet; brass, 36 feet.

CUTTING ANGLES.

The cutting angles of tools should be as follows. For soft wood, 25° to 32°; hardwood, 40°; wrought-iron and steel, 60°; cast-iron, 70°; brass and gun metal, 80°; very hard gun metal or chilled iron, 90°. The angle of relief, or "clearance," as it is sometimes called, should be from 3° to 6°.

A NEW CANADIAN TOWN.

The rapid growth of Winnipeg and some other Canadian cities has been more than equalled during the past summer by the development of the British Columbia mining town of Rossland. Canada has mineral regions that are proving themselves the successful rivals of the well-established mines of the Rand and of Australia and of California. The interest in mining development in Canada is widespread, and the East is seeking for information as eagerly as the West. The Toronto *World* of Oct. 15th was a special issue, in which sixteen pages were occupied with information about the mines and the town of Rossland, which was compiled by a representative of the paper who visited British Columbia for the purpose. Among the features of the issue are historical sketches of the mines and the miners, and a classified business directory of Rossland.

As evidence of the confidence felt by capitalists in the future of the town, the railway between Trail and Rossland is just completed, and three other lines are projected. One from the east to connect Lethbridge with Rossland by way of the Crow's Nest Pass; one from Vancouver to Rossland in an air line; and another westward to Penticton. The mines at present opened have proved very valuable, and there is no reason to believe that they will not prove more so. None of the mines have been abandoned after a partial working, but have become more valuable as the works progressed. The future of Rossland seems, therefore, assured as a mining city, but until the railways have been built, and the lines of traffic finally determined, its position as the trading and financial centre is uncertain.

Two years ago there were less than 150 people in Rossland; the population is now about 6,000. Eighteen mines have been equipped with steam plants, and fourteen have reached the point where they are actually shipping ore, or have ore on the dump ready for shipment. These are Le Roi, War Eagle, Iron Mask, Cliff, O.K., Josie, Poorman, Crown Point, Nickel Plate, Kootenay and Columbia, Centre Star, Jumbo, Lily May and Evening Star.

Wages are said to be good, and the following quotations are made:—Head engineers, $4. blacksmiths, $4; machine men in mine, $3 50; machinists' helpers, $3; outside laborers, $2.50. The men work 10 and 9 hours a day, according to the shift, and seven days a week. It must not be supposed, however, that the demand for labor is unlimited, or that these figures represent a very high real wage, because the necessary expenses of living are very great.

In his report on the Trail Creek mining district, Wm. A. Carlyle, provincial mineralogist, says that Rossland is the scene of constantly growing activity Much good exploring work has been begun, much more is being projected. Already five air compressor plants are installed, and six more are being put in, while larger hoisting engines and pumps have also been bought, most of this machinery being of Canadian make, *i.e.*, the Ingersoll-Sargeant Drill Co., Montreal, the Rand Drill Co., Sherbrooke, Quebec, and the Jenckes Machine Co, of the same place. Altogether, $175,000 worth of machinery and supplies have been ordered for this camp.

Total number of tons smelted to July 1st, 1896..	27,085
" " of ounces of gold.....	45,234
" " of ounces of silver	67,793
Total number of pounds of copper	1,265,362
" gross value recovered by smelters	$1,007,007

Average net values per ton—gold, 1.67 oz.; silver, 2.5 oz.; copper, 2.3 per cent. Value, $37.18.

R. G. McConnell, of the Geological Survey of Canada, after a short visit in 1894, reported the country about Rossland to be "an area of eruptive rock, mostly diorite and uralite porphyrite cut by many dykes," but as no complete geological survey has yet been made, Mr. Carlyle continues, nor any reported lithological study, only a very general description can now be attempted. The main mass of all the country rock is evidently diorite, although it presents many different gradations in composition and structure, varying from a fine grained aphanitic rock with very little horneblende at one extreme to nearly massive horneblende at the other, often showing mica and pyroxene. Much of it looks like a basic syenite, and samples have been taken for microscopical examination and later report, but the main point of interest is the fact that these ore bodies or veins traverse the diorite, although cores from the hanging or foot walls of the Le Roi shute will be examined as well as samples from either side of the Centre Star ore shute, so well defined in the cliff running up Centre Star Gulch, to ascertain whether these samples are all one class of rock or two. In going over this region the variations are seen to be very marked, in some places the rock being stratified as if of sedimentary origin, but in all probability a more or less altered eruptive. Porphyry dykes from one foot up to 60 and 80 feet wide traverse the country, many with a north and south strike, but with no apparent dislocation of the veins which they cut through; indeed, at six such points of intersection the ore seemed to be concentrated, and even to follow along the dyke for some distance, but this must be made clear by further underground work.

In this Rossland ore, much prospect work has shown clearly that there is a large system of lines of fracture with an east by west and north-east by south-west trend, and a persistent northerly dip, along which more or less ore has concentrated, either as bodies of solid sulphides or sulphides scattered through the country rock. Some of these fissures can apparently be traced through several 1,500-foot claims, and along them are the large ore shutes now being mined or developed, the maximum width of pay ore so far being about 35 feet, and maximum length 310 feet. Many of these fissures have been or are now being prospected, and in many instances with surface indications of the most unfavorable character the improvement has been very marked in the increase of the amount of ore and its value, and the great probability that more rich ore shutes will be found by following these fissures has made all such property valuable, and is deciding the commencement of extensive exploratory work. Again, large shutes of low grade ore, mostly the coarse grained magnetic iron pyrites or pyrrhotite, assaying from traces to $6 to $8 in gold, have been found, and are being explored for better grade ore, and so far with some success, but development, except on a few claims, has hardly yet begun, and so far only the shutes that have been exposed at the surface are being worked, and it is yet impossible to foretell how much extensive underground mining will be rewarded. Further details as to the ore bodies will be given in the description below of some of the mines. The surface of these ore shutes is covered with the typical iron capping, or reddish brown sintery mass, and experience enables the prospector to distinguish between disintegrating sulphides and barren diorite heavily iron stained by the oxidizing of the bisilicates, or the iron pyrites nearly always present in this rock. Although it is difficult to prospect such rock, which may be much iron stained, but with no vein whatever in the vicinity, nearly all work is done along one wall, and the ore appears to follow along one wall, where the rock is not too full of fissures that disguise true conditions, but it is doubtful if more than one wall ever really exists, although a parallelism of lines of fracture may for a short distance seem to prove the contrary. Wherever the ore is found to consist almost of pure sulphides, it will be found lying along and parallel to such a wall, after which ore is disseminated more or less through the inclosing rock, often following along small fissures that in some cases form small veins of good ore that run for a considerable distance away from the main deposit. In all the mines the ground is faulted, thus dislocating the ore deposits and stringers, and complicating the search; but these slips will be better understood as work progresses, although much development work will have to be done by driving steadily ahead along the general course of the veins and cross-cutting, for the good rule of following the ore is seldom possible for any distance by reason of these dislocations.

The ores at Rossland, Mr. Carlyle reports, with the exceptional free-milling gold-quartz of the O. K. mine, may be divided into three classes:—

(*a.*) Those large deposits of coarse-grained massive pyrrhotite, locally known as the "iron ore," in which very little or no value in gold is carried.

(*b.*) The ore found in many claims on the south belt, as the Lily May, Homestake, Mayflower, Curlew, Gopher, R. E. Lee, etc., in which the sulphides are not pyrrhotite, but iron pyrites and marcasite (white iron); within some of these mines much arsenopyrite, and also zinc blend and even galena, in which case the silver value exceeds the gold, and the percentage of copper is very small or nothing.

(*c.*) The typical ore of the camp, as sold by the Le Roi, War Eagle, Iron Mask, or Josie, is divided into first-class and second-class. The first-class consists of nearly massive fine-grained pyrrhotite and copper pyrites, sometimes with a little magnetite, or mispickel, with more or less quartz and calcite. In this class of ore, as got from the lowest workings of the Le Roi, the amount of quartz is much higher, the smelter returns giving 41 to 52.8 per cent silica, and 20.6 to 26.8 per cent. FeO., but this is proving the best ore in the mine; the average smelter returns were on 1,200 tons, 2.6 oz of gold, 1 S oz. of silver, and 2.5 per cent. of copper, or $53.05 (not deducting freight and treatment charges), net, per ton, while some shipments went as high as 4.06 oz. in gold.

NEW MINING COMPANIES IN BRITISH COLUMBIA.

The following are the mining companies* incorporated under the British Columbia laws during the six months ending October, 1896. It must, of course, be borne in mind that the enormous capitalization is in many cases nominal, and in most much in excess of what the actual operation of the mines would demand.

Name of Company.	Capital Stock.	Date of Registration.	Head Office.
Helen Gold Mining Co.	$ 600,000	April	Spokane, Wa.
Pittsburg and Cariboo Gold Dredging Co.	500	"	Pittsburg, Pa.
Rochester Gold Mining Co.	500,000	"	Spokane, Wa.
Van Anda Copper and Gold Co.	5,000,000	May	Seattle, Wa.
Jumbo Gold Mining Co	500,000	"	Spokane, Wa.
St. Mary " "	500,000	"	"
The Lightning Creek Gold, Gravel and Drainage Co., Ltd.	1,000,000	Feb.	Vancouver, B.C.
43 M. and M. Co. of Cariboo, Ltd.	600,000	"	North Bend
British Columbia Syndicate, Ltd.	100,000	"	Rossland
Consolidated Alberni Gold Mining Co., Ltd.	500,000	"	Victoria
Antler Creek Mining Co., Ltd.	1,000,000	"	Vancouver
Georgia Gold Mining Co., Ltd.	1,000,000	April	Victoria
Quadra Mining and Milling Co.	500,000	"	"
Freeburn Gold Mining Co.	500,000	"	"
Bunker Hill and Blackwood Mining Co.	500,000	"	Vancouver
Allison Ranch Hydraulic Mining Co	250,000	May	New Westminster
Palo Alto Gold Mining Co	1,000,000	"	Victoria
B C. Mining and Development Syndicate	2,000,000	"	Rossland
Wolverine Gold Mining Co.	500,000	"	Trail
British Columbia School of Mines	30,000	"	Vancouver
Hansard Gold and Copper Mining Co.	1,000,000	"	Nelson
John A Hume Co.	25,000	June	New Westminster
Mineral Hill Gold Mining Co., Alberni	750,000	May	"
San Joaquin Gold Mining Co.	1,000,000	June	"
Alberni Mountain Rose Gold Mining Co.	250,000	"	Vancouver
London and Rossland (B C.) Mining Co	750,000	"	Rossland
Rossland Star Gold Mining Co	500,000	"	"
Rossland Syndicate	50,000	"	"
Alliance Prospecting Syndicate, B C.	100,000	"	Vancouver
Eric Gold Mining Co.	1,000,000	"	Rossland
Mount Adams Mining Co.	150,000	"	New Denver
Queen Gold and Silver Mining Co.	500,000	"	Vancouver
Red Mountain View Gold Mining Co.	1,000,000	"	Rossland
Victoria Mining and Development Co.	1,000,000	"	Victoria
Columbia Mining Co. of Victoria	100,000	"	"
Kootenay-London Mining Co	1,000,000	"	Rossland
Pittsburg Gold Mining Co	750,000	"	"
San Francisco Gold Mining Co	1,000,000	"	"
British Lion Mining and Milling Co.	600,000	"	"
C. & C. Mining Co	500,000	July,	"
Golden Cache Mines Co	500,000	"	Vancouver
Ivanhoe Gold Mining Co	1,000,000	"	Rossland
Independent Mining Co	1,000,000	"	New Westminster
B.C. Gold Mining Co	1,000,000	"	Vancouver
Hinckley and Black Colt Mining Co.	1,000,000	"	Kaslo
Alhambra Gold and Copper Mining Co.	600,000	Aug.	Victoria
Bondholder Mining Co	1,000,000	"	Vancouver
Gold King Mining Co	1,000,000	"	Rossland
Rainy Day Gold Mining Co	600,000	"	"
West Wellington Coal Co	500,000	"	Vancouver
Channe Mining Co	1,000,000	"	"
Morning Glory Mining Co	500,000	"	Vernon
Columbia and Ontario Gold Mining Co.	750,000	"	Rossland
Pacific Consolidated Gold Mining Co	500,000	"	Victoria
Phœnix Consolidated Mining Co	750,000	"	Sandon
Rossland Homestake Gold Mining Co	1,000,000	"	Rossland
Silver Belle Mining Co	1,000,000	"	"
Two Friends Mining Co	750,000	"	Vancouver
Young British American Gold Mining Co.	1,000,000	"	Rossland

* Published in the B. C. *Mining Record*.

Name of Company.	Capital Stock.	Date of Registration.	Head Office.
B.C. Consolidated Gold Mining Co	$1 000,000	Aug.	Rossland
Consolidated Sable Creek Mining Co	1,500,000	"	Vancouver
Delacola Gold Mining Co	1,000,000	"	Rossland
Ferguson and Orr Co	10,000	"	Trail
Lardeau Mining and Development Co.	500 000	"	Revelstoke
Picton Development Syndicate	15,000	"	Nelson
Standard Gold Mining Co.	1,000,000	"	Victoria
Yale Gold and Copper Mining Co.	1,000,000	"	Rossland
Badger Tourmaline Consolidated Gold Mining Co	1,500,000	"	Rossland
Mount Mabel Mining and Smelting Co.	1,500,000	"	New Denver
Seymour Creek Gold Mining Co	1,000,000	"	Vancouver
Copper Belle Mining Co	1,000,000	Sept.	Rossland
Ida Queen Gold Mining Co	1,000,000	"	"
La Regina Gold Mining Co	750,000	Aug.	"
Beaver Quartz Mining Co	1,000,000	Sept.	Vancouver
Colonna Gold Mining Co	1,000,000	"	Rossland
Gold Hill Quartz Mining Co.	750,000	"	Victoria
Athabasca Gold Mining Co	1,000,000	"	New Westminster
All Gold Mining Co	1,000,000	"	Rossland
English and French Gold Mining Co.	2,000,000	"	Grand Forks
Fanny Bay Gold Mining Co.	600,000	"	Vancouver
Kootenay & Slocan Prospecting and Promoting Co	100,000	"	"
Kootenay Salmon Gold Mining Co	600,000	"	Rossland
London Hill Development & Mining Co	150,000	"	Kaslo
Reco Mining and Milling Co	1,000,000	"	Sandon
Electrical Reduction and Refining Co.	25,000	"	Rossland
Exchequer Gold Mining Co.	1,000,000	"	Nelson
Hercules " "	2,000,000	"	Rossland
King Solomon's Mines	500,000	"	Vancouver
Northern Light Gold Mining Co.	250,000	"	Victoria
Commander Mining and Smelting Co.	500,000		"
Lily May " " "	500,000	"	"
Rambler and Cariboo Consolidated Gold and Silver Mining Co.	1,000,000	"	"
Bean Pot Gold Mining Co	500,000	"	"
Buffalo " "	500,000	"	"
Camp Bird " "	1,000,000	"	"
Consol " "	1,000,000	"	"
Acme " "	600,000	June	"
Beaver " "	750,000	May	"
Blue Bird " "	600,000	June	"
Crown Point " "	1,000,000	May	"
Gold Stream " "	1,000,000	"	Cudahy, Wis.
Hattie Brown " "	1,000,000	"	Spokane, Wa.
Mayflower " "	1,000,000	June	"
Monarch " "	750,000	May	Northport, Wa.
Monte Christo " "	1,000,000	June	Spokane, Wa.
Morrison " "	1,000,000	May	"
Republic " "	750,000	"	"
Wonderful Group "	1,000,000	June	"
Ontario Gold Mining Co	1,000,000	"	"
Emu " "	£10,000	"	England
Green Crown Mining and Milling Co	$1,000,000	"	Spokane, Wa.
California Gold Mining Co	2,500,000	"	"
Interstate " "	750,000	"	"
Butte Gold-Copper Mining Co	1,000,000	July	"
Delhi Mining and Milling Co.	750,000	"	"
Randolph Gold Mining Co	750,000	"	"
Deer Park " "	1,000,000	"	"
Little Jumbo " "	650,000	"	Seattle, Wa.
Quesnelle & Criboo (B.C.) Gold Fields Exploration Syndicate	£12,000	"	Sheffield, Eng.
Rob Roy Gold Mining Co.	$ 500,000	"	Spokane, Wa.
Rossland Red Mountain Gold Mining Co.	1,000 000	"	"
Eastern Star Gold Mining Co.	500,000	"	"
Fairview " " "	1,000 000	Aug.	Seattle, Wa.
Big Valley Creek Gold Mines	£125,000	"	London, Eng.
Golden River, Quesnelle, Ltd.	£350,000	"	"
Kootenay Consolidated Mining Co.	$1,000,000	"	Everett, Wa.
Price Eaton Co	500,000	"	San Francisco
Noble Five Consolidated Mining and Milling Co.	1,000,000	Sept.	Spokane, Wa.
Delaware Mining and Milling Co.	1,000,000	"	"
Elkhorn Silver Mining Co.	1,000,000	"	"
Portland Gold " "	600,000	"	"
Vancouver and British Columbia General Exploration Co.	£25,000	"	London, Eng.
Grand Prize	$1,000,000	"	Spokane, Wa.
Hill Top Gold Mining Co.	1,000,000	"	"
Olive Mining and Smelting Co.	20,000,000	"	"
Silver King Gold Mining Co	750,000	"	"
Alberta " " "	1,000,000	"	"
B. C. Exploring Syndicate	£20,000	"	London, Eng.
B. C. Mining Co.	20,000	"	"
Chicago Gold Mining Co.	$ 500,000	"	Spokane, Wa.
Lily May " " "	1,000,000	"	"
Old Glory " "	1,000,000	"	Seattle, Wa.
B. C. Smelting and Refining Co.	2,500,000	Oct.	Jersey City, N.J.
Blue Bird Mining Co.	300,000	"	Spokane, Wa.
Big Three Gold Mining Co.	3,500,000	"	"
Celtic Queen " " "	750,000	"	"
Kohinoor " " "	1,000,000	"	"
Seattle Mining and Smelting Co.	6,000,000	"	"
Kootenay and Algoma Gold Mining Co.	1,000,000	"	Rossland, B.C.
Star Mining and Milling Co.	1,000,000	"	Sandon, B.C.
Silver Band Mining Co.	250,000	"	Victoria, B.C.

THE ROASTING OF IRON ORES, WITH THE VIEW TO THEIR MAGNETIC CONCENTRATION.*

By Prof. H. Wedding, Bessemer Gold-Medalist.

Long before iron ores were smelted for pig iron in the blast-furnace, roasting processes were employed prior to the direct extraction of the metal from the ore, and, after the introduction of the blast-furnace process, the roasting of iron ores was still retained. As a rule, the roasting is preliminary to the reduction process. It is only exceptionally or incidentally that it has to effect the purpose of simultaneously eliminating elements, such as sulphur or arsenic, that could detrimentally influence the iron produced. It is only in very recent times that roasting processes have also been employed in order to render iron ores magnetic, so that they can subsequently, by magnetic concentration, be freed from gangue, that is, from constituents not containing iron, and be enriched in iron.

On considering the composition of the ferruginous constituents of the ores practically employed in the metallurgy of iron, there will be found, as a rule, in the ores supplied by nature, oxides, hydrates, and carbonates of iron; magnetic oxide in magnetite ores; ferric oxide in red hæmatite ores; ferric hydrate in brown hæmatite ores; ferrous carbonate in spathic iron ores, clay iron ores, and carboniferous iron ores. If sulphur compounds occur, which have to be used as iron ores, as, for example, iron bisulphide in iron pyrites, they must always be first converted into ferric oxide (purple ore) before the material can be further utilized in iron works practice. Again, from the hydrates water must be expelled, and from the carbonates carbon dioxide, before the iron of these ores can be reduced.

The heats of combination of all iron ores show that a reduction to iron cannot occur as long as sulphur, water, and carbon dioxide are still present. It might consequently be assumed that the only object of roasting was the expulsion of sulphur, water, and carbon dioxide, with a view to the reduction of the iron, were it not that the practical facts were in contradiction to this, in that they show that as a matter of fact, even more iron ores that contain neither sulphur, water, nor carbon dioxide, but that consist only of magnetic oxide or ferric oxide, can with advantage be subjected to roasting. The object of this is either to facilitate the subsequent reduction by the formation of the most easily reducible oxygen compounds, or to facilitate the reduction by loosening the texture of the iron ores.

INFLUENCE OF ROASTING ON THE REDUCIBILITY OF IRON ORES.

Before the question of the advisability of magnetic roasting can be gone into, it is first necessary to consider the question of roasting as a preliminary to reduction It is known that the heat of combination of ferrous oxide, FeO, with a molecular weight of 72, is equal to 74.59 gramme-calories;† that of magnetic oxide, Fe_3O_4, with a molecular weight of 232, is 269; and that of ferric oxide, Fe_2O_3, with a molecular weight of 160, is 210.08 (according to Favre and Silbermann, Berthelot, and Thomsen). The heats of combination of the two compounds of ferric oxide with water, and of ferrous oxide with water, are as follows:

Ferric hydrate, $2\,Fe + 3\,O + 3\,H_2O = 191.15$ calories.

Ferrous hydrate, $Fe + O + H_2O = 68.28$ calories.

At the same time, in the combination of Fe_2O_3 with $3\,H_2O$ 19.06 calories are lost, that is, for one atom of water 6.35 calories, and for one atom of iron 9.536 calories are lost. or in other words 170 calories for every kilogramme of iron. These figures prove that brown hæmatite must decompose in dry air at ordinary temperature and liberate water. The more, however, this happens, the greater becomes the affinity of the water and the less easily is it liberated. According to the researches of Muck and Tommasi, by remaining for a long time i. a dry place, or even by heating in water of from only 35 degrees to 40 degrees Cent., a portion of the water of hydration may be expelled; at 90 deg. to 95 deg. Cent., moreover, the oxide can be prepared perfectly free from water. It follows from the figures mentioned that for the separation of the water from the ferric oxide not only is there no need for heat to be employed, but even that the heat which is required for the expulsion of the water is lessened. For the decomposition of brown hæmatite there is required for each kilogramme of water:

	Kilogramme-Calories.
1. Conversion of the solid water into the fluid state of aggregation	76
2. Heating to 100 deg. Cent	100
3. Evaporation	536
Total	712

On the other hand there was obtained $\frac{6354}{18} = 353$ kilogramme-calories, leaving the balance of heat consumed = 359 calories.*

From this it may be seen that for the decomposition of hydrated oxide of iron into ferric oxide and water, so slight an amount of heat is required that a preliminary roasting is necessary only when the reduction has to be carried out directly, as in the "direct processes," in which the waste heat of the fuel cannot be utilized; whilst in the modern blast-furnace process the waste heat can be utilized, after the reduction of the iron oxides is completed by the gases rising through the charge. This perfectly suffices for expelling the water. A roasting of the brown hæmatites previous to the blast-furnace process is consequently quite superfluous for facilitating the reduction.

With carbonate of iron the case is quite different. Raw carbonate of iron was neither formerly employed for direct production of iron or steel, nor is it used at the present day in the blast-furnace, except in small quantities or in exceptional circumstances. The carbon dioxide is rather always first driven off. The reactions that take place during this expulsion of carbon dioxide are largely dependent upon the temperature. At a moderate temperature the following reaction takes place:—

$$6\,FeCO_3 = Fe_6O_7 + CO + 5\,CO_2,$$

or according to other authorities—

$$17\,FeCo_3 = 5\,Fe_2O_3 + 7\,FeO + 5\,CO + 12\,CO_2.$$

According to the one or other of these views there are obtained different quantities of heat units, which are necessary for the decomposition. Berthelot found for $FeCO_3$ 10,000, Kosmann, 13.-596 kilogramme-calories. Naumann, under the reservation that the minerals used in his investigations were not pure, gives for spathic iron ore the atomic heat of 21 1. According to Regnault's researches it amounts to 22.4. As an average it may be assumed that the heat of formation of anhydrous carbonate of iron from ferrous oxide and carbon dioxide, as measured from the heat of formation of oxides of other earths and metals in combination with carbon dioxide, may amount to 30,000 or, in other words, to 259 calories for one kilogramme. It must, however, be pointed out that this heat value is less than that of many other carbonates, for example, calcium carbonate. The same heat is required for the decomposition as for the formation. All such thermal decomposition processes differ according to whether the gaseous products of decomposition remain in the space in which the decomposition is effected or are drawn off from it. In any case it is possible, without any difficulty, to drive off the whole of the carbon dioxide from all iron carbonates before melting results. This is not the case with all carbonates, as for example, with lead carbonate. It is remarkable, too, that, unlike other carbonates, for example, calcium and magnesium carbonate, this decomposition is not possible without a simultaneous partial change of the carbon dioxide. A not inappreciable portion of it is converted into carbon monoxide, and the atom of oxygen thus set free combines with the ferrous oxide to form a higher oxide. As for this decomposition, in whichever way it is effected, there are necessary in any case for the kilogramme of carbonate about 259 calories, for which, in the heat of the gases remaining after the reduction of the iron oxides, an adequate source cannot be found; it is right that the iron carbonates should be roasted before they pass to reduction, that is to say, before they are charged into the blast-furnace. In any case the heat required for driving off the carbon dioxide is produced and utilized more cheaply outside the blast-furnace. If, on the other hand, it is desired to carry out the roasting in the blast-furnace itself, which, as has been already pointed out, is occasionally done, there will result the drawback that the reduction of the iron ores will take place in zones considerably deeper than after a preliminary roasting, and that consequently an increased consumption of fuel (coke) will be necessary.

If iron carbonate is decomposed in a glass tube without access of air, and the gaseous products drawn off in such a way that there is never an excess of pressure in the tube, the reaction that takes place is that previously given:

$$6\,Fe\,CO_3 = Fe_6O_7 + CO + 5\,CO_2.$$

Carbon dioxide is never obtained alone according to the equation

* Paper read before the Iron and Steel Institute.

† See Wedding, "Handbuch der Eisenhuttenkunde," second edition, vol. i., pages 904-928.

* Compare "Eisenhuttenkunde," vol. i., page 910.

$$Fe\,Co_3 = Fe\,O_4 + CO_2.$$

nor is the reaction

$$3\,Fe\,CO_3 = Fe_3O_4 + CO + 2\,CO_2.$$

The case is different when atmospheric air is allowed to enter By higher oxidation of the iron the reaction can then be as follows·

$$2\,Fe\,CO^3 + O = Fe_2O_3 + 2\,CO_2.^*$$

Proceeding from the equation $6\,Fe\,CO_3 = Fe_6O_7 + CO + 5\,CO_2$, there is obtained $6\,Fe\,CO_3 + O = 2\,Fe_6O_7 + CO + 5\,CO_2$ or $6\,Fe\,CO_3 + 2\,O = 3\,Fe_2O_3 + CO + 5\,CO_2$, or in other words, heat is gained with each higher step of oxidation.

Still, if it has been shown that by the roasting the carbon dioxide is driven off, and consequently the reducibility of the carbonate brought about, the further question arises, what kind of roasting of the carbonates—that is to say, whether simple decomposition or the roasting in an oxidizing or reducing atmosphere—would be of the greater advantage for the subsequent reduction? and with this is connected the question whether by the roasting of oxide of iron, red hæmatites, for instance, any advantage whatever is gained for this reducibility. Such an advantage exists as a matter of fact, otherwise red hæmatites would only then be roasted when this was intended either for increasing the porosity of the ore, or for the expulsion of sulphur.

This question was thoroughly investigated so far back as 1880 by Akerman in connection with the roasting of Swedish iron ores.

Akerman deals in particular with assays which had been performed by Tholander. It was shown that there was a variation in the reducibility of the native magnetic iron ores, of the composition Fe_3O_4, which varied not inconsiderably according to the temperature to which the ore was subjected during the roasting process. This change is of such a nature that when the ore is heated at a low temperature with free access of oxygen, considerable advantages ensue as regards the fuel consumption in the blast-furnace. Akerman concludes that the reducing by roasting of a non-carboniferous ore can never be of real advantage in the blast-furnace, and that it is at the most merely non-injurious where sintering does not result after the deoxidation, and the ore is not rendered more compact from this cause. The ore never, however, becomes compacter by a sintering action, if during the roasting it is so strongly heated, that despite the fact that the furnace atmosphere is maintained of an oxidizing character, it is reduced to a lower stage of oxidation. In this way the reducibility even of an iron ore containing oxide can be diminished by roasting at a high temperature. The fact that oxide iron ores can be somewhat more readily reduced after a slight roasting than results if they are charged into the blast-furnace direct and entirely unroasted, follows naturally from the change in their physical condition. In the case of magnetites an oxidizing roasting is always of advantage, even when these ores are heated until they are completely sintered, provided that their state of oxidation is maintained at that of the oxide, which, it is true, is only then the case if the rise in temperature is slowly and carefully effected, and if there was an adequate supply of air during this process.

The advantage that exists in oxidizing roasting of magnetites is especially shown in the case of those iron ores which are accompanied by so-called dark gangue stuffs, that is to say, by silicates containing ferrous oxide Akerman holds that the influence exerted by the roasting on the reducibility of the ores is largely due to the tendency shown by them to decompose carbon monoxide, and to take up carbon from this. If, as has been shown by Sir Lowthian Bell, iron ore is reduced by carbon monoxide at temperatures below 400 degrees Cent. (350 degrees to 400 degrees Cent.), carbon deposits in ore, carbon dioxide being formed in accordance with the reaction $2\,CO = C + CO_2$, this reaction has naturally influence on the reducibility of the ore, and on the fuel consumption in the blast-furnace. The greater, therefore, is the tendency of the ore to separate and absorb carbon from carbon monoxide, the more advantageous is roasting to the blast-furnace treatment, and in this direction, too, as Tholander's† investigations have shown, oxidizing roasting at a low temperature has an important influence. Akerman's observations are undoubtedly accurate, but the explanations given need further development, as is seen from the publications of Wiborgh‡ and Kosmann.§ The latter observes, justly, that Wiborgh contented himself with deducing the greater or lesser degree of reducibility from the greater or lesser degree of compactness of the ores. In some respects this may be right, for it has been often customary, for a very long time past, to roast ores for the sole reason of making them less compact Ores which could not be broken down in the ordinary way before roasting, may subsequently often be very readily reduced in size, especially if they are cooled down in water while still hot, or allowed to lie exposed to the air after the termination of the roasting operation In the case of some iron ores, indeed, considerable care must be taken when roasting, as otherwise a complete pulverization of the ore may be the result Still, as Kosmann justly observes, this behaviour possesses only a minor importance The fact, he says, is that the changes in the heats of combination in the roasted ores constitute the true cause of the altered degree of reducibility The different degrees of oxidation correspond to different heats of combination, and to these those temperatures run parallel at which a decomposition ensues, either into oxygen and metal or into oxygen and a lower oxide Metallic iron and ferrous oxide change, as is well known, when slightly heated in contact with air, into oxide; on the other hand, when strongly heated at the roasting temperature, one obtains not the ferric oxide but the magnetic oxide. Kosmann forgets, it is true, to draw attention to the difference which ensues from the oxidation on the one hand to Fe_6O_7, and on the other to the magnetic oxide Fe_6O_8 He gives, indeed, as an example, that if at a red heat steam is passed through an iron tube, magnetic oxide is formed on the inner surface of the tube, and not the ferric oxide; that is to say, that the magnetic oxide must have a higher heat of formation than the ferric oxide; but it must be added that, besides the magnetic oxide, the lower oxide Fe_6O_7 also forms, and that this possesses a higher heat of combination than does the higher oxide Fe_6O_8. Ferric oxide is reduced, therefore, and at first sight one might say most unexpectedly, more readily by carbon monoxide or carbon than are the other oxides, and even at a temperature below the boiling point of mercury. The reduction by hydrogen, too, takes place very readily at a low temperature, and slowly at a high temperature, a fact which was known to Berzelius. One may, on the other hand, assume that, using a high temperature, ferric oxide would be first reduced to one of the two oxides Fe_6O_8 and Fe_6O_7, or to FeO, before it changed into iron.

(To be Continued.)

* Never, however, as Grenier assumes, $3\,Fe\,CO_3 + O = Fe_3O_4 + CO + 2\,CO_2$, because free oxygen must then remain in excess. The equation then would rather be $6\,Fe\,CO_3 + O = 2\,Fe_3O_4 + CO + 5\,CO_2$. Compare *Verhandlungen der Vereins zur Berforderung der Gewerbfleisses*, 1895, page 376.

† *Vide* Akerman, "The Roasting of Iron Ores."

‡ *Stahl und Eisen*, 1888, No. 1.

§ *Ibid.*, No. IX., *Journal of the Iron and Steel Institute*, 1888. No. II., page 232.

THE BANGS PATENT OIL CUP.

We have been illustrating in our advertising columns a new oil saving patent device which to all persons interested in steam plants should prove attractive. The construction of the cup may be described as having a spoon shaped surface on one side, allowing it to be placed in a position that by the motion of machinery the oil is thrown against this surface to top of cup, from which point oil is fed through a fine hole and a continuous supply obtained only when machinery is in motion, thus preventing the continuous waste of oil when bearings are not in use, which is the case with some of the cups now in use. A set of four feeds is supplied with each cup to suit the varying requirements, and a new feature in the manufacture of these goods is that they are now being made of aluminum, which reduces the weight, thus promoting their durability and at the same time adding to their appearance. This is claimed to be the first article of its kind manufactured of this metal for this purpose. The patentee has placed this oil cup in the hands of the well-known manufacturers of these goods, the James Morrison Brass Manufacturing Co., Ltd., through whom the Canadian trade is supplied Before this firm decided to take hold of the cup they put it to an actual test on their own machinery. The results, they report, were very gratifying. After a 30 days trial, they found that where they had filled a cup of the same capacity five times, in the same space of time they only filled the Bangs cup once, which meant a saving of eighty per cent of oil, with bearings fully lubricated and surroundings clean. They have since fully equipped their engine, and are satisfied where they purchased their supply of oil every six months, they need only to buy at the outside once in two years. A further indication of the value of this cup is, that they are used by the many ocean steamship companies, and are finding their way into the United States navy, an armed cruiser having recently been equipped throughout. The English patent has been disposed of for the sum of $20,000, and they are now being introduced into France.

CARRIER, LAINE & Co., Levis, Que., have been awarded the contract for the iron superstructure of the bridge over the St Charles River, Quebec.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The sixth annual convention of the Association of Railway Superintendents of Bridges and Buildings was held at the Leland Hotel, Chicago, Ill., from October 20th to 22nd, 1896. Thirty-five members were in attendance, in addition to a number of invited guests and railroad officials. Twenty new members were enrolled. The next convention will be held at Denver, Col., in October, 1897.

Committee reports on the following subjects were read and discussed: 1. "Different Methods of Numbering Bridges." "Should all Waterways be Numbered?" 2. "Drawbridge Ends, Methods of Locking"; and under this head include locking of turntables. 3. "Protection of Trestles from Fire," including methods of construction. 4. "Local Stations for Small Towns and Villages," giving plans of buildings and platforms. 5. "Tanks, Size, Style and Details of Construction," including frost-proof protection to tanks and pipes. 6. "Best and Uniform System of Report Blanks for Bridge and Building Department." 7. "Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges." 8. "Best and Most Economical Railway Track Pile Driver." 9. "Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate Girders and Lattice Bridges for Spans from 50 to 110 feet."

Discussions took place on the following reports from last year:—1. "Methods and Special Appliances for Building Temporary Trestles over Washouts and Burnouts." 2. "Strength of Various Kinds of Timber Used in Trestles and Bridges" 3. "Best Method of Erecting Plate Girder Bridges." 4. "Sand Dryers, Elevators, and Methods of Supplying Sand to Engines, including Buildings." 5 "Best Method of Spanning Openings too Large for Box Culverts, and in Embankments too Low for Arch Culverts." 6. "Pumps and Boilers."

The following subjects were selected for committee reports to be presented at Denver next year:—1. "Methods of Heating Buildings where Three or More Stoves are Now Used." 2. "The Most Suitable Material for Roofs of Buildings of all Kinds. 3. "Round House Construction, including Smoke-jacks and Ventilators." 4. "Care of Iron Bridges after Erection." 5. "How to Determine Size and Capacity for Waterways." 6. "Protection of Railroad Buildings and other Structures from Fire." 7. "Designs for Ice Houses." 8. "Best End Construction for Trestles Adjoining Embankments." 9 "Bridge Warnings for Low Overhead Structures." 10. Stockyards and Stocksheds, including all Details of Construction" 11. "Floor System on Bridges, including Skew Bridges"

The officers elected were as follows President, James Stannard, Wabash; first vice-president, Walter G. Berg, Lehigh Valley, second vice president, Joseph H Cummin, Long Island, third vice-president, Aaron S Markley, Chicago and Eastern Illinois, fourth vice-president, R. M Peck, Missouri Pacific, secretary, S. F. Patterson, Boston and Maine, treasurer, N. W. Thompson, Pittsburg, Fort Wayne and Chicago. Executive members, W. O. Eggleston, Chicago and Erie; W. M Noon, Duluth, South Shore and Atlantic; Jos H. Staten, Chesapeake and Ohio, G. J. Bishop, Chicago, Rock Island and Pacific; C. P. Austin, Boston and Maine; M. Riney, Chicago and North-western.

ACTION OF THE SYPHON.

Editor CANADIAN ENGINEER:

Looking over your valuable journal for October, 1896, I carefully note the remarks of your correspondent from Purdue University, La Fayette, Ind., U.S.A., criticising my remarks in your August number on the syphon, which I still hold to be correct until convinced to the contrary, and with your permission will repeat:

"There is nothing in the way of hydraulic apparatus much more simple than the syphon, but strange mistakes are sometimes made about it and the causes which enable it to perform its work. Its action does not depend, as some old writers on natural philosophy supposed, upon any inequality of atmospheric pressure upon the liquid in the two arms. As a matter of fact, the pressure is slightly greater upon the orifice of the longer or discharging arm, because of the two it is nearer the earth, and therefore a higher and heavier column of air rests upon it. Nor does it depend upon the difference in the actual length of the two arms, or in their diameters, but the larger the tube the more water will be discharged. What causes the syphon to act is the destruction of hydrostatic equilibrium, by the discharging part having a greater perpendicular length than the receiving part, as the pressure of fluids depends upon the depth of the column only, that in the longer arm necessarily preponderates, so that when once a partial vacuum has been artificially formed within the syphon, the fluid in the deeper arm is forced to descend, leaving still a partial vacuum behind it, into which the liquid is forced by the atmospheric pressure on its surface. The property of cohesion which all fluids in a liquid state possess enables the particles to drag those in the shorter arm over the bend, and in this way a constant discharg. is kept up."

Your correspondent says: "It is news to know that cohesion of the particles draws the water from the shorter tube in the longer, when one would naturally suppose that a cohesive force would tend to retain the water in the shorter tube" I understand the word cohesion to mean sticking together. Solids and fluids differ in this degree He says further: "Had he suggested repulsion, instead of cohesion, the case would have been more simple and probably equally as truthful." I wonder if your correspondent knows that if air is admitted in the shorter arm of the syphon that there will be no cohesion of the particles of water, and that the syphon will not work, or does he suppose for a moment that I meant that the water would stick to the pipe?

I cannot see where the word repulsion applies to the syphon. Perhaps some new meaning is applied to the word; if so, I would like to know it In all my experience in connection with pumping machinery, I have yet to hear the word mentioned in connection with water. I do not suggest anything new in this syphon question. I state, as far as possible, practical facts. And I claim that if the water entering the short arm of the syphon is charged with air that there will be no cohesion of the particles, and that the syphon will not work any more than will a pump drawing air through its suction pipe. And I would distinctly state that I mean cohesion of the particles of water, not cohesion of water to the pipe There is a certain amount of friction in water flowing through a pipe, but that is not under discussion. Yours,

WILLIAM PERRY,
Montreal, October 17, 1896. Hydraulic Engineer.

Editor CANADIAN ENGINEER:

In the October number of THE CANADIAN ENGINEER I notice an objection to the theory, that it is "cohesion that causes the column of liquid in the shorter limb of the syphon to follow that part of the column in the longer limb." But perhaps it would be well to supply the true reason and experimental proof therefor. As Mr Perry explains, the atmospheric pressure is slightly (very slightly) greater upon the orifice of the longer limb, for the reason he gives, and the liquid also flows from the longer limb on account of the greater perpendicular length. But it is due to the atmospheric pressure upon the liquid in the reservoir that the liquid flows up the shorter limb. This is proved by the fact that mercury cannot be syphoned through a tube of which the top of the bend is much more than 30 inches from the surface of the mercury in the vessel, because the column would outweigh the atmospheric pressure Neither can water be syphoned over a greater vertical height than from 40 feet to 45 feet. Moreover, the height over which a liquid can be syphoned is lessened by any reduction in the atmospheric pressure. For instance, a syphon will not work at all in a vacuum, there being no pressure to drive the column up the shorter limb. The question of the following on of the liquid up the shorter limb is explained in the trite observation, "Nature abhors a vacuum."

H. SPURRIER,
Chemist Morse Soap Co., Toronto.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

C.A.S.E., Toronto No. 1, held its regular fortnightly meeting in Engineer's Hall, 61 Victoria street, on Wednesday evening, 21st ult., at which one candidate was initiated. After the regular routine business, Bro. Cross gave an interesting "Chalk Talk" on figures, and was rewarded by a hearty vote of thanks. The library committee reported that the first of a series of book cases was on view in the library room, and that upwards of 100 volumes were already on the shelves. They wish to thank those who have been so kind as to donate towards this work, and wish to state that they would be pleased to hear from the manufacturers or others who feel inclined to assist this branch of the association's good work. The banquet committee reported that they had made arrangements for the tenth annual banquet, to be held at the Palmer House on Nov. 25th, Thanksgiving Eve. This hotel is centrally located, at corner of King and York streets, and its dining room has accommodation for 300 guests, so all may be sure of getting to the first table. The secretary hereby extends a hearty invitation to all members of C.A.S.E. associations, and hopes that in case written invitations are not received that all officers and members will consider the above invitation sufficient.

G. C. MOORING,
Sec. of Com., 15 Charlotte St.

Industrial Notes.

W S MAYO, machinery, Ottawa, has assigned to P Larmouth.

Town of Rossland, B C, will spend $5,000 on fire-fighting apparatus.

THE Grand Trunk shops at Fort Erie, Ont, are working eight hours per day

PHILLIPS & MARLETT, Beeton, Ont, are adding a hoop factory to their planing mills

THE business of the Ontario Folding Iron Gate and Guard Company is being wound up

HAMILTON, ONT, will re-pave nine miles of streets Vitrified brick is favored by the city engineer

TRURO *News* reports that the Acadia Mines blast furnace has closed down, probably for six months.

THE Windsor, N.S, Plaster Co is meeting with success in placing its "Selenite" on the market

THE Niagara Falls Metal Works Co has placed steam heating and electric lighting apparatus in its works.

JAMES FLEMING & SON, St. John, N.B., supplied the machinery for the new mills on the Big Salmon River, N.B.

THE Henderson Bicycle Co., of Goderich, Ont., is extending its premises so as to do an enlarged business in 1897.

FIFTY-TWO new buildings of various kinds were begun between a recent Monday morning and Wednesday afternoon in Rossland, B C

THE mills on Slocan Lake are inadequate to supply the demands made on them for lumber, says the New Denver, B C, *Ledge*

THE *Kootenaian* reports that very satisfactory progress is making on the Kaslo, B C, waterworks, and that they will soon be complete

THE Laprairie, Que., firm of Racine, DeGruchy & Co, who started in the canning business four years ago, are reported to be embarrassed.

THE Verity Plough Co., Brantford, Ont, has erected a drop for smashing old car wheels and castings, which does the work at a considerable saving

IT is claimed that Brantford, Ont., sent $102,042 worth of bicycles to other countries for the year ending Oct. 1st, as against none during the previous year.

A "HOSE-JUMPER was used at a recent fire in Montreal It is a sort of bridge upon which the street cars pass over the hose, which are laid across the track

W P MCNEIL, New Glasgow, N S., has completed the construction of two iron bridges for Victoria county, Cape Breton, and one for Kings county, N S

THE pumping plant supplied by the Northey Manufacturing Co, Toronto, for the Deseronto waterworks is now in position. Capacity, 1,500,000 gallons daily.

CRAIG, MCARTHUR & Co, the Toronto representatives of the J. C McLaren Belting Co, Montreal, have removed their city office to 69 Bay street, Toronto

WELLINGTON BOULTER, president of the Canadian Canning Association, has closed his branch cannery in Toronto and will confine his operations to Picton, Ont

BERLIN, ONT, will have a new G T.R. station Engineer Baker, of Stratford, Ont, has surveyed the ground and Chief Engineer Hobson is preparing the plans

THE contract for the widening of the Queen street, Toronto, subway, has been awarded to R Grant & Co, Toronto, at $63,375, the work to proceed as the city council may direct

THE C P.R. car shops at Perth have been busy for some months turning out a new series of box cars of increased standard capacity, 35 feet long and carrying 60,000 pounds

IT is said that the Pope Manufacturing Co., of Boston, U S., intend establishing a branch factory in Canada A number of Canadian towns are trying to secure this industry

IT is reported that the Danville, Que, Slate and Asbestos Co is to be capitalized at $2 000,000 and English capitalists are now visiting the works in connection with the proposition

THE Thompson Lumber Company, of Windsor, Ont, has secured the contract for the lumber required for the new Grand Trunk Railway shops at London It will take 1,000,000 feet.

THE Granby Rubber Company, Granby, Que., is putting in machinery for the manufacture of paper boxes

C REEVES, Woodstock, Ont., has perfected a metallic spring bicycle tire which he claims to be superior to the rubber pneumatic tires now in use.

THE Department of Railways and Canals has awarded the contract for the new bridge across the Rideau Canal at Smith's Falls to Mr Grant, of Ottawa

IT is said that the refineries of the Canada Oil Co. at Sarnia have been bought by Hiram Walker & Sons, and will be used in refining the product of the Bothwell oil fields.

IT is said that the bridge to connect Hull and Ottawa will be proceeded with at once as if $50,000 is not expended on the works before 1st of January, 1897, the bonus voted by Ottawa City will lapse

W. E GOWER, mechanical engineer, Montreal, is trying to introduce a patent incinerator into Hamilton, Ont., which will, he claims, consume the sludge from the new sewage interception works.

THE Chesley Chair Co, Ltd, is to be incorporated to manufacture chairs in the village of Chesley, Ont Capital, $20,000. Provisional directors D M. Halliday, J H. Elliot and J Krug, Chesley, Ont

THE Dominion Bridge Company has been awarded the contract for the construction of a bridge at Maddington Falls, Que, for the Drummond County Railway The bridge is to be of steel, and is to cost $26,000

THE MacKey Stained Glass Company is applying for incorporation to manufacture stained glass in Toronto. Capital, $2 000. C E. Booth, S E Booth, and A. A MacKey, Toronto, are the provisional directors.

TORONTO city council will lay brick pavements on the following streets: Dovercourt road, from Queen to College street; Foxley street, from Dundas to Dovercourt road, Huntley street, from Bloor to Earl street.

THE Hanover Chair Company, Ltd, applies for an Ontario charter to manufacture furniture and woodenware generally at Hanover, Ont. Capital, $48,000; provisional directors re G. Hollinger, A. B. Taylor, R. J Ball

ROBERT LARMOUR, a former superintendent of the G.T.R., is endeavoring to organize a Canadian company to manufacture the American Standard Rail Joint Mr Larmour has an option on the Canadian patent, which is valued at $10,000

THE Lucknow Central Furniture Co, Ltd., is applying for an Ontario charter to manufacture furniture in Lucknow, Ont. Capital, $20,000. Provisional directors D. B Forster, G W Berry, W. H Johnston, J G. Murdoch and A. Morton, Lucknow, Ont.

THE Willson Carbide Works of St Catharines, Ltd, is applying for incorporation, with a capital of $200,000, to manufacture calcium carbide in Merritton, Ont. T L Willson, E. A Neresheimer, A. M. Scott and J Garry, St. Catharines, Ont, are to be the provisional directors.

THE Canada Switch and Spring Company (Ltd) is applying to the Quebec Legislature for an Act to confer upon the company power to authorize the increase of the stock of the company, and the division of such stock into preference and ordinary shares, and to provide for the allotment thereof

THE contract for the steel bridge across the Severn at Severn Bridge has been awarded to the Central Bridge Co., of Peterboro, for $3,500. The bridge consists of three spans of seventy feet each and is to be finished by Dec. 15th. A G. Cavana is the engineer in charge.

THE city of Victoria, B.C., is to be allowed to complete the pile bridge to Point Ellice to replace the one which was the cause of the terrible accident last summer, but the city must erect a permanent bridge within two years and remove the temporary structure when the new one is completed.

THE Gardner tool works, which was bonused to settle in Brockville, Ont., about seven years ago, is moving to Sherbrooke, Que., where another bonus, exemption from taxation, etc., is given them. The works give employment to about fifty men, the majority of whom will remain in the employ of the firm.

A COMPANY, composed of B. Carruthers, H V. Lyon, and J. McLeod, of Kingston, Ont., has purchased the right for the Dominion of Canada from S. M. Stevens, of New York, to manufacture and sell the Emergency Fire Extinguisher and appliances. The contract to make the machines has been let, it is said, to a Kingston firm.

A WOODENWARE factory has been established at Formosa, Ont.

THE main building of the new hub and spoke works at Sarnia, Ont., has been completed.

A. GREENE'S fuel economizer will be placed in the main pumping station, Toronto water works

D. & H. RITCHIE'S new saw-mill at Newcastle, N.B., will be equipped with eight boilers of large size.

J. W. HOWRY & SONS, Fenelon Falls, Ont., are rebuilding their saw-mills in that town, burnt down recently.

THE Goldie & McCulloch Co., Galt, Ont., is supplying the machinery for H. S. Dowd's roller mill at Arnprior, Ont

IT is said that the Metallic Supply Co., of London, Ont., has amalgamated with the Locked Wire Fence Company of Ingersoll.

AN auxiliary pumping plant for the London waterworks is required, and J. M. Moore, superintendent, is preparing estimates.

THE McEachren Heating Co., of Galt, have the contract for the heating apparatus for the Demmill Ladies' College, St Catharines, price $3,000.

IT is probable that the town of Yarmouth, N S., will put in a boiler plant to operate the waterworks pumps and the dynamos of a proposed municipal lighting system.

PRESTON, ONT., has voted $10 000 to J. J Stevens, of Galt, for manufacturing purposes for ten years, without interest, and exemption from taxes for this period.

THE new machinery has been put in position at the cement works of the Rathbun Company at Napanee mills, and the output of the mills will be greatly increased

THE president and two officers of the Glen Falls Paper Co., New York, U.S., have been up the line of the Lake St. John Railway, Quebec, looking for sites for two large pulp mills.

AT Dent, a village near Merlin, Ont., the boiler in Geo. Peters' saw mill exploded last month, and Solomon Gray, a mill assistant, was killed, and the proprietor, Geo. Peters, was badly injured.

GENNELLE & Co. are about to begin building a large mill at Arrowhead, B.C., that will have a capacity of from 75,000 to 100,000 feet per day They will also add a sash and door factory next summer.—*Kootenay Mail*

V M ROBERTS, C E., is at Huntsville, Ont., where his plans for a new system of waterworks to be constructed by the town have been accepted, and work will be commenced at once. E. Farquhar, of Toronto, has the contract.

DRAPEAU, SAVIGNAC & Co., of 140 St. Lawrence Main street, Montreal, tinsmiths, plumbers and roofers, have consented to assign on a demand made of Thos. Robertson & Co. The liabilities are in the neighborhood of $25,000.

THE Mechanics' Supply Company, Quebec which makes a specialty of water works supplies, has recently furnished the necessary pipe and fittings for water works at Ste. Marie de la Beauce, and also for Trois Pistoles, Que

THE Toronto Auer Light Company, Ltd., applies for a grant of supplementary letters patent, confirming a by-law for reducing the capital stock of the company from $500,000 to $200,000, and extending the operations of the company to a number of counties outside Toronto

NOTICE of incorporation is given of the Cleeve Canning and Cold Storage Co., limited liability, to take over the business of the Texas Lake Ice and Cold Storage Co., of Vancouver and Westminster. The capital is $250,000 and the principal place of business Vancouver

THE Benjamin Manufacturing Company of Yarker, Ltd., has been incorporated, capital $20,000, to manufacture vehicle wheels. The incorporators are. R. McLaughlin, Oshawa; A. W. Benjamin, F. E. Benjamin, E. W. Benjamin, Yarker, Ont.; C. H. Finkle, Newburgh, Ont., G. A Richardson, Kingston.

THE Mechanics' Supply Co., Quebec, has just sent to Paris, France, a complete hot water heating apparatus, which Monsieur H. Menier, the great chocolate king, intends trying, with a view to adopting this system in some of his immense establishments. The shipment included "Safford" radiators, with an Oxford boiler.

GEO. HUNT, engineer, doing business as dealer in mill and engine supplies, under the firm name of St Lawrence Machinery Supply Co., has assigned on the demand of H. G. Rogers. The assets consist of the stock in trade at No. 361a St. James street, Montreal. The liabilities will amount to about $2,000. The business will be wound up.

THE Fire and Light Committee of the Toronto city council has accepted the offer from the Waterous Engine Company to loan the city a fire engine until a new engine is built, in place of the one rejected. Amended specifications for a new engine have been approved. The Waterous Company will build the new engine.

H S. BURRELL, Belleville, Ont.; W. McMillan, Trail, B.C.; J. S. Tower, Belleville; Julia Byers, wife of J. P. Byers, Brockville, Ont., and Daniel MacLaren, Ottawa, are applicants for a charter of incorporation as the Mac Machine Company, to carry on the business now under the name of the Mac Machine Company. Place of business, Belleville, Ont., and Trail, B.C. Capital, $100,000.

AT the annual meeting of the Province of Quebec Association of Architects, the president, A. C. Hutchison, being in the chair, the following officers were elected for the current year: President, A. T. Taylor; 1st vice-president, J. F. Peabody; 2nd vice-president, A. Raza, secretary, J. Venne, treasurer, E. Maxwell. Council A. C Hutchison, H. C. Nelson, J. Wright, R. Findlay, C. Baillarge and F. X. Berlinquet, Quebec.

THE claims of the principal creditors of Grothe Bros., contractors, Montreal, are as follows (amounting in all to $120,000, which includes $40,000 in mortgages):—J. A. Bulmer & Co., $8,166.24; Jos. Paquette, $10,940.19; J. O. Grier, notes, $2,675.85; A Pallascio, notes, $1,858 08, Montreal Roofing Company, notes, $1,200: Montreal Roofing Company, indirect, $500; McIntosh & Hyde, mortgage, $20,000, Trust and Loan Company, $20,000; A. Grothe, $15,000.

THE industrial classes under the control of the Council of Arts and Manufactures, Montreal, are now open for the winter. Freehand, mechanical and architectural drawing, lithography, modeling and wood carving, stair building and building construction, pattern making (for boot and shoe makers), plumbing are taught. It is probable that through the generosity of J. C. Wilson, the well-known manufacturer, who has promised $5,000 towards that end, a regular technical school will be established in Montreal.

THE Westinghouse Air Brake Co. has received an order from the Grand Trunk Railway for brake equipment for 10,000 cars and 400 engines, and it is the railway company's intention to equip in the near future all its freight trains with the appliance. As a result of the business to be done in Canada, the Westinghouse Air Brake Company has bought the McKechnie factory in Hamilton, Ont., and will establish its works in that city. A Dominion charter has been applied for.

THE *Review* says:—"We are pleased to note the Ed. P. Allis Co., of Milwaukee, Wis., which makes specialties of all that relates to machinery for mining purposes, has established relations with the Wm. Hamilton Manufacturing Company, at Peterboro', Ont., for the manufacture of the Allis machinery. An agency of this Milwaukee-Peterboro' company will probably be established in British Columbia, as the Allis Co. has already equipped a number of mining properties at Sandon, B.C., and elsewhere.

THE agreement arrived at before the trial by the Hamilton Auer Light Company and W. J. Walsh, is as follows. Each party drops his suit against each other on the following conditions.—The Auer Light people pay their own costs, and Walsh sells no more Welsbach burners, but instead the Auer burner, which the Hamilton Auer Light Company gives him the right to sell and rent. The Hamilton Auer Light Company exonerates all users of the Welsbach burner supplied to them by W. J. Walsh, and further agrees to in no way interfere with his customers now using the Welsbach burner.

THE Canada Machinery Company, Montreal, has assigned. The liabilities are scheduled at $23,525.01; deficit, $16,260.80. The chief liabilities are: McLaren Belting Co., $418.92, R. McFarlane, $277.61; Montreal Oil Co., $100; Wm. Beck & Co., $83 07; W. C. White, $82.49; Frothingham & Workman, $76.75; The James Robertson Co., $55.40; Evans Brothers, $45.57; Temple Electric Co., $40.89; James Wilson & Co., $39.82; Orr & Semborew, Reading, Penn., $1,457.77; Robb Engineering Co., Amherst, N.S., $1,277.34; Cant Bros., Galt, Ont., $1,434.34; McGregor, Gourley & Co., $165.03; Gutta Percha and Rubber Mfg. Co., Toronto, $1,139.78; Machinery Construction Co., Rochester, N.Y., $750; S. A. Woods Machine Co., Boston, $551.63; F. X. Bertrand, St. Hyacinthe, $335.76, O. Chalifoux, $108.03; Berlin Machine Works, Beloit, Wis., $747.60; John Bertram & Son, Dundas, Ont., $403.14; Yale & Towne Mfg. Co., New York, $269.86; H. B. Smith Machine Co., Smithville, N.J., $252.21, F. L. Reed & Co., Worcester, Mass., $240, Greenlee Bros. & Co., Chicago, $210.63; R. Whitelaw, Woodstock, $200; Prescott Emery Wheel Co., Pres-

cott, $132 77, Wells Bros. & Co, Greenfield, Mass., $127.51. The assets are: One share Merchants' Tel. Co., $100; bills receivable, $74 66; stock as per inventory, $5 774.04; book debts, $1,315.81.

MESSRS CONNOLLY, the well-known contractors, have secured two of the largest dredging contracts ever let in the United States, which are for dredging the harbors of Philadelphia and New York respectively. The former contract is for an amount in the vicinity of $3,000,000, while the latter will exceed $2,000,000.

F A. DALEY, Chicago; B E Eldred, Toronto; Louise Daley, Chicago; Grace Minnie Weeks, Toronto, apply for incorporation as the Weeks-Eldred Company of Toronto, Ltd., with the four first-named of the above persons as first directors, and the capital $21,000, to buy, sell, manufacture and deal in mechanical stokers, engines, boilers, furnaces, heaters, ventilating and heating plants and appliances, and general machinery, and to carry on a general business as mechanical, civil, sanitary, heating and ventilating engineers and general contractors.

THE Volcanic Shaking Bar Grate manufactured by the Gurney Foundry Company, Toronto, is growing steadily in favor among steam users. The following is a partial list of those put in quite recently: Four sets in the Insane Asylum at Hamilton, on the order of the Ontario Government; two sets in the Temple Building, Montreal, one set in the Thompson Shoe Company, Montreal, one set in the Sanford Manufacturing Company, Hamilton, two sets in the Dominion Cotton Company, Kingston, two sets in the Sick Children's Hospital; two sets in the Kemp Manufacturing Company, and several sets for the Goldie & McCulloch Company, Galt. The latter company have assured the makers that they consider the "Volcanic" the only mechanically correct grate in the market, and have backed up their assertion by numerous orders to be placed under boilers to be put in for their different customers. There has not been a day in the last twelve months when the Gurney Foundry Company have not had orders on their books for these grates.

THE Jenckes Machine Co., Sherbrooke, Que., is very busy on orders for the Rossland Mines. The machine shop is a substantial brick building, 300 feet long and 100 feet wide, well lighted. The erecting floor is 40 feet wide and 300 feet long, with a 15-ton electric travelling crane, serving the entire floor. Bordering the edge of this floor, so as to be served by the crane, are the heavy planers and tools. The foundry is constructed on a similar plan to that of the machine shop, only with less floor space, it being 200 by 80 feet. This building also has a floor for large work, extending through the centre of the shop, 35 by 200 feet, which is served throughout the whole length by a 15-ton electric travelling crane. One of the pieces of work in progress is a large compressing machine for the LeRoi Mine, at Rossland. This engine is said to be the largest of its kind yet constructed in Canada. It is of the duplex type of compressor, with compound Corliss steam cylinders, 22 and 40 by 48, with compound air cylinders, 22 and 34 inches respectively, and 48-inch stroke. This machine will weigh, when completed, nearly 200,000 pounds, and is fitted with the very latest improvements Although it has a capacity of forty drills, it is so adjusted and regulated that it will run a small number of drills with great economy. The Jenckes Machine Co, working in connection with the Canadian Rand Drill Co, have, during the season, furnished the complete equipment for the following mines at Rossland, viz.: The O K. Gold Mining Co., Commander Gold Mining Co., Crown Point Gold Mining Co, War Eagle Gold Mining Co., Georgia Gold Mining Co., Monita Gold Mining Co., and have also about ready for shipment a very extensive plant for the Rossland Red Mountain Co. They have also furnished machinery for the Lucky Jim mine, at Sandon, and those remarkable silver producing mines, Hall and Slocan Star, in the Nelson vicinity.

Electric Flashes.

PEOPLE of Point Edward and Sarnia, Ont., are agitating for an electric railway.

CONSTRUCTION has been begun on the electric street railway in Quebec city.

ALEX. ANDERSON, Toronto, has been awarded the contract of putting in a fire alarm system for Orillia, Ont.

THE Sherbrooke, Que., Gas and Water Co. is putting in new water wheels, which will give 3,000 h.p. additional power for electric development.

THE papers in Halifax, N.S., are agitating for the appointment of a city electrician who would inspect all apparatus and wiring in the city, both when erected and periodically.

AN electric railway is proposed to connect Brantford, Port Dover, and Galt, Ont.

IT is said that the Rosamond Woolen Co., Almonte, Ont., are about to establish a large power plant to operate their mills.

THE Royal Electric Company is installing a lighting and power plant for the Brookfield Mining Association at North Brookfield, N.S.

THE Royal Electric Co. has just completed the installation of an incandescent lighting plant in the A. W. Brodie's woolen mills, Hespeler, Ont.

THE dynamo and incandescent lighting plant installed by the National Electric Co., of Eau Claire, Wis., in Goderich, Ont., is now in operation.

E. H. THOMAS & Co., Norwich, Ont., are lighting their factories by electric light. The Royal Electric Co. is furnishing and installing the apparatus.

THE T. H. TAYLOR Co., LTD, of Chatham, Ont., is lighting its mills by electricity, and has placed an order for a 200-light dynamo with the Royal Electric Co.

IT is thought that the development of the water-power at Chambly, Que., will make an electric railway between Montreal and St John's, Que., possible

THE Beamsville extension of the Hamilton, Grimsby and Beamsville Electric Railway is now in regular operation. The road is expected to pay a dividend in January.

IT is said that A. A. Wright & Co. and Mackay & Guest, of Renfrew, Ont., will unite their electric lighting plants and that the joint plant will supply both power and light.

TRAIL, B.C., is to have electric lights. The Canadian General Electric Co. has supplied one dynamo of 1,000 incandescent lights capacity and another of 25 arc lights capacity.

G. A. ADAMS, Adamsville, P.Q, has recently installed a lighting plant for illuminating his saw mill and residence. The apparatus was supplied by the Royal Electric Company.

THE Canadian Pacific Railway is said to be considering the connecting of the various sections of the road by telephone. This was shown to be advisable during the recent strike.

"THE Electrician," Electrical Trades' Directory and Handbook for 1897 is now in course of preparation. Details upon application to Salisbury Court, Fleet street, London, E.C.

THE net profits of the Montreal Street Railway for the past year amount to $462,196, against $351,349 for the year before. The gross receipts were $1,265,898. The net earnings were $555,633.

APPLICATION will be made to the Quebec Legislature at its next session to incorporate the Northern Electric Company, to build an electric road, with ferry connection, between Montreal and St. Jerome, Que.

S. H. HOLMES, secretary of the Dartmouth, N.S., Gas, Electric Light, Heat and Power Co., Ltd., has issued a circular to its patrons stating that the company will raise its rates 7½ per cent. after November the first.

N. WENGER & BROS., Ayton, Ont., are lighting their grist mills and a portion of the town by electricity; they will install about 200 lamps. The dynamo, etc., is being furnished by the Royal Electric Company.

THE Welland Vale Manufacturing Company, St. Catharines, Ont., has completed the large addition to its factory. It is being lighted throughout with electricity. There will be about 500 lamps, for which the plant is being furnished and installed by the Royal Electric Company.

THE Royal Electric Company is installing for the Sussex Water and Electric Company, Sussex, N.B., one of its 40 K.W. "S.K.C." two-phase generators, with 350 16-candle power lights capacity, with transformers, and are wiring the town. The Sussex Company supplies both arc and incandescent lighting, as well as power from the same dynamo and circuits.

THE Ontario Electric and Engineering Co., Ltd., is applying for an Ontario charter to manufacture and deal in electrical machinery. Head office, Toronto; capital, $10,000. Provisional directors, W. C. P. Heathcote, H. Ritchie, J. J. Ashworth, D. Grimston, G. J. Ashworth, Toronto.

MESSRS. MELDRUM, CARNEGIE AND KENDRY have developed the water-power at the Meldrum mills, Peterboro, and will transmit power about 1½ miles into the city, where they are furnishing power for manufacturing purposes. The first order for power was given them by the Canadian General Electric Co., and is for the delivery of 200 h.p. at their works as they require it.

THE Brantford, Ont., Street Railway is putting closed vestibules on its motor cars.

THE Asbestos & Danville Railway Company is to be incorporated to build an electric railway, from Danville, Que., on the G. T. R., to the village of Asbestos.

ROMAINE CALLENDER, of Brantford, Ont., has gone to Europe to promote an improved system of telegraphy which he has invented, and which it is claimed will make it possible to turn out over half a million words in less than 28 seconds.

PETERBORO has closed a contract with the old electric lighting company at $65 per lamp per year of 300 nights, a reduction of $7 per lamp from the old figure, the company to also pay $400 per year for the rental of the streets for the use of their plant.

E. HENDERSON, H. Moxey, F. G. Beckett, F. Snyder and H. Beckett are to be the provisional directors of the Hamilton, Chedoke and Ancaster Electric Railway, which is seeking a charter from the Ontario Government. Hamilton, Ont., is to be the chief place of business; capital, $100,000.

AT the annual meeting of the Merchants' Telephone Co., Montreal, the president reported that 231 new telephones had been placed during the year, making a total of over 900 now in operation. F. X. Moisan (president), L. E. Beauchamp (treasurer), J. E. Beaudoin, A. S. Delisle, G. N. Ducharme, L. H. Henault, M. T. Lefebvre and F. Dagenais were elected directors.

THE Owen Sound Electric Manufacturing and Illuminating Co. has decided to furnish incandescent light and power, as well as the arc lighting to the town of Owen Sound. The waterpower is situated three miles from the centre of the town. It has been improved, and now furnishes a steady power of 200 horse the year round. The Royal Electric Co. has secured the contract of furnishing "S.K.C." two-phase dynamos and apparatus to supply power during the day, and at night the arc and incandescent lights.

THE following tenders were made for the telephone service of Toronto, now operated by the Bell Telephone Co. :—Tender No. 1, by George Musson, offered to furnish telephones to private houses at $20, public offices at $36, and to pay 6 per cent. of the gross receipts to the city. Tender No. 2 proposed that the Citizens' Telephone Company, of Toronto (to be incorporated), would furnish the Wilhelm Telephone Company, of Buffalo, system for $18.50 to private residences, and $32.50 to public offices. Tender No. 3 was by Clark, Bowes & Co., on behalf of a client, who offered for 20 years to furnish private telephones at $25, and public offices at $35 per annum, and also to pay 3 per cent. on the gross earnings between $100,000 and $150,000, and 5 per cent. over that sum. Tender No. 4 was from Messrs. Beachman, Montreal, offering to furnish a service on the basis of the Merchants' Telephone Company, of Montreal, at $25 each.

THE North Shore Power Company, of Three Rivers, Que., has secured a franchise from the city of Three Rivers to supply incandescent and arc lamps, as well as to pump the city water. The corporation of the city of Three Rivers had installed a municipal lighting plant, but has turned the whole over to the North Shore Power Co., who are going to operate it with power generated on the Batiscan River at Batiscan Chute, and conveyed to Three Rivers, a distance of 16 miles. The company has purchased from the Royal Electric Company two of its S.K.C. two-phase generators, with a capacity of 240 K.W. each. It is intended to generate the current at the water power, using step-up transformers, bringing the pressure up to 11,000 volts, and at Three Rivers step-down transformers will be used to reduce the current to a working pressure of about 100 volts, where it will be connected to the present lighting circuits. The step-down transformers are located in the old lighting station at Three Rivers, and the present circuits for incandescent lighting will be directly connected to the step-down transformers, and the expense in making the change in the Three Rivers station is practically *nil*. The transformers in use for about 3,000 lights already installed are of the Royal type of 16,000 alternations, and as this is also the periodicity of the two-phase generators being installed, no change on their lines or transformers is necessary. The corporation of Three Rivers had in operation one arc dynamo of 50 lights, and one with 30 lights capacity. It is intended to drive these two arc machines with one of the single-phase alternators which have been in use a number of years there, and which will be coupled in one side of the two-phase circuit and driven as a synchronous motor.

AT the general meeting of the Kalso and Slocan, B.C., Railway Co., the following officers were elected: D. J. Munn, president; A. Guthrie, vice-president; Alex. Ewan, J. Hendrie and Charles Ffolliett, directors; Robt. Irving, secretary.

Railway Matters.

IT is said that the Tobique Valley Railway will be operated by the C.P.R.

THE work of reconstructing the Hamilton and Dundas Railway is in progress, a force of men being employed laying ties and rails.

BELL & WILKIE, engineers and surveyors, Almonte, Ont., have completed the preliminary survey for the Carp, Almonte and Lanark Railway.

J. W. SHANNON, of the Westinghouse Air Brake Co., is delivering a course of lectures to Grand Trunk Railway men on the use of these appliances.

A. NORTHEY and W J. Ryan, two Hamilton machinists, have invented an automatic apparatus which it is claimed will give warning of washouts and misplaced rails.

THE following have been elected directors of the Q., M. and C. Railway: H. J. Beemer, president. Frank Ross, vice president; T. A Piddington, John T. Ross, Gavin Moir, P. P. Hall and H. G. Beemer.

NOTICE is given that an application will be made to the Parliament of Canada for an Act to permit the Kingston and Pembroke Railway to be sold for the payment of the indebtedness of the company.

THE British Columbia Southern Railway Company, which has provincial incorporation, has applied to the Federal Parliament for authority to extend its line east into Alberta. It already has authority to construct westward from the Crow's Nest Pass.

THE St. Lawrence and Adirondack Railway has introduced a novelty on Canadian railways, in the shape of an electric headlight. The light is generated from a small dynamo erected on the front end of the boiler, and it is claimed that it throws a search ray over a mile ahead of the train.

THE Yarmouth *Herald* reports 500 men at work on the Coast Railway between Yarmouth and Barrington, and that Robt. G. Hervey expects to start work immediately on the railway from Shelburne to Caledonia, Queens county, to connect at New Germany with the Nova Scotia Central.

THE contract for the construction of the Manitoulin and North Shore Railway has been let to W. B. Strang, Jr., & Co., of New York and Philadelphia. It covers the entire work of construction and equipment of forty-two miles of standard gauge railway from Little Current, Ontario, to a junction with the Canadian Pacific.

AT the annual meeting of the stockholders of the Concord and Montreal Railway, held Oct. 13th, the following directors were elected: Frederick Smyth, B. A. Kimball, J. H. Pearson, W. M. Parker, J. A. White, A. J. Pillsbury, C. E. Tilton, S. Kimball, C. E. Morrison, L. C. Paltee, Frank Jones, N. S. Clark and Hiram M. Turner.

THE Railway Committee of the Privy Council proposes to allow the T., H & B. Railway Company to build a high level bridge over the Desjardins Canal, Hamilton, Ont., the bridge to become the property of the city. It is their intention also that the city and county shall pay a sum of money to buy out the Hamilton and Milton toll-road company.

THE C.P.R. will not, apparently, build the Crow's Nest Pass Railway without Government assistance. The C.P.R. should not be allowed to operate this line even if it were willing to pay a large amount for the privilege. The experience of California with the Pacific Railway companies should be warning enough to the British Columbia people in this connection.

THE Ottawa, Arnprior and Parry Sound Railway is now completed from Ottawa to the Georgian Bay. The first sod in the construction of this line was turned at Carp, in July, 1892. Since that time 260 miles of railway have been laid in four and a-half seasons' work Madawaska will be the permanent divisional point, being situated 130 miles from Ottawa, exactly half-way between Ottawa and Parry Sound. The official and final inspection of the line was made by Robert McCallum, inspector for the Ontario Government, accompanied by A. W. Fleck, secretary-treasurer; Geo. A. Mountain, chief engineer; and engineers Bruce and Cranston.

Mining Matters.

THE Empress Gold Mining Company (Ltd.), will apply for an Order-in-Council changing the name of the company to the name of "The Lake Superior Development Company (Ltd.)."

JNO. LAMB, J. K. Kerr, and Geo. Dunstan, Toronto, are to be provisional directors of the Lake Superior and Loon Lake Mining Co., now applying for incorporation; capital, $99,900; head office, Toronto.

A SUNDAY MORNING AT LAKE HAROLD. THE MEN'S CAMP AND STOREHOUSE IN THE DISTANCE.

C. S. BOTSFORD, J. A. Meldrum, T. D. Law, A. Mackenzie, J S. Lowell, Toronto, are applying for incorporation as the Victoria Mining Co., Ltd., to do a general mining business in Ontario. Capital, $500,000.

LETTERS patent have been issued to A. M. McIntyre, J. Pool, D. C. Clay, C. St. C. Leitch, Dutton, and A. Crane, Dunwich, as the Lake Erie Oil and Gas Company of Elgin (Ltd.), with a total capital stock of $45,000.

THE Heather Bell Gold Mining Company of Toronto (Ltd.) is to be incorporated; capital, $1,000,000. Provisional directors: J. J. Withrow, E. Nerlich, A. F. Webster, I. E.Suckling, N. McCrimmon, Toronto.

THE Sweden Gold Mining Company, of Ontario, Ltd., is applying for an Ontario charter. Head office, Rat Portage, Ont. Capital, $500,000; provisional directors, T. H. Fahey, T. Black, A. Bruhler, J. T. Roberts, Winnipeg, Man., and J. A. Herman, Rat Portage, Ont.

THE Modstock Mining Co. (Ltd.) has received a Nova Scotia charter to mine gold and other minerals in Nova Scotia. Capital, $300,000. The incorporators are: R. D. Kirk, R. Dickson, C. N. Wilkie, John D. Copeland, Antigonish; A. D. Wilkie, Kingston, Jamaica.

THE Western Canada Mining Co. of Rat Portage, Ltd., applies for an Ontario charter to do a general mining and smelting business, with head office at Rat Portage, Ont. Capital, $750,000; provisional directors, R. W. Jameson, R. H. Agur, J. E. Steen, R. H. Beck, John Plaxton, H. S. Crotty, H. G. Wilson, all of Winnipeg.

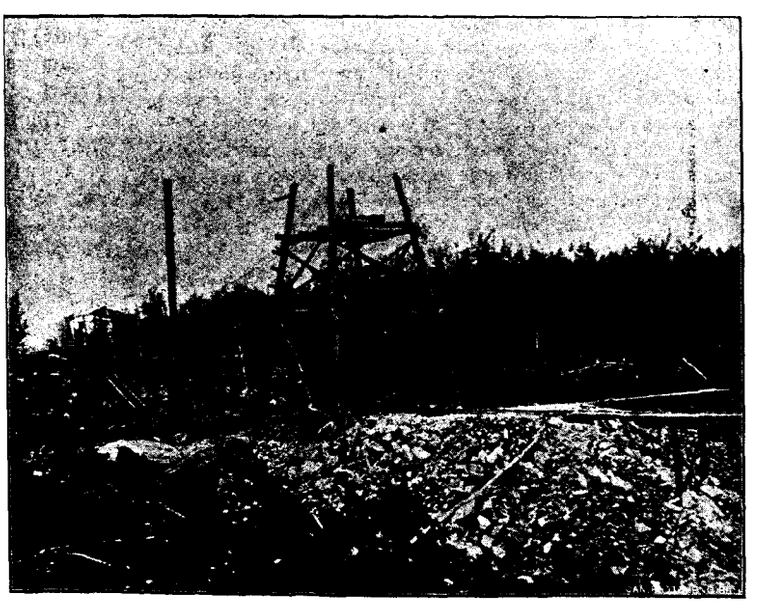
THE Yellow Jacket Co. Mining Company of Seine River (Ltd.) applies for an Ontario charter. Head office, Toronto; capital, $300,000. The applicants are: W. Croft, J. A. McKee, J. Goodall, L. K. Cameron, A. J. H. Eckardt, Rev. J. Hunt, J. W. Lester, S. R. Clarke, S. J. Sharp, G. L. Lennox, all of Toronto; R. Palen, Buffalo; M. T. Lester, New York; J. Croft, G. K. Dunstan, Toronto.

THE Imperial Mining and Development Company of Ontario (Ltd.) is applying for an Ontario charter. Head office, Rat Portage; capital, $500,000. The incorporators are: T. W. Taylor, D. G McBean, H. Byrnes, L. McMeans. G. A. Glines, Winnipeg, Man.

THE Bothwell Oil and Gas Co. Ltd., is to be incorporated to bore for, sell, manufacture, and otherwise dispose of natural gas and petroleum. Capital, $250,000; provisional directors, Hiram A. Walker, A. Ekstrom, and Hiram Walker, Walkerville, Ont.

THE Rainy River Gold Mining Co. is to be incorporated. Head office, Rat Portage, Ont.; capital, $1,000,000; provisional directors, T. Walsh, T. R. Deacon, N. Schnarr, H. Wright, H. Langford, C. E. Neads, Rat Portage.

THE Colcleugh Gold Mining Co. of Rat Portage, Ltd., applies for an Ontario charter. Capital, $1,000,000; head office, Rat Portage, Ont. The provisional directors are: J. A. McRae, Niagara Falls, Ont., and J. Arbuthnot, Winnipeg.



NO. 1 SHAFT, DOWN OVER 100 FEET, SAW BILL LAKE GOLD MINE.

THE Iron Capping Gold Fields Mining Company of Toronto, Ltd., is applying for an Ontario charter. Head office, Toronto; capital, $1,250,000; provisional directors, A. W. McDougald, Chicago; J. A McIntosh, and J. G. Hay, Toronto.

THE Block House Gold Mining Company, Ltd., is applying for a Nova Scotia charter to do a gold mining business in that province. Head office, Block House, Lunenburg Co., N.S.; capital, $8,000; provisional directors, G. Smith, W. H. Prest, J. K. Dawson, D. Stewart, A. K. McLean.

THE Columbia Mining Co. of Canada, Ltd., is to receive a Dominion charter to do a general mining business in British Columbia and elsewhere; head office, Winnipeg, Man.; capital, $80,000; provisional directors, G. Broughall, W. J. Christie, J. McRae, Toronto.

A TEN STAMP GOLD MILL AT LAKE HAROLD. THE SUPERINTENDENT'S CAMP.

THE Hopewell Gold Mining Co., Ltd., is applying for a Nova Scotia charter to carry on gold mining in Hopewell, Pictou Co., N S Capital, $15,000; provisional directors, J. G McQuarrie, Sherbrooke, N S.; A. F Grant, Riverton, N S; H Gray, Hopewell, N S.; Robt McLeod, Hopewell, J R. Porter, Stellarton.

THE Ontario Gold Mines Co. applies for an Ontario charter to do a general mining business in that province, with head office in Windsor, Ont. Capital, $200,000; provisional directors, R A. Demme, Detroit; T. J. Hurley, Brooklyn; C. N. King, Jersey City; H. Weston, New York; A. St. G. Ellis, Windsor, Ont.

THE Great Northern Mining, Exploration and Development Corporation (Ltd.) is applying for an Ontario charter. Head office, Toronto; capital, $475,000 Provisional directors Sir Melville Parker, Bart., Cooksville, Ont., F. Rodgers, Sault Ste Marie, Ont., H. A. Drummond, G. J. Ashworth, Toronto, T. H. Murray, Sault Ste Marie.

THE London Gold Mining and Development Company (Ltd) is applying for an Ontario charter. Head office, London, Ont; capital, $500,000. The incorporators are W F Roome, M D, G. N Weekes, J Powell, C E, G Burness, A A Campbell, W Spittal, J W. Butler, W J. Weekes, M.D., A. Greenlees, R D. Miller, S Wolverton, D L.S., M J Burns, T E. Robson, J. F Sangster, F. W. Daly, merchant; S. B. Coon, London, Ont., and W. Drew, I. Unsworth, G. D. Lockhart, M.D., Florence, Ont.

THE Golden Gate Mining Co., Ltd., applies for an Ontario charter to mine in Algoma and Lake of the Woods district. Head office, Toronto; capital, $300,000; provisional directors, Francis Fitzgerald, Judge, Port Arthur; A. H. Macdonald, Q C, Guelph; J. D. Warner, New York, N.Y.; A. M. Hay, London, Eng.; R. H. Ahn, Rat Portage.

A YEAR BOOK of Mining is to be compiled for the Province of British Columbia. Owing to the increasing attention being directed to British Columbia, and the rapidly growing interest in its mineral and other resources, there is likely to be much demand for such a volume. It is now under preparation, and is intended to contain everything pertaining to the history, politics, trade, industry, laws, social conditions, etc., of the province. The author and publisher is R. E. Gosnell, librarian of the Legislative Assembly and secretary of the Bureau of Statistics.

FOLLOWING the good example of the Ontario Government in placing the services of a diamond drill at the disposal of the owners of mining claims at a nominal figure, the Government of New Brunswick announces in the *Gazette* that it will secure a diamond drill early in 1897, and asks for applications for its use.

THE Sudbury Gold Mining Co. is applying for an Ontario charter to do a general mining business. Head office, Sudbury, Ont.; capital, $100,000. Applicants are: W. A. Quibell, R. H. Arthur, M.D., W P. Martin, Sudbury; D. C. Fraser, of New Glasgow, N.S.; D. McGregor, Sault Ste. Marie.

DINNER HOUR, DAY SHIFT, SAW BILL LAKE GOLD MINING COMPANY.

THE Original Swede Boys Prospecting Company of Rainy River District applies for an Ontario charter to carry on a general prospecting and mining business. Head office, Fort Francis, Ont.; capital, $90,000; first directors, J. Berg, G. Asplund, J. Franson, A. Franson, Erik Franson, Rainy Lake City, Minn.

THE Canadian Mining Trust Company is a new corporation which seeks Dominion incorporation to carry on a general mining business with all other branches appertaining thereto. The chief place of business is in Toronto, and the capital stock is set down at

$100,000. The following are the applicants D. Matthews, H. P. Dwight, president of the Great Northwestern Telegraph Co.; Wm. R. Brock, Thos Walmsley, S. F McKinnon, H M. Pellatt, Frederick Nicholls, C J Campbell, A S Irving, A. E Ames, Wm. McKenzie, president of the Toronto Railway Company, and Hugh Ryan, all of Toronto

ARRANGEMENTS are being made to bore for oil at Pelican Rapids, on the Athabasca River, some distance from where experiments are now going on. It is believed that here oil-bearing shale underlies the country at a depth of not more than 700 feet. Although after boring over 1,700 feet at Athabasca Landing a flow of oil has not resulted, much useful information has been secured

Marine News.

THE International Navigation & Trading Co.'s new steamer is now running on Kootenay Lake.

THE addition of a cradle to the Cape Breton Marine Railway, large enough to accommodate a 3,000-ton vessel, is in contemplation

CHIEF ENGINEER ANDERSON, of the Marine Department, Ottawa, is to locate new lighthouses in New Brunswick and Nova Scotia.

THE Vancouver Marine Railway Company states that it has secured a site near the sugar refinery close to the Canadian Pacific Railway track.

JAS. PLAYFAIR, Midland, Ont., has bought one of the largest Case Outward Thrust Propeller Wheels, which has been manufactured by A. Wells Case, Highland Park, Conn., U S.

FOUR steamers of the Furness line are to ply direct between London and Halifax this winter Their names are the "Halifax City," "Damara," "St. John City," and "Boston City."

SANFORD FLEMING, the eminent civil engineer, declares that a twenty-knot passenger service to Europe by the St. Lawrence route is an impossibility, from its dangers through fogs, icebergs, shallows, etc.

THE R. & O. steamer "Carolina," which ran on the Saguenay route throughout the summer, has been in the dry dock at Levis, having her keel repaired. After this is completed, she will be sent on to Sorel, Que

THOUGH the financial statement of the company will not be made public till the annual meeting, it is learned that the profits of the Richelieu & Ontario Navigation Company are larger this season than last.

THE Owen Sound Dredge and Construction Company, Ltd., is applying for incorporation; capital, $50,000 Provisional directors: James Canan, Owen Sound; Edward H. Horsey, Ottawa; Thomas Saddler, Wm. Needler, and J A Barron, Lindsay

HON A G BLAIR Minister of Railways and Canals, accompanied by Collingwood Schreiber, Chief Engineer and Deputy Minister, recently inspected the Trent Valley Canal. It is, of course, by no means certain that the canal will be completed.

DUNCAN ARMSTRONG, of Port Colborne, Ont., has let the contract for constructing a new tug to A. Abbey, of Port Dalhousie McCleary & McLean, of Merritton, will supply the oak, and the machinery will be purchased in Buffalo.

THE Marine Department has decided to present a watch each to Stephen Bradley and Henry Hughes, of Bruce county, Ont., for gallant conduct in rescuing the crew of the barge "Severn," wrecked in Lake Huron last October.

THE Marine Department has leased the steel screw steamer "Petrel" of Kingston, belonging to the Collins' Bay Rafting Company, for the iceboat service between Capes Tormentine, N.B., and Traverse, P.E.I., for six months, for $6,000.

THE St. John *Telegraph* says that David Lynch will build the hull of the proposed new steamer for the Star Line. James Fleming & Son will furnish the machinery, and the intention is to have the boat on the route by July 1st next She is expected to cost about $30,000.

TROOP & SON, Ltd., of St. John, N.B., apply for incorporation as shipowners and forwarders Capital, $100,000. The incorporators are.—H. D. Troop, J. E Irvine, J. V Troop, C. McL. Troop, D. V. Troop, St. John; William Pugsley, solicitor for applicants.

INDICATIONS are that the shipping of the Canadian lakes will be better than usual next season Already several vessels have been chartered for next year, chiefly to engage in the timber trades. Charters are made on the basis of the present year's prices, fifty cents per thousand.

Personal.

J. B. CHARLESTON, of Ottawa, has been appointed Supervisor of Dominion Public Works.

ANDREW THOMPSON has been elected president of the new Quebec Electric Railway Company.

WILLIAM A HARRIS, manufacturer of the Harris-Corliss engine, died at Providence, R.I., October 18.

MRS. J. B. ARNOLD, mother of Willis Chipman, C.E., Toronto, died at her home in Brockville, Ont., on Oct. 22nd.

NEWTON J. KER, assistant city engineer, Toronto, was married recently to Miss Dickie, daughter of Lieut.-Col. Dickie, Brantford.

GEO. HENDERSON, assistant engineer of steamer "Rosemount," was severely injured by an accidental fall into the fire-hold last month.

OLIVER D COWAN, Gananoque, Ont., proprietor of the clothes wringer factory, and ex-mayor of the town, died of paralysis October 6th.

WAUD B. MUNDY, architect, formerly of Hamilton, Ont., has on hand the erection of the new Chicago fair building, which is to cost $1,000,000.

A S WIGMORE, manager of the Holmes Electric Company, Toronto, has recovered from the injuries received in a bicycle accident, some time ago.

MERLE KNIGHT, son of Mayor Knight, of Woodstock, Ont., died recently in Guatemala, where he was superintending the construction of a railway.

IT is said that Mr. Blair, Minister of Railways and Canals, has tendered the position of Deputy Minister to Wm. Wainwright, of the Grand Trunk Railway.

B. C FARMER, resident engineer of the sewage works, Salford, Eng., was recently in Hamilton, Ont., the guest of Principal Ireland, of the Hamilton Art School.

HURD PETERS, city engineer, St. John, while inspecting the new harbor improvements, fell and sustained injuries from which he has since been confined to his bed.

ALAN MCDOUGALL, C E, while on a visit to England, has taken seriously ill His friends will be glad to learn that he hopes soon to be well enough to sail for Canada.

TIMOLAUS BRAURIEN, the well-known head of the Compagnie Maritime et Industrielle de Quebec et de Levis, died recently at St. Joseph, Levis, from a stroke of paralysis.

THE Ontario Government has appointed Thomas Hodgins, Q.C., Master-in-Ordinary, to be referee for the purposes of the Drainage Law, pro tempore, without salary, in the stead of B. M. Britton, Q.C., resigned.

BENJAMIN ERNEST CHARLTON, of Hamilton, and James Bampfield, of Niagara Falls, Ont., have been appointed by the Ontario Government to be members of the Board of Commissioners for the Queen Victoria Niagara Falls Park.

JOHN BROW, G.T R. engineer at Galt, has been railroading for forty years. The Berlin *News* says he took the first train over the new G.T.R. from Toronto to Kingston, with a load of general managers and officials, about thirty years ago.

H. A. WALKER has resigned his position as superintendent of the mechanical and rectifying departments of the firm of Hiram Walker & Sons, and will, it is said, go to Bothwell as a member of the Essex and Bothwell Gas and Oil Company.

W. E. HALL, formerly of the Alice and Paulin mines, near Butte, Mont., has taken charge of the Le Roi mine at Rossland, B.C., as superintendent, in place of John Moynahan. Mr. Hall was for 15 years superintendent of the Alice. Before going to Butte he held a similar position at the Prince of Wales mine in Utah.

E. H. KEATING, city engineer, Toronto, has been elected a member of the Water Works and Water Supply Committee of the American Society of Municipal Improvement, whose convention was held last month in Chicago. Among other Canadians present were John Jones and Bernard Saunders, Toronto.

CHIEF ENGINEER ARCHIBALD, Superintendent Brown, and General Manager Pottinger, of the I.C.R., accompanied H. C. Stanley, chief Engineer of the Queensland Government, on a tour of inspection on the Intercolonial Railway recently.

DR. SHEARD, Medical Health Officer, Toronto, has received from the Dominion Government the appointment of honorary secretary for Canada of the section of anatomy and physiology of the second Pan-American Congress, which will be held in the city of Mexico on November 16, 17, 18 and 19.

NEW IDEAS.

SELF-CONTAINED MOTOR CARS.

George A. Washburn, of Cleveland, Ohio, has devised an arrangement consisting of a gasoline engine, dynamo-motor, and storage battery combination, which seems to be closer to a solution of a self-contained motor car than any thus far devised. The engine has only a moiety of the maximum power required, and the combination is thus operated: When the car is running on level stretches the motor or engine may be used alone, and when descending a grade the power is cut off from the car axles and the motor operated as a dynamo, charging the cells; when ascending a grade, the engine and motor both propel the car, the latter energized by the storage cells. Whether such a combination will compete with the central station system in present use, or the new combination of storage battery and trolley, remains to be seen, as the gas engine cannot be made as noiseless as an electric motor, and the occasional failure of perfect combustion will cause objectionable smells.

ELECTRICAL INSPECTION IN PITTSBURG.

About a year ago a scheme was conceived by Morris Mead, the city electrician, which has proven to be of much good to the city of Pittsburg. The idea was to have the erection, construction and inspection of all appliances used for electrical purposes placed under the supervision of the department of public safety, in order that safety, comfort, convenience and welfare of the people, and also protection from careless or negligent use of dangerous substances, might be insured. The ordinance provided that the department of public safety be given the supervision over all electrical conductors now in use in the city, which includes telegraph, telephone, trolley and other lines and appliances in which electricity is used, and the construction thereof, says the *Electric Engineer*. It also vested the department with the power to supervise the construction of wires and appliances used in private houses, and gave them the right to prohibit the use of either wire or appliance that would be defective or dangerous, either in material or workmanship. A number of inspectors were appointed, whose duty it is to visit buildings and thoroughly examine the electric wires or appliances therein. If a defect is found the owner of the building is notified to attend to it at once, and the refusal to take cognizance of this notice subjects the offender to severe punishment. Since the adoption of this new idea—eleven months ago—1,339 buildings have been inspected, which is on an average of 122 per month, to say nothing of the outdoor work that has been done. Many defects have been found, and on many occasions these would have been the cause of much damage had they not been attended to. The city, in this respect, is in a very good condition at present, which is due to the passing of the said ordinance. No fires of any account have been reported as caused by defective electric wires, and many accidents among machinists who have to tinker with electrical apparatus have been avoided. The scheme was a good one, and as time goes by the benefits derived therefrom will be more noticeable.

ELECTRIC THRESHING MACHINES.

Farmers in Pennsylvania are using electric power for threshing, the change from portable boilers and engines being caused by the fact that sparks from the boilers have caused many fires, and it is thought that by using motors this danger is eliminated.

WATER IN RESISTANCE.

Notes by Prof Fleming show that water is quite non-inductive when used as a resistance in an alternating current of 2,000 volts, and that the product of ampere and volt readings will be the actual energy consumed.

LOSS IN CONVERTERS.

Prof. Fleming has reported that the losses in alternating current converters in Great Britain from the magnetizing current (on open circuit) are equal to 1,600,000 k.w. hrs., or about 16,000,000 lbs. coal, amounting to $30,000 per annum.

CAR PAINTING BY COMPRESSED AIR.

Car painting by compressed air is being tried on the Pittsburg & Lake Erie Railway. The yard is well supplied with air pipes, and the barrel of specially prepared paint is mounted on a hand truck so that it can be moved to any part of the yard. The air line consists of 100 feet of 1-inch heavy hose; the paint suction hose of 50 feet of half-inch heavy hose. The barrel is equipped with a float of pine wood with 4-inch hole in the centre. Over the hole is a small hose-bearing tower, used as a support and hose regulator, insuring a uniform feed of paint. This device is light in weight, and can be readily carried to top of a box car for spraying the roof. The time for carefully spraying a box car is 30 minutes. To employ a man to follow with a long-handled 8-inch whitewash brush, 30 minutes additional, making labor cost one hour per box car, each coat. To coat a coal car of 60,000 lbs. capacity takes 20 minutes for each coat, including the time of two men. This road is also using a device for spraying on paint for the lettering, which, for covering uniformly, is considered a decided improvement over the stencil brushes, and will lead to a great saving in the wear and tear of stencil plates.—*Engineering News*.

VALUABLE FUEL IN ALGOMA.

The expected report by Dr. A P. Coleman, provincial mineralogist, on the reported discovery of coal in Algoma, Ont., is not conclusive in either direction. The substance is apparently not anthracite coal, but selected specimens are admirable fuel, and if the quality improves with depth of working and the deposits prove extensive, the fortunate discoverers will not quarrel about the name. Following are some of the points discussed by Dr. Coleman in his report. He says:

"A select specimen of the pure mineral when burnt gave only 4.10 per cent. of ash. As the specimen analyzed came from the surface of the deposit, it seemed probable that the amount of ash might be above the average. On this account assays were made of a general sample of the specimens taken by myself, and of a picked sample representing good material from the bottom of the pit. The results are as follows:

	Average sample.	Best sample.
Volatile matter (including four per cent. of moisture)	5.3	5.3
*Fixed carbon (coke)	64.7	74.2
Ash	30.0	20.5
Total	100.0	100.0
Specific gravity	2.0784	1.8708

"It will be seen that the results of the different analyses vary greatly in the amount of ash, which is less in the sample from the bottom of the pit than in those from nearer the surface.

"Looked at from the economic side, it is probable that the anthraxolite from Balfour may have considerable value as a fuel for local use. Hard coal is sold in Sudbury for $9 per ton, and this fuel could be laid down in that town for less than half that amount. If it should prove to contain less ash than at present on sinking upon the deposit, the anthraxolite should have the ordinary uses of anthracite It appears to be too fragile, however, for use in iron furnaces, which require a fuel capable of resisting a considerable crushing force. The amount of anthraxolite available can of course only be guessed at. If the vein goes down a hundred feet with its present area of about five hundred square feet, it would contain about 3,000 tons, and two hundred feet would of course double that amount. The vein may be worked out in a comparatively short time, as was the case with the somewhat similar vein of albertite in New Brunswick some years ago. The source of the anthraxolite is probably to be looked for in bituminous matter contained in the adjoining beds of slate, which carry 6.8 per cent. of carbon. By metamorphic action most of the volatile matter has been removed from the once fluid or plastic bitumen, leaving the present cracked and quartz-cemented solid anthraxolite. As to the age of the deposit, there is no evidence to show that the slates are later than Cambrian, as decided by Dr. Bell; but it is evident that these slates must have been consolidated and fissured, probably also faulted, before the original bitumen flowed into its present position. In what geological age this took place, it would be rash to venture an opinion. Other finds of a similar mineral are reported from the Sudbury region, and a very coal-like specimen was given me from Fairbank township, some miles southwest of the Balfour deposit. An assay showed, however, only 10.3 per cent. of carbon in this specimen, so that if this is an average sample, the material is worthless as a fuel."

*The percentage of fixed carbon in the coal now used by the Toronto waterworks is 81.79.

ENGLISH SEWAGE AND WATERWORKS.

In the article published in your last issue I made an error when describing the carbonized refuse system of sewage purification adopted at Baildon, England, when saying, on page 159, that "I believed there is no patent on the apparatus." Since writing the paragraph I have read a paper published April, 1894, by Duncan & Pickard, engineers, giving details and particulars of both the carbonized refuse and ferrozone methods of cleaning sewage, showing that Baildon and other similar works were then built from designs patented by B. & H. B. Jagger

It also gives a report of an analysis of the carbonized refuse taken from the destructors, viz.; Carbon, 12.50; oxide of iron and alumina, 15.52; carbonate of lime, 10.60, phosphate of lime, 3 00; carbonate of magnesia, 3 14, alkaline salts, 3 00; insoluble matter (sand, etc.), 47 70, moisture, 4 71 They describe the Baildon system as an artificial land filter that can be cleaned or renewed when necessary, having a continuous flow which can be kept in action in all kinds of weather This cannot be done with irrigation farms, which get too fat and are often flooded. The filters extract over 60 per cent. of the albuminoid ammonia, together with all other solid matters from the sewage.

In my opinion the settling tanks at Baildon could be improved upon, and the cost of erecting such works materially decreased, at the same time increasing their efficiency, making it easier to remove the sludge and compel the sewage to release more sediment before passing to the filter beds

This carbonized refuse system requires no precipitant, and the filtering medium costs nothing. After the destructor is once lighted the refuse burns itself, therefore there is no expense for fuel. Formerly the towns were put to considerable expense carting the night soil, etc., to a distance, now it is dumped within their own limits at less than half the cost and the towns' refuse purify the towns' sewage Moreover, the skimmings and top dressing of the filters after being used become a useful fertilizer, and can be sold at four shillings per ton It may be interesting to explain of what the ferrozone and polarite used by the Huddersfield corporation to clean their sewage water with is composed. Quoting from Messrs. Duncan & Pickard, ferrozone costs fifty shillings per ton, and contains sulphate of iron, 24.42, sulphate of alumina, 3 16, carbon, 0 81, matter insoluble in water, 45.09, moisture, 20 86 other matters, 7.72 Polarite costs six pounds per ton and contains sesquioxide of iron, 53.98, magnetic oxide of iron, 19 19; protoxide of iron, 7 25; calcium oxide, 1.43, silica, 15.10, carbon, 1 80, water, 1.44. Through the kindness of J. H. Cox, Esq, M Inst. C.E., I have in my possession a book giving a full description of 53 public sewage works, including the cost of erection and present management.

W. M. WATSON.

47 Dundas street, Toronto.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metals imported into Canada from Great Britain during September, 1895 and 1896, and the nine months to September, 1895 and 1896:

	Month of Sept.,		Nine m'ths end'g Sept.,	
	1895.	1896.	1895.	1896.
Hardware and cutlery	£6,647	£6,195	£41,227	£46,867
Pig iron.....	5,502	3,838	21,626	21,230
Bar, etc.....	1,118	1,101	9,820	12,606
Railroad	23,612	28,040	107,715	158,153
Hoops, sheets, etc.....	8,519	4,354	41,581	35,758
Galvanized sheets	6,815	5,291	48,135	42,212
Tin plates	13,211	6,401	95,492	91,909
Cast, wrought, etc., iron ..	7,730	5,103	41,090	40,651
Old (for re-manufacture) ..	4,970	1,058	11,543	14,862
Steel	9,595	10,519	52,642	73,060
Lead	2,536	1,015	17,219	10,486
Tin, unwrought	1,844	419	17 037	11,716
Cement	4,173	5,279	21,066	24,589

THE business of James Cooper, railway supplies, etc, Montreal, is being turned into a joint stock company, with a capital of $99,000. The incorporators are. James Cooper, merchant; S J Simpson, manager, F. H. Hopkins, manufacturer; W H C Mussen, clerk, and T. J. Kennedy, engineer, all of Montreal The company will manufacture and deal in railway and mining plant.