The Canadian Engineer

VOL. III.—No. 9. TORONTO, JANUARY, 1896. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE AND SANITARY ENGINEER; THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto, and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR
R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto office.

CONTENTS OF THIS NUMBER:

THOMAS LEOPOLD WILLSON.

THOMAS LEOPOLD WILLSON, whose name is now known throughout the scientific and mechanical world in connection with calcium carbide, and acetylene gas, and whose portrait is given to the public for the first time through THE CANADIAN ENGINEER, was born at Princeton, near Woodstock, Ont., on the 14th March, 1860, and is therefore in his thirty-sixth year. He is above medium height, rather slight frame, and like most men who have attained to real distinction in the world, is of modest and unassuming demeanor—as may be gathered from the fact that he has personally shrunk from publicity, and invariably declined the request of leading American and foreign journals to allow his portrait and biography to be published, and only now consents on personal grounds, and because the writer was born and lived near his old family seat in the county of Wentworth. So little is known of Mr. Willson personally, by the scientific press, that his nativity has been ascribed to half-a-dozen places, ranging geographically from North Carolina to Ontario.

Mr. Willson's grandfather, the Hon. John Willson, was one of the ablest men who sat in the early legislature of the old Province of Upper Canada. He represented the West Riding of York (now Halton) from 1809 to 1820, and the county of Wentworth from 1820 to 1831, being made speaker of the House of Assembly in 1825. He was a fine type of the pioneer settlers of Upper Canada, and his public life was marked by high integrity and broad views. It may not be known, except to those who have made the early history of the province a study, that he had the principal hand in laying out the lines on which the present unrivalled educational system of Ontario was framed. This system was afterwards elaborated by Dr. Ryerson, but the foundations were laid by the Hon. John Willson—a work sufficient of itself to give him a name in history.

Yours. Most Truly
Thomas L. Willson

The subject of our present sketch is the only son of his grandfather's youngest son, the late Thomas Whitehead Willson, who died in 1874, the Hon. John Willson having died at Winona (then called Ontario) in 1861. Like his grandfather, Mr. Willson is largely a self-made man. His father moved to New York in 1865, and at an early age he began the battle of life on his own account. At the age of 13 he returned with his parents to Canada, and his father having died in the following year, he was sent to school in Hamilton, where he remained till 1882. His education in that city was chiefly at the Collegiate Institute, under Geo. Dickson and Prof. Spencer. While at school here he showed a special aptitude for chemistry and physical science, and it was following this natural bent of mind which led him afterwards to the discovery that has already made his name famous. When electricity began its development as a practical science, its wonders formed a field of irresistible attraction for Mr. Willson, who at the age of 20 had obtained such a mastery of electrical work that he constructed an arc light apparatus, and in association with Senator Sanford and John Hood, of Hamilton, gave the citizens there the first exhibition of the electric arc light—perhaps the first shown in Canada. This was given at Dundurn park on the occasion of the reception of the Marquis of Lorne, in 1881.

In 1882 Mr. Willson returned to New York and obtained employment with the Fuller Electrical Co., as inspector of construction work. After leaving this employ he was about a year with the Remington Gun Company (1885-6), and then went to Akron, Ohio, where he carried out some interesting experimental work in arc head-lights, as adapted to railways, on the Cleveland, Akron and Columbus Railroad, in 1886-7. From 1887 to 1890 we find him again in New York in business on his own account, in experimental work in association with Geo. F. Seward, of New York, and J. T. Morehead, of North Carolina, in developing the work of the Willson Aluminum Company, who in 1890 started to put in a plant at Spray, a suburb of Leaksville, N.C., for the reduction of aluminum and other ores by electricity.

Coming to Mr. Willson's discovery, it should be stated that as far back as December, 1887, he had been able to reduce refractory ores by electricity, and carried out such work on a large scale while employed in the shops of the James Brady Mfg. Company, Brooklyn, and in the early part of 1892 had completely worked out the problem of producing calcium carbide on a commercial scale. This was at the works at Leaksville, where he lived from 1890 to Aug., 1893, when he once more returned to New York, his present home. At the shops in Brooklyn, in 1887-8, he was working at the electrical reduction of all oxides—calcium oxide among others—and had a plant of 20 electrical horse-power, which was enlarged when the scene of his work was transferred to Leaksville.

Some writers dealing with Mr. Willson's remarkable discovery, have claimed for him, what he never laimed for himself, that is, the discovery of acetylene gas itself. As long ago as 1862, Wohler, by fusing an alloy of zinc and calcium with carbon, made impure calcic carbide in a powdered condition, and used this as a source from which to obtain acetylene by the action of water. No further advance was made till 1892, when Macquenne prepared barium carbide by heating a mixture of barium carbonate, powdered magnesium and charcoal, by which combination he obtained acetylene by treating it with water; while later still Travers made calcium carbide by heating together calcic chloride, carbon and sodium. Now, while acetylene is the simplest compound among the hydrocarbons—being formed of two atoms of carbon united to two atoms of hydrogen—it could only be produced in very minute quantities. Its value was known and appreciated, but how to obtain it in quantities sufficient to apply it to the science of commercial life, appeared so far beyond reach that attempts at this object have been few, if any. Indeed, Mr. Willson's own discovery was made, like many of the world's greatest scientific revelations, by chance during his search for another object. While working with his electrical furnace, trying to form an alloy of calcium from some of its compounds, he noticed that a mixture containing lime and powdered anthracite, acted on by the arc, fused down to a heavy semi-metallic mass, which having been examined and found not to be the substance sought, was thrown into a bucket containing water, with the result that violent effervescence of the water marked the rapid evolution of a gas, the overwhelming odor of which enforced attention to its presence, and which on the application of a light burnt with a smoky but luminous flame. It was acetylene gas.

Further experiments showed that in a properly built electrical furnace, finely ground chalk or lime, mixed with powdered carbon in any form (whether charcoal, anthracite, coke, graphite or peat) can be fused, forming the compound known as calcium carbide, and that when this is brought in contact with water a double decomposition takes place, resulting in the formation of calcic oxide or lime and acetylene gas, the small cost of the gas not only bringing it within the range of commercial use, but enabling the chemist or manufacturer to build up a host of other compounds on a scale of cheapness hitherto undreamt of. An article that has hitherto been made in grains can now be manufactured by the ton, and made available for such a variety of purposes in the sciences and arts that no one can yet calculate the changes it will produce in the conditions of life. The fact that acetylene gas gives a light which the spectrum shows to have all the elements of sunlight, and which can be produced probably at one-half the cost of common gas or electric light, gives us only one element in the practical value of calcium carbide. Such is the vista opened before the world by Mr. Willson's wonderful discovery.

The remarkable properties of calcic carbide and acetylene, and their commercial developments, are referred to more in detail in another part of this issue. To us it must be a source of pride that a discovery of such far-reaching importance to the world was made by a son of Canada; and though Mr. Willson is now a naturalized citizen of the United States, he cherishes the warmest feelings towards the land of his birth. He is now building for his mother and sister a beautiful homestead at Woodstock, in which he takes much pride and interest. Mr. Willson was married August 27th, 1895, to Miss Mary Parks, eldest daughter of the late Wm. H. Parks, for a long time speaker of the Legislature of California.

THE CHICAGO CANAL, AND SOME SANITARY PROBLEMS CONNECTED THEREWITH.*

BY DR. P. H. BRYCE, M.A., TORONTO.

Probably most people know the character of the work on the Chicago Canal from an engineer's standpoint better than I do, but you may not have learned the reasons why it has been undertaken as a sanitary work. As you are aware, Lake Michigan has a height of 579.60 feet above sea-level at Sandy Hook, and is some two feet higher than Lake Huron. As you will also observe from the diagram before you, the waters of the lake at Chicago are separated from those of the Des Plaines River, which flows into the Mississippi River, by some two miles only of a water-shed. The elevation of this land between the two greatest water systems of the continent is only some 6 or 8 feet, and is, indeed, so little that in the construction of the canal a spill-way, or the river diversion works, has had to be planned, whereby the lower portion of the valley of the Des Plaines will, during flood time, be relieved of the flood waters in the upper reaches of the river when they exceed 600,000 feet per minute, by their being turned into the lake through this aqueduct, some 12 miles long and 200 feet wide, and having a fall of 6 feet to the mile.

The little stream called the Chicago River, at its

* An address before the Engineering Society of the School of Practical Science, Toronto.

nearest point, only two miles from the Des Plaines River, empties into Lake Michigan at the south end of the lake, and has become naturally the great central sewer of the city; while Lake Michigan, by nature a beautiful clear blue water, is as naturally the source of the Chicago water supply. Thus most of the broad facts of our lesson are before you. The city of Chicago, as you are aware, has had a remarkable history of growth and development. Fifty years ago it was a great marshy tract at the head of the lake, with only a few Indian huts here and there.

In 1870 its population was .. 298,000 say 300,000
" 1880 " " .... 593,000, an increase of 66 per cent.
" 1890 " " ....1,100,000, " " 120 "

With the invariable history of the cities on our inland waters, Chicago began years ago to find as her population increased that the short intake pipes laid into Lake Michigan were supplying other materials besides the pure lake water; and so we have the history of, first, the extension of pipes into the lake, and, second, the construction of a tunnel with the hope of obtaining a water taken beyond the point of pollution of the waters with sewage; but all was in vain.

Then a scheme was thought of, which was to divert the sewage by pumping it over the watershed out of the Chicago river and into the Des Plaines valley. This accomplished some good, but it was found that it only required a heavy rain to fill up the sewers, when the river became filled, much beyond the capacity of the pumps, and the black stream began to pour again into Lake Michigan. Thus it was soon felt that no mere temporary expedients could avail, and the Chicago engineers sought some permanent remedy. This was first in the shape of a great aqueduct out some four miles into the lake, and that the case was urgent is seen in the fact that in 1891 there were recorded some 1,700 deaths from typhoid in a city of 1,000,000 or so inhabitants. This tunnel was completed in 1893, but with six other pumping stations, with local sewers at no great distance from their intakes, only partial improvement was possible.

Along with this tunnel scheme was conceived the idea of constructing a great sewer to the Mississippi, which would flow at all times. This is being rapidly constructed. It is to have an ultimate maximum capacity of 600,000 cubic feet per minute, with a depth of from 22 to 35 feet. Its uniform width in the rock section is 162 feet, and will be 200 feet in the earth portions when completed. There can be no doubt of its being a great and costly work, but as is apparent, it is simply the cutting of a great canal through clay, black loam, and an easily worked limestone. The State of Illinois, by legislation in 1889, provided for the incorporation of the Sanitary District of Chicago, and granted a permit for the work to be carried on, having a beautiful and sublime disregard for anyone but the good people of Chicago, who, getting tired of drinking their own sewage, proposed to supply it to all the dwellers along the Father of Waters down to its mouth.

In return for any incidental inconvenience from this source, they said in effect to said dwellers on the Illinois and Mississippi, "We will supply you with a foot more water to float boats in and improve your commerce"; and to the people living in the other cities and towns, and who go to the sea in ships and do business on the great lake waters, and who are suffering from chronic low water, at the Limestone crossway, in the Detroit river and elsewhere, "Don't be disturbed, if we rob you of the one-twenty-fifth of the total water which flows down the Detroit river, since, at any rate, the Chicago people will be happy and healthy."

Setting aside, however, all but the sanitary problems attaching to this great work, we can see in them the following immediate effects:

1st. The great sanitary improvement of Chicago, if the lake is freed from sewage pollution and pure water is supplied to the citizens.

2nd. A certainty of the pollution of the Illinois River, already bad, even at Joliette, some thirty miles down, owing to the sewage from the present pumping works.

3rd. An immediate and definite lessening of the volume of water which receives the sewage of the towns along the St. Clair, Detroit and Niagara Rivers.

It is of interest for us to estimate what the pollution of the river at Joliette will mean, and we can understand this by estimating the degree of dilution of the sewage by the waters which will flow through the canal from the lake. As already stated, the estimated flow through the rock section at its maximum capacity will be 600,000 cubic feet per minute, or 864,000,000 per diem. It is calculated that this will be realized with a population of 2,000,000. Assuming this population, and a flow of 100 gallons per head of sewage in the canal, we find that 200,000,000 gallons of sewage per diem equals a flow, including the extra amount from rainfall on the streets, of one hour's flow of the canal. In other words, the dilution of the sewage will be 1 in 24 parts. If we compare this with other cities we find that Pettenkofer states that in the Isar at Munich, the sewage is 25 per cent. of the river flow, and considers this a sufficient dilution to remove all nuisance. Stearns, the engineer of the State Board of Massachusetts, does not consider that 1 in 40, or even 1 in 120, can be accepted as a standard under all circumstances at which rivers may receive sewage pollution. This is in the matter of the creation of a nuisance only, and is not intended to refer to the potability of a river water for a public supply. It is quite apparent, therefore, that the pollution of the Illinois River in its upper portion, at any rate, will be beyond redemption; and, as has already happened, we may expect the question of damages to towns below to crop up at every stage.

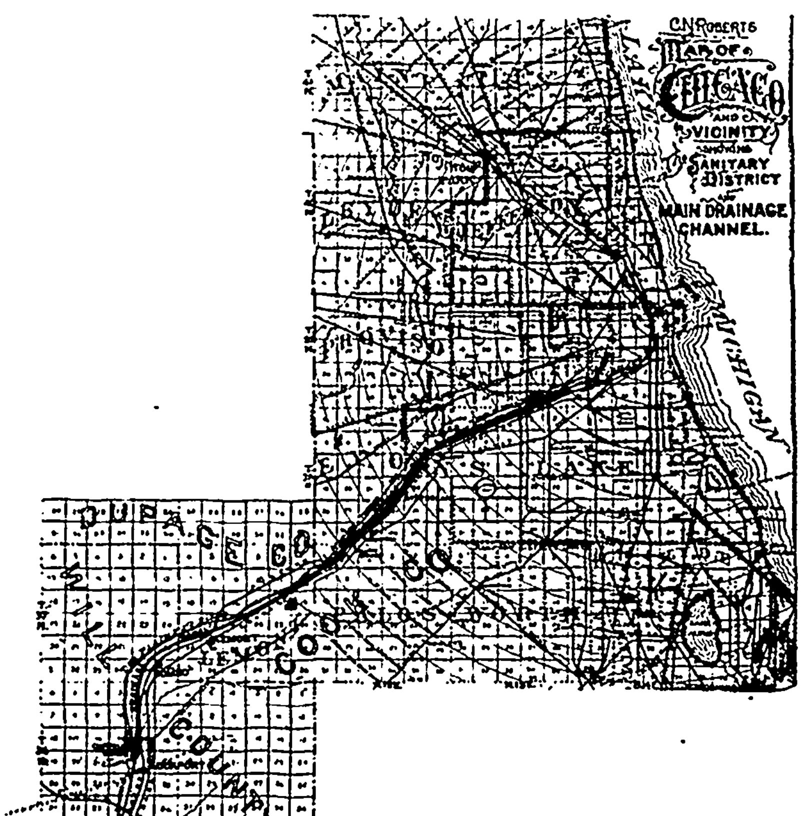
As compared with such pollution, that of the St. Clair, the Detroit or the Niagara might be described as accidental; but we already know that the dilution in 18 miles from Buffalo to Niagara Falls, or the diffusion in $\frac{5}{8}$ of a mile between Walkerville and Windsor intake, roughly calculated as 600 times, has not removed the danger from sewage, if it contain the germs of typhoid fever.

The case of Chicago, situated on a lake, in a position similar to Cleveland, Toronto, etc., is an interesting and instructive one, since it supplies us with a sequence of conditions which have in a smaller degree been realized by all the lakeside cities and towns between Chicago and Kingston. The manifest first source of danger is the increase in the population of these cities. The cause of this is a natural one, since in 1890 our great lake system of waters carried 20 per cent. of the tonnage of the water-borne freight of the United States, and, in 1893, 26½ million tons passed through the Detroit River. But more than this, we find that over 90 per cent. of the cities of over 10,000 in the United States and Canada, are situated on navigable waters.

Thus, those on the Great Lakes increased in years between the census of 1880 and of 1890, as follows:— Wisconsin, 43 per cent.; Minnesota (Duluth), 38.56 per cent.; Michigan, 73 per cent.; Ohio, 40 per cent.; Pennsylvania, 46 per cent.; New York, 37 per cent.; Indiana, 46 per cent. Michigan (those on Detroit River), 83 per cent. New York State (on Niagara River), 63 per cent. Canadian side (on Detroit and Niagara Rivers), 38 per cent.

We therefore find that as municipal operations are always behind public needs, we have constantly public water supplies deficient in quantity and very often in quality. And that, in addition to this, there is invariably a pollution of even large bodies of water, which, in spite of dilution and sedimentation, in spite of oxidation and the decomposition and nitrifaction of the organic matters in sewage, establishes a factor of permanent pollution in the lake waters near such cities.

These two results of city building are constants, and to engineers they supply the most ample field for the exercise of their talents in making the best use of the present methods, and of developing others for the effective dealing with the difficult problems which are constantly cropping up in regard to water supply and sewage disposal.



In a paper read before the American Public Health Association, recently, in Denver, I illustrated by these facts the need of International Rivers Conservancy Boards to prevent notably the evils arising from polluted water supplies, but also those political dangers so readily created and solved only with such great difficulty.

The directions in which we have to look for dealing effectively with these two conditions, are of necessity two—and broadly two only. Which shall we put first?

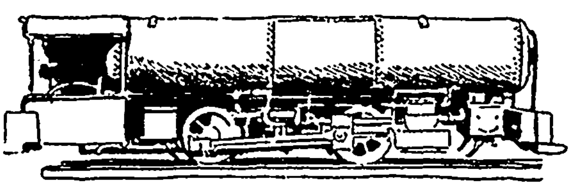
It would be largely true, that if we could supply unpolluted water to our cities, we need not be very anxious as to whether a few hundred thousand gallons, more or less, of sewage were carried into our great lakes and rivers. But even then it is found, as in Glasgow, that tidal streams may attain to a degree of foulness which makes them sources of nuisance and positive danger for the neighborhoods through which they pass. I anticipate such will be found in the instance of the Chicago canal. But can we afford to depend upon our water supplies without any attempts to deal with sewage as well? In the instance of Chicago, artesian waters have been found available for some of the towns and cities along the Illinois River; others have, or will be forced to put in filtration works, which may or may not purify. It seems quite possible, however, to supply these towns by a common water pipe carried from Lake Michigan, but it will be expensive. We may then consider whether it would have been possible to deal with Chicago sewage in any other way than that proposed.

At Pullman, 40 miles away, the sewage has for years been purified by irrigating the land; could Chicago have done the same? There were, so it was stated by statistics, during the winter of 1894, 150,000 people unemployed. Everywhere outside of the city, and notably in the valley of the Des Plaines, great tracts of prairie land are lying uncultivated or nearly so. Is it not a practical question to discuss, whether with some of the engineering skill utilized in making the canal, a system of dealing with sewage by a sewage farm, as at Berlin, Germany, could not have been instituted, which by irrigation would have given employment and homes to many thousands of people now supported by charity, or for public safety by the municipality. The utilization of the waste organic products of cities has become the characteristic work of the great municipal engineers of Britain and Germany, and their labors have made of them philanthropists to a degree which, perhaps, has not to any other class been possible. Should we apply it to the case of Toronto, what would be possible? The utilization of land which bountiful Nature seems to have supplied especially for our needs! Hundreds of acres are lying around Ashbridge's Bay, and acres more forming every year, and demanding our attention. Our beautiful bay is increasingly a cesspool. Surely when we have thousands of unemployed, permanent employment to hundreds can be given by allowing them to labor at the work of cultivation on a great sewage farm. This is one amongst many of our unsolved municipal problems.

In the other work of the purification of water, we have in Ontario an equally great need, and are, perhaps, at a more doubtful stage. The principles underlying each work are the same, but the reasons urging work forward are different. Each town hopes to be able to dispose of its own sewage cheaply, by simply turning it into the nearest stream, but is often prepared to spend much to purify water polluted by another town. It seems very clear, then, with these facts before us, that as sanitary engineers our energies will be directed with the greatest effect towards designing schemes comprehensive in character, and which, like township drains and irrigation works, are instituted on the assumption that the common need, and not that of some individual, or individual town or city, has interests apart from those of the general community. With the cultivation of such a spirit, it becomes easy to see how, not only intermunicipal and interstate interests may be provided, but also how the questions of international importance will be found of easy and simple solution.

TRIAL OF A COMPRESSED AIR LOCOMOTIVE AT NEW ORLEANS.

At New Orleans last month there was successfully tested a locomotive of a type different to any previously constructed. Although compressed air locomotives have been in use in mines for some time past, this one is stated to be an improvement on all others. Many advantages are claimed for this engine for mines, tunnels or underground work, as it distributes fresh air and is free from smoke, fire, and deleterious vapors. There are three of these engines in use, one at the Susquehanna Coal Company, Pittsburg, and two at New Orleans on the Western Railway, hauling cotton and other inflammable freight. They result in a great reduction in c st and danger from fire in handling freight, when sparks from locomotives would be dangerous. They have also many advantages for use in tunnels, etc. Their shape presents no obstruction that would hinder their entrance into a small level shaft. The engine being self-contained and having no tender, can be run around sharp curves and steep grades; further, the working parts are few in number, with no wear and tear of boilers, so that they are simple, easy of operation and durable. Their low cost is also an advantage. The dimensions of the locomotives, a sketch of which is here



shown, are as follows: 17 feet 6 inches long, 5 feet 2 inches wide over all, and 5 feet high. Its weight is 1,900 lbs., the cylinders are 14 by 18 inches, the pressure of compressed air in the tanks is 600 lbs. to the square inch, after being charged at the charging tank. The charging can be done in a very short time. The capacity of the tank at this pressure is 140 cubic feet. The air is delivered to the cylinders at 120 lbs. to the inch and expanded four or five times on the pistons. The tank heads are convex outwards, the circumferential seams are double riveted and the horizontal ones treble riveted. There is a man-hole in the front head which is of very strong construction to be safe under the great pressure. It is, however, not considered that an explosion would be dangerous should one take place, as the condition would be entirely different to that of a steam boiler with a large body of highly-heated water and steam. A powerful brake is provided, braking each of the four driving-wheels. The axles, crank pins, rods, cross-heads and guide-bars are all steel and hardened; removable bushes and pins are provided throughout for the valve gear. Sand boxes are also on the engines as on locomotives. All operating levers and valves, link motion, etc., are immediately at the hands of the engineer. The work on these engines throughout is of the best locomotive class designed for the best efficiency under severe conditions. They are found in practice to do all that was promised or expected of them. A charging air-compressing engine pumping into a tank furnishes the compressed air. It is always ready when required.

COMBUSTION.*

BY THOMAS WENSLEY, OTTAWA.

(Concluded from last issue.)

I will here give you an approximate list of square feet of heating surface per horse-power in different styles of boilers and various other data for comparison:

Type of Boiler.	Square feet of heating surface for one horse-power	Coal per sq. foot b s. per hour.	Relative economy.	Relative rapidity of steaming.	Authority.
Water tube....	10 to 12	.3	1.00	1.00	Isherwood.
Tubular	14 to 18	.25	.91	.50	"
Flue..........	8 to 12	.4	.79	25	Prof. Trowbridge.
Plain cylinder..	6 to 10	.5	.69	.20	
Locomotive ..	12 to 16	.275	.85	.55	
Vertical tubular	15 to 20	.25	.80	.60	

A horse-power in a steam engine or other prime mover is 550 foot lbs raised one foot per second, or 33,000 lbs. one foot per minute.

In *Engineering* of August 17th, 1894, there is a report of two tests made with a triple expansion mill engine of 1,000 horse-power, built by Victor Coates & Co., limited, of Belfast, for the spinning mills of the Brookfield Linen Company, limited, of the same city. This engine was set to work on the 18th of September, 1893, and has been at work ever since, giving satisfactory results, especially in the matter of fuel consumption and steady driving. As shown by these tests, the amount of water used is remarkably small, being 11.5 lbs. per hourly horse-power, and the coal consumption was 1 lb. The diameters of the cylinders are respectively 19, 29 and 46 inches, with a stroke of 48 inches. The steam was generated in two Lancashire boilers, 7 feet 6 inches in diameter and 30 feet long; each boiler has two furnaces of the Adamson type, having five Galloway tubes in each, and the total heating surface of the two boilers is 1,900 square feet. On these tests the engines were not running at full power, but were developing 787.4 horse-power, so that the heating surface per horse-power in this case was 2.41 square feet. The feed water was heated in the economiser to 250° Fahrenheit, and if we include the heating surface of the economiser, 3,600 square feet, there would be a total of 5,500, or 7.112 square feet per horse-power. The economiser is placed in the base of the chimney, and the feed water is heated by the hot gases which are passing away to the atmosphere, and would otherwise be a total loss.

When anthracite or hard coal is used, there should be from 22 to 24 inches between the top of the bars and the lowest part of the boiler. If bituminous or soft coal is the fuel used, then from 27 to 30 inches.

It is an absolute condition of economy and efficiency that the grate bars shall at all times be well and evenly covered with the fuel, but this condition is one that is frequently neglected. If the bars are not uniformly and evenly covered, the air enters irregularly in streams, passing through the thinnest or uncovered parts; if too thickly covered it prevents the air entering. You all know that the thickness of the fire will depend upon the size of the coal used. The smaller the fuel the thinner the fire. With egg coal from 6 to 8 inches, and with furnace coal from 8 to 10 inches, have been found the best results in practice. In burning soft coal the charges should be light, as, the gases which are evolved will have a better opportunity of getting the requisite quantity of oxygen.

* A paper read before the Canadian Association of Stationary Engineers.

I have seen from 15 to 16 inches of coal on the bars at a time, and upon asking the fireman his reasons for having such a heavy fire, his answer has been that he could not get steam unless he had that quantity. It is argued by some that it is necessary, when a boiler is worked to a high rate of capacity, to maintain heavy fires, and that thin fires are well enough for slow rates of combustion; but when the call for steam increases, it must be met by an increased thickness in the bed of coal on the grate. The ordinary fireman is apt to favor this method, for the reason that he can introduce large quantities at a firing, and afterward he is not obliged to give the fires much attention, for perhaps an hour's time, when he will again fill the furnace full in the same manner as before. As an explanation, however, of the favor which this method receives, it is probable that the class of labor which is generally employed considers the muscular effort required much less of a task than the more frequent and careful attention which is needed when the fires are thin. Under such conditions it is almost impossible to regulate with natural draught the supply of air, upon which we must depend entirely for perfect combustion and economy.

As regards a comparison between thick and thin fires, the fact is that more capacity can be obtained from a boiler when a fire of medium thickness is carried and proper attention is given to its condition, than can be realized by any system of management when the fires are exceedingly heavy, and advocates of thick fires, who take the ground that they are a necessity, are mistaken. As to the economy of the two, some persons maintain that heavy fires give the most economical results, but this is questionable. Valuable information on the subject has recently been brought out by the results of two evaporative tests which were made on a 72-inch return tubular boiler, having one hundred 3½-inch tubes, 17 feet in length. The heating surface amounted to 1,642 square feet, and the grate surface to 36 square feet, the ratio of the two being 45.6 to 1. On the thick fire test, the depth of the coal on the grate varied from 10 to 20 inches, being heaviest at the rear end and lightest at the front end. On the thin fire test, the depth was maintained uniformly at about 6 inches. The coal was New River semi-bituminous coal. The difference in the results, as appears from the figures, is an increased evaporation due to thin fires amounting to 15.6 per cent.

The quantity of heat generated in the furnace is dependent on the relative weight of hydrogen first, and carbon afterwards, chemically combined with their equivalent weights of atmospheric oxygen. If chemistry did not teach us this, our daily experience would soon convince us.

In using soft or bituminous coal, which contains a large percentage of volatile matter, it is necessary to introduce air over the fuel (unless we are working with the forced draught system), as we cannot get sufficient air through the grates, and that which comes is loaded with carbon which it has picked up in its passage through the fire. For this purpose we have apertures in the doors, or we leave the door ajar after a new charge of coal. You will readily perceive that the admission of any large quantity of air in this way must be objectionable, as it will cool the gases below the point of ignition, and if too much is admitted it will carry off heat from the furnace. There are a number of ways of admitting air to a better advantage; the simplest is to conduct the air through a hollow bridge wall and discharge it through apertures in the top, the air mingling with the lower strata of the burning gases as they pass over the bridge, thus ensuring a more perfect combustion.

George W. Barrus, M.E., made tests with a boiler where provision had been made for the admission of air as above, with Cumberland, anthracite and a mixture of two parts pea and dust, and one part Cumberland. In the case of the Cumberland, the evaporation was increased about six per cent.; with the anthracite, the evaporation was decreased about one per cent. The hot air completed the combustion of the volatile products of the soft coal, which would otherwise escape unburned. The slower burning anthracite did not need this supply and did better without it. The effect which the introduction of air had upon the appearance of the products of combustion, as viewed from the "peek hole" back of the bridge wall, was very noticeable in both cases, but greatest with the soft coal; but Mr. Barrus says that there was a heightened color and increased activity to the flame, which ever fuel was used, notwithstanding the average evaporative result with the hard coal was lower. Mr. Barrus' conclusion, drawn from many tests, is that a considerable advantage attends the admission of air above the fuel when bituminous coal is employed, but that there is no advantage when mixtures of anthracite screenings and bituminous coal are used, and little or no benefit is derived when anthracite coal is used.

The importance of good draught, natural or mechanical, for the supplying of sufficient oxygen for the rapid and economical combustion of fuel, has long been felt by the engineer. The gain both in capacity and efficiency which would be obtained by the rapid and energetic combustion of the various kinds of coal, and the high furnace temperature resulting therefrom, is well established, but its importance has only been admitted within the last few years. High initial furnace temperature is essential with all kinds of boilers to obtain the greatest economy, and to obtain this high temperature requires proper draught to deliver an abundant supply of oxygen to the furnace. This result is obtained by natural draught in a well-proportioned chimney, or forced draught obtained by mechanically creating a pressure under the grates with a fan or blower. The advantages of the forced draught are: 1st. It is under complete control. 2nd. The more perfect combustion of fuel by reason of the more abundant supply of oxygen to the furnace, and the possibility of using a cheaper grade of coal, with a proper combustion of the same. It is a fact, however, that the most perfect plant will be a failure if the firing of the boilers is not properly attended to, and the fires kept at an even and uniform thickness suitable to the grade of coal used, and it is to be regretted that so little attention is paid to this fact.

There is a furnace in use in the United States, a sketch of which I submit herewith, and known as the Hawley Down-Draught Smoke-Consuming Furnace. The characteristic features of the Hawley setting will be of interest; it consists of a double set of grate-bars, one above the other; the upper, or water grate, is made of 2-inch pipe, screwed into headers, or drums, connected with the circulating system of the boiler. The supply pipes to the front header are taken from near the bottom of the front end of the shell, the water passing through the grates into the rear header, which is connected to the boiler shell some distance back from the front, just below the water line, and the space between the drum and shell is built up solid with fire-brick. The operation of the down-draught furnace is directly opposite to that of the ordinary setting. Comparatively little air is admitted below the water grates, and the entire supply of coal, and practically all the air, entering above. The fire burns downward, instead of upward, there being no passage except downward through the grates. The gaseous products of combustion, together with the finely diveded carbon particles which form the visible smoke, are forced through the incandescent mass of coals and are highly heated, after which they meet the equally hot flame from the lower grate, on which there is burning what is practically a coke fire. The combined water of the volatile matter in the coal, as well as its moisture, are decomposed into hydrogen and carbonic oxide gases, and these combine with the air supplied below the grate, or drawn downward through it, and burn, thus adding to the efficiency of the furnace. The separated carbon meanwhile is transformed into carbonic acid gas, and the result is almost complete combustion. Whatever additional air is required is furnished through registers in the doors between the two grates, or through those of the ash pit. This style of furnace requires a somewhat increased chimney capacity, if it is desired that the boilers be capable of doing as much work as those set in the ordinary way. If the demand for steam never greatly exceeds the rated capacity of the boiler, the ordinary chimney will answer, it simply being necessary to carry thinner fires. The best results, however, in efficiency and smokelessness, as well as in capacity, are secured by having a chimney of ample height, but this is equally true with regard to ordinary settings, which rarely have enough chimney. They claim a saving for this furnace of from 20 to 30 per cent.

The highest value that has been found by actual test of a pound of coal is 14,603 heat units, and each heat unit is equivalent to 778 foot pounds, so that each pound of coal furnishes the equivalent of 11,361,134 foot pounds per hour, but we only get back 1,980,000 foot pounds, or about one-sixth of the mechanical equivalent of the heat supplied.

A pound of coal or any other fuel has a definite heat-producing capacity, and is capable of evaporating a definite quantity of water under given conditions; this is a limit beyond which even perfection cannot go, and yet, I have heard, and doubtless you have heard, of cases where inventors have claimed that their improvements will enable you to evaporate from 16 to 17 pounds of water per pound of coal, and so-called engineers have certified to these results.

You all know that this is impossible, the highest value for a pound of coal being 14,603 heat units, and it is a known fact that it takes 965.7 heat units to evaporate one pound of water from and at 212° Fahrenheit, so that by dividing 14,603 by 965.7, we have 15.1 pounds of water per pound of coal, and then only when every heat unit is put into the water. The highest value of evaporation so far has been 11.5 pounds of water per pound of coal, per hour; but, as a general rule, it is from 7½ to 8 pounds per pound of coal, per hour.

In conclusion, I would say that in the combustion of fuel there is but one body combustible to be dealt with, carbon and hydrogen, and but one supporter, the oxygen of the air. That in combustion, atmospheric air is the principal element, but it is the one to which practically the least attention is given, either as to quantity or control, and that chemistry and experience teach us that combustion depends, not so much on the quantity of air passing through the incandescent fuel, as upon the weight of oxygen taken up in its passage through it. In fact, the quantity of air passing through it may be destructive of combustion if improperly introduced and distributed. That the quantity of heat generated depends upon the relative weight of carbon or hydrogen, and chemically considered, their equivalent weights of atmospheric oxygen, so also the quantity of steam generated does not depend so much upon the intensity of the fire as on the quantity of heat absorbed by the water. Now, it is well known that success in generating the most heat and steam, and consequently power, from a given amount of coal, depends upon a compliance with the necessary conditions to perfect combustion, which involves not only a theoretical knowledge of chemistry, but also a practical knowledge of the best methods of combining them with mechanical appliances, and the perfect mixing of the constituent elements with which we have to deal, in strict accordance with the laws of nature.

For the standard method of testing coal referred to in this paper, the following is the outline of procedure: For the moisture a finely ground sample is dried for one hour in an air bath at 105° to 110° C. For the other constituents a fresh sample is taken of about a gram in quantity and put in a platinum crucible, the crucible being covered; it is now heated for 3½ minutes over a Bunsen burner, followed immediately with the highest temperature of the blast lamp for an equal length of time. The loss in weight, less the moisture obtained, equals the volatile combustible matter. The fixed carbon is next burned off by removing the crucible cover and heating in the flames of a Bunsen burner, with access of air till the carbon is burned off; the loss of weight equals the carbon, the residue is ash.

THE FUTURE OF GAS ENGINES--WILL THEY SUPERSEDE STEAM POWER?

A very large amount of attention is now being given by mechanical and electrical engineers to the remarkable economical results developed in the working of gas engines of from 40 horse-power to 500 horse-power, run by Producer gas. In an economical sense, steam in comparison is not "in it." It now becomes a question as to how to adapt it to marine and locomotive practice. No less an authority than George Westinghouse is seriously looking into this important matter. He is materially helping the advance toward perfection. He, it is stated, has brought this matter before the directors of the Pennsylvania Railway, telling them that they are wasting on their steam locomotives at least 4,000,000 tons of coal per annum, or that electricity, obtained by Producer gas, would save them $5,000,000 per year, an amount that would justify any changes that might be required in their system. Attempts have been, and are being made, to produce electricity from the coal pile. The nearest approach to this yet arrived at is the generation of power by Producer gas applied to the dynamo, and from it to the modern electric motor. The electric motors on the locomotive at the Baltimore tunnel are run by a current developed by steam power. This locomotive is no doubt one of the most powerful in existence, as proved by its wonderful pulling power. It may not be out of place to describe it here. This machine, the weight of which is 96 tons, hauled a loaded freight train 1,800 feet long, weight 1,900 tons, and two locomotives (no steam on them), also a local freight train of 15 cars and one locomotive, a total weight of 3,800,000 lbs., and started this enormous weight on a grade of 1 to 125 without splutter, sparking or the least slip of the wheels. The draw bar pull, when this train was in motion, was over 60,000 lbs., say 30 American tons. At 12 miles per hour as speed of train, what amount of brake horse power this will represent can be seen from the following simple calculation: 5,280 feet per mile × 12 miles per hour = 63,360 feet ÷ 60 = 1,056 feet per minute × 60,000 lbs. draw bar pull = 63,360,000 lbs. ÷ 33,000 lbs. = 1,920 horse-power for electric locomotive when hauling this train, including weight of three locomotives in motion without steam in cylinders. If this train had been hauled by these three locomotives, each engine would have had to develop 640 horse power. Allowing 5 lbs. of coal per brake horse-power per hour, each engine would use 3,200 lbs. of coal per hour, or 9,600 lbs.; for three gas engines to do the same work would be guaranteed to develop 1,920 horse-power with less than 2,000 lbs. of common coal or culm. Further, the cost of attendance on the locomotive power would be three times that of electric locomotives and gas engines to run the dynamos. The best engines in existence run with about 1¾ lbs of coal per horse power per hour; marine triple expansion engines, from 2¼ to 2½ lbs.; engines in general use, from 3 to 4 pounds; the best locomotive high pressure compound, from 4½ to 5 lbs., while from 7 to 10 pounds per horse-power per hour is a common quantity.

Gas engines will no doubt in the near future not only develop power during each revolution, as some do now, but will be so far improved as to have an impulse on each side of the piston during one revolution, making four times the power for each revolution of those in common use now; they will then be applicable for all power purposes for which steam is now used, both at sea and on land, without carrying enormous reservoirs of highly heated water and steam under very dangerous pressures; while the gas generating apparatus takes up very much less room and is of not more than one-fourth of the weight of steam boiler, steam engine and fuel, and of less original cost per h.-p. developed. There are a number of gas engines in use that develop 500 h.-p.; some very extensive electric light power plants are run by gas engines, also mills and factories, so that the application of the gas engine to all general purposes such as stationary engines, is practically arrived at. The fact that the gas engine is vastly more economical of fuel than the steam engine is not the only consideration in its favor. The high economy is found in all sizes of gas engines. Small steam engines generally use from 10 to 12 lbs. of coal per horse-power per hour, against 1½ lbs. for the small gas engine; also the first cost of a small steam engine and boiler, their maintenance and operation, are more than three times that of the modern gas engine; so that the electric motor run by potential from steam power will not have the same chance of knocking out the steam engine as they would have if run by modern gas engines. Gas engines, kerosene and gasoline engines are all of the same class. The gas engine will ere long drive the trolley car off the roads. The gas engines direct on cars, or for other work working direct, must of necessity be cheaper in the production of power than a gas engine in a central station running a power generator distributed over wires and on to motors, by electricity. Even the supplying of gas for a trip of a known distance, confined in a tank under pressure, is now commonly done in Europe and found to answer fairly well. The horseless carriage is now largely before the public, and will be soon as common as other vehicles. Many great improvements are continually made, as the best mechanical engineers are now making a study of them. The lay-reader will understand that the engines now referred to are those in which the gas is produced from oil introduced into the engine in the form of oil and not in the form of gas.

The gas locomotive is even now within the bounds of practical probability, just as the electric locomotive has been. The gas engine locomotive would have important advantages over the electric ones. The builders of the electric locomotive seem to think that these engines are the rivals of steam, yet the gas engine may soon take the precedence of both of them, in fact, rival all other sources of artificial power.

It must be conceded that a very great advantage over steam power is found in an economical gas engine, as it does not depend on its economy for a large supply of water for condensing purposes, that can be only had in certain localities. The gas engine can be placed in the most suitable position for the distribution of its energy for every purpose. It is cheaper in first cost than any other method of developing power, as also in attendance and maintenance. There are several European firms that will build them to develop 1,000 horse-power with much less than 1,000 lbs. of coal for this power per hour. It ought, therefore, to be a question with all those requiring power for electric lighting, pumping and power distribution, to look into this very important matter, which appears to have escaped notice by large power users in Canada.

THE KANE-PENNINGTON MOTOR.

The description of the Kane-Pennington motor, by Mr. Killey, and our editorial comment thereon, were based entirely on the account of it given in the *American Machinist*, a journal which is usually very careful in its statements. THE CANADIAN ENGINEER sent a representative to Chicago and Racine to investigate the facts, and the result of his mission is to convince us that the ideal motor for horseless vehicles has not yet been invented, much less has the Kane-Pennington motor solved the problem of aerial navigation. It is true that one of these motors, weighing only 17 lbs., was attached to a bicycle and ran a mile in 58 seconds, and that this feat was performed more than once, but they never ran it for three or five miles at that rate simply because the cylinders would have heated, as would be expected. The fact is that the supposed production of a new species of gas within the cylinder, brought about by the so-called "ripening spark," is a mere fiction calculated to sell patent rights to those who may not analyze the claims of a new invention very closely. While the Kane-Pennington motor may prove to be a very good machine, we may fairly question, in view of the dissipation of their alleged theories, whether it is even the best of those already on the market.

That the *American Machinist* was misled by its investigator, is evident from the following quotations from an editorial in a subsequent issue:

"In the account of the Kane-Pennington motor which we printed, some stress was placed upon the fact that there were two sparks introduced into the cylinder for each explosion, the first of these being what was called a mixing spark, the second the exploding spark. It was claimed that the use of the first, or mixing spark, doubled the efficiency of the engine, and at the same time decreased the heating effect on its cylinder walls. We were aware at the time that these statements would probably strain the credulity of engineers, but we have reason to believe that our correspondent was entirely sincere, and concluded to print them as an honest record of observed phenomena and wait for the explanation. We now have the explanation, and it is to be found in the fact that the observer deceived himself by simply misinterpreting what he had observed. If, in operating a gas engine, we introduce our igniting spark too late in the stroke, we shall of course decrease the power and efficiency of the engine If, then, we leave this spark as it is and introduce another spark earlier, we shall get the explosion earlier, and the increased power and efficiency will be due solely to that fact and nothing else, the later spark being thereafter entirely useless so far as effect upon the operation of the engine is concerned.

"This is just what we now ascertain did happen, and the increased efficiency accompanying the introduction of the earlier spark led to the theory of the mixing or preparatory spark—a theory which was, we believe, honestly conceived but entirely without foundation, as would have been quickly shown if, in the trials, the later spark had been omitted instead of the earlier ones.

"The alleged cooling effect of the first spark was arrived at by an equally ingenuous and guileless method. The cylinder was, in that trial, water-jacketed and was piped top and bottom to a water tank. The pipe from the top of the jacket entered the tank about six inches below the water level, while the pipe from the bottom of the jacket entered the tank about six inches from its bottom. The changes in temperature of the water in this tank were taken as indicating a corresponding rise or fall of temperature in the walls of the cylinder, and the temperature was taken by a mercurial thermometer immersed to a uniform depth in the tank, always below the hot water inlet. The result was that, while the surface of the water gave off a cloud of steam, it was cold at the bottom and seemed to get colder as the engine ran on and the water level descended by evaporation, thus decreasing the depth of hot water and therefore exposing the thermometer to less depth of hot water and correspondingly greater depth of cold water. Our correspondent was not the experimenter in this case. . . . We do not believe any one connected with the affair consciously misrepresented things. It is simply an example of how easy it is for an inexperienced person to deceive himself in such a matter."

TO THOSE INTERESTED.

We thank the friends of THE CANADIAN ENGINEER for their recognition of our efforts to improve the paper during the past year. Since the first of January last, over 1,200 new subscribers have been added to our list, and the increase during the past month alone was 350. We may say, however, that owing to the necessary enlargements in the paper, from time to time, the subscription price does not cover the annual outlay on each paper. We do not wish the subscription price raised; neither does the reader, but it is only by prompt remittances from all quarters that we can avoid doing so. The subscriptions are payable in advance. Please consult the label on your paper and see how the matter stands.

For THE CANADIAN ENGINEER.

OVERCROWDING IN THE INSTALLATION OF GENERATORS.

BY WM. GOLDING, C.E., NEW ORLEANS, LA.

It is the practice to install as many electric generators in a given area as the floor space will admit, never thinking that the electric fluid which is being gathered from the atmosphere may become exhausted.

The object of this note is to direct attention to the probable fact, that as all of the known ingredients of the atmosphere may be separated, the quantity of electricity collectible upon a given area may be limited.

As is well known, the life-sustaining property of the atmosphere, whether for animal or plant life, becomes exhausted by overcrowding, thus suggesting that the supply of electric fluid over a given area may also become exhausted by excessive and continuous withdrawal.

There are many well-equipped and seemingly well-installed electric generating plants that do not deliver the current of which they are theoretically capable, and there are al .any electric plants to which large additions of power have been made wherein no satisfactory results have followed, in which the failure may be due to overcrowding.

THE GROWTH OF GODERICH.

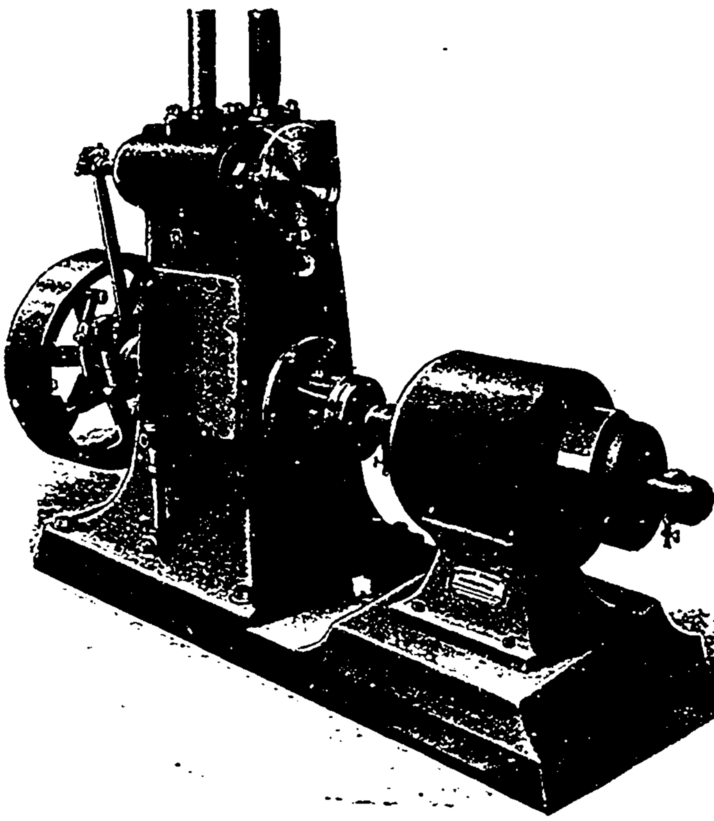
(Correspondence of THE CANADIAN ENGINEER.)

Our good town is progressing solidly and steadily. Already our Citizens' Committee have succeeded in establishing upon solid foundation a fine large bicycle factory and a knitting factory, the former now running, and the latter will be in a few days. We have also now closed terms for the establishment of a large saw-mill and the rafting of timbers from all along the coast to cut and ship from here. This mill will make a specialty of cutting stuff for furniture factories. We have made application to the Government for a lease of property suitable for our purposes, and if this is granted the matter will go on at once. We are offered another very important factory, and hope to close with it before the end of the year. We have special facilities for all wood-working factories, and expect to arrange for several here within a few months. We are also one of the best centres for fruit, fish and vegetable canning, and feel that one of such establishments should be located here. We hope also to have some practical capitalists establish a sanitarium, and make use of our magnificent sulphur and iron mineral waters and our salt water. We want further hotel accommodation for summer visitors, and we want such to be first-class only. Even now our hotels are full, and a vacant house is something strange to see. The season has been one of the liveliest building seasons for some years, and already contracts are closed for many fine dwellings in spring. Considering our progress and the future possibilities, we feel it important that more railway facilities be obtained. and after considering all the schemes offered in this line, we look confidently to the electric system to give us the quickest, and possibly best, facilities to insure continued progress. A lake shore line running from Sarnia to Wiarton should pay and would develop the eastern shores of Lake Huron. Already several charters are being applied for that we feel interested in, especially those from Waterloo to Goderich, Southampton and Walkerton to Goderich. The C.P.R. is also applying for extension of their charter from Guelph to this town, but they have dallied so long over it that we have lost interest in them, and now think that the electric roads, besides giving us facilities wanted, will cost less to build and equip, and hence more likely to form investments to stockholders. We feel sanguine that our proposed county belt line (recently described in THE CANADIAN ENGINEER) would be one of the best investments of the kind in the country, and we hope to see the scheme taken up soon by parties devoting time and capital to such pursuits.

A. McD. ALLAN.

THE STOREY MOTOR OR DYNAMO.

The Storey motor is a machine combining beauty, symmetry, and simplicity, with usefulness and economy, embodying in its design the most advanced theories both electrically and mechanically, and possessing several unique features which, while giving the machine advantages as a dynamo or motor, transmitting power in the ordinary way by shafting and belting, specially adapt it for direct driving, and an enormous range of work which will readily suggest itself to the mechanical mind.



STOREY DYNAMOS DIRECT CONNECTED TO ENGINE.

The Storey dynamo and motor is in its construction extremely simple, compact and symmetrical. It is a perfect cylinder in shape, the exterior of which is without flanges or bolts. The end caps, in which the shaft bearings and commutator are located, extend slightly from the heads of the cylinder, and the armature shaft projecting through them is coincident with the axis of the cylindrical shaft. The bases are detachable, leaving the machine a perfect cylinder adapted to fit into spaces and corners where ordinarily a motor could not be located.

One of the chief characteristics of this machine is embodied in the field magnet, the location of the pole pieces and the disposition of the field winding being quite novel. The machine is four polar, two of the poles projecting inwards from the middle of the cylinder like a T, with the cross-head parallel to the axis, while the other two project inwards from the edges of the cylinder and are L-shaped, thus forming two annular spaces, one at each end of the cylinder and in which are located the field coils. The cap ends are checked into and bolted to the ends of the cylinder, thus making the machine as rigid as one solid casting. One of the ends is caped-shaped to form a housing for the commutator and brushes, to which access may be readily had by means of removable tight caps. The journal boxes are formed in these ends and they carry self oiling bearings.

The direction of the current in the coils is such that the middle of the cylinder is of one polarity, while both ends are of opposite polarity. From this it can be seen that while this is a four-pole machine, it has eight distinct magnetic circuits, making the path of the magnetic lines uncommonly short and of very low resistance, and being entirely free from the common defect—magnetic leakage. There is no external magnetism whatever, and the efficiency is increased thereby.

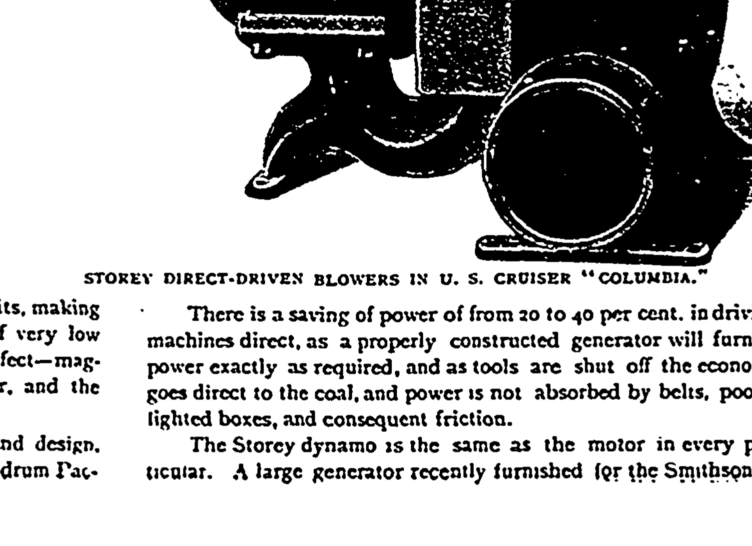
The armature is a masterpiece of workmanship and design, and is almost indestructible The core, which is of the drum Pacinati type, is of well laminated iron; the grooves are heavily lined with mica and each coil is well taped before it is inserted.

The commutator is well constructed The segments are of the best tempered copper well insulated and rigidly put together, the brush holders are very simple, consisting of rectangular sleeves which carry adjustable bronze springs which press against the rear end of the carbon brush. The brushes can readily be examined or changed.

The cylinder part of the machine is made from steel; this together with the peculiar location of the pole pieces and disposition of the field winding, give a magnet field of enormous strength. The armature being, relatively weak and of low resistance, and the machine being free from leakage and wasteful currents, the highest possible efficiency is obtained. Another advantage in this is shown by the low heat limit met with in the Storey motor, there being simple radiating surface on the exterior to dissipate what little heat there is generated. The machines are entirely closed in, requiring no ventilation like the ordinary motor. The brush holders, when once set, never require shifting for varying loads, as the neutral point never changes and the machines run absolutely sparkless under all loads.

Although the machine is lighter in weight than the ordinary motor and the speed considerably slower, all the parts that require strength and rigidity, such as the shafts, bearings, etc., are unusually heavy and massive. All the internal parts of the motor, including the field coils, are easily accessible and can be removed to be examined in a few minutes. From the above description it will be evident that the motor is practically an hermetically sealed machine. Thus it is protected on the outside against moisture, dust or any external injury, and being entirely enclosed, no outside injury can possibly arise from any internal condition incident to the operation of the motor, such as sparks etc. These features make the motor water-closed and fireproof. It must be apparent that the Storey motor is particularly advantageous for such places as mines, breweries, laundries, flouring mills, wood-working mills, woolen mills, or in fact any place where the air is laden with dust, smoke or moisture.

A reference to the accompanying engravings, one showing a direct-driven fan and the other a buffing lathe, of which several sizes are made, will at once suggest the adaptability of the Storey motor for a large variety of work, including the direct-driving iron and wood-working machinery, or in fact nearly every class of machinery. The buffing lathes and emery grinders are ideal pieces of apparatus and well illustrate the utility and advantage of a dust-proof motor. This is certainly a severe test for a motor where the machine is surrounded by iron dust and emery, and the full load is applied instantly by the operator hundreds of times in a day; but many of these machines are in use daily and giving universal satisfaction.

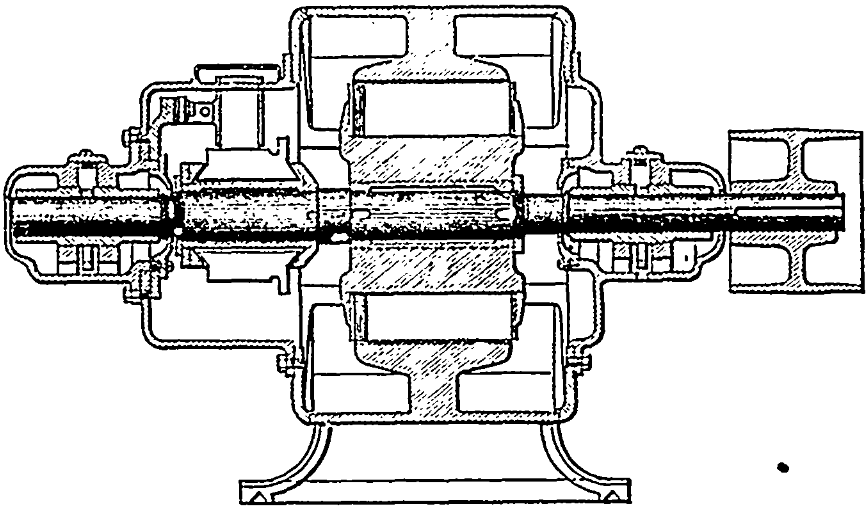


STOREY DIRECT-DRIVEN BLOWERS IN U. S. CRUISER "COLUMBIA."

There is a saving of power of from 20 to 40 per cent. in driving machines direct, as a properly constructed generator will furnish power exactly as required, and as tools are shut off the economy goes direct to the coal, and power is not absorbed by belts, poorly lighted boxes, and consequent friction.

The Storey dynamo is the same as the motor in every particular. A large generator recently furnished for the Smithsonian

Institute, Washington, was put under severe test by the Government experts, and the results were highly satisfactory. The machines regulated perfectly; there was no shifting brushes, no sparking, and after a ten hours' run in the hottest part of July, with full load, the rise in temperature in the machine was only 48 degrees.



SECTIONAL VIEW OF STOREY MOTOR.

In a future issue we shall describe this motor as applied to towing canal boats on the Erie Canal. At the recent test of canal haulage on this canal at Tonawanda, the Storey motor proved a great success.

The manufacturers are the Storey Motor and Tool Company, of Philadelphia, and Hamilton, Canada, the Canadian branch having recently been established in Hamilton, under the management of Mr. Arthur S. James.

CALCIUM CARBIDE AND ACETYLENE.

In another part of this paper we have given a sketch of T. L. Willson, to whom the world is indebted for the vast possibilities opened up to the scientist and the mechanic, and through them, to mankind in general, by the discovery of the method of producing calcic carbide on the scale to bring it into commercial use. The reader will also be interested in knowing more about the substance itself, and the results of its cheap production on civilized life.

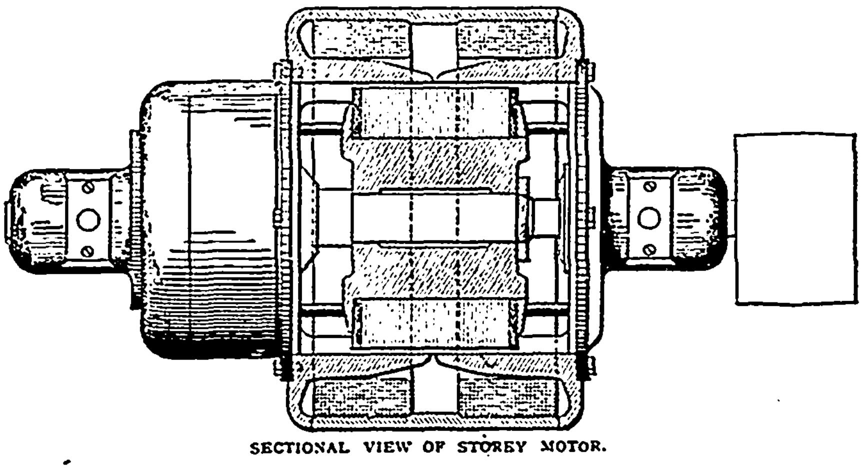
The breaking up of compounds into their ultimate constituents is called in chemistry "analysis," and the building up of a compound from the elementary matter again, is called "synthesis." The latter is a far more difficult process than the former; and until this century, scientists supposed that all organic bodies could be produced only as the result of animal and vegetable life. Chemistry has, however, been able laboriously to build up compounds synthetically; but never till the discovery of Mr. Willson, could this process be carried out to commercial advantage The direct combination of carbon and hydrogen in the electric arc, says Professor Vivian Lewes, in a recent paper before the Society of Arts, of London, is a true case of synthesis, and if we could form acetylene in this way in sufficiently large quantities, it would be perfectly easy to build up from the acetylene the whole of the other hydrocarbons which can be used for illuminating purposes. For

BUFFING LATHE—STOREY MOTOR AND TOOL CO.

instance, if acetylene be passed through a tube heated to just visible redness, it is rapidly and readily converted into benzol; at a higher temperature naphthalene is produced, whilst by the action of nascent hydrogen on acetylene, ethylene and ethane can be built up. From the benzol we readily derive aniline and the whole of that magnificent series of coloring matters which have gladdened the heart of the fair portion of the community during the past five and twenty years, whilst the ethylene produced from acetylene can be readily converted into ethyl alcohol by consecutively treating it with sulphuric acid and water, and from the alcohol again an enormous number of other organic substances can be produced. Thus acetylene can without exaggeration be looked upon as one of the great keystones of the organic edifice, and, given a cheap and easy method of preparing it, it is hardly possible to foresee the results which will be ultimately produced.

From acetylene we can produce all those bodies which we are accustomed to look upon as the most important ones in our coal gas, and which up to the present time have never been produced from anything but coal, hydrocarbon oils, or other organic matter undergoing destructive distillation, but it has often occurred to those of us who are interested in the manufacture of illuminating gas that as the supply of coal gets smaller, and as oil in time begins to share the same fate, some new sources for our illuminants and our fuels must be sought; and in the mind of Prof. Lewis, at any rate, the synthetic production of hydro-carbons has long been a day dream, which he never expected to see possible on a commercial scale.

Calcium carbide, as described by Mr. Willson in a paper reproduced with an interesting preface by Archibald Blue in the last report of the Bureau of Mines, is a dark brown, dense substance, having a crystalline metallic fracture of blue or brown appearance, and a specific gravity of 2.262; it evolves a peculiar odor when exposed to the atmosphere, due to the action of atmospheric moisture. In a dry atmosphere it is odorless. When exposed to the air in lumps it becomes coated with a layer of hydrate of lime, which to a great extent protects the rest of the substance from further deterioration by atmospheric moisture. It is not inflammable, and



SECTIONAL VIEW OF STOREY MOTOR.

can be exposed to the temperature of the ordinary blast furnace without melting. When exposed to the flame of a Bunsen blast lamp it can be heated to a white heat, the exterior only being converted into lime. When brought into contact with water or its vapors at ordinary temperatures, it is rapidly decomposed, one pound generating when pure 5.892 cubic feet of acetylene gas at a temperature of 64° F. It also decomposes with snow at a temperature of —24° F. It is not acted upon by the vapor of water at high temperatures. It abstracts moisture readily from alcohol, also from liquefied ammonia gas, rendering the latter anhydrous. If small pieces are treated with common sulphuric acid, a violent reaction ensues. Acetylene is generated with considerable increase in temperature. Experiments show that while it is very inert in its action on other compounds, the ease with which it decomposes water is remarkable. Place it in a glass flask, then allow water to drip on it from a tube, and decomposition at once begins, the acetylene gas pouring off in a continuous stream.

Acetylene is a clear colorless gas, with an intensely penetrating odor, which somewhat resembles garlic, its strong smell being a very great safeguard in its use, as the smallest leakage would be at once detected; indeed, so pungent is this odor that it would be practically impossible to go into a room which contained any dangerous quantity of the gas This is an important point to remember, as the researches of Bistrow and Liebreich show that the gas is poisonous Acetylene is soluble in water and most other liquids, and at an ordinary temperature and pressure, but is practically insoluble in saturated brine—100 volumes of saturated salt solution only dissolving five volumes of the gas The gas is far more soluble in alcohol which at normal temperature and pressure takes up six times its own volume of the acetylene, whilst 10 volumes of paraffin under the same conditions will absorb 26 volumes of the gas. It is a heavy gas, having a specific gravity of 0 91 When a light is applied to acetylene it burns with a luminous and intensely smoky flame, and when a mixture of one volume of acetylene with one volume of air is ignited in a cylinder a dull red flame runs down the cylinder leaving behind a mass of soot and throwing out a dense black smoke When acetylene is mixed with 1 25 times its own volume of air the mixture begins to be slightly explosive, the explosive violence increasing until it reaches a maximum with about twelve times its volume of air, and gradually decreases in violence until with a mixture of one volume of acetylene to twenty of air it ceases to be explosive. The gas can be condensed to a liquid by pressure, and this liquid is mobile and highly refractive. When sprayed into air the conversion of the liquid into the gaseous condition absorbs so much heat that some of the escaping liquid is converted into a snow-like solid, which catches fire on applying a light to it, and burns until the solid is all converted into gas and is consumed. Owing to its intense richness it can only be consumed in small flat-flame burners, but under these conditions emits a light greater than that given by any other known gas, its illuminating value calculated to a consumption of five cubic feet an hour being no less than 240 candles. The following is the illuminating power of the various hydrocarbons for a consumption of five cubic feet of gas:—

	Candles.
Methane	5.2
Ethane	35.7
Propane	56.7
Ethylene	70 0
Butylene	123.0
Acetylene	240.0

Prof. J. Suckert, who has studied the character of this light, says it is identical with sunlight, and that the spectroscope proves it. Prof. Lewes shows that the explosive qualities of the gas can be controlled as easily as coal gas or water gas. The London *Journal of Gas Lighting* thus described the Professor's experiments:

"Upon a piece of this material (the carbide) he sprinkled a few drops of water from a wash bottle, and put a lighted taper to it. The nascent gas—acetylene—immediately ignited with more than the brilliancy of the pitchy flame of highly bituminous coal in an open fire, and continued to burn fitfully over the wetted surface until all the water was gone Then came the display of the same gas evolved in a jar, which contained pieces of the carbide in water and stored in make-shift glass holders. It was a dramatic denouement of Professor Lewes' little plot when he applied a light first to a single open flat-flame burner, and then to a group of five similar burners, and people saw for the first time in a public place the intensely brilliant white and solid looking flame of burning pure acetylene It is indeed a flame to wonder at Nothing like it ever before came within the ken of a gas manager or dazzled the vision of a photometrist. There is something startling in the suggestion that gas of 240 candle power—calculated in accordance with photometrical practice, upon the basis of a consumption of 5 cubic feet per hour—can be burnt by means of an open flat-flame burner. When the carbide of calcium first came into Professor Lewes' possession this had not in fact been done, and in order to get a flame of acetylene at all the American handlers of the gas had fallen back upon the brutal device of diluting it with a certain proportion of air. This was to repeat the crude American way of rendering naphtha gas usable. But the dilution of acetylene with air is even more objectionable than is the same treatment in regard to naphtha gas, inasmuch as it is more easily converted into a violent explosive mixture Professor Lewes, in succeeding in burning acetylene in the pure state in which it comes from the mixture of calcium carbide and water, has saved its prospects as an illuminant He showed on Wednesday those wonderful acetylene gas flames already mentioned, each produced by burning the gas as made in the simple way described, without any adventitious mechanical or chemical aid, after the rate of half a cubic foot per hour, and stated to yield a measured illuminating power of 25 candles This could easily be credited. But what it is more difficult to convey in mere words is the impression of, steadfastness, whiteness, and, so to speak, solidity which the flames in question made on the observer. At a little distance no non-luminous zone could be perceived, but on a close inspection a tiny speck of blue over the top of the burner was visible. No smoke or smell escaped from these flames, which, although exhibiting in their color the evidence of intensely active combustion, were found to be much cooler than oil-gas or albo-carbon gas flames of the same size. This is a most striking feature of free-burning acetylene. The incandescent electric lamps of normal brilliancy by which the lecture theatre was lit were made to look as dull as 'red-hot hair-pins' by the aggressive acetylene, which itself by virtue of the irradiation produced by its dazzling white flame appeared to form balls of almost blinding light when viewed directly in face or sideways of the flame. The mantle of the incandescent light is no whiter than, if it is so white as, the naked acetylene flame, which does not flicker or change color, but in the absence of means of making a direct comparison between the two lights it is rash to say which would bear the palm for purity of tint."

FIG. 1. FIG. 2. FIG. 3. FIG. 4.

The possibility of liquefying acetylene by pressures about those at which liquid carbon dioxide is produced enables enormous volumes of this gas to be compressed into the liquid state in small wrought iron or steel cylinders, and in this condition, by means of suitable reducing valves and burners of the right construction, it may be stored and burnt. Used in this way, it will be of the greatest possible value for floating buoys, and the small cylinders can also be arranged in the form of portable lamps, whilst for use in the country, where no gas is available, a large cylinder of the liquid gas placed in an outhouse would supply a country house with light for a very long period, and there is no doubt that there is a very great field for it in this direction, as by utilizing suitable burners a consumption of half a cubic foot an hour will give a light equal to from 20 to 25 candles. Many other uses would at once be suggested, such as for railway work, bicycle lamps, etc. For use in houses where no gas supply exists, the following is recommended:—A strong steel cylinder, 4 inches in diameter and 16 inches in length, is fitted with an opening in the top of such size that a pound cartridge, or stick of the calcic carbide, can be passed through it. The cylinder has a second opening at the bottom, closed by a screw for cleaning out the lime left by the decomposition. The right proportion of water is put into the cylinder, and the stick of carbide coated with a slowly soluble glaze is inserted and the head of the lamp screwed on. The head contains a double reducing pressure valve, which brings down the pressure existing in the cylinder to that necessary for the proper consumption of the gas, it also being fitted with a valve. As the glaze dissolves from the surface of the stick of carbide, acetylene is generated, and the five cubic feet are compressed by their own pressure, the cylinder being placed in a vessel of cold water whilst the gas is generating, and the gas can then be burned from a suitable jet at the rate of half a cubic foot per hour, which will give a light of over 20 candles for something like 10 hours. When the gas is all burnt out from the cylinder, the top of the lamp is screwed off, the bottom plug also removed, and the lime washed out from the interior of the cylinder by a rapid stream of water.

Despite its high illuminating power, acetylene gives a decidedly cool flame, giving out but a little more heat than an incandescent electric light of like power.

The accompanying cuts represent some of the experiments carried out by Messrs. Willson and Suckert. Fig. 1 shows the gas burning with a sooty flame in an open jar. Fig. 2 is a tank containing the liquefied gas, with burner attached; and Fig. 3 the liquefied gas in a glass tube, surrounded by a metal casing. One pound of the liquid will produce 14½ cubic feet of gas at atmospheric pressure, or a volume 400 times that of the liquid. The tank shown in Fig. 4 contains liquefied acetylene, which has been cooled to a temperature of —28° F. in order to prevent the escape of too large a volume of gas during the process of its solidification. Attached to this valve, inside of the tank, is a tube which reaches within half an inch of the tank bottom, and is open at its lower end. Attached to the valve is a flannel bag to receive the solidified gas. Upon opening the valve the liquefied gas escapes, the solidified portion remaining in the bag, while the gas formed escapes through the pores of the bag. In making these experiments a portion of this solidified gas is shown for inspection; another portion is packed into the tube, a thermometer is inserted (Fig. 5), when the temperature falls to — 118° F. Another portion is placed on one pound of mercury contained in the saucer (Fig. 6); and the intense cold of the solidified gas almost immediately solidifies the liquid metal. A portion of the solidified gas or "acetylene snow" is now dropped into the vessel (Fig. 7), containing water. Being lighter than water, it floats upon its surface, and when touched with a light the gas surrounding each particle of the solidified gas burns with a sooty flame, and continues to burn until all the solidified gas has disappeared. The gas evolved from the

FIG. 6. SOLIDIFIED GAS.

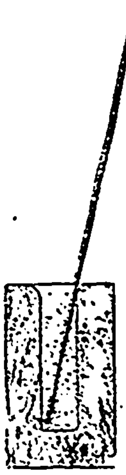


FIG. 5.

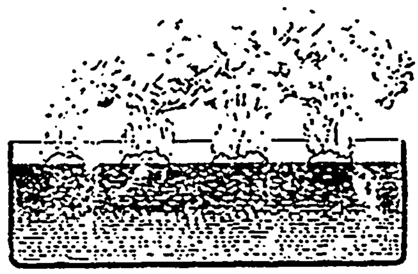


FIG. 7. FLAME OF SOLIDIFIED GAS.

acetylene snow in this dish is now ignited, showing a solidified gas at — 118° F., giving off gas which can be ignited, and which, although evolved at this low temperature, possesses the same illuminating power as at higher temperatures.

Thus is acetylene shown in its three physical conditions, namely, as a gas, a liquid and a solid. The fact that it readily assumes these conditions is of vital importance to its commercial application.

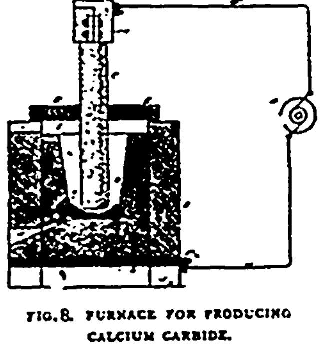


FIG. 8. FURNACE FOR PRODUCING CALCIUM CARBIDE.

Fig. 8 shows an experimental furnace built by Mr. Willson for making the carbide: *A* designates the outer masonry shed or bench of the furnace; *B* the carbon or graphite crucible or hearth; *C* the carbon bar or pencil constituting the movable electrode, and *D* the dynamo for generating the current. From the terminal brushes of this dynamo one wire, *w*, leads to and communicates with the crucible *B*, while the other wire, *w'*, leads to and communicates with the carbon pencil *C*. The connections are usually made in the manner shown, the wire *w* being connected through a fastening-bar *a* to an iron plate *b*, underlying the crucible *B*, and the wire *w'* being connected to a metal socket *c*, embracing the upper end of the carbon pencil *C*. The bench *A* is generally made of firebrick, which is a non-conductor of electricity, and the furnace is covered with a plate, or, preferably, two plates, *EE*, of carbon, having a central hole through which the carbon pencil C projects down into the crucible. For tapping out the resulting product a tap-hole *d* is formed, which in operation is closed by a plug *e*, of clay or other suitable refractory material. The carbon plates *EE* rest on the top of the firebrick walls *A*, which project above the top of the crucible, forming an intervening space *f* for the furnace, between *B* and *E*. For the vertical adjustment of the carbon pencil a screw-threaded shaft *g* is provided, which may be moved up and down by the engagement therewith of a suitably mounted rotative nut *h*.

The acetylene may be generated in the following manner. Upon the carbide contained in the closed jar (Fig. 9) water is poured in small quantities through the glass funnel communicating

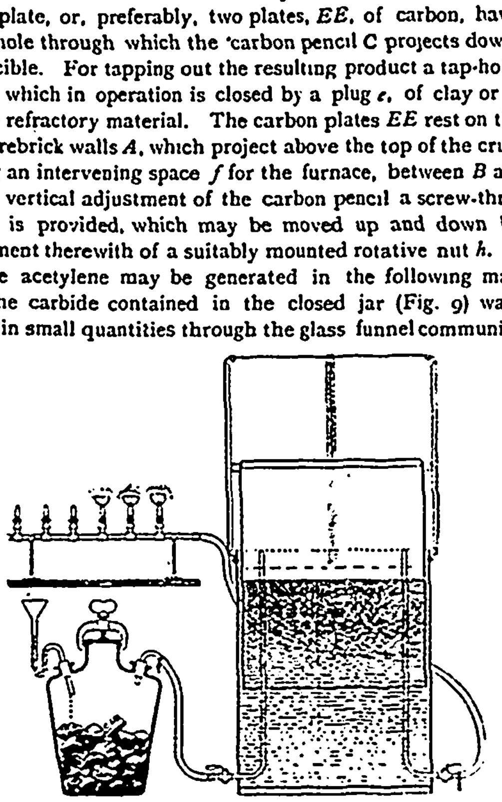


FIG. 9. APPARATUS FOR THE MANUFACTURE OF ACETYLENE FROM CALCIUM CARBIDE.

with the interior of the jar. The acetylene gas generated passes through this tube to the inside of the gasometer, thereby lifting the holder to the position which it now occupies, and the gas can then be conducted from the holder to the burners by means of this rubber tube. As the gas is being consumed and the holder lowers, the supply is rapidly renewed by pouring an additional amount of water through the funnel upon the carbide contained in the closed jar.

Regarding the cost of calcium carbide Dr. Francis Wyatt makes the following statement: "As the actual result of its recent practice, the Willson Aluminum Company has found that it can produce one short ton of calcium carbide from a mixture of 1,200 lbs. of fine coal dust and 2,000 lbs. of burnt lime, and at an expenditure of about 180 electrical horse-power per hour for 12 hours. These figures are not very far from those required by theory, and they agree very closely with those given by H. Moissan, who has also produced the carbide in an electrical furnace of his own invention. It would therefore seem safe to formulate the approximate cost of production somewhat as follows for both the carbide and the acetylene:—

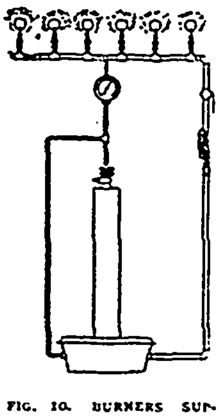


FIG. 10. BURNERS SUPPLIED BY LIQUEFIED ACETYLENE.

1,200 lbs. coal dust, say	$2 50
2,000 lbs. powdered burnt lime	4 00
180 e. h.p. from water at say 50c. per hour for 12 hours	6 00
Labor, etc.	2 50
Cost per 2,000 lbs. Ca C_2, say	$15 00
Cost per 2,000 lbs. C_2 H_2, say	37 00

These figures would hold good not only for the present works in North Carolina, but at any other place where very cheap water power and equally cheap coal, lime and labor are procurable and accessible. . . If to the estimated cost already given for the calcium carbide there be added say $15 per ton for freight, incidentals and profit, the material for producing such a gas could be obtained at nearly all points for 30 cents per 1,000 cubic feet, ready for burning, and the convenience with which the calcium carbide can be packed and freighted, combined with the easy preparation of the gas itself in great or small quantities, at any time, should enable it, if not to be adopted for the common supply of large cities, to supply the requirements of country hotels and dwelling houses and of railway cars "

The great advantage possessed by Canada in this field is the large number of places where water power for producing the electricity, charcoal or coal and limestone—the three essential elements for its production—can all be had so cheaply.

We may add that the Canadian General Electric Company have been licensed to manufacture calcic carbide and acetylene gas in Canada, and are conducting experiments at their works with the view of manufacturing here. Meanwhile, about twenty sub-companies have been licensed in the United States by the parent company, known as the Electro Gas Company of New York. Corporations like the Chicago Gas Company, and the Equitable Gas Company, of New York, have already been brought to adopt the new gas; while the Philadelphia sub-company are now preparing to erect a plant of 1,000 electrical horse-power for the manufacture of the calcium carbide at Niagara Falls.

THE CHICAGO CANAL.

The pressure that has been brought to bear on the Government relative to the appointment of a commission to ascertain what effect, if any, the Chicago drainage canal will have on the level of the lakes, has so far succeeded that Gen. O. M. Poe, Corps of Engineers, U.S.A., in charge of engineering projects in the northwest division, and Major Ruffner, Corps of Engineers, U.S.A., stationed at Buffalo, assisted by Capt. Marshall, U.S.A., stationed at Chicago, will report on the canal project to the Chief of Engineers.

It is known that Major Ruffner believes that when the canal is put in operation the level of the lakes will be materially lowered. The commission which is to make the investigation was appointed at the request of the Lake Carriers' Association, and other bodies. As a matter of course, Chicago does not believe that Major Ruffner's conclusions are warranted by the facts. The Chicago *Journal* points out that there are constant variations in the lake levels, and thinks that by comparison "the three inches of fall which engineers say will be produced by the drainage canal are infinitesimal. A summer breeze has more effect on the Straits than will be exercised by the drainage canal, even when it is enlarged to carry 600,000 cubic feet of water per minute out of the lake and down to the gulf."

The members of the commission are without doubt aware of the fact that the work which they have to perform is no easy task. All possible data for each month throughout a series of years will need to be taken into consideration, and the fluctuations of levels from all natural causes thoroughly inquired into, so that any compensatory conditions that might have existed to regulate or control certain levels will be given due weight in their findings. It is questionable if sufficient scientific observations and similar data can be secured so as to render the conclusions which the commission may arrive at beyond the criticism of those who have worked out a result showing an annual decrease of levels through the vast volume of water sent through the big ditch. The question of a permanent set and drift in the form of either surface or under currents is a feature also deserving of attention, and about which lake seamen ought to be advised at the earliest possible date.

One of the final results of the work of the commission will no doubt be to limit the flow of water through the canal to a stated quantity during certain months of the season, thereby establishing a minimum and maximum outflow according to the mean level of Lake Michigan as deduced from the official records kept for many years past.

The interests on both sides are great; at the same time it is a foregone conclusion that the great commercial and transportation lines so widely developed in lake commerce must not be endangered even by the lack or loss of one inch of water in the links connecting the several large basins, as the carrying ability of deep draft vessels is not in the least influenced through the lowering of the mid-lake sections, but rather controlled by the lowest depths found in the rivers

Major Ruffner's investigations of the outflow of Lake Erie past Black Rock led him to the conclusion that the average discharge of the river was a little over 200,000 cubic feet per second. This tallies closely with the estimate made by Prof. G. Frederick Wright, of Oberlin, the eminent geologist, who has made a special study of the basin of the Great Lakes in connection with his investigations of the geological evidences of the glacial age in America. Prof. Wright says the total drainage area of the four upper lakes is 250,000 square miles, with a rainfall of about thirty-one inches. On a liberal estimate of a discharge through the Niagara river of from 35 to 40 per cent. of this, the outflow by that channel would be in the neighborhood of 200,000 cubic feet per second, which is the estimate of Major Ruffner, reached by a different method of investigation. The Illinois legislation, authorizing the construction of the canal from Lake Michigan to the Illinois river, requires a discharge at the opening of not less than 10,000 cubic feet per second, or about five per cent. of the quantity now flowing down the Niagara river. The canal engineer, basing his estimate on imperfect data ante-dating the investigations of Major Ruffner, said the level of the lakes would be lowered not to exceed five inches, and might not be more than two inches. Major Ruffner holds that a diversion of five per cent. of the outflow would cause the water in the connecting channels between the lakes to sink nine inches. This of itself would be a very serious matter for the navigation of these connecting channels, which the United States is now spending millions to deepen, and would have to spend many millions more in order to overcome the damage inflicted by the Chicago diversion, but worse things are threatened. The engineers in charge of the canal talk freely of diverting 15 or 20 instead of 5 per cent. of the water of the great lakes into the Illinois, so as to make that river and the Mississippi navigable at all times for ocean-going steamers. The United States Government, which has spent so much money to deepen the lake waterway, is expected to spend more in aiding to shallow it by supplementing the work of Chicago and the State of Illinois with a series of improvements in the Illinois River.

Well! As we opposed this project several years ago, and were called down by eminent talent for doing so, we are not a little gratified to find that it is now becoming a pertinent, if not a most important question, and the subject should not be allowed to rest until all is known that can be known relative to the drainage canal effect upon lake levels.—*Marine Record, Cleveland.*

FIRES OF THE MONTH.

Dec. 12th.—Jas. McCraken's mill, Tilbury West and Mersea town line. Insurance, $1,000; not nearly enough to cover the damages.——Dec. 19th.—The railway station at Granfield, Que., on the Gatineau Valley railway.——Dec 20th.—Patterson & Corbin's car factory, St. Catharines, Ont. The machine, cabinet and paint shops were gutted. Loss $12,000. Partially insured.——Dec. 23.—The vinegar works of S. Allen, Norwich, Ont. Loss, $30,000. Insurance, $10,000.——Dec. 24.—Vancouver, B.C., Cassidy & Spicer's mills and the B.C. Cooperage; damage, $50,000. Dec. 28th.——Saw mill of James Porter, M.L.A., at Andover, N.B. Totally destroyed. Loss, $4,000; to be rebuilt.——Dec. 29th.—London, Ont., Glass' pottery. Loss, $13,000. Insurance, $5,000.——Jan. 2nd.—The Oshawa railway car shed, Oshawa, Ont. Loss, $12,000; covered by insurance.——Jan. 3rd.—Power house in rear of 99-111 Adelaide street west, Toronto. Loss, $10,000. Partially covered by insurance.——Jan. 7th.—The Ottawa Carbou Works were damaged to the extent of $200.

THE GRAND TRUNK MANAGERSHIP.

All that was best and brightest in Canadian public life, whether in politics or business, on the bench or at the bar, was represented around the well spread tables of the Windsor when the Board of Trade of Montreal gave a dinner to the retiring general manager of the Grand Trunk railway, Lewis J. Seargeant. There were about four hundred guests present, and the gallery was crowded with ladies. When Mr. Seargeant rose to reply to the toast of the guest of the evening, he was greeted with tremendous applause. In the course of his speech he gave a short historical sketch of the railway with which he had been so long and so honorably connected, showing the development from the building of the Champlain and St. Lawrence, the first Canadian railway, to the present day, when the sixteen miles of that road have become 4,000. In 1851 there were 93 miles of railway, and in 1852 the Act was passed by which the Grand Trunk obtained its charter and the road was completed, in spite of enormous difficulties, in 1860. Since then the prosperity of the Grand Trunk has been the prosperity of Canada. Mr. Seargeant has sent out a farewell note, in which he takes leave of the employés of the road, thus: "We have worked together for nearly twenty-two years, and I am honestly sorry to terminate the very pleasant and harmonious official relations which have existed between us. It is, however, a great satisfaction to know that my connection with the company does not end with this official retirement, and on the other side of the Atlantic I shall continue to take the greatest interest in Canada. I shall do this from the knowledge that a more loyal, well disciplined, and more trustworthy staff nowhere exists, and the surest recommendation to any one of you, apart from his personal merit, is that he has been a Grand Trunk employé."

Chas. M. Hays, the new general manager of the Grand Trunk, took up the task that Mr. Seargeant laid down on the first o January. Much is already being said of the moderation and tactf displayed by the new manager, and none but favorable opinions are heard upon all sides. A sketch of the lives of both Mr. Hays and Mr. Seargeant, accompanied by portraits, it will be remembered, was published in the December number of THE CANADIAN ENGINEER.

CARRYING CAPACITY OF PIPE.

When the number of acres to be drained, and the grade of drain is known, it is easy to determine the size of the pipe required by the following table, which shows the number of gallons discharged per minute, for specified sizes and grades:—

GALLONS PER MINUTE.

Size of Pipe.	1 inch fall per 100 ft.	2 inch fall per 100 ft.	3 inch fall per 100 ft.	6 inch fall per 100 ft.	9 inch fall per 100 ft.	1 foot fall per 100 ft.	2 foot fall per 100 ft.	3 foot fall per 100 ft.
3 in. ..	13	19	23	32	40	46	64	79
4 " ..	27	38	47	66	81	93	131	163
6 " ..	75	105	129	183	224	258	364	450
8 " ..	153	216	265	375	460	529	750	923
9 " ..	205	290	355	503	617	711	1006	1240
10 " ..	267	378	463	655	803	926	1310	1613
12 " ..	422	596	730	1033	1273	1468	2076	2554
15 " ..	740	1021	1282	1818	2224	2464	3617	4467
18 " ..	1168	1651	2022	2860	3508	4045	5704	7047
24 " ..	2396	3387	4152	5871	7202	8303	11744	14466
30 " ..	4187	5920	7252	10257	12580	14504	20516	25277

Statistics show the maximum rain fall to be about one inch per hour, excepting very heavy and uncommon storms.

One inch rain fall per hour gives 22,633 gallons per hour for each acre, or 377 gallons per minute per acre.

Experience shows that owing to various obstructions, not over 50 or 75 per cent. of the rain falling will reach the drain within the same hour. Due allowance should be made for this fact in determining the size of the pipe required, as severe storms are generally of short duration.—*From a circular of the Hamilton and Toronto Sewer Pipe Co.*

PORTLAND CEMENT TESTS AT THE McGILL LABORATORY.

Editor CANADIAN ENGINEER:

DEAR SIR,—I append a table of results of some Portland cement tests which I have made at the McGill laboratories within the last year. I have given the *best* test which I have yet obtained from cements from each country, and you will observe that the tests show themselves to be very closely equal to one another, and all the cements of a very high grade. No doubt the agent for each cement will be able to point out some superiority for his brand, but my object in sending this to you is twofold: (1) To illustrate how numerously and easily obtained are high grade cements, and (2) to show that Canadian Portland cements are being made, to-day, equal to the best of other countries. I have carefully examined the works of the "Star," of Napanee mills; the "Samson," of Owen Sound, and other work, which are running, and am convinced that the continuous, careful, chemical guard that is placed over the daily output of these mills renders the product reliable. It is a matter of satisfaction that such results have been obtained at such an early stage in the history of the industry in this country.

I would call your attention to the method of making 3 to 1 tensile tests, out of courtesy to long custom. I have made tests with 12 per cent. water and rammed the mortars into the moulds, but I have also made the same tests with 20 per cent. water (which gives a soft, mason's mortar), and placed the briquettes in the moulds under a uniform pressure of 20 lbs. per sq. inch. This gives results more in accordance with the manner in which mortar is manipulated in practice; results more uniform in their determination, and, therefore, at the same time scientific and practical, which is often a difficult feat to accomplish.

This method is in accordance with the final report of the Canadian Society Civil Engineers, on cement tests, and it is hoped that other engineers will make or have made tests in the same way, so that results may be compared. Yours truly,

CECIL B. SMITH.

McGill College, Montreal, Jan. 6th, 1896.

ED. NOTE.—The following are the tests referred to by Prof. Smith, and they effectually dispose of the assertions made in some quarters, that first-class cements cannot be made in Canada.

SOME CEMENT TESTS—McGILL COLLEGE CEMENT TESTING LABORATORY.

Country.	Brand.	From whom received for testing.	Specific Gravity.	Residues per cent. on sieves. No. 50.	No. 80.	No. 100.	No. 120.	Times of set. Initial.	Full.	Per cent. of water. For standard consistency.	Result of blowing test. (Hot water.)	Neat tensile strength per square inch. 3 dys.	1 wk.	4 wks.	2 mos.	3 to 1 tensile strength. 20 per cent. water. 20 lbs. per sq. inch in moulding. 1 wk.	4 wks.	12 per cent. water. Rammed into the moulds. 1 wk.	4 wks.	Neat compressive strength. 1 week.	4 weeks.	3 to 1 compressive strength. 12 per cent. water rammed into moulds. 1 week.	4 weeks.
Canada	"Star"	Manufacturer	3.12	0.0	0.4	0.9	2.3	6°00'	....	24	Good.	375	482	625	701	..	..	82	121	2,017	2,962	....	....
Canada	"Star"	Mr. Storey	3.14	0.5	2.5	4.0	6.5	1°30'	4°45'	25	Good.	414	467	558	....	61	114	132	204	2,217	3,047	850	1,475
Canada	"Star"	Manufacturer	3.14	0.5	1.8	2.6	4.9	4°00'	7°00'	25	Good.	440	479	566	..	109	161	167	217	3,545	3,870	1,150	1,390
Denmark	"Aalborg"	Mr. P. A. Peterson	3.105	0.0	0.5	1.7	5.5	2°00'	....	24	Good.	522	596	706	729	71	115	137	312	......	......	....	....
Belgium	"Josson"	Mr. C. I. Desola	3.08	2.4	8.4	10.3	13.8	4°00'	7°00'	25	Satisfactory.	493	561	631	777	110	165	178	258	3,962	4,883	1,262	1,656
England	"Anchor"	Currie & Co.	3.09	1.2	7.0	9.2	17.2	25'	3°00'	25	Good.	....	432	551	685	81	122	169	216	4,037	5,300	1,012	1,600
Germany	"Heinmoor"	Hyde & Co.	3.135	0.2	1.8	2.8	5.1	5°15'	8°00'	25	Good.	350	482	637	....	64	134	145	252	3,467	5,012	1,025	1,537

ELECTRICAL RADIATION.*

BY C. A. CHANT, B.A., LECTURER IN PHYSICS, UNIVERSITY OF TORONTO.

With radiant light and radiant heat we have long been acquainted, but to most of you present, I doubt not, radiant electricity is a veritable stranger. Only in recent years has he appeared openly amongst us; but his growth has been almost phenomenal, and now he is a well-developed youth In almost all the latest works on electricity you can learn about his appearance and his doings.

And yet, this branch of electrical science did not grow up with such wonderful suddenness after all. Fully fity years must we look back to see its beginning. At that time the great Faraday was cross-examining nature with a penetration little short of intuition. He held a magnet near another magnet, or near some bits of iron, and even though many inches apart their mutual attraction or repulsion could be seen. Again, one electrified body was observed to influence another some distance away. He also discovered that when a current of electricity in one coil was started or stopped, a galvanometer attached to another coil, entirely disconnected from the first coil, was affected. This truly was not a weed which he drew up, but a most valuable fish.† Many a time also, he was impressed with the grandest of all these attractions, namely, that between the heavenly bodies—the force of gravitation.

Faraday learned, as generations have been taught, that one body attracts another, the force decreasing inversely as the square of the distance, but with that knowledge he could not rest. Such a delicate skeleton might suffice to bear the gauzy garments woven in the subtle brain of the mathematician—often, truly, of surpassing beauty, if you are able to see them—but the great investigator demanded something more tangible. If body *A* attracts body *B* when ten inches apart, there must be ten inches of something between them. The influence passes from *A* to *B*; it surely cannot pass if there is nothing to carry it. What then is the mechanism by which the transfer is effected? And, in the second place, how much time is required to make the transfer?

These were questions of amazing difficulty, but Faraday resolutely set himself to find the answers, and in his search he enriched our store of natural knowledge more than any other man has done. To the first, he obtained answers fairly satisfactory to himself; on the second, his work was not conclusive. But, to his death, he persisted in the belief that the action was not instantaneous, and that the time rate would be measured. Lord Kelvin says that the last time he saw Faraday at work he was in the cellar of the Royal Institution, which had been chosen on account of its freedom from disturbance; there he was arranging experiments to test the time of propagation of magnetic force from an electro-magnet, through a distance of many yards of air, to a fine needle polished to reflect light; but no result came from these experiments. About the same time, his attempts to connect magnetism with gravity were unsuccessful.

To determine the part in the action played by the medium, Faraday placed various substances between mutually attracting or repelling bodies. By this means electrical and magnetic actions were very greatly modified, but by no means which the experimenter's fertile mind could suggest was the behavior of the force of gravitation altered in the slightest degree. From these experiments arose two sets of fundamental constants which are ever recurring in electrical theory, and which are now usually represented by the letters K and u. Suppose we have two small bodies similarly electrified and separated by an air space. The force between them will be numerically represented by $\frac{qq'}{r^2}$ where q, q' are the quantities of electricity on the bodies and r is the distance between them Now immerse the bodies, charged as before, in coal oil, or paraffin, or any other non-conductor, the force of repulsion is altered and is equal to $\frac{1}{K}\frac{qq'}{r^2}$.—that is, it is only one-*Kth* part of what it was in air. This quantity K is usually called the *specific inductive capacity* of the insulator, or the *dielectric constant* The values of K for many substances have been determined, and some are as follows :—

Substance.	K.
Glass, plate	8.45
Glass, extra dense flint	10.1
Paraffin	2.29
Sulphur	3.84
Mica	6.64
Resin	2.55
Petroleum	2.10
Carbon bisulphide	2.67
Distilled water	75.7

The other quantity, u, can be defined in a similar way, though that is not the usual method. If two magnet poles of equal strength, m, be placed a distance, r, apart, the stress between them will be $\frac{1}{u}\frac{m^2}{r^2}$, where u is the *magnetic permeability* of the medium in which the poles are placed. The only substance whose magnetic permeabilities differ much from their values in air are iron and its compounds, and in good wrought iron the value of u sometimes rises to 3,000.

In Faraday's footsteps followed James Clerk Maxwell, but where the former was somewhat deficient the latter was strong, namely, in mathematical power and training. After carefully studying Faraday's researches, Maxwell set to work to translate them into mathematical language. Though great difficulty was experienced in dealing with Faraday's lines of force, polarized dielectrics, etc., the mathematician persisted in his work, and finally in 1873 gave to the world his two large volumes. The work was a masterpiece, and has proved the epoch-making book on the subject. The third edition was published in 1892, and is more studied now than ever before.

There is not a continuous consistent development of a single theory throughout the two volumes, the confusion being due to the attempt made to weld the old theories to new ideas. Maxwell applied the laws of mechanics to a discussion of the electromagnetic field, and on pushing his theory to its logical conclusion he reached some very remarkable mathematical equations. On interpreting them he deduced the result that electric and magnetic disturbances are propagated through any medium with a velocity,

$$v = \frac{1}{\sqrt{Ku}},$$

where K and u are the quantities I have already defined. Now there are two systems of electrical measurement, one called the electrostatic, the other the electromagnetic method. A *quantity* of electricity can be defined by both methods, and Maxwell further showed that the quantity v should numerically be equal to the number obtained on dividing the electromagnetic unit quantity by the electrostatic unit. Forthwith experiments were devised to measure this ratio (which is, as we saw, the speed with which electric and magnetic effects are transmitted), and the astonishing result was reached that (within the limits of errors of observation) this velocity agrees precisely with that of light.

Years before this the battle in defence of the wave theory of light had been fought and won, and it had been established to the satisfaction of most scientists that there is a certain all-pervading, practically imponderable, medium throughout all space. This is now well known as the *ether*, and its vibrations are believed to be motions made in transmitting radiant heat and light with a velocity of 185,000 miles per second. New Maxwell's mathematics led him to believe that electromagnetic effects are transmitted with the very same speed, and that they also must be propagated by some medium. As all space was already filled with the luminiferous ether, it was hardly philosophical to postulate a new medium to transmit the new effects, and so the natural conclusion to arrive at was that electric and magnetic actions are transmitted precisely as light, and by the same medium; in fact that the only difference is in the wave-length. That is how the electromagnetic theory of light arose. It was first published thirty years ago; now it has been completely verified, and is almost universally accepted in the scientific world.

Thus far theory led; how to test it was now the problem. If these disturbances are propagated through air and other insulators, some means should be possible for their detection. Light waves are evident from the manner they affect the retina; heat waves, impinging upon ordinary matter, exhibit well-known heat effects; but how can electric waves be made to manifest themselves?

Some seven or eight years ago intense interest was aroused in the subject by the announcement by Heinrich Hertz, a young German professor, that he had actually observed and measured these electric waves. No experimental work was ever received with more enthusiasm, and though the gifted worker died on New Year's Day, 1894, at the early age of 37, he carried with him to his grave the honor and admiration of every nation.

Hertz demonstrated experimentally that electrical energy is transmitted precisely as Maxwell predicted. He determined the

*A paper read before the Astronomical and Physical Society of Toronto, and published by permission of the Society.

† In a letter to R. Phillips, September 23rd, 1831, Faraday says: "I am busy just now again on electro-magnetism, and think I have got hold of a good thing, but can't say. It may be a weed instead of a fish that, after all my labor, I may at last pull up"—*Life and Letters*, *Vol.* 2 *p.* 3.

best methods for producing and measuring the effect, measured the velocity of propagation, calculated the wave-lengths which he used, and in fact clearly identified electrical with the other forms of radiation.

In 1886, when experimenting with some apparatus which he was using for lecture purposes, he happened to notice a spark where he had not expected it, and at once a method for investigating electrical oscillations was suggested to him. For his first radiator he used two metal plates, 40 cms. square, from each of which ran a wire terminating in a knob. (Fig. 1.) These were then attached

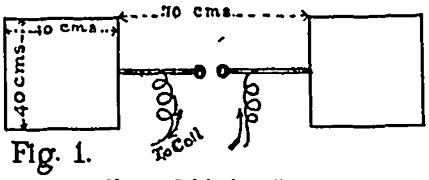
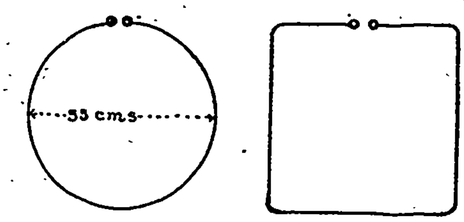


Fig. 1.

Hertz's Original Radiator.

to the secondary of an induction coil, which caused sparks to pass from one knob to the other. In 1853 Lord Kelvin had shown mathematically that when a Leyden jar is discharged there is not a single spark, as generally supposed, but a series of them. The electricity does not simply rush across and stay there, but it behaves as does water in a trough when one end is quickly raised or lowered. In this case the liquid rushes to one end, then back to the other end, and after several motions back and forth equilibrium ensues. So it is with the jar; there is a series of motions to and fro across the spark-gap; each time the electrification leaps across, a spark being produced. Four years later, Feddersen analyzed the discharge in a rotating mirror and confirmed Kelvin's deduction. The sparks were separated, but by not more than a millionth of a second.

Now the arrangement adopted by Hertz is quite analogous to a Leyden jar, each plate and its knob corresponding to a coating of the jar. These very rapid oscillations set the surrounding ether in vibration and this motion is radiated in every direction. To receive this radiant energy he used a wire ending in knobs, and bent either in the form of a rectangle or of a circle. (Figs. 2 and 3) Hertz found that when his circle had a diameter of 35 cms. a spark would



Figs 2 & 3.

Circular Receiver. Rectangular Receiver.

pass between the knobs (which were pretty close together), even when held some feet from the radiator. The radiator sent out the energy of undulatory motion, and this manifested itself in the shape of a minute electric spark.

I just said that the circle's diameter was 35 cms., and in every instance, for the best effects, the receiver had to be of definite dimensions, the rule being that the little sparks which occur across its air space must succeed each other at the same rate as do those of the radiator. In other words, the times for an oscillation in each must be the same Perhaps I can best illustrate this from acoustics. I have here three tuning-forks. The first and second each give 1,024 vibrations per second, the third 1,016. When I vibrate the first I find the second, even though some distance away, responds; but no matter how vigorously I vibrate the first or second, no motion is appreciable in the third. This seems to indicate that a single swing or a single wave is ineffectual; but when a whole series of properly-timed waves beat against the second fork their efforts are added together, and finally elicit a decided response from the unison fork. It is quite the same with the radiator and receiver. The impulses from the former arrive at the proper times to increase the disturbance in the receiver until at last the rush of electricity is violent enough to make it leap over the gap and exhibit the spark.

The simplest method of showing this unison phenomenon is due to Prof. Oliver Lodge. Indeed I may say that nearly all the experiments I have to show to-night are due to this same physicist. At the time of Hertz's discovery he was engaged in researches which would probably have led him to the same result. Let us take two similar Leyden jars (Fig. 4). From the outside coating of one a wire, ending in a knob, is bent round until its knob almost touches that running up from the inside coating. The second jar

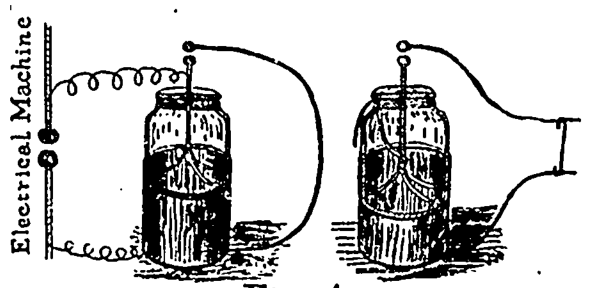


Fig. 4.

Lodge's Synchronized Leyden Jars.

has its coatings joined by a wire whose length can be varied by means of a slider. If this is moved so that the jars are synchronized, when a spark is produced in the first there is a strong oscillation in the second; its electricity tends to overflow, but of course in ordinary cases cannot do so. Now let a piece of tin-foil lead from the inside *almost* to the outside; the overflow at once occurs, and the spark is seen. Some of you might suspect that the action here is due to ordinary electrostatic or electromagnetic induction, but this cannot be so, as a slight motion of the slider either way destroys the action. By doing this the jars are thrown out of tune.

The only method of detecting these electrical surgings which I have so far mentioned is that of observing a spark; but in various ways has this same result been reached ' Vacuum tubes can be illuminated; wires raised almost infinitesimally, though measurably, in temperature; an exceedingly sensitive galvanometer can be affected; thermo-electric phenomena have been shown; a suitable electrometer has been used; but the most sensitive and most convenient of all is the simplest as well. This is also due to Lodge. He discovered that electrical waves have a peculiar effect on two conductors touching loosely; these are made to *cohere* slightly. As an experiment he cut the wire connecting an electric bell with its battery, and then put a knob on each end of the severed wire. These were then placed so close together that a very slight current would flow, but not enough to ring the bell. Then on placing them in the path of electric waves, they were found to cohere so distinctly that enough current would flow to work the bell. The waves improved the bad contact. Now a tube of iron borings or turnings contains a great many bad contacts, and, as in the other case, the waves cause a minute coherence, and the electrical resistance of the tube is decidedly lowered. The best way to show this is to join in circuit a tube of turnings, a voltaic cell and a galvanometer of moderate sensibility. (See Fig. 8.) The resistance of the tube is so high

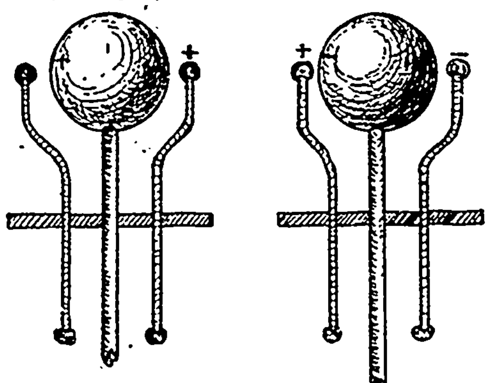


Fig 5. Fig 6.

Distribution of Electricity on the Spherical Radiator before and after spark.

that in its ordinary condition very little current can pass and the galvanometer needle is but slightly deflected; but when the coherence takes place the current increases and deflects the galvanometer much more. By simply tapping the tube the turnings are reduced to their original condition, again ready for action. This method of detecting the presence of electric waves is the one I propose to show you to-night.

Let me describe my apparatus. First of all take the radiator. It consists of a 5-inch brass sphere, with a small knob on each side of it. (Figs. 5, 9.) These latter are attached to the secondary of an induction coil, which will cause sparks to pass between the knobs and the sphere. Perhaps I had better explain more fully the action of this part of the apparatus. I have several times stated my belief that electrical action is due rather to strains and stresses of the medium than to the presence of anything in or on the conductor, but as this view is so new, and also so difficult to picture to the mind, I shall explain the action on the old two-fluid hypothesis.

When the primary of the induction coil is interrupted positive electricity is gathered on one knob, negative on the other, or the potential of one knob is raised, that of the other is lowered. At once, by electrostatic induction the distribution on the sphere is altered, positive rushing to the left (Fig 5), negative to the right. Then the spark passes. The charges rush back to produce equilibrium, but go past their original position and the distribution is reversed. (Fig. 6.) Then another back rush ensues and the first distribution is produced. This rapid motion continues until the energy is dissipated. By this means you see the electricity on the sphere rushes to and fro from pole to pole. These oscillations are sufficiently quick to set in motion the surrounding ether, which at once sends out the energy in every direction. If we wish to make this radiation more definite in direction and increase its power, we enclose it in a copper hat and thus project the beam out from the opening. For most experiments it is more convenient to put the coil and its battery in a metal-lined box, screw the copper hat on the front of it, and lead the wires into the latter through glass tubes. (Fig. 7.)

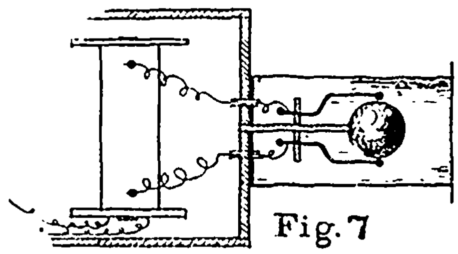


Fig. 7
Radiator with in copper hat on outside of tin-lined box, coil within the box.

The smaller the sphere the quicker will be the oscillations, and hence, the shorter the wave-length. The wave-length is approximately 3.6 times the diameter, and hence for this five-inch sphere the waves are about 18 inches long, and their frequency is over 600 millions per second It will be seen how great is the discrepancy between these waves and those of light. To affect the retina the latter must have a frequency of at least 400 *millions* of millions. To produce these the sphere would have to be of atomic dimensions - and yet all these waves have been shown by actual experiment to travel at the same rate!

To receive the radiation, I use a tube almost filled with iron turnings, placed at the back of another copper hat (Figs. 8, 9). It will be seen that these copper hats take the place of parabolic mirrors in ordinary light experiments My most sensitive tube is about seven inches long and half an inch in diameter. It is filled with turnings made from cast iron, the shavings being rather thin and curled up. One filled with fine filings was quite unsuccessful.

The galvanometer consists of a flat coil, *C* (Fig. 8), of fine wire, with a magnetized needle suspended above it by a silk fibre. The coil is wound with three ounces of number 32 (B & S.) copper wire, there being about 2 500 turns on it. When a current traverses the coil the needle above is deflected, and to render these deflexions visible to you all, a small mirror, *m*, is fastened above the needle, and a beam of light, projected by the electric lantern against it, is

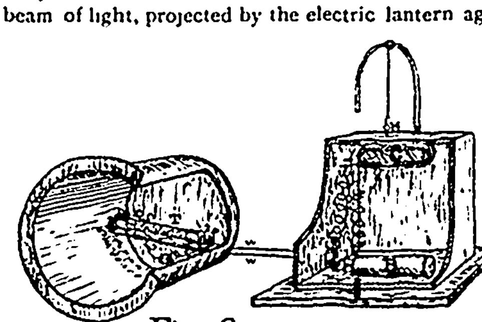


Fig. 8
Arrangement of various parts of Receiver and Galvanometer, and connections.

reflected upon the wall before you. When the needle is deflected, the light-spot will travel on the wall. The galvanometer coil is screwed to the top of a box, on the inside, and below it in the box is a single voltaic cell, *B*—in this case a dry cell. The coil, the cell, and the tube of turnings, *T*, are joined in a single circuit. As the electric waves will run along a wire whenever they can (the wire behaving towards them like a speaking-tube to sound-waves), and as they cannot pass through a metallic conductor, the connecting wires, *w*, *w* and also the coil of the galvanometer, are all protected by metal coverings The coil and battery are in a copper box; the connecting wires are simply incandescent lamp cord wrapped with tin-foil, and then over-wound with rubber-tape to keep the foil in place With this arrangement, if the galvanometer is affected, this disturbance must come from within the receiving copper hat.

Let us now try some experiments First, I shall use the smaller of the two coils I have and allow the energy to radiate freely in every direction The receiver being placed a few feet away, the galvanometer responds readily. (Fig 9) On tapping the tube, the galvanometer needle goes back to its former position. For more powerful effects I shall use the larger coil which is within the tin-lined box, and whose secondary is connected to the radiator in the copper hat (Figs. 7, 10.) Now the effect is decided even when the radiator and receiver are at opposite sides of the room. Professor Lodge obtained marked effects at a distance of forty yards. If I hold a sheet of metal over the radiator or receiver the energy is stopped, it cannot go through a conductor. An ordinary electrical gas-lighter (which is simply a small static machine) can drive the spot across the scale But observe that the waves escape through the ebonite handle; this end, as you see, must be held towards the receiver.

Now turn the receiver away so that direct waves cannot enter it. When I hold a metallic sheet (in this case brass, though copper is a better reflector), at the proper angle, the waves are reflected into the receiver, upon the turnings, and at once drive the light spot across the room. Almost any angle of incidence is successful in this experiment. A glass plate or a board has no appreciable effect as a reflector

Refraction experiments are interesting. In them, however, the effect is not so marked as in direct transmission or reflection. My refracting prism is of roofing pitch. The angles are 45°, 60°, 75°, and the largest side is about eighteen inches square. The pitch was cast in a wooden box and the latter then removed. I shut off part of the radiation by putting a diaphragm with a 6-inch hole over the radiating hat, and turn the receiver until the light-spot moves only a short distance. Now, putting the prism in the path of the rays, so as to use the largest angle, the galvanometer responds and drives the spot almost across the room. (Fig. 10.) This effect is not so easily exhibited as in optics, owing to the greater wave-length.

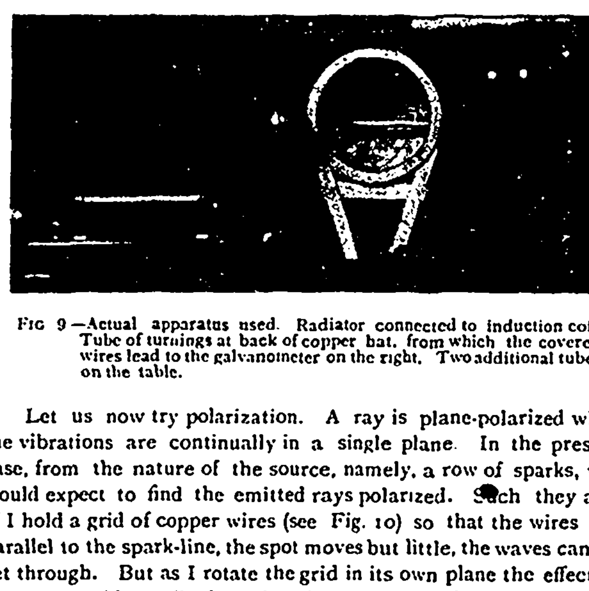


FIG 9—Actual apparatus used. Radiator connected to induction coil. Tube of turnings at back of copper hat, from which the covered wires lead to the galvanometer on the right. Two additional tubes on the table.

Let us now try polarization. A ray is plane-polarized when the vibrations are continually in a single plane. In the present case, from the nature of the source, namely, a row of sparks, you would expect to find the emitted rays polarized. Such they are. If I hold a grid of copper wires (see Fig. 10) so that the wires are parallel to the spark-line, the spot moves but little, the waves cannot get through. But as I rotate the grid in its own plane the effect is more noticeable until when the wires are vertical the spot moves farthest. If I take two grids and cross them the screening is almost perfect. I turn them until the wires make an angle of 45° with the spark-line and the tube in the receiver; on removing one grid the spot moves some distance; on taking away the other the spot goes clear across the room. This experiment is precisely similar to the one in optics in which two crossed tourmaline plates extinguish the light. In my experiment the grids are simply square wooden frames, 14 inches across, with parallel copper wires about ¼ inch apart strung on them.

Many other researches and experiments have been made in this fascinating branch of science, but I have not time at present to refer to them.

I hope I have in a general way shown that electrical radiation is a reality, and that it follows laws similar to those in optics. I hope, too, that I have in some imperfect manner shown the probability that all those so-called forces acting at a distance are really some peculiar action handed on by that invisible and unweighable, ever-present substance which fills

"The lucid interspace of world and world."

and which is usually called the *ether*. The marvellous properties of this remarkable medium are now receiving the most careful attention of workers all over the globe, and when the man of science contemplates how the forces of heat, light, electricity, magnetism, gravitation, and the rest are all due to its mysterious behavior, the stupendousness and the intricacy of the mechanism of the universe almost overawes him. With the late Laureate he will conclude.

"To these still-working energies
I s?y nor term nor bound."

[The meeting at which the foregoing paper was read was held in the Physical lecture room of the University of Toronto, where on other occasions Mr Chant had lectured at open meetings of the Astronomical and Physical Society. It had been announced that several of the already classic experiments of Hertz would be repeated and for the first time in Canada. All present seemed to enter most heartily and sympathetically into the spirit of the work as the lecturer proceeded with experiment after experiment, all most successfully conducted in illustration of his subject. The apparatus was most complete, and when it is added that the instruments were all either of Mr. Chant's own construction or of his own design, it will be understood what pains he had taken to present his paper to a popular audience.

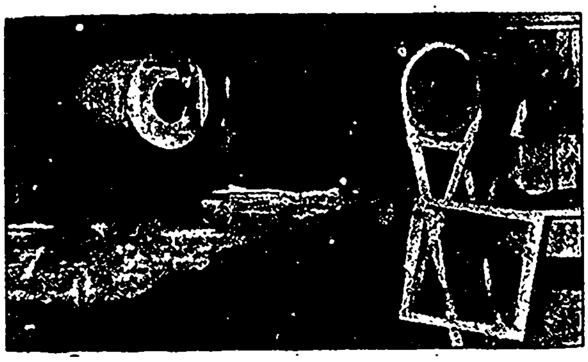


FIG. 10—Apparatus arranged to show refraction through pitch prism. Polarizing grids hanging on galvanometer table in front.

The experiments showing the polarization of electric waves were the most interesting of all. This was probably due to the fact that many of those present had on a former occasion heard Mr. Chant's exhaustive lecture on "Polarization of Light," and were forcibly reminded of it now On the occasion referred to the late Mr. Charles Carpmael complimented the lecturer by saying that he had brought into one comprehensive paper the most brilliant results of experimentation by Faraday, Tyndall and Stokes.

Mr. Chant concluded amid enthusiastic applause, and W. A. Douglas, B.A., moved a cordial vote of thanks to the lecturer and his able assistant, Mr. Plaskett, to whose careful manipulation much of the success of the experiments was due. Mr. Douglas referred to the enormous strides which electrical science had made during the past score of years, and voiced the opinion of all present when he stated that he was proud to have had an opportunity of hearing in Toronto such a lucid exposition of a most difficult subject. The vote of thanks was seconded by Ald. Davies, and tendered amid hearty applause.]

THE MOTO-CYCLE CONTEST.

Editor CANADIAN ENGINEER.

DEAR SIR,—In your December number, your article on the Chicago moto-cycle contest is very misleading. You state that "the three wagons which distanced all competitors were of German make." The Duryea carriage, on which the writer acted as umpire, was designed and constructed in the United States by Chas. E. and Frank Duryea. The whole device, including engines, is decidedly American and quite different from the other two wagons, which were of German design and driven by Bentz motors. The old saw, "Honor to whom honor is due," is applicable here, especially where a wagon of new design, and the first one built at that, wins in such a severe test against old tried wagons, a *fac simile* of one of which won the Paris-Rouen race.

I notice an article in one of your recent issues relative to a Canadian motor wagon contest. I would like to see it boom. This would give an impetus to inventors and manufacturers in this line, the same as it did in the United States. The fact that over 500 applications for patents, for motor cycles and parts thereof, were received at the Washington patent office during 1895, speaks volumes. If we could start 300 good, smart, competent Canadians thinking, the outcome would be a guarantee that Canada would not be behindhand in manufacturing an article that is bound (in the writer's opinion) to come into use almost as quickly as did the bicycle.

While writing on this subject, I would like to forward the idea of holding a trial at London, Ontario, not before, say, next September, because it is a central point for Canada and easy of access for the larger cities, both east and west, in the United States. Besides this, the best roads an' . nd accommodation can be offered. I would not advise holdin., .. too early, as it might meet the same fate, so far as Canadian competitors are concerned, as did the Chicago first race, when a foreign machine took first place, simply because the American manufacturers did not have time to complete their machines.

Kindly give this early publication, and probably others more competent than the writer will give the public their ideas on the matter.

Wishing you a prosperous New Year, I am, yours truly,

ARTHUR W. WHITE.

Geo White & Sons, London, Jan. 3rd, 1896.

Editor CANADIAN ENGINEER:

SIR,—I notice on page 201 of the December number of THE CANADIAN ENGINEER the following statement. "It is worthy of remark that the three wagons which distanced all competitors were of German make." This is a statement to which I must take exception. I am prepared to demonstrate to your satisfaction and the satisfaction of your readers that the Duryea motor wagon which was awarded the $2,000 prize, was a vehicle of American design, American manufacture, and directed by Americans on the day of the race. If you will kindly correct this statement, you will confer a very great favor upon the designer, and Americans in general. Wishing you the compliments of the season, I am

Very truly yours,

EDWARD E. GOFF,
Manager Moto cycle Publishing Co

Monadnock Block, Chicago, Jan 2, 1896

KEROSENE GAS-DRIVEN FIRE ENGINES.

Editor CANADIAN ENGINEER:

SIR,—The question of improvements in the Hamilton Water Works is now occupying the attention of the ratepayers of this city. An expert has been appointed by the city authorities at a cost of $650, to advise and assist them in this matter. Some of the cost of the proposed changes will be voted upon on municipal election day, this applies to a change in the main pipes, for the better distribution of the water pressure for fire purposes. A proposal has also been made by the expert to place two 6,000,000-gallon pumping engines on Sherman avenue, at a point near the city, only 40 feet above the level of lake water, these engines to have the water they are to pump sent to them by one or other of the 4,000,000-gallon high-duty engines at the pump-house. This would necessitate a very large tank and reservoir of some kind at the engine-house, as it is very risky to take water direct from the discharge pipes of pumps in motion below them. What the object is in doing this has not been explained satisfactorily, as there can be no advantage in placing two engines in that position, employing a staff of engineers and firemen, and adding many other items of expense to the city without any corresponding gain whatever—in fact, doing at Sherman avenue what could be done at the lake pump-house with the present hands, and having three engines in motion, with their boilers, etc., to do what two could do at the present pump-house without any difficulty. There would also be the advantage of reducing the now great loss in the summer from the friction in the pipes, somewhere about 35 lbs. to the inch, when the whole supply from the pumps is sent into the city. If a new 24-in. pipe was put into use from the city to the beach, and placed in a suitable position, it would decrease the frictional loss nearly two-thirds and thereby increase the pressure on fires, when the distribution pipes are of sufficient capacity, as there is no reason whatever why the engine proposed to be placed should not be in the present engine-house along with the others. The engine at Mimico is supplying West Toronto Junction through some five miles of pipes, pumping against a pressure of 160 lbs. to the square inch. This has been done for about ten years past. It is not proposed to pump in Hamilton at more than 140 lbs. It has been suggested by the expert to pump this water to the present high level reservoir. One of the engines could fill it about six times a day, so that great care would have to be taken against over-pumping, in fact, no reservoir is necessary, as it is useless to pump against a heavy fire pressure all the year, and burn the large quantity of coal required to keep the pressure up when not more than forty-eight hours in a year would be required to put out fires in the district to be served. By keeping a domestic supply pressure during the whole year and instantly raising the pressure on the Holly or direct system, for free pressure without a standpipe, a very large saving of coal can be effected, as also wear and tear of machinery by the increased useless pressure. There is very little probability of the design of the expert being carried out so far as the Sherman avenue engines and pumps are concerned Our city engineer is opposed to it, favoring placing the engines at the present engine-house. Mr. McFarlane, the mechanical engineer, agrees with Mr. Haskins on this; as does every person who has any knowledge of the subject.

Mr. Walton has an offer to build three self-propelling kerosene fire engines for the city authorities. He guarantees that these engines will start for a fire with their own power, and be on their way in less than one minute. The pumps would also run by kerosene gas and be at work in one minute after arriving at the fire; the engines to be always ready for work summer and winter, and only require the attention of one man and no horses. The cost of each engine, fully equipped and guaranteed, to be $3,000; they will be very much lighter than steam fire engines, pump fully as much, and require comparatively little attention when in their stations This has been proposed, instead of the changes in the engines and pipes. Personally, the writer is confident that a redistribution of the water pipes is necessary to get a sufficient supply of water for the fire engines. If adopted, there is no reason why kerosene fire engines will not work satisfactorily in Canada, as they do in France and Germany, in fact, better in some respects than steam, as there is nothing about them to freeze. No matter how cold the weather, they are always ready for immediate use. Yours, etc., J. H. KILLEY

Hamilton, 1st Jan., 1896.

THE QUEBEC MINING ASSOCIATION.

The sixth annual meeting of the General Mining Association of the Province of Quebec was opened at the Windsor Hotel, Montreal, on January 8th. The attendance of members was large, and everything pointed toward a successful session. The annual report of the secretary showed that the society was in a healthy condition and doing a good work. There were three meetings held in Ottawa in November and December, to determine a more satisfactory method of grading Canadian mica, and of arriving at an agreement as to the standard schedule of prices for the grades. An agreement was arrived at and the prospects of profitable mica mining are thought to be much improved. The scheme of federation which originated at the annual meeting in 1893 has been carried out, and the societies of Nova Scotia and Ontario have joined with that of Quebec. The Canadian Mining Institute, on the board of which the Quebec association will have four delegates, wiil publish a volume of the proceedings of the societies in the federation. The secretary expressed a hope that the efforts of the Federated Board would be turned towards urging on the Government some improvements in the mining laws, especially as regards the payment of royalties in Quebec. There were also some points in the interpretation of the customs tariff where great benefit would accrue to the mining industry through a somewhat more liberal reading on the part of the authorities. A kindly reference was made to the recently established mining schools at Kingston and McGill, and the excellent work they are doing for the development of the mineral wealth of Canada. The report concludes by expressing the hope that provision will be made by the Legislature of the province for the collection of ores and minerals, and for the establishment of a library, embracing the mining literature of the day, where the student, mineral operator and inventor may obtain information relating to mining and engineering.

At the afternoon session of the first day's meeting the election of officers was proceeded with and resulted as follows: President, R. C Adams, Anglo-Canadian Phosphate Co; vice-presidents, G. E. Drummond, Canadian Iron Furnace Co.; James King, M.L.A., King Bros, Quebec; H. H. Budden, Intercolonial Co., and J. S. Mitchell, Beaver Asbestos Co, Sherbrooke, treasurer, A W. Stevenson; secretary, B T A Bell, *Mining Review* Members of the Council—John J. Penhale, United Asbestos Co., Black Lake; E. R. Smith, Bell's Asbestos Co., Metford, J. B Smith, British Phosphate Co, Glen Almond; F Boas Danville Asbestos and Slate Co., St Hyacinthe; S. P. Franchot, Emerald Phosphate Co, Buckingham; J T McCall, Canada Iron Furnace Co, Montreal, J. W. Jenckes, Sherbrooke; W T. Bonner, Babcock & Wilcox Co., Montreal; C H Carriere, Carriere, Laine & Co, Levis Delegates to the Federated Institute—John Blue, Eustis Mining Co., Capelton; R T Hopper, Anglo-Canadian Asbestos Co, Montreal; J. J. Penhale, United Asbestos Co, Black Lake. The following gentlemen ware elected to membership—E. H. Baker, manager of Black Iron Mine, Templeton; D. L. Lockerby, Montreal; E. S. McFarlane, Ottawa; H. W. De Cloustney, Frith Steel Co., Montreal; Lewis McLawrie, Templeton; F. H. Hopkins, Montreal; H. P. H Brummell and J. H. Featherstone, Vancouver.

G. E. Drummond read a very interesting paper on "Iron Mining and Trade," which we propose to lay before our readers at an early date John Blue, C. and M.E., Capelton, read a paper on "Pyrites and Copper," from which it appeared that the quantity of copper and pyrite ores mined in Quebec during 1895 amounted to 37,560 tons, of which there was exported to different points in the United States 22,760 tons. The amount treated in Canada was 8,800 tons, and the amount in stock was 6,000 tons, being a total of 37,560 tons. All this was mined in the township of Ascot, Sherbrooke county. A very pleasing feature was the increased demand for and consumption of sulphuric acid in Canada, a sure indication of the healthy condition of trade in the Dominion. The number of men employed in the mining of the ores averaged about 250 daily. John J. Penhale, Black Lake, read a paper on "Asbestos Mining," which was followed with considerable discussion, the president remarking that the asbestos industry was one of the most successful and most important industries of Canada. H. P. H. Brummell, Ottawa, delivered the concluding paper of the afternoon session. His subject was "Graphite," which, he said, had not been mined successfully in Canada, and although it had been mined here for the past 30 years, it was comparatively a new industry. He gave a detailed description of the difference between the Canadian and the foreign product. In Canada lead was found from Cape Breton to British Columbia, but was found in such a way that it "was good only in spots."

At the evening meeting a committee, consisting of the Hon. Geo. Irvine, Capt. R. C. Adams, and Messrs. John Blue, G. E. Drummond, John J. Penhale, James King, John E. Hardman and R. T. Hopper, was appointed to ask the Government for aid for a mining bureau. J. D. Higginson, of Buckingham, Que., read a paper on "Phosphate," in which he took a gloomy view of the future of the industry, owing to the agricultural depression. R. M. Ellis, Ottawa, dealt with "Gold in Quebec," and Dr. R. W. Raymond, New York, discussed the Quebec mining laws. No morning session was held on the 9th. In the afternoon, J. Obalski, Inspector of Mines, Quebec, read a paper on "Chromic Iron." W. T. Bonner, Montreal, presented a paper on "Water Tube Boilers," and J. T. Donald, Montreal, one on "Some Conditions to Successful Gold Mining." "The Trail Creek Gold Mining District, B.C.," was the subject on which J. W. Sword wrote, and B. T. A. Bell contributed a brief paper on "Imports of Coal." The evening session was devoted to hearing some of the students' papers entered for the prizes given by the association. They were: "The Petrolia Oil Industry," W. M. Weld, McGill; "Notes on the Eustis Mine," Raoul Green, McGill; "The Chlorination Process for Extracting Gold," C. G. Rothwell, Kingston School of Mines; "Aluminum," — Hillary, McGill. On the 10th, papers were read on "Hydraulic Mining," and on "Wire Ropes," by J B. Hobson, M.E., Vancouver, and F. H Hopkins, Montreal, respectively. On the morning of the 11th, the Federated Society met to consider the proposed amendments to the mining laws; and in the evening a grand concert concluded the sixth annual session of the association.

THE BICYCLE A MODERN MARVEL.

It seems absolutely impossible that a wheel thirty inches in diameter, with a wood rim and wire spokes, so light that the whole structure weighs only twenty ounces, should sustain without permanent distortion the weight of four men standing on its side, with supports at four points only under the rim, and no hub support whatever. It also seems incredible that a cycle capable of carrying a man of 160 or 175 pounds in weight can be made so light that the whole structure weighs less than nine pounds. Yet this has been done; even at the roadster weight of twenty-two or twenty-four pounds, the cycle carries a greater load with safety than has ever been put on any other vehicle.

The influence of the cycle on social life is already great and will probably constantly extend, as it provides an outdoor sport and amusement for women which did not previously exist in any form in America. American women are not walkers, but the cycle is perhaps even better suited to woman's use than man's, and seems destined to add an outdoor element to the life of woman the world over which was not possible without the "winged wheel."

The miracle of the bicycle lies in its birth, death and resurrection, in its incredible load-bearing power in proportion to weight; in its displacement of the horse as a means of pleasure, and in the selection of its mechanical details of compressed air support, tubular framing and chain driving.

All these are details often before introduced in machines, but never before permanently retained. That these cast-offs are undeniably power-savers is convincingly proved by the continued use under human muscle driving power. Finally, the one great achievement of the bicycle is to increase the human powers of locomotion so that the slow-footed man is made one of the swiftest of all running creatures.—*Engineering Magazine.*

A CANADIAN WINDOW SHADE FACTORY.

A Philadelphia gentleman, with a wide experience in the window shade trade, recently paid a visit to the window shade works of Menzie, Turner & Co., King street subway, Toronto, and pronounced it to be unequalled on the continent of America. He said it was not the largest, but in completeness of equipment it surpassed any in the United States, while in the quality of its products it was unexcelled. The works of this firm now contain three buildings, one of which is 50 x 185 feet, three stories high, and have 50,000 square feet of floor space. It is the only factory of the kind in Canada which does the sizing of shade cloth, and the only factory which does its own coloring. Connected with the works is a leatherette factory—the only industry of the kind in this country. When made up these goods can scarcely be told from genuine leather, and their wearing qualities are remarkable. This company, who deal largely in window shades and fixtures for all purposes, have hitherto bought their poles from outside, but before the present month is out they will be manufacturing their own poles and wood ends and trimmings, thus enabling them to have supplies on hand at all times and under their own control.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Toronto branch of the Canadian Association of Stationary Engineers have lost no time in completing arrangements for their new quarters, which are at 61 Victoria st. On Thursday evening, Jan 23rd, the new hall is to be inaugurated with an entertainment, to be followed by a supper and dance. G. C. Mooring is chairman and T. Eversfield secretary of the committee of management.

A M Wickens and E. J Philip have been elected by Toronto branch C.A.S E to represent the association on the board of management of the Toronto Technical School.

During the month of December the following engineers have been examined and received certificates from the Ontario Association of Stationary Engineers: Wm. Gray, Galt, 1st class; G. B. Risler, London, 2nd class; A. J. House, Sudbury, 2nd class; Thos. Leake, Stratford, 2nd class; J. G. Archibald, Woodstock, 2nd class; Jno. Kappler, St. Mary's, 3rd class; R. Hutt, Queenston, 3rd class; J. Wedgery, Woodstock, 3rd class; J. F. Glennie, Listowel, 3rd class. The following engineers who formerly held 3rd class have passed the examination and received second-class certificates, viz: Wm. Cole, Thos. Young, D. McKay and R. Topping, all of Woodstock. During the month seventeen engineers tried the examination and thirteen were successful. Yours, etc.,

A. E. EDKINS, Registrar, O.A.S.E.,
Office 139 Borden street, Toronto.

P.S.—I shall be glad to send copy of by-laws, etc., to any engineer who will send request for same on postcard.

The following is from Ottawa, No. 7: We have now moved our place of meetings to a more comfortable place in Borbridge's hall, Rideau street; our meeting nights are second and fourth Saturdays, till we are able to change to a more suitable night. Wishing you the compliments of the season, I beg to remain,

J. O. B. LATOUR, Rec. Sec. No. 7, C.A.S.E.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of this society will be held at the society's rooms, Montreal, on the 14th inst., Thomas Monro, president, in the chair. After routine business the proposed Acts of incorporation of the society in the Dominion and local legislatures will be discussed. In the evening of January 14th at 7.30 p.m., a members' dinner will be held. Arrangements as to the dinner will be announced at the forenoon meeting. Wednesday, January 15th the meeting will be called to order at 10 o'clock a.m., to receive the reports of the scrutineers and transact general business. An afternoon session will be held if found necessary. At 8 p.m., January 15th, a lecture will be given in the Physics Building, McGill University, by Prof. C. A. Carus-Wilson, on "Electric Power Waves," and after the lecture refreshments will be served in the building.

The only candidate for the presidency so far is Herbert Wallis, mechanical superintendent of the Grand Trunk Railway.

WM. MURDOCH, C.E., ENGINEER OF SEWERAGE AND WATER DEPARTMENTS, ST. JOHN, N.B.

Wm. Murdoch, C.E., was born in Paisley, Scotland, in 1848, and removed to Saint John with his parents, in 1854. His education was obtained in the common schools of that city, and finally in the grammar school. After an experience of four years in foundries and machine shops, an apprenticeship was served with ex-City Surveyor R. C. Minnette, after which employment was obtained in the office of the superintendent of sewerage and water supply. Since then all the surveys and plans for sewerage and for water extensions, including the laying of a new leading main, have been made by him and the work performed under his supervision. During this time he also built up a private practice, including a large surveying business, his appointment of D.L.S. by the Crown Lands Department of the Province having been made in 1871. He made a survey for the water supply of Charlottetown, P.E.I., in co-operation with the late Gilbert Murdoch, his uncle, whom he also helped to introduce the waterworks for Moncton.

On the death in May, 1894, of Gilbert Murdoch, who had been superintendent of waterworks for 45 years, and of sewerage since 1865, Mr. Murdoch was appointed engineer of these two departments, Mr. Hurd Peters still remaining engineer of the harbor and public lands. The office came to him entirely unsolicited. He married in 1876, and is now the father of eleven children, the eldest of whom succeeds him in his surveying practice.

LITERARY NOTES.

The town council of Amherst, N.S., has issued a pamphlet, "Facts on Sewage," which contains the answers received from a large number of towns and cities in the Dominion to letters asking a series of questions about the cost, maintenance and success of the sewage systems of these towns. It is an extremely valuable compilation, and will be of great service, not only to other municipalities, but to civil and sanitary engineers, etc.

Canada now has a ten-cent magazine. It is too soon to ask how long we are to have it; we hope always. *Massey's Magazine*, January, 1896, presents many features of interest. Professor Clark, of Trinity, writes of English Cathedrals and Sermons, and Charles G. D. Roberts contributes poems. Dr. Drummond, of Montreal, is the author of a charming French-Canadian dialect poem, which will well repay reading. It is not only amusing, but it is moral. The Massey Press, Toronto.

"The Indian and Eastern Engineer Diary," published by the Indian Engineer Company, London and Calcutta, is a most convenient volume. It is a substantial quarto, containing, besides the usual space for memoranda, a variety of commercial and statistical information of Britain's empire in the East. The foreign equivalents for English weights, measures and values will be found extremely valuable to those having dealings with the native population. The work is a monument to the energy and intelligence of our Anglo-Indian contemporary.

The latest issue of the *American Artisan* series is entitled the "Workshop Manual and Compendium of Useful Information," and is compiled by John J. Davies. It is a volume of 249 pages, small octavo, substantially bound. It has many diagrams and has a wealth of valuable tables for artisans in the metal trades. One chapter is devoted to workshop recipes, one to pattern cutting, and another to tables for tinners and sheet metal workers, while there are other chapters on miscellaneous tables, weights and measures, metals and their properties, mouldings, slate and its uses in roofing, etc., and miscellaneous information. It is issued from the press of the *American Artisan*, Chicago.

The Rochester Lamp Co. have issued a very handsome catalogue giving details of their banquet, table, piano, library and hall lamps, parlor heaters and oil stoves. One very interesting feature of the catalogue is an historical sketch of lamps from the early Roman down to the latest Rochester designs. George C. Card, 69 Bay street, Toronto, is Canadian agent.

We have received the initial number of *Industrial Canada*, a 20-page monthly devoted to the industrial features of Canada in their wider sense. It has articles on Canadian foreign trade, the lumber industry, mining, agriculture, etc., while the first page contains an appreciative sketch of Sir Mackenzie Bowell. There are several illustrations and the typography is very creditable.

"Photography; its Materials and its Appliances," is the title of one of the most comprehensive and intelligently compiled catalogues on a special subject we have yet seen. It contains 128 pages and an illustrated supplement of 140 pages, 8½ x 10½. Besides a vast variety of information on the science of photography as applied to engineering, surveying, etc., it contains a catalogue of books and periodicals devoted to the subject in England and America. The publishers are John Birch & Co., 11 Queen street place, London, E.C., England.

HAMILTON SMELTING WORKS.

DESCRIPTION OF THE NEW PLANT.

A special correspondent of THE CANADIAN ENGINEER sends us the following description of the new smelting works at Hamilton, which were opened on New Year's Day:—

Number of engines, two. Diameter of steam cylinder, 42 in.; diameter of blast cylinder, 84 in., length of stroke, 60 in. Each engine has two balance wheels, weighing 15 tons each, and are 18 ft. in diameter, in two segments. The crank shafts are 15 in. diameter, and the two crank pins to each engine are 7 in. diameter, 6 in. long. The cross-head is a heavy forging 3¾ in. thick and 24 in. deep, running in slides, and to which the connecting rods to crank pins are attached. The steam cylinders are placed above the crank shaft, and between the shaft and the blowing cylinders. These engines have disengaging valve gear, so that they can be moved by hand to start or stop them. The speed of these engines can be increased or diminished according to the strength of the blast required. They will continue to run at this speed until altered.

The work on the whole of this machinery is all that could be desired for the purpose, the work being first-class, without any unnecessary work intended for display only.

The boilers, 12 in number, are in one battery. The shells of the boilers are 59 in. diameter and 24 ft. long, each containing five lap welded tubes, 12 in., same length. Across each pair there is placed a 30 in. x 9 ft. steam drum, connected to boilers by two 12-in. legs, 30 in. long. The boilers are made of the best soft steel, tensile strain 60,000 lbs. to the square inch. The boilers will be fired by the waste products of combustion from the ovens and furnaces. When the furnace plant is large and efficient engines are used, all the steam required for the works can be generated by the waste gases from the furnaces.

The smelting furnace is 16 ft. in diam. in the bosh and 75 ft. high, the furnace casing is 21 ft. in diam. at the bottom and 19 ft. at the top, the first ring of casing is 7-16 inches thick and the balance 5-16 lbs. thick, on each edge of which is riveted 4 inches x 4 inches angle iron. The entire shell is double riveted on the longitudinal seams, and the horizontal seams single riveted.

At the top of the furnace is a strong platform and bridge composed of 5-16 lbs. plate iron strapped and riveted with countersunk rivets, to allow the charging barrows a smooth surface to run on, around this is a strong guard rail. This platform is attached to the furnace shell by 3 inches x 3 inches angle iron. There will also be a bell and hopper, of latest construction, operated by a 12-inch steam cylinder. There will also be a double 12 inch x 12 inch cylinder hoist engine to furnace. The cages for hoist will have automatic safety attachments to prevent accidents. The hoist will operate through a framed tower very strongly constructed. Hot air stoves, three in number, diam. of casing 19 feet, height of do. 60 feet, made of ⅜ inch and 5-16 lbs. iron, the vertical seams are double riveted. The chimney is 40 feet high above the conical top, where there is a circular platform 24 inches wide, there is a hand rail around these platforms.

These stoves are formed with brick chambers to take up the heat from the furnace gases, which is led to them alternately and transferred to the air from the blast engines before it enters the blast furnace to do the smelting of the iron ore. Steam blowers are also used to clean dust and deposit out of the stoves occasionally.

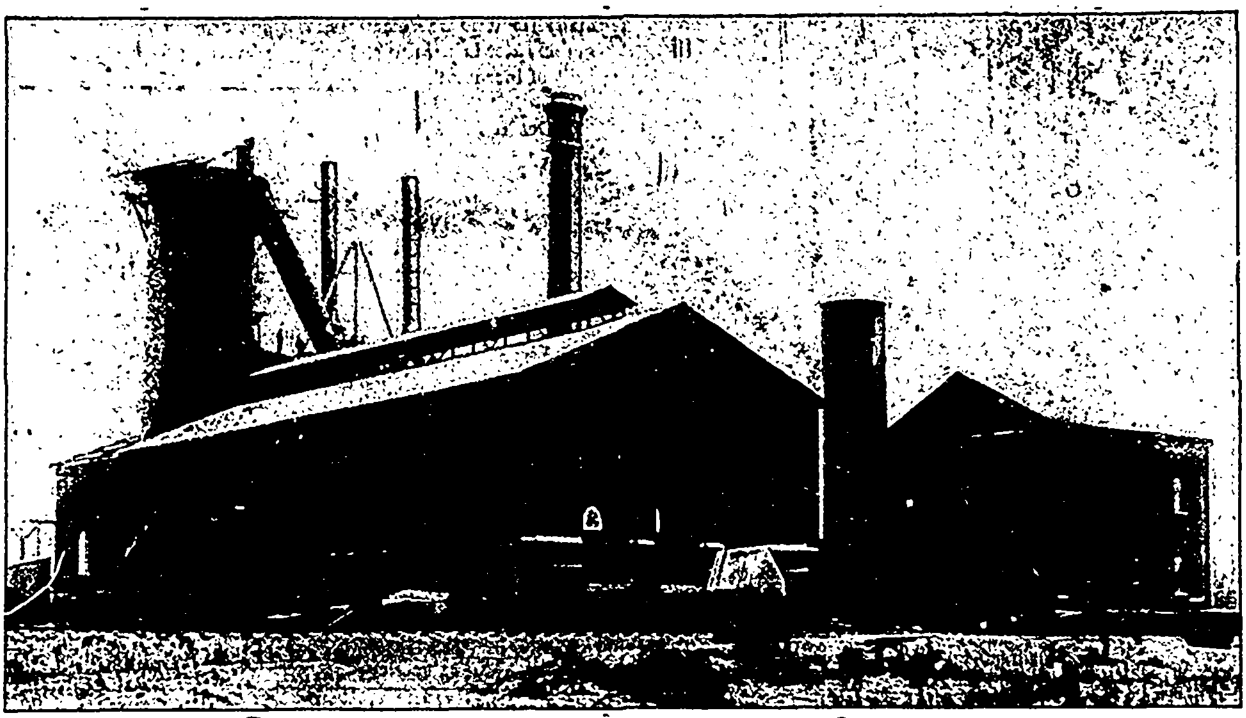
When the ore is brought down to pig metal and the furnace charged with it, it is run out in channels on the molding floor in various directions and formed into pigs, as is seen in the foundries. It is a very interesting sight to see this going on, as the rivers or streams of melted metal are seen running into their various molds direct from the furnace mouth.

The great wrought iron chimney of the works is briefly described here. This chimney will be 7 feet diameter inside, and 135 feet high: cast iron foundation 181 inches; thickness 2 inches, eight 2-inch foundation bolts; cast iron washers for the 12-inch square shell; base diameter at bottom 168 inches, at top 100 inches. Height of base 198 inches, and to have an ornamental top. This chimney has a fine appearance, and looks symmetrical as it stands among its fellows. To describe these large works and plant, which have, it is stated, cost $400,000, would take more room than you could spare in your journal, unless divided over a number of your issues.

There are some people yet who are not quite assured of the possibility of smelting being carried on in Ontario at a profit. They point out, and quite correctly, that Ontario has no coal, and when reference comes to be made to the new smelting works at Hamilton, they go further and assume that a locality that has neither iron nor coal cannot be the centre of an iron industry. This position is apparently well taken, and any one unfami-

THE HAMILTON SMELTING WORKS.

liar with the history of the developments in the iron and steel industries in the United States of late years would find the argument unanswerable, but the facts we observe across the boundary lead us to quite another conclusion. It is that proximity to the consumers is a sufficient off-set to absence of coal and iron from the immediate vicinity of the smelting plant, when that plant is situated so as to avail itself of the cheapness of water carriage for the raw materials. Cleveland has become a great iron producing centre, and it has neither iron nor coal. In 1895 more than 10,000,000 tons of ore were shipped to Cleveland from the different lake ports, from Duluth down; coke is brought from Connelsville, Pa., and it is claimed that iron manufacture is more profitable in Cleveland than in Pittsburg.

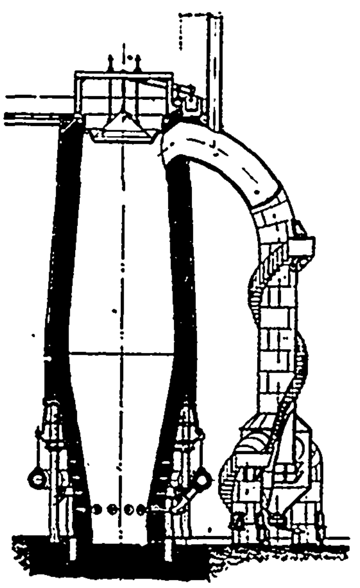


THE HAMILTON SMELTING WORKS.

There is room in our market for more iron than the new works can turn out, and if the management are able to meet outside competition, as there can be no doubt they can, there is nothing to fear from home competitors, as there are only two coke furnaces and one charcoal furnace in Nova Scotia, and one charcoal furnace in Quebec.

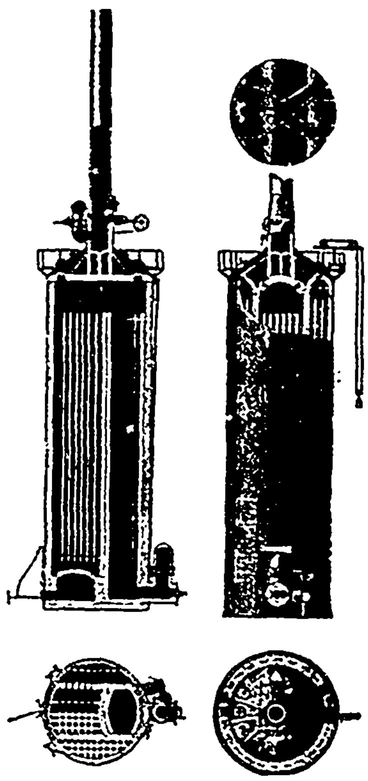
The "blowing in" took place on Dec. 30th, 1895, and every friend of Canadian progress will join in the hope so freely expressed at the time, that it may be long before the fires then lighted are allowed to go out. A large number of invitations were sent out to prominent manufacturers and others, and when the special train left the King street station for the scene of operations, between six and seven hundred people were on board. Among the well-known people present were: N. Clarke Wallace, M.P.; A. McKay, M.P.; Hon. J. M. Gibson, M.P.P.; W Gibson, M.P. (Beamsville); R. McKechnie, John Bertram and A. F. Pirie (Dundas), President J. H. and Mrs. Tilden, of the Hamilton Iron and Steel Co.; Mrs. and Miss Millard, Mrs. T. H. Pratt, Mrs. Hardy, Vice-President J H Milne, W Southam, A. D Braithwaite, manager of the Bank of Montreal; J. J. Morrison, manager of the British Bank; J. Turnbull, manager of the Bank of Hamilton; J. M. Lottridge, W. Vallance, Dr. Baugh, President C. J. Myles, of the H., G. and B. Electric Railway; J. N. Young, of the T. H. and B.; J. H. Killey, J. G. Bowes, W. A. Robinson, George Roach, Dr. Osborne. George Lynch-Staunton, A. T. Freed, J. Patterson. F. W. Fearman, R. R. Osborne, F. Mackelcan, Q.C., George E. Tuckett, A. E. Jarvis (Toronto), W. Magee, W. G. Walton, Chief Aitchison, N. Awrey, M.P.P., James McPherson, H. G. Wright, C. K. Domville, C. E. Doolittle, W. J. Copp, H. F. Gardiner, J. R. Cameron, W. J. Grant, W. H. Gillard, Rev. Dr. Burns, Alexander Turner, A. T. Wood, John Kenrick, Major McLaren, Sheriff Murton, Joseph Wallace, and nearly all the aldermen.

The train pulled into the siding at the works about 2.30, and the first thing that impressed the visitors with the extensive character of the enterprise was the network of railway switches, on which were train loads of iron ore and coal. The works stand on the shores of the bay at the foot of Sherman avenue, and cover about ten acres of ground. A group of low-set brick buildings, dominated by huge tubular iron towers, and a lofty brick smoke-stack, form the centre of the plant, and south of this is a long wooden shed into which run several tracks for unloading coke and and above which is a spidery-looking steel framework, up which the ore elevator runs. From the top of the elevator is an iron platform across to the mouth of the blast furnace, 75 feet above the ground. The first centre of attraction was the cast house, 175x50 feet, in which is situated the furnace, which is constructed of firebrick sheathed with steel, and is 16 feet in diameter and 75 feet high. This is where the ore is smelted, being elevated to the top of the furnace and melted with hot air at a temperature of 1,200 to 1,600 degrees. In this building, President Tilden made a short speech to the visitors, in which he outlined the future course of the company. Mrs. Tilden, who was accompanied by a party of ladies, then lighted the fires. A piece of tow soaked in inflammable material and placed on the end of a rod, was ignited and handed to her, to insert it into the furnace. The crowd cheered heartily, and in about a minute the crackle of the flames inside the big shaft indicated that the fire was alight all right.



SECTIONAL VIEW OF BLAST FURNACE.

The engine house was next visited. It is 118 x 50 feet and contains twelve boilers of which six are reserve. The engine house stands at the northwest corner of the group of buildings, and contains two engines, among the largest of their class in Canada, each being 1,200 horse-power. Jno. H Milne, the vice-president of the company, explained that as the fires could not be allowed to go out for several years, all the machinery in connection with the plant must be in duplicate to guard against an accident to the water pumps, air pumps, engines or boilers. After a short speech from Mr. Wood, who pointed out the advantages of locating the works in Hamilton, Mr. Milne pulled the lever and the large fly-wheel began to revolve.



HOT BLAST STOVE—HAMILTON SMELTING WORKS.

In the even... a banquet was held, at which prosperity was predicted for Hamilton and Ontario by a number of prominent speakers, among whom were N. Clarke Wallace, A. McKay, M.P.; Hon J. M. Gibson, N. Awrey, M.L.A., Major McLaren, Ex-Mayor Stewart, Messrs Watkins, Carscallen, J. T. Middleton, M.L.A., Messrs. McKechnie, W. J. Copp, A. T. Freed, A. F. Pirie, Tuckett, Wanzer and H N. Kittson.

Our account of the opening ceremony is condensed from that of the *Hamilton Spectator*, to whom we are also indebted for the exterior view of the works

HEATING FEED WATER.

Editor CANADIAN ENGINEER.

SIR.—Let us consider briefly the percentage of saving of fuel effected by heating feed water by exhaust steam or waste gases, by the formula—

$$\frac{100\,(T-t)}{H-t} = \text{percentage of saving.}$$

Where H = the total heat in the steam boiler pressure, T = temperature of feed-water after heating, and t = temperature of feed-water before heating. Thus, suppose a boiler working at a pressure of 60 pounds per square inch above the atmosphere, fed with water at a temperature of 60° F., and driving a non-condensing engine, the exhaust steam from which is allowed to escape into the atmosphere. By utilizing this exhaust steam in a properly designed feed-water heater, to raise the temperature of the water to, say, 212° F., the percentage of saving of fuel would be—

$$\frac{100\,(212-60)}{1207.2-60} = 13.24 \text{ per cent. saving effected.}$$

Where H = 1207.2 (the total units of heat in steam at 60 pounds pressure above the atmosphere), T = 212° (the temperature of feed-water after heating); t = 60° (the temperature of feed-water before heating) If the feed is drawn from the hot well of a condensing engine, at say 100° F temperature, the result of heating it to 275° F in an economizer in the flue, would work out to—

$$\frac{100\,(275-100)}{1207.2-10} = 15{\cdot}8 \text{ percentage of economy gained.}$$

With a coal consumption of only fifteen tons per week (the coal costing, say $2 per ton), the saving in the cost of coal alone, taking the lower figure of 13.24 per cent., would amount to no less than $195 in a single year of fifty weeks, which would more than cover the outlay of installing a suitable heater.

The subsequent economy being so much clear profit, the relative saving would, of course, be greater with coal costing more, or by raising the temperature of the feed-water higher.

In addition to the actual saving of fuel resulting from the heating of feed-water, there are incidental advantages accruing which, although not so strikingly apparent as a reduction in the coal bill, are none the less real, among which may be mentioned the obviating of expensive repairs and renewals due to wear and tear caused by unequal contraction when the hot plates are cooled by currents much below the normal temperature of the great bulk of the water in the boiler. More power can be obtained from boilers fed with hot water, as the heat from fuel performs its proper function of evaporating, instead of being partly dissipated in raising the temperature of the water to the boiling point. Priming and smoke emissions often result from having to force the fires to heat up large quantities of cold water in the boilers, when this has not been previously heated.

With limy waters a considerable proportion of the lime salts is precipitated by heating the water to boiling point, and this is especially the case where suitable reagents are used, with the result that purer water is sent to the boilers, obviating to a great extent the evils of incrustation and internal corrosion.

YOUNGSTER.

Deseronto, 2nd Jan., 1896.

CALENDARS.

The Cleveland Twist Drill Co. of Cleveland, O., has sent us a combined diary, calendar and memorandum, which is exceedingly neat and convenient.

The Boiler Inspection and Insurance Co. of Canada has favored this office with a handsome wall calendar. The blank spaces are filled with good advice for owners of boilers. We would suggest, however, that the company at once inspect the boiler so graphically shown on the calendar, as the steam-gauge shows a pressure of about forty pounds, though the man-hole is open. If this is not done, we fear an explosion will result before the year is out and a policy be due on the artist's work when the fires are started again.

One of the most substantial and serviceable calendars which has reached us this season comes from the works of the B. Greening Co., Ltd., Hamilton, Ont., manufacturers of wire goods and metal perforators. The fact that our copy of the calendar was stolen from our office inside half an hour of its receipt testifies to its value.

DEFINITION OF "ENGINEER."

An appeal concerning an assessment of branch sewers was heard recently in Stratford, Ont. The city council had employed the assessor to prepare the assessment, basing their authority on the Ditches and Water Courses Act, 1894, in which the term "engineer" is stated to mean "civil engineer, Ontario land surveyor, or such person as any municipality may deem competent and appoint to carry out the provisions of this Act." Judge Woods, before whom the case was tried, held that a duly qualified civil engineer should have been employed.

C A CHANT, B A, Lecturer in Physics, University of Toronto, received his preparatory education at the High School, Markham, Ont., and at the Collegiate Institute, St. Catharines, Ont. He entered the University of Toronto in 1887 and took the degree of Bachelor of Arts in 1890, after an honor course in Mathematics After graduating with high honors, Mr Chant was appointed Fellow in his department in 1891 and Lecturer in 1892, which appointment he still holds.

Industrial Notes.

THE chemical works at Deseronto, Ont., are very busy.

WATERFORD has a new factory for the making of horse-clippers.

THE screw factory at Hamilton, Ont., has been closed down for a few weeks.

NEW boilers and engine are to be put in the Stewart Mill at Bathurst, N.B.

BRANTFORD, ONT., electors will not build the proposed new $25,000 school.

THE electors of Meaford, Ont., do not want an extension made to their present waterworks system.

THE Oxford, N.S., Furniture Co. has finally closed down, and will not start again until sold out.

MT. FOREST has granted a $5,000 loan to the Zollner Furniture Company by a majority of 28.

ADAM E. KLIPPERT, of New York, has purchased the Wegenast Mfg. Co.'s business in Waterloo, Ont.

THE Jenckes Machine Company, Sherbrooke, Que., are moving their machinery into their new shops.

MARTIN MCGILLIS is re-building his saw-mill, at St. Andrew's Ont., which was destroyed by fire not long ago.

ALLANDALE, ONT., people are discussing waterworks, amalgamation with Barrie, and the poor house question.

WORK has begun on the new steel arch bridge over the Niagara River. The abutments are now in course of erection.

W. T. MURRAY & CO., of Sarnia, are to start the erection in March of a large new saw-mill which is to be in operation in May.

ROCKLAND, ONT., will have a large hotel built at once. Mr. Ranger, of Ranger & Allard, Ottawa, Ont., is promoting the scheme.

J. T. SCHELL & CO., of Alexandria, Ont., have sold out their extensive shingle and lumber camp at Sayabec, Que., to an American firm.

THOS. MILLER, St. John, N.B., denies that he has purchased the Chesley foundry with the intention of turning it into a nail factory.

THE Hogan Boiler Co., of Middletown, N.Y., are in communication with parties in Canada for the manufacture of their water-tube boilers in this country.

A BY-LAW for a $3,000 bridge at Palm street, St. Thomas, Ont., forming a second link between the north and south sections of the city, was carried this month.

ALEX. DICK, proprietor of the Alton, Ont., foundry, had his hand mangled so badly in his machine shop the other day, that it may have to be amputated.

THE plans for the new Collegiate Institute and Ontario Normal School have been approved by the Minister of Education and the Board of Education of Hamilton.

ST. ANDREW'S marsh, north of Winnipeg, will be drained by C. Whitehead & Co., of Brandon, Manitoba. Cost $91,760. A large area of ground will be made of value.

THE Stevens Manufacturing Co., of London, Ont., are looking for a reduction of the taxes on their foundry. They want their assessment fixed at $10,000 for the next ten years.

J. Y. ROCHESTER, Mattawa, Ont., is promoting the establishment of a creamery at that place. The buildings will be somewhat smaller than those recently erected in Renfrew, Ont.

PARK BROS., Chatham, Ont., have been awarded the contract for the pumps and machinery of the Dauphin drainage scheme in Tilbury, operations on which will begin in the spring.

J. J DRUMMOND, of the Canada Iron and Furnace Company, Montreal, is in Northern Sweden, examining the iron industries of that country. He is expected home at the end of this month.

THE works of the Maritime Nail Co., St John, N.B., will be in operation before the end of this month. The first cargo of wire for the works was unloaded at the company's wharf from the steamer "St. John City," the other day.

C. BERKELEY POWELL and J. A. Seybold, representing a new industry for the manufacture in Ottawa of metal pantaloon buttons, want the duty on this class of button increased, so as to protect the new industry from undue foreign competition.

THE Hamilton glass works have been compelled to close down for a time owing to lack of orders.

THE new Masterman Pulp Mill, at Mill Cove, N.B., is fitted up with Canadian machinery and will employ only Miramichi labor. Eighty cords a day will be turned to pulp.

THE by-law to grant $10,000 towards the establishment of the National Consumption Sanitarium at Gravenhurst, was passed by a big majority, only five votes being cast against the by-law.

LETTERS patent have been issued to J. A. Bain, D. Lowery, E. A. Brown, J. A. Wallace and J. D. Patterson, of Brantford, and L. M Jones and W. E. H. Massey, of Toronto, as the Bain Wagon Company.

A. GARTSHORE, James Thomson, J. G. Allan, W. J. Thomson, of Hamilton, and W. M. Gartshore, of London, are seeking incorporation as the Gartshore-Thomson Pipe and Foundry Company, limited, with a capital of $50,000.

J. C. DUMARESQUE is the architect of the Lefebvre memorial hall at St. Joseph's College, Memramcook, N.B. The ground floor is to be used as a museum and laboratories, and the upper part will contain a large assembly hall.

IT is stated that the Montreal Bridge Company have made arrangements with a big New York syndicater, to construct the proposed bridge over the St. Lawrence from Montreal to Longueuil, recently described in this journal.

THE Diamond Roller Mills, at Ridgetown, have closed down for three months. During that time the old machinery will be taken out and replaced by the latest and best, an $8,000 contract having been given to a Canadian firm.

THE by-law exempting the building, machinery and plant of C. A. Farrar's wire-mat factory, Meaford, Ont., from municipal taxation for the period of ten years, was given the six months' hoist at a recent meeting of the Meaford town council.

IT is stated that the parties who bonded the mill property at Greenfield Queens Co., N. S., have given notice to the several owners to have their deeds ready. Their object is to build a pulp mill and a railroad from Greenfield to Port Medway.

IT is said that Macgregor, Gourlay & Co., of Galt, are contemplating removing their foundry and machine shop to Hamilton. The Galt premises are unsuitable, and they say it will be necessary to either rebuild or remove. They employ 250 hands.

THE estate of William Clendinneng & Son, Montreal, has been sold through Kent & Turcotte, accountants. The amount realized was $275,000, the whole of which was taken by La Banque du Peuple, who had a mortgage for a large amount upon it.

THE Northey Manufacturing Co., manufacturers of steam pumps, have prepared plans for two new additions to their large works at the King street subway, Toronto. The erection of the two new buildings will be proceeded with at an early date.

W. P. HEATHCOTE, representing some New York capitalists has recently visited Hamilton in quest of encouragement for the establishment of a steel industry. The town of Thorold is interested in the matter and is considering the offer of a bonus.

A BICYCLE factory has been established in Ottawa under the firm name of Curry & Radmore. The sample wheels will be on exhibition this month. The wheel is to be called the "Capital," and they expect to turn out at least 200 wheels during the present winter.

THE London *Free Press* says that negotiations between James Lydcott, of Toronto, Ont., and the town council of Leamington, Ont., have been concluded, and a glass factory will be established which will employ from fifty to one hundred hands. The factory will cost $25,000.

A NEW furnace is being built for burning the waste and making steam at Stetson and Cutler's mill at Spar Cove, Indiantown, N.B. Blasting is now in progress and the work is being pushed rapidly. The mill will probably begin sawing again about the middle of March.

ONE of the first horseless carriage motors advertised in THE CANADIAN ENGINEER is the "Facile Carriage Motor," manufactured by the Britannia Co., of Colchester, Eng. The makers claim a great many points, which are detailed in circulars they have just issued.

AMHERST, N.S., is trying to get E. F. Bunker to locate the proposed carriage factory in that town instead of Truro, and a committee is after subscriptions. Mr. Bunker offers to put in $4,000 of the $25,000 capital required. Meanwhile Truro has not altogether given up the idea of securing the factory.

ALEX. GIBSON, Marysville, N.B., is about to build fifteen refrigerator cars.

GREENWOOD, B.C, one of British Columbia's new mining towns, proclaims its lack of a saw mill in the local papers.

IT is said that sand suitable for glass manufacture has been discovered at the peat works, Wainfleet, near Welland, Ont.

A $30,000 extension is being made to the Walkerville brewery. Its products will be sent in wood to Detroit and bottled there.

PLANS are being prepared for a new R. C. cathedral at Charlottetown, P.E.I., to cost about $100,000. The architect is Mr. Berlinguet, Quebec.

AN offer of 20 cents on the dollar is made by Kelley & Murphy, carriage makers, of St. John, N.B. The liabilities are in the neighborhood of $50,000.

THE bridge at Ste. Anne de la Perade, Que., was carried away by an ice shove, December 30th. All the machinery and material for the new bridge was also swept away.

R. R. DOBELL and other wealthy men in the city of Quebec are said to be organizing a company for the cold storage and exportation of meat and agricultural produce.

THE Collins Manufacturing Co., of Toronto, are reorganizing and intend to go extensively into the manufacture of metallic shingles and wire fencing this coming season.

JOHN COATS, C E., president of the Ottawa, Ont., Gas Co., is spoken of as a Liberal Unionist candidate in the approaching election in South St. Pancras, London, Eng.

GODFROI TREMBLAY, owner of a saw mill at Lorette, has taken suit in the Superior Court against the city of Quebec for $12,000 damages. He alleges that the water works deprives his mill of the required power.

THE Steam Boiler and Plate Glass Insurance Co., London, Ont., have abandoned the steam-boiler branch of their business in favor of the Boiler Inspection and Insurance Co. of Canada, head offices in Toronto

THE purchase of a second steam fire engine for Toronto, which was to have been made from an Elmira, N.Y., firm, has been deferred until after the engine now ordered from the Waterous Engine Company has been delivered and tested.

THE town of Arnprior, Ont., seems to be favored by industrial promoters at present Two different parties from the United States are talking of establishing pulp mills, and a glass factory that's "out-o'work" has its eye upon the town.

THE district immediately north of Peterborough is to have three new saw mills this winter Coon's mills, near Havelock, will be rebuilt at once, and North River Bridge, Belmont township, and Otter Lake, Methven township, are the sites of the other two.

PLANS for the proposed extension of the Protestant Hospital, Ottawa, Ont., have been submitted by Arnoldi & Ewart, and A. M Calderon The plans were all within the limit of $45,000 set. The decision of the committee as to which plans are accepted will shortly be announced.

AT the municipal elections in Hamilton the proposed water works extensions were voted down by a big majority. The electors did not see their way to spending $175,000 on a scheme which would give them no more water than at present Some new plan will be proposed later on.

THE annual report of the city engineer, of Toronto, shows that the pumping station consumed 21,033,210 pounds of coal in pumping 6,639,763,535 gallons of water. There were 5.816 miles of pavement of various kinds constructed. The new down-draught furnaces at the water works have effected an enormous saving in coal.

WHITMAN BREWER, of St. Mary's, N.B., has been awarded the contract for building the new bridge across Vaughan's Creek, at the foot of Hardscrabble Hill, and also the breakwater in Vaughan's Creek to protect the roadway from the sea thrown in by the Dominion Government breakwater at the mouth of the harbor.

THE canning factory boom goes gaily on. Miller & Soby, of Picton, Ont, will receive a free site and exemption from taxation in Napanee T A Code, John Hart, Andrew McArthur, W. A. Moore, Dr. Grant, J G Campbell and J. M. Rogers, of Perth, are the incorporators of the Perth Canning Co., under letters patent from the Ontario Government A number of gentlemen interested in the establishment of a large canning factory in Hamilton, Ont., were in the city recently Among them were G L. Pearson, of London; John Shaw and Robert Logan, of Waterford; James and John Gosnell, of Highgate; D. C Gosnell, of Dutton, and the Messrs. Morrow, of London, Ont

Cornwall, Ont., has a chance to secure the Watson Heater Co.'s works for that town. R. S. White, J. Bartley and J. Watson, of Montreal, recently looked over the town with a view of locating there. From 60 to 200 men would be employed, and plumbers' supplies generally would be manufactured as well as heaters.

THE B. Greening Wire Co., of Hamilton, have received the Canadian patent for their cow tie, under date of Dec. 27th. An English manufacturer has already sought to place an infringement on the market, but the Messrs. Greening are fully prepared to enforce their rights should any of these goods be sold in Canada.

THE people of Ottawa, Ont., do not want to spend any money on improvements at present. The public library scheme was voted down in spite of the offer of the Perley estate of a residence valued at $70,000 for the purpose. The proposed expenditure of $40,000 on Landsdown Park and $45,000 for fire protection were also voted down.

A NEW wholesale fruit market building is to be erected in Toronto early in the spring. It will be built under the auspices of the City Council, and will be situated at the foot of Yonge street. The Council are also preparing to build a new pumping station at the Island. This will cost about $15,000, including the machinery, which will amount to about half the total.

WHAT felt like the shock of an earthquake was experienced at Ottawa on the 6th Dec. It was learned subsequently that 2,000 pounds of nitro-glycerine had exploded at the factory of the Ottawa Powder Company, situated about two miles from the city. The explosion took place in the mixing-house, which was demolished, with a loss of about $1,000. John Reynolds, assistant foreman, received injuries from which he died. He was 26 years of age, and a native of New Jersey.

AMONG the fires of the month one of the most serious was that in St. Catharines, which destroyed so much of the valuable plant in Patterson & Corbin's car factory. The large middle building of the works, containing the machine shop, cabinet shop and paint shop, was completely gutted and the machinery ruined. The insurance will not cover the loss, which amounts to fully $12,000. We hope to see Messrs. Patterson & Corbin put their plant into operation again with their usual enterprise and energy.

THE estate of the Watson Manufacturing Co., of Ayr, which has been in the hands of the liquidator for some time, was sold by auction at Judge's Chambers, Berlin, on Dec. 13th. The purchaser was Wm. D. Watson, and the price paid $14,500, for the factory plant, book debts, and all assets. The many friends of the Watson Company will be glad to learn that the matter is satisfactorily settled, and that they have been successful in securing the business again.

THE Westinghouse Air Brake Company is creating quite a stir in several Canadian towns by sending round a representative to look up a site for a branch of their business in Canada. Hamilton, Toronto and Ottawa are the chief points being considered, we believe The Ottawa Land Company, which is composed of a number of the leading shareholders in the Electric Railway Co., will make a gift to the W. A. B. Co. of water power and land at the Little Chaudiere sufficient for their purpose, if they will locate in Ottawa.

A MONTREAL firm has been lately in correspondence with the mayor of Almonte, Ont., Wm. Thoburn, the well-known woolen manufacturer, endeavoring to make terms for the establishment of a glass factory in the town We have not been able to learn whether the necessary sand is alleged to be procurable in the neighborhood, but from the fact that the enterprise appears to be of the usual got-up-among-local-capitalists-by-the-retiring-as-soon-as-complete-outsider, we suspect it is merely the (gold) dust that is to be of local origin.

AT the annual meeting of the St. John, N B., Iron and Hardware Association the following officers were elected: President, W. H Thorne; vice-president, Thomas McAvity; secretary treasurer, John J. Barry. Directors, J. C. Robertson, R. B. Emerson and S. Hayward. Executive committee, the officers and directors. Wholesale committee, W. H Thorne & Co., T McAvity & Sons, S. Hayward & Co., Kerr & Robertson, M E Agar, J. C. Robertson & Co. and Emerson & Fisher. Manufacturers' committee, J. C. Robertson, of the Portland Rolling Mills Co; Geo. Ketchum, of I. & E. R. Burpee & Co.; Jas. Pender, of James Pender & Co., R. B. Emerson, of Emerson & Fisher: Geo McAvity, of T. McAvity & Sons; John Robertson, of J. Robertson & Co., and S. Sheraton, of Sheraton & Whittaker.

AT the annual meeting of the Metal and Hardware Association of Montreal, James Crathern was re-elected president; Thomas J.

Drummond, vice-president; and J. B. Lermont, treasurer. The directors elected were F. Fairman, James Phymister, A. C. Leslie and Wm. McMaster. The matter of discrimination in freight rates was discussed and a commission was appointed to confer with the different railways. A better classification of articles of hardware was again considered. The Government's classification of small hardware imports has been a serious menace to the trade. One article, such as shears or scissors, for instance, may be under a half dozen different classifications, and can be placed in any one of these classes by the inspectors, thus being subject to variable duties and discriminations.

THE *Truro Sun* says. A project is on foot to transfer Rhodes, Curry & Company's car works from Amherst to Halifax. Some parties have offered a free site of twelve acres of land near the city. The Dominion Coal Company has offered a supply of coal at a low rate for a term of years, and the Peoples' Heat and Gas Company offer gas at a nominal rate to furnish power. The *Amherst Press* interviewed Rhodes & Curry in reference to the reported proposition to remove the Rhodes-Curry works to Halifax. Neither gentleman said that anything formal had been done in the matter. The Dominion Coal Company have large interests in the capital, and the offer that is spoken of would represent about $100,000 in land and remission in taxes, water and power. As considerable stock of the Rhodes-Curry company is held in Halifax, it may be that the promoters of the scheme for removal will try to secure a controlling interest by buying all stock that is on the market and so vote for removal. At present the scheme is nothing more than talk.

THE New Glasgow Iron, Coal and Railway Company has been united with the Nova Scotia Steel Company, and the combination promises to be the most successful joint stock venture Nova Scotia has ever seen. The company is supplied with an admirable Bessemer pig from its furnace at Ferrona. The possibility of lengthening the run of this furnace on steel material is itself an item of economy, rendered feasible by the growth of the steel works. After a long period of idleness, the Londonderry works are into blast again, and, it is reported, are contemplating the reopening of their roller mill The large contract secured by this company for the pipes of the new gas company in Halifax will keep their foundry running for some time. The charcoal furnace at Bridgeville, Pictou county, was run for about a month, but, however, the price of charcoal pig has not recovered itself sufficiently to permit of their continuous operation. The Torbrook mine has been running steadily, with a total output of 9,940 tons, divided between Londonderry and Ferrona. The vein worked at this mine improves in depth, in quality and thickness, and has been found to extend about three-quarters of a mile to the westward of the present works. The Nova Scotia Steel Company have suspended operations at their Arisaig mines, having discovered a deposit of iron ore of a high grade at Bell Island, near St. John s, Nfld., which they are opening for shipment next spring. The production of pig iron stands as follows for the twelve months ended September 30th, 1895, although the output is more truly for the last six months of that period:

	Tons.
Pictou Charcoal Iron Company	323
Nova Scotia Steel Company	17,321
Londonderry Iron Company	11,446
Total	29,090

Returns so far show that during the year there were 79,636 tons of ore mined, of which amount the charcoal company, in addition to 589 tons melted, mined and sold 7,541 tons. There were 36,532 tons of coke reported from the Pictou coal mines and the Ferrona furnace, and about 25,050 tons of limestone quarried.

J. P. MACDONALD, who died at Stratford, Ont., on the 3rd inst., aged 68, was head of the old firm of Macdonald, McPherson & Co., which was established there in 1876. In 1892 he became manager of the North American Mill Building Co., which position he soon resigned, owing to ill health.

J. A. GARIEPY, superintendent of the Longueuil, Que., aqueduct, died last month, at the age of 64. The deceased, before taking this place, had been thirty years in the service of the Grand Trunk, and was one of the best engine drivers on the line. On one occasion, says the *Witness*, when he noticed a child on the track, he with characteristic coolness and courage, reversed his engine, and leaving the box reached the cow-catcher just in time to catch the child and snatch it from death. Mr. Gariepy was also the engineer in charge of the locomotive when the Prince of Wales proceeded in a special train to make the solemn inauguration of the Victoria Bridge, in 1860.

Mining Matters.

THE daily output of coal from the Lethbridge mines is now 650 tons.

COAL shipped from Parrsboro, N.S., during the past year amounted to 120,000 tons.

IT is claimed that $200,000 a month is paid out in wages in the mining towns in southern Kootenay.

A TRIAL shipment of British Columbia silver ore will shortly be made to England for refining there.

THE citizens of Kingsville, Ont., have voted by a majority of 146 to take the gas supply of the town into their own hands.

BRITISH COLUMBIA mining papers are calling attention to the oil and gas finds in the Flathead Valley in the East Kootenay region.

HALIFAX, N.S., reports are to the effect that a valuable find of gold has been made on the farm of the Rev. Lee, near Mount Hope asylum.

THE chlorination plant at Cariboo, B.C., upon which the British Columbia Government spent $20,000, is said to be falling into decay.

THE *Calgary Tribune* says that a seam of coal three feet thick was struck, at a depth of 265 ft., recently, in boring an artesian well at Maple Creek.

WORKMEN have been engaged for some time in putting in the new roasting f[illegible] and chlorination plant in the mining laboratory in the Kingston School of Mines.

THE new gas well put down at Welland, Ont., for J. Reeb, by Carmody Bros. has turned out a gusher, and Mr. Reeb now has a daily output from his wells of 2,000,000 feet.

AT the School of Mines, Kingston, Ont., lately, $190 was extracted from a ton of ore from a mine in Rathbun township, near Mattawa, Ont., belonging to the Crystal Gold Mining Co.

DR. ROBT. BELL, of the Geological Survey, Ottawa, Ont., the other day read a paper on "Proofs of the rising of the land around Hudson Bay," at the meeting of the Geological Society of America at Philadelphia.

W. J. GRAHAM, Edmonton, Alberta, reports having struck a five-foot seam of excellent coal. It is in a lower stratum than that in which the other mines in the Edmonton district occur and can be taken out in large blocks.

THE recent sale of the plumbago mine in Renfrew, Ont., to an Ottawa firm, has stimulated the interest of the people there in mining James Bailey has lately opened a vein of black lead about six miles from Renfrew, which is said to be very valuable.

NATURAL gas is not hard to find in the township of Tilbury East, Ont. It was discovered to be issuing from the ground without a well of any kind having been sunk on the farm of McNerney Bros., near Quinn, Tilbury East.

THE copper deposits at River St. John and Cariboo, N.S., are likely to be developed before long, as United States capitalists, among them H. M. Whitney, of the Dominion Coal Co., are said to be taking the matter up.

A CONGRATULATORY letter to George A. Spotswood, M.E., of Kingston, from the Newfoundland Oil Company, says that in the first of the series of wells located by him for the company, oil was struck at a depth of nearly 900 feet.

ED. FEARON, M.L.A., has, we understand, a boring machine at work in the Cypress Hills, Man., ascertaining the depths, etc., of the body of manganese ore found there last summer. If the prospects pan out as well as the surface indications promise, it is said that arrangements will likely be made to work the mine in the spring.

MESSRS. MCDOUGALL AND GILLIES, M.P.'s, and Messrs. Gragg and Hyell of the Coxheath copper mines, interviewed eight Dominion Ministers last month, and urged that a bounty be granted on the higher grades of copper produced in Canada, it being the intention of this company to erect smelting works. They have already expended $400,000 in mining.

J. W. MCRAE, Hector McRae, George P. Brophy, John Brophy and S. H. Flemming, Ottawa, have purchased a plumbago property situated about eight miles from Calabogie, and about thirteen miles from Renfrew, Ont. The find is thought to be very valuable. The vein is 7 to 12 yards wide and 64 feet deep, and almost pure plumbago. It has been traced for about 300 yards to a point where it dips under the lake.

WILD reports have been circulated about the value of the Paysplat silver discovery near Port Arthur. Though these reports one of which put a value of $800,000 on the ore in sight—are greatly exaggerated, the property is believed to be a very rich one.

DEVELOPMENTS in the Seine River gold district point to a considerable output of gold in the near future. W. D. Ferguson, of London, and W. Hamilton Merritt, of Toronto, Ont., are said to be interested in an English syndicate which has taken options on all the finds made by Thos. Wigand, who made the first discoveries.

J. McDONALD, of McDonald Bros., who operate mines in the Lake Memphremagog district, says that they are developing a galena mine in the township of Pottin, near Sherbrooke, Que. The vein opened up was sixteen feet wide and has been traced seventy-five feet on the surface. A ton of the product panned out 34 ozs. of silver and 70.95 ozs. of lead.

THE Empire Gold Mining Company, Ltd., is being organized at Port Arthur and Fort William, to work McKellar's rich gold discovery at Jackfish. The capital stock is being placed at $1,000,000, of which the original owners get half for the property. Walter Ross, of Rat Portage, is the principal promoter. It is expected that work on a ten-stamp gold mill will be started this month.

THE size of the coal area of Nova Scotia has been the subject of investigation lately. The formation of the Dominion Coal Co. aroused interest in the coal fields and a great deal of prospecting has been done. To determine the value of the newer finds the Geological Survey is about to issue new maps, which will, it is claimed, show that Sir Wm. Logan's survey was accurate, and that the Dominion Coal Company have not overlooked many valuable deposits in making their purchases. The map of the Pictou district is now in press, that of the Sydney district will issue during the year, and the survey for that of Cumberland Co. will also be made at once.

THE lot of T. J. Watters, ex-acting Commissioner of Customs, is not a happy one. On the 14th Dec., he was arrested at Gatineau Point, on a charge of fraud, laid by F. R. White, a Boston mica dealer. White makes affidavit that Watters undertook to operate mica mines for him in Templeton township, the whole of the product to go to White. If the expense of operation exceeded $60 per ton for two months in succession, the mine was to be closed down. He alleges that Watters purposely operated the mine so as to increase the expenses, and which led to the suspension of mining, and that, moreover, he sold a portion of the product to other parties. Mr. White claims $2,500 overpaid to Watters and $6,000 damages.

THE Kootenay country has become well known during 1895. At the beginning of the year very little mining was going on and the out-look was not bright. At present there are towns numbering thousands of inhabitants and railways and other large works in connection; the mines are being pushed vigorously. At Nelson, says the *Miner*, in a review of the year's work, a smelter of 100 tons capacity has been built, and connected by a 4½-mile tramway with the famous Silver King mine. The Hall mines there have entered upon a period of profitable production after a large outlay of capital. At Pilot Bay a smelter was in operation throughout the greater part of 1895. It produced 3,860 tons of silver lead bullion, which it shipped to the United States. Most of the ore came from the Slocan Mines. In the Trail Creek section the progress of the country has been most rapid. Rossland, the centre of that mining region, which had one or two buildings at the end of 1894, has now a population of 3,000 people. Trail, a town site in the same part of the district, is building a smelter. Kaslo, another mining centre, is now connected by rail with Landon, in the Slocan country, which is also the terminus of the Nakusp and Slocan branch of the Canadian Pacific Railway. Since March the owners of the Slocan Star mine have received a dividend of $50,000 from it. Other mines have paid dividends of 7½ per cent. The War Eagle has made profits of $132,000 since the beginning of 1895. The exports from Nelson alone for the last four months of 1894 amounted to $619,023, almost exclusively the produce of the mines.

FRANK J. HART has been appointed a member of the Board of Harbor Commissioners, Montreal, in place of the late Hon. Edward Murphy.

O. P. ST. JOHN, formerly inspector of marine boilers for the Dominion Government, and latterly chief engineer of the steamer "Lakeside," has been appointed an inspector for the Boiler Inspection and Insurance Company of Canada.

Railway and Marine News.

THE wages of some of the C.P.R. employés were advanced 15 per cent. on Jan. 1st.

THREE new stations have been opened on the O. A. & P. S. R'y, Goshen, Admaston and Caldwell.

THE C. P. R. has put on a service of heated freight cars from Winnipeg to Portage la Prairie.

THE Rockland branch of the Canada Atlantic Railway was opened for regular traffic on Dec. 9th.

THE D. A. R. declines to use the new railway station in Halifax, and the board of trade of that city is very indignant.

THE G.T.R. yard at Port Dover is a lively place since the Conneaut ferry boat "Shenango No. 2" appeared on the scene.

THE Merrickville, Ont., people are petitioning the Government to do the work of dredging the river at that village by local labor.

THE T., H. & B. have taken 10,000 car loads of gravel from the pit at Ridgeville since they began work there in November last.

THE first regular train on the T. L. E. & P. B. R. left Tilsonburg on Jan. 1st, for Pt. Burwell, in charge of General Manager Teal.

THE Ottawa Forwarding Co.'s steamer "Welshman," is undergoing repairs. A new boiler is being put in, and the decks and cabins renewed.

THE G.T.R. proposes to do away with one of the bridges at Berlin, Ont., and build a new bridge, purchasing a new roadway from the Eby estate.

THE ferry steamer "Janet Craig," which was burned last season, has been rebuilt at Arnprior, Ont., and will go on its former route on Chat's Lake in the spring.

JAS. FREEBORN, the man in charge of the powder magazine on the Lakefield-Peterboro section of the Trent Valley Canal, was killed by the explosion of the magazine on Jan. 1st.

THE Montreal Transportation Co. will add a new steel steamer to the fleet similar to the "Bannockburn." Capt. Gaskin left for England on Dec. 18th, where he has placed the contract.

THE new dam recently constructed across the Rideau canal, at Newboro, has turned out to be of no use and another one of solid blue clay had to be built. This is found to give complete satisfaction.

THE reorganization of the Moncton and Buctouche Railway was completed Dec. 20th. With the exception of John L. Harris, Moncton, the directors are all Americans. Arrangements were made for the equipment of the road and operation next summer. F. M. Hall, of Annapolis, is local manager of the line.

A SUB-CONTRACTOR, named John Wilson, narrowly escaped death by the premature explosion of a blast on the Arrow Lake branch near Revelstoke, B.C. Three of the men working near were seriously injured, and another has not since been seen, and is believed to have been blown into the river.

JAMES W. HENDRIE, of Hamilton, Ont., has brought suit against the Grand Trunk Railway for 24,000, the amount alleged to be unpaid on 240 shares of stock in the Toronto Belt Line Railway, against which Mr. Hendrie holds a judgment of $20,000. John Bell, solicitor, and E. Wragge, local manager of the Grand Trunk, are being sued for $1,000 each on ten shares.

F. W. AYLMER, Golden, B.C., is preparing plans for the proposed new Kicking Horse bridge. The British Columbia Government promised to erect a double-track bridge which would accommodate the C.P.R. traffic as well as vehicles and foot passengers. This is now thought to be too expensive a bridge for the traffic it would carry, and the present idea is to have a single-track bridge which would be wide enough for vehicles and which would be closed to vehicles when a train was passing over.

J. W. MCRAE & Co., of Ottawa, Ont., have made two trial borings in the Straits of Northumberland during the past autumn, in order to discover the nature of the underlying strata and the cost of the proposed tunnel. The borings were made about the middle of the Strait, 3½ miles from shore. The first was sunk in 73 ft. of water to a depth of 72 ft., and the second in 52 ft. of water to a depth of 60 ft. Sandstone was encountered all through. A third boring was commenced, which can be resumed whenever the Minister of Public Works deems it expedient.

THE Grand Trunk Railway will widen the overhead bridge at the Wharncliffe Road in London, Ont., and the city will pay part of the expense.

NOTICE has been given that the sale of the stock, chattels, dredge, etc., of Connolly Bros., at Kingston, has been postponed until January 14th.

THE Mountain Incline Railway at Montreal has declared a dividend of 5 per cent. W. J. Withal has been elected president, and Wm. Mann, manager.

A NUMBER of townships in Pontiac county, Que., will take concerted action to oppose the extension of time for which the Pontiac Railway will apply at the present session of Parliament.

THE Sault Ste. Marie and Hudson's Bay Railway Co. is applying for an extension of the time in which the road may be built and for other amendments to their charter.

A. T. WOOD, Hamilton, has made a formal offer to the Hamilton city council to build the T., H. and B. road from Hamilton to Toronto without a bonus, and to put up $25,000 as a pledge of good faith.

R. B. ROGERS, C.E., superintending engineer of the Trent Valley Canal, has been ordered to Europe by the Dominion Government to examine and report upon a newly invented canal lift-lock being introduced in Germany.

WORK on the L.T.C. bridge across the Ottawa is progressing rapidly. Several carloads of British Columbia pine timber was brought here for the piers, and some of the longer spans.—*Mattawa Tribune.*

THE Rocky Mountain Railway & Coal Company are applying for an extension of the time allowed for completion of the line and for power to extend the line from Calgary to or near Lethbridge and on to the boundary, with a branch to MacLeod.

THE M C. R. is the possessor of a Russell snow-plow said to be the first of its kind in Canada. It was made at a cost of $3,500 by the Ensign Mfg. Co., of Huntington, W. Va. The weight is 6,700 lbs., and it can run thirty-five miles an hour with its wings open

THE new central depot, at Ottawa, was opened on Dec. 21st by the mayor of the city. The city council and the officials of the road took part in the formal opening. The finance committee of the council met after the inspection of the depot and voted that the O. A & P S Ry. had earned its bonus of $50,000.

REFERRING to the tests of the Case propeller given in our December number, A. Wells Case, the inventor, writes us that the yacht "Bonita" in a recent test made a gain of a little over five per cent. with the Case wheel. The yacht had previously had on a large number of wheels of different makes. Mr. Case is now having calls from Canada for his new wheel, and is building propellers of larger size than any hitherto attempted.

A DEPUTATION from Brantford, headed by Hon. A. S. Hardy, waited upon L. J. Seargeant, at Montreal, to request that the Grand Trunk workshops should not be removed from that city. Brantford gave the company a bonus of $30,500 to get the shops, but will insist on having it back if the shops are removed. Mr. Seargeant promised to consider the matter carefully, and the deputation left, satisfied that the shops would not be removed.

THE contract for five double track gates, from Charles to Catharine streets, Hamilton, Ont., was let to the Buffalo Gate Company. There will be three towers, and when a train is within a mile of the crossings, either way, electric bells in the towers will ring, notifying the watchman that the train is that close As it approaches the gates will go down, and as they do so another bell will ring at the crossings. It is said the contrivance is almost a perfect guarantee against accidents.

A BILL for a high bridge across the Detroit river at Detroit is before the Michigan Legislature's Committee of Commerce. This is the culmination of a plan long contemplated, which it is thought will result in the actual construction of a bridge. The Michigan Central Railway is the moving factor in the project, and will undertake the construction at a cost of $4,000,000, in case Congress authorizes the structure. The plans contemplate a broad bridge without draw, and a clear span, giving no obstruction to vessels.

BY the retirement of George Olds the position of general traffic manager of the C. P. R. is abolished, and the following appointments are made: G. M. Bosworth, freight traffic manager, with office at Montreal, in charge of freight traffic on all the company's lines; D. McNicoll, passenger traffic manager, with office in Montreal, in charge of passenger traffic on all the company's lines; Robert Kerr, traffic manager of the company's lines west of Fort William, with office at Winnipeg.

THE people of Edmonton, Alberta, are being urged to sign a petition asking the council to submit a by-law granting $50,000 bonus to the proposed new railway in that district. Signatures are freely secured.

LONDON, ONT, has passed the bonus offering $100,000 to the Grand Trunk Railway to erect car shops there to employ 300 men or 40 years, in accordance with the agreement made with the city last month.

THE T., H. and B. ran its first trains on New Year's Day. The time-table provides for three trains a day each way. A large section of the new Hamilton city council propose to contest the city's liability to pay the $250,000 bonus.

THE Ontario Peat Fuel Co. is applying for an Act enabling it to operate a short stretch of railway from its works in Wainfleet, in Welland county, Ont., over the Welland Canal Feeder, to the Grand Trunk Railway, and thence to the Canada Southern Railway.

THE Red River Improvement Co is applying for an Act enabling them to improve the navigation of the Red River, to build a canal to connect Lake Manitoba and the Assiniboine River, to expropriate lands for the purpose, and to produce and transmit electric power.

H. C. SECORD and F. R. Boselly, of Toronto, are promoting a colonization railway in New Brunswick. It is proposed to run from Campbellton, on the I.C.R, across the counties of Restigouche, Victoria and Madawaska, and will eventually connect with the Bangor & Aroostook Railway, giving practically a through line from Bay Chaleur to Bangor, Portland, Boston, etc. It is about 106 miles in length, and will open up a fertile section of the province, in addition to stimulating the lumber industry, the country through which it runs being heavily timbered with spruce, cedar and hard woods. The prospects of traffic from the fish trade of the Bay Chaleur is also good and in time would assume large proportions.

Electric Flashes.

THE Royal Electric Co. are installing a 500-light alternating plant in Georgetown, and a plant for Forest, Ont.

ATHENS, Ont., is the home of an electric light agitation. If the agitation is big enough, the Athenians will get the light.

THE Kingston, Ont., Street Railway Co. is fitting up its cars with six electric heaters each, instead of four, as formerly.

FOR over a week Gravenhurst, Ont., depended on coal oil for its light, on account of a break down of the incandescent light dynamo.

AN attempt is being made at Ottawa, Ont., to organize a private telephone service in opposition to the Bell Telephone Company.

LA BANQUE JACQUES CARTIER has made a demand for assignment on J. F. Guay, manufacturer of electric appliances, St Valier street, Quebec.

IT is expected that the extension of the G., P. and H. electric line to Hespeler will be ready for use in a few days Till now the cars have been running only to the Forbes woolen mill.

IRA CORNWALL, of St. John, N.B., is about to form a company to make and deal in electric apparatus generally, also bicycles and knitting machines, for whose incorporation application is now made to the New Brunswick government.

AT the annual meeting of the Hamilton Street Railway Company the following directors were elected: B. E. Charlton (president), George E. Tuckett, E. Martin, Q.C., W. Gibson, M.P., J. B. Griffith, William Harris and F. W. Fearman.

R. ANDERSON, electrician, of Ottawa, is installing a 600-light plant for John D. McRae, Eganville, Ont., to include about 50 h.p. in motors and street lights. He is also installing a 100-light plant for the North American Graphite Co., Buckingham, Que., and a 600-light plant for H. Francis, Pakenham, Ont., for lighting the mill and village.

THE International Electric Radial Railway is not making much headway at present, the promoter, W. E. Forsyth, being laid up at Buffalo with a broken ankle. A new manager will be appointed, and the company claims that it will shortly be in a position to resume progress. The office furnishings in Hamilton were recently seized by the bailiff and sold to satisfy judgments of $150, taken out by the landlord and by M. W. Hopkins, C.E.

If Architect Lennox has his way Toronto will spend $15,000 on an electric light plant for the new city and county buildings.

Kingston, Ont., is talking about civic ownership of the electric light and gas plants. The city solicitor and the mayor are consulting on the subject.

Mayor Laidlaw, of Durham, Ont., has been appointed local treasurer and a provisional director of the electric railway which E. A. Pew is so enthusiastically promoting.

The Toronto, Hamilton & Niagara Falls Electric Railway Co. has given notice of application for a charter at the next session of Parliament. The personnel of the company is not given, but the C.P.R. is said to be behind the deal.

The Lanark village council will submit a by-law to the ratepayers to grant a bonus to the proposed electric railway between Lanark and Perth, Ont. The company has agreed to the conditions proposed by the council, among others a forfeit of $5,000 if the road is not operated after the bonus is paid.

On the 2nd inst. a fire broke out in the car barn belonging to the Oshawa Street Railway Company. Three of their new largest improved cars were totally destroyed, and the building, which had just been rebuilt and painted, was badly damaged. Had it not been for the metal roof much more damage would have been done. It is estimated that the loss will exceed $6,000. The fire was said to have started from a wire.

Chatham, Ont., is ambitious to make itself the centre of an electric railway system, embracing the principal towns and townships within a radius of 30 miles. H. A. Beatty and J. W. Horne, of Toronto, who represent a syndicate, discussed the subject with the mayor and some leading citizens, and a report will probably be made by an engineer as to the cost and prospects of the scheme.

Through the slipping out of a bolt at the Orillia electric light station, one of the dynamos was stopped on Sunday night, and the Presbyterian Church plunged into darkness. By a strange coincidence, Dr. Grant's lesson that evening was the story of the Ten Virgins, and he had just reached the point where the foolish said to the wise, "Give us of your oil, for our lamps are gone out."

The new heavy copper metallic circuit Montreal-Toronto telephone line is now open for business. The time unit per conversation is three minutes, and the rate from London, Ont., to Montreal, Que., is $2.60, and 70 cents for each extra minute. Half rates of above between 7 p.m. and 6 a.m. The rate from Toronto to Montreal is $2 for three minutes, and $1 from Toronto or Montreal to Kingston.

Letters patent have been issued to the Drummond Electric Company to supply electric light and power in the town of Drummondville, Que. The applicants for incorporation are: William Mitchell, railway manager, Samuel Newton, railway secretary; William Houston, railway superintendent, A. Ouellette, general freight agent, Drummond County Railway, all of the town of Drummondville, and William Alexander Mitchell, railway conductor, of the town of Nicolet.

At the annual meeting of the London, Ont., Street Railway the following directors were chosen for 1896: H. A. Everett, of Cleveland, president, E. W. Moore, Cleveland, vice-president, Chas. W. Watson, Cleveland, Thomas H. Smallman, London, and H. F. Holt, Montreal. Chas. Currie, formerly assistant, was appointed secretary, vice S. R. Break, and Chas. E. A. Carr was re-engaged as manager.

In the Stanstead and Sherbrooke Fire Insurance Co. vs. the Bell Telephone Co., the Court of Appeal gave judgment against the telephone company. This was an action by which the Insurance Company sought to recover from the Bell Telephone Company the sum of nine hundred dollars paid for loss by fire on the stock of Mr. Hamilton, who was also the telephone company's agent at Richmond. Both the Superior Court and the Court of Appeal maintained the action on the ground that the fire was due to the wires of the telephone company which had come in contact with those of the electric light.

President C. J. Myles, Vice-President T. W. Lester, Director John Hoodless, and Solicitor F. R. Waddell, of the H., G. & B. Railway Company, attended a public meeting at Beamsville, Ont., on Dec. 14, when the question of the extension of the H., G. & B. to Beamsville was discussed. The meeting was practically unanimous for the extension of the road, and representatives of Beamsville Council and Lincoln County Council promised the H., G. & B. people a free right of way through their territory if they would build the road to Beamsville. The H., G. & B. representatives assured the crowd that the road would be extended as soon as the municipal councils concerned would pass the necessary by-laws, and they hoped Grimsby and North Grimsby would elect men in January who would favor the H., G. & B. in this respect. President Myles said the company would have cars into Beamsville by July 1, 1896, if the right of way could be secured at a reasonable rate. Since this meeting there has been a hitch, owing to the attitude of the Grimsby township council.

Brief, but Interesting.

The deepest shaft in the world is shaft No. 5 of the Paruschowitz colliery, near Rybnik, Upper Silesia. It was completed recently at a depth of 6,120 feet. The coal vein, struck at this depth, is 11 feet thick.

At a meeting of the Board of Aldermen of Berlin, Germany, September 16, a very important decision was rendered. It was decided that in the years 1896-97 no other than asphalt pavements should be laid, except where the condition of grade or extraordinary heavy traffic made stone necessary, and that the extension of asphalt pavements should be encouraged in every way. This decision was arrived at principally through the large number of petitions sent in by citizens in favor of asphalt. Nearly all the asphalt pavements in Berlin (during the last twenty years) were laid by La Compagnie Generale des Asphaltes des France.

At the "blowing in" of the new iron furnace at Hamilton the president is reported as saying that it was the first blast furnace started in Ontario. Mr. Tilden is altogether mistaken. In 1800 the first was blown in at Furnace Falls, on the Gananoque river, and it was blown out in 1802. In 1823 the second was started at Normandale, and it ran for more than twenty years. The third was built at Marmora, and was in blast at intervals for thirty or forty years from 1823. The fourth was at Olinda, where pig iron of good quality was made from 1831 to 1837. The location of the fifth was at Madoc. It was built about 1835, and was worked irregularly for ten years. The sixth was built in Houghton township in 1854 to manufacture car wheel iron for the Great Western railway, but the iron proved unsuitable.—*London Advertiser.*