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CONTENTS OF THIS NUMBER:

PURIFICATION OF SEWAGE BY IRRIGATION.

BY W. M. WATSON.

There is a good deal of misconception with reference to sewage purification by irrigation. It appears natural to convey all filth and manure to the land from whence it came, and make the cycle of production and consumption complete, and probably on this ground the many scientists and public officials favor irrigation. But experience and discovery have shown that land can only act as a filter, that is, a place for the lodgment of micro-organisms, that live and do the work of cleaning the dirt from the sewage, thus bringing the fluid back to its former state of purity. To enable the microbes to do this, that able scientist, W. E. Adeney, proves that air must be supplied and properly distributed to every separate atom of sewage in the proportion of three parts of air to one of sewage. Air cannot possibly be distributed into all the particles of the soil of a farm or any other land to a greater depth than about one foot, and often less, and when sodden with water or snow very little if any atmosphere can penetrate. Many inventions are being tried to aerate even artificially made filters. The best yet known is to fill the filter quickly, allow it to stand for a given period, then slowly draw the fluid off. As the fluid settles from the filtrate air is drawn into the interstices between the small cubes the filter is filled with, in that way the micro-organisms secure sufficient oxygen to give them vitality. By another method porous pipes are placed among the small cubes of coal, coke, clinkers, or whatever material may be used to filter or separate the particles of sewage fluid and atmospheric air passed through them at a pressure of about four inches of water by a fan, so that a constant supply of air is conveyed to the interior of the filter and is distributed throughout during the time the sewage is passing through, and on that account the filters work continuously. It is obvious that land that cannot secure air except at the surface, therefore cannot form a lodgment for microbes that must have air to live. If there are no microbes then there is no purification, and a milk sieve would do just as good work as any land, or even any artificial filter that cannot be supplied with air by some process or its equivalent (as some claim) of soda or similar chemicals. Arthur Turley, C.E., inspector of English sewage disposal works, states on page 5 of his report for 1890, that where irrigation is adopted, either alone or in combination with some precipitating process, the foreign matter in solution in the sewage is frequently increased by salts washed out from the soil. German chemists have given much attention to this disadvantage attendant on land filtration. The Teltower Sea, a lake near Berlin, was fouled by the effluent from the noted Berlin sewage irrigation works. Professor Muller reports that during nearly six months of the year no vegetation takes place on the land, and in hard frosty weather the land will not act properly, and the sewage must be stored up in tanks. Dry earth exerts a strong purifying influence on fœcal matter, but has very little if any effect on the other ingredients contained in sewage which contain millions of dangerous bacteria. People go into ecstacies if they see a sewage irrigation land that appears to perform its work well, as they usually do for one year, and sometimes as much as four years, and the success is proclaimed far and wide.

It came to my knowledge that a sewage farm near Montreal was considered to be very near perfection, and on September 14th last I had the privilege of inspecting this farm at St. Lawrent College, St. Lawrent, a village near Montreal. The farm contained 1¼ acre or 6,000 square yards of land, raised by light soil to a level of over 20 inches above the natural ground line. The population served by this irrigation system was said to be 400 persons, the daily sewage was about 4,500 gallons, an average of 11¼ gallons per head, which would allow the very small amount of only three quarts of sewage to one square yard of land per day. This system cannot properly be called a sewage farm, it is really the land filtration system, because the soil is well underdrained by having a row of land tile pipes laid under the centre of each of the twelve bays or divisions which deliver the effluent after the sewage has passed through the land into the parish drain, this coupled with the fact that the land was raised with light porous soil makes it an artificial land filter. The surface appearance of the land is that of a checker board having twelve trenches cut across from the distributing channel to the opposite side and to cross trenches, each trench being about 15 inches deep. The irrigation land and necessary appliances were said to have cost $3,500, or an average of $8.75 per head of population. This is

exclusive of the sewage storage and collecting tank and the steam pump. This is a high price to pay for a system of sewage purification that can't possibly work efficiently during hard frosty weather, and that gives off a disagreeable and unhealthy odor each time the sewage is run onto the land.

The engine and pump send each day's collection onto the irrigation land in the space of about two hours, so that the land gets only two hours' work and 22 hours' rest and aeration daily, and it may also be observed that the small amount of only ¾ of a gallon of sewage to one square yard of land cannot make any serious effect on the light soil, and it will be quickly absorbed during the hot dry weather of summer. If it was possible for each town to secure a light porous land, well underdrained, and to allow their irrigation filters 22 hours' aeration each day, a bright, pure effluent would be the result for several years until the porous soil got fatty.

But not one town in ten can secure suitable land for sewage purification works, and if the land has to be properly prepared and underdrained so that it cannot possibly become waterlogged, then the cost is so high as to be prohibitive, because artificial tank filters can be built at about the same price that will do fifty times the amount of work, and work efficiently both summer and winter. It is next to impossible to efficiently aerate irrigation lands, and on that account they gradually become sick and clogged with injurious microbes, therefore, in time, they become utterly useless as did the irrigation system adopted at Berlin, Germany.

A week prior to inspecting St. Lawrent sewage works I was engaged to go to the Georgian Bay district and find out why a sewage works had become totally disabled and was discharging foul odors. This irrigation filter is very similar to the St. Lawrent one, but with more advantages, because it is built on high ground and can be clearly drained to a depth of over four feet.

The whole filter at the Georgian Bay was created by piling up gravel and sand inside of a wooden fence. It is only used in the four hottest months of the year, that is during the tourist season. The population using the irrigation filter when the place is full with guests is under 300, including servants. The size of this irrigation land is 80 by 45 feet, which is ample to purify the sewage discharged when the fact is taken into account that all the solid matter contained in the sewage is supposed to be extracted by settling tanks prior to to its being discharged over the irrigation filter, on the intermittent system of working 30 minutes and resting three hours, and at the rate of only 10 gallons per yard per day when working at the fullest capacity.

After working for only two months the pores of the filter got so clogged that no sewage would pass through it, the cause being that the sheet iron settling tanks were not large enough to give sufficient time for the solids to separate from the liquids and to prevent the manureal matter from passing over on to the irrigation filter, and when a filter becomes badly clogged or sick it is impossible to clean it except by putting the whole of the filtrate through a furnace, and bringing it to a red heat, or by turning it all over with a hand spade and spreading it out in thin layers exposed to the purifying influence of the air for a year.

The apparent success of the St. Laurent sewage works is delusive, for like all other similar irrigation works the soil will in time become sick and clogged, and proof is already to hand, for we were told that during this summer the underdrains have not collected any effluent, yet that during the corresponding period of last summer they did collect considerable, so the bottom and heavy portion of the irrigation land is already sick, and the sickness will grow until the light porous soil at the top is also contaminated. It must come to that state, because land will not continue to purify sewage unless it can be often and thoroughly aerated to the level of the underdrains, which is very difficult. Much stress was put on the fact that the crops grown on the land were abundant and proved the system a paying one, but if such light soil had got watered by clean rainwater of the same amount as the sewage supply the crops would have been equally abundant, and certainly more wholesome. That eminent medical authority, A. Parks, adviser to the British Government, in his book on Hygiene, written for the benefit of the British army, states that plants grown on land irrigated by raw sewage are unsafe to eat (see page 354). On pages 119 and 121 he proves that the atmosphere near all sewage irrigation farms is impure, and people living near are subject to enteric fever and other disorders, so that the surrounding land always must decrease in value.

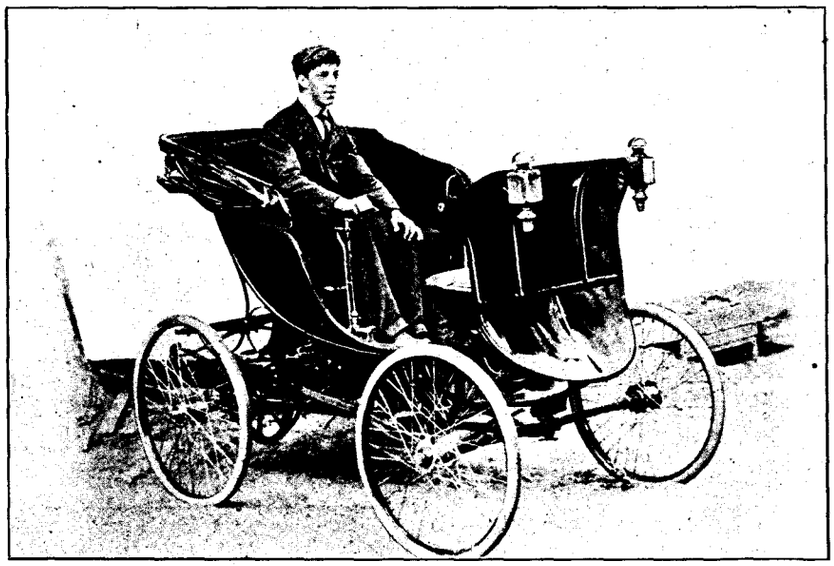
THE MOTOR CARRIAGE INDUSTRY.

It is with satisfaction that we note the present condition of the motor carriage industry, as the business seems to have passed the dangerous stages. The period of booming is passing, and after an enormous expenditure of capital in valueless patents, unsound companies and empty advertising, autocar makers are acting upon ordinary business principles. France takes the lead, and already there is invested in the autocar business in that country the enormous sum of $150,000,000, while 2,000 men are constantly employed in the industry. This condition of affairs is due to two causes: First, the magnificent roadways in France, and secondly, the fact that the French peasantry are very hard-working and extremely frugal, and thus have an immense sum total of money always in reserve to invest in enterprises that have the virtue of novelty as well as the promise of success. Added to this is the fact that the leaders of French society have taken very kindly to the new pastime of "motoring," and large sums from private fortunes are being lavished upon the manufacture of motor-cars of all descriptions. The Count de Dion deserves special mention in this connection. Twelve years ago he prophesied the wonderful development we are now witnessing in horseless carriages; and during all these years he has lavishly spent time, thought and treasure in supporting the inventive genius of his mechanical associate, M. Bouton. It is satisfactory to note that the daring and dashing enterprise of the rich Frenchmen are being rewarded by enormous business returns. One firm, Panhard et Levassor, in a single month recently took orders for autocars amounting to a quarter of a million dollars. M. Frankel, who designed a small tricycle carriage to sell at $400, in less than a month took orders for $40,000 worth. All the autocar shops in France are so crowded with orders that customers have to wait from six to fifteen months for their carriages. These factories are in nearly every case huge establishments employing several hundreds of men.

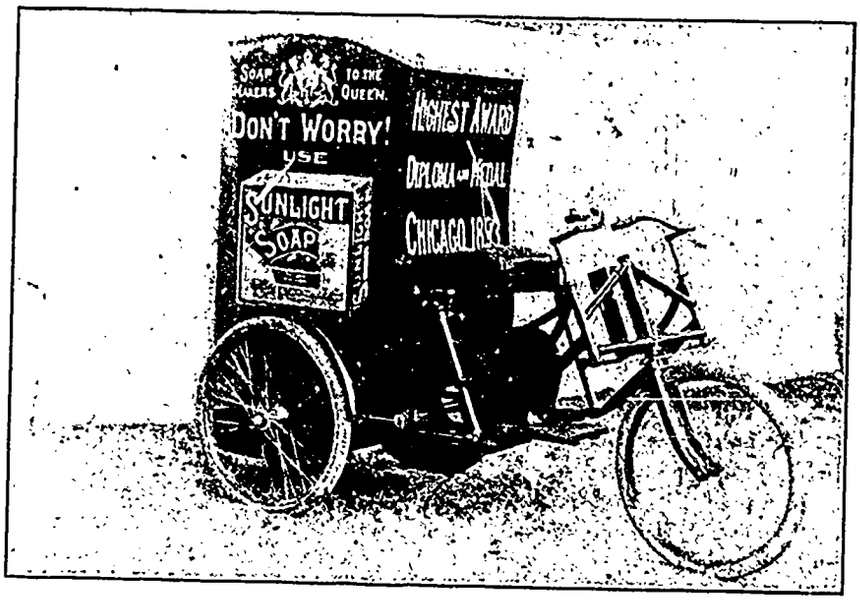
There is some activity in Germany and Belgium, but nothing is being done worthy of special mention. Crossing over to the British Isles there is a perceptible improvement in the autocar industry there. True, the hand of the promoter is visible in many of the schemes that are being exploited, and a great deal of experimentation is still being done; yet in various parts of England, especially in Coventry, and also in Scotland, praiseworthy efforts are

being made to get the business down to a commercial basis. The Daimler Motor Company, which works under the patents of a German inventor, seems to be taking the lead, but they have had some trouble recently in connection with a complaint by Henry Sturmey, the editor of The Autocar, in reference to the election of a novice as chairman of the board. The result has been the appointing of an investigating committee of three able persons, whose efforts, it is hoped, will result in good to the shareholders and the industry. Her Majesty's mails are being carried in some places by motor vans. The recent trials of heavy haulage autocars in Liverpool were a failure so far as new methods of propulsion are concerned, there being no entries of electric or hydro-carbon systems, and the steam vans, while showing structural improvements upon those of sixty years ago, have not yet overcome some of the inherent difficulties. In a recent issue we gave a full outline of the Liverpool trials. An American engineer, Hugh Dolnar, makes some caustic and critical comments on the exhibition, and it may be interesting to quote some of his conclusions. In an article in the Cycle Age, he says: "Such were the actual results of the Liverpool trial, the wagons in the hands of their builders showing that they had power enough to pull the loads over a bad road, it is true, but that otherwise they were wholly unsuited to any existing conditions of transportation now performed by the aid of horses. . . . . The heavy, self-driven wagon has not been built yet. It will be built, but no such absurd assertions that failure is success as are contained in the Automotor's silly editorial will make it come a day sooner. The situation calls for a calm consideration of facts and results obtained. In all mechanical operations the quickest way out is to recognize failures, and so be in a position to look for elements better adapted to meet actual conditions. None of these wagons shown at the Liverpool trial could do anything whatever towards city trucking, and it does not seem at all likely that any steam engine driven wagon will ever be found suitable for heavy work, loads of say from two to four tons, such as are commonly drawn on two-horse trucks. The heavy truck is a far more difficult problem than the four or six-passenger vehicle, and absolutely must have all four of its wheels driven, and must be able to place itself as quickly as a horse-drawn vehicle can be placed at the curb or on a crowded pier." In London the electric cabs are only partially successful. Recently there was a strike among the drivers, and one of them stated their grievances to be: numerous break-downs of the mechanism, for which the drivers had to pay although they were not liable; the slow speed of the cabs, thus reducing the drivers' margins; poor pay as compared with that allowed drivers of horse cabs. The matter was patched up after a few days by concessions from the company. The London electric omnibuses are not yet running. The real reason for this, as well as for the trouble with the electric cabs, we believe to be the lack of storage batteries that while lighter than those now in use will yet give off more power. The immense dead weight carried by the London omnibuses, each of whose batteries weigh about 1,600 lbs., adds enormously to the perplexities of the problem, and it is safe to say that until a lighter battery equipment is provided the solution will be far off.

In the United States the industry has made very little headway. As the editor of The Cosmopolitan—who two or three years ago gave a prize of $3,000 for the encouragement of the industry in the United States—remarked in an article published in his magazine last month, it is astounding that a people so progressive as the Americans should be so far behind France, and indeed England, in this industry. One explanation of this backwardness is found in the fact that the American roads are about as bad as they can be. Worby Beaumont, the president of the Society of Engineers of England, remarked to the editor of The Horseless Age, when on a visit to New York recently, that the American roads were the worst in the world, and he could quite understand why the horseless carriage industry had not made further progress there. Col. Pope, of bicycle fame, has spent nearly a quarter of a million dollars in exploiting electric equipment for carriages, and from his motor vehicle factory in Hartford has turned out several of the Pope carriages. Their price is $3,000, their weight about 2,500 lbs., and their carrying capacity only two persons, their running power only about 25 miles; and these limitations and conditions have prevented ready or rapid sale. Col. Pope is now exploiting gasolene with Hiram Maxim at the head of that department. So far, however, nothing striking has been produced. The Duryea motor carriage, of which so much was expected, has sunk into comparative insignificance. This carriage won about $8,000 in prizes at various races; but attempts to establish companies for its manufacture in New York and in Canada have proved failures, and the sample carriage which was sent to New York under option to capitalists there has been returned to the shops in Springfield. This gasolene carriage is of reasonable weight and speed, though the efficiency of the engine is not great.



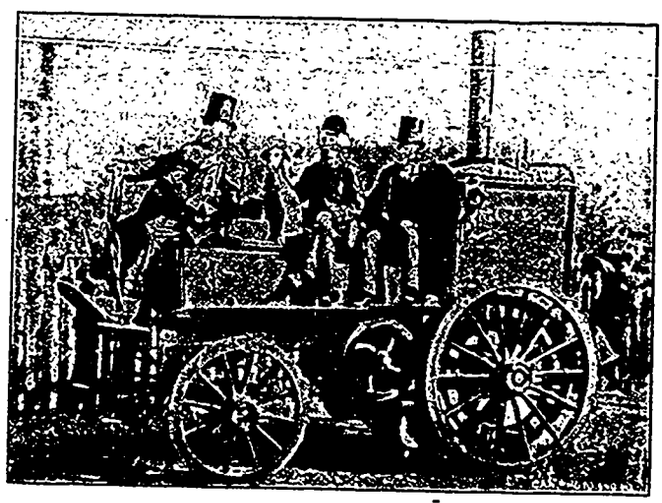
The Winton gasolene carriage of Cleveland is now taking the lead, yet only fifteen of these have been sold to date. Mr. Winton, who is a bicycle manufacturer, has been working for about five years on his gasolene engine, and has produced a creditable carriage, two of which have found purchasers in Canada in the Messrs. Moody, of Hamilton. The carriages sell at $1,000, carry two persons, weigh about 2,300 lbs., and show go d speed and efficiency; but there is nothing radical in the construction of the engine.



The Electric Vehicle Company of New York is pushing the introduction of electric cabs with great energy and spirit. An interesting illustrated description of their battery system was published in the September number of the American Electrician. They certainly deserve success, yet their cabs while carrying only two passengers in addition to the motorman, are so heavy that they represent over 1,000 lbs. per passenger, and this enormous dead weight requires the construction of special wheels made of cast-iron mounted upon pneumatic tires. The cabs, however, are popular, and if once brought down to a commercial basis could be made a highly profitable business. A correspondent recently drew attention to the enormous field for motor carriages in California, where alfalfa hay is dear, and yet has to be transported with the caravans in order to feed the immense number of horses needed. It is usual to hitch up twelve horses to a single wagon, and yet with this enormous hauling power only twenty or thirty miles per day can be made. So far there has been no attempt made in the United States to develop the haulage of heavy traffic by autocars. There is to be an exhibition of motor carriages in Boston this month and next in connection with the 20th Triennial Exposition of the Mechanic Association, and prizes are to be offered in connection with motor carriage races, but nothing definite has yet been announced.

The steam carriage shown in the accompanying illustration was built in Birmingham, England, in 1870, by J. & W. R. Inshaw, now of New Bedford, Mass. The brothers were then in partnership with their father in the engineering trade. This carriage held ten passengers, not including the steersman and the boy who acted as stoker. The gross weight when loaded with water and coke was 3,000 pounds. There were two tanks for carrying water, which was introduced into the boiler with a force pump and injector; the tanks held sufficient for a two hours' run. The boiler, which was of the watertube type, steamed very rapidly, and steam could be raised to 100 pounds pressure in 1½ minutes from cold water. The engines consisted of a pair of long-stroke engines, with cylinders having a diameter of three inches and a stroke of 12 inches. These drove an intermediate shaft which had a clutch arrangement, and the power was carried by means of a chain, From Coventry to Birmingham (eighteen miles) in one hour is the best work this carriage has done when carrying its full complement of passengers.

We speak of Canada last. The Canadian Motor Syndicate has recently begun the manufacture of storage batteries on the Still Battery System, and have already equipped two types of vehicles (shown in the illustrations), one an advertising tricycle having a speed of ten miles per hour and a capacity of twenty miles without recharging, the battery weighing 150 lbs., and carrying in addition to the driver a load of 250 lbs.; and a Victoria seating four persons, having a speed of fourteen miles per hour, a capacity of thirty to thirty-five miles without recharging



and a battery weight of 350 lbs., the total weight of carriage being 800 lbs. As compared with the American and English, these Canadian electric carriages and their batteries weigh only about one-fourth, and yet are claimed to possess equal if not greater efficiency. The finishing touches are being put upon a new gasolene engine of Mr. Still's invention, to which reference was made in the illustrated article in THE CANADIAN ENGINEER of April last.

GARBAGE DISPOSAL IN MONTREAL.

BY W. M. WATSON.

Lately I visited and inspected the garbage incinerators in Montreal, which I was told cost $45,000. They have twelve furnace grates, six on each side of the main flue. The fire, places are about six feet wide each, and sixteen feet from front to rear, and have each two clinkering doors. The grate bars form a steep incline, and appear to be six feet higher at the rear than at the front doors, and terminate at the rear end—with a short shaft passing up to the floor line of the tipping floor—through which the refuse is passed down to the fire bars. Each furnace will hold about three tons, and they are apparently only charged two or three times each day. When first built they had a boiler which raised steam from the wasted heat (or should have done so), and steam blowers were supplied to increase the draught, and raise the temperature of the furnaces. But all such appliances have been taken off the apparatus; probably the men appointed to manage the works did not know the value of the appliances, and could not work them to advantage. There is also an extra furnace in the chimney flue that was placed there for the purpose of burning the fumes discharged from the furnaces prior to passing up the chimney and out into the atmosphere, but this is not used and no pretence is made of consuming the foul smelling gases passing up the chimney or to prevent the dust from escaping.

The fires are of course kept at a low temperature, and the ashes and clinker taken from the furnaces are of a soft nature and of little value for use on public works, though if a high temperature incinerator were near the clinker might be reburnt and made hard enough to use for roads, concrete, etc. The heat from the twelve fires is all wasted, showing how rich Montreal is. If the same amount of rubbish was burnt in England they would make profitable incomes from the heat coming from the fires from the many things of value that come mixed with the garbage, and also from the clinker that was drawn from the furnaces. But the British public authorities cannot afford to waste valuable products, they turn even their garbage into cash. There is a fine long chimney and large, straight flue running between the fires, having main and local dampers, so that the draughts can be wholly or locally cut off from each fire separately. There is also an incline road and tipping floor that covers all the fires and flues, well housed and roofed in. The garbage is chiefly vegetables, fish, meats, and light refuse, together with dead animals.

These incinerators are an improvement on the Toronto crematories, but even then they are a long way behind the garbage destroyers used in Europe, both from a sanitary and financial standpoint. As soon as some public authority has the pluck to have a first-class destructor erected and afterwards intelligently managed, the advantages over the present kind will be so apparent that Canada will see the last of the wasteful incinerators now in use.

—Toronto is about to make an experiment aiming at retaining trade in the eastern portion of the city by building a large hotel. The site chosen is one on King st. east, which has been left vacant by the failure of a large dry goods store. The promoters are not able, so far as we know, to point to a single instance in which it has been possible to alter the course of trade when once in motion toward the west. The new city hall and the large office buildings which have been built in the past couple of years to the north and west of the proposed site will have a much greater influence in drawing business towards them than will an hotel, even if the hotel succeeds, which upon the face of it is in the present case unlikely. To succeed it would require to attract tourists and to hold largely the local restaurant trade of the best class. The proposed site is away from the theatres, the fashionable promenades, the railway stations, the large departmental stores, from everthing that should be near at hand, and is in addition hot and unpleasant in summer, thus rendering a tourist trade impossible.

—There may be too much interference on the part of the Government with private interests, and we are accustomed on this continent to look with suspicion on Government regulations of any sort, but we are beginning to see more clearly the necessity of Government inspection of all works which are likely through defect to cause danger to public life or health. Liability of the owner to make good damages resulting from defective construction is not the safeguard in America that it has been found to be in England. Sometimes here the owner is a great corporation or controls a large local influence and investigation is burked. In the United States this is a usual, in Canada an exceptional circumstance. An example of what might have been a serious accident was recently brought to our notice. A high chimney for a large power-house had its foundation put in on a site where the nature of the soil and the work done made its collapse a certainty. Fortunately an engineer who happened to examine the work called the attention of the owners to the matter, the structure was taken down and a suitable foundation put in. In advance of an official report on the subject it is impossible to state the cause of the collapse of the O. & N. Y. railway bridge at Cornwall, Ont., described in another column. Had there been an efficient Government inspection of the work done on all railway bridges in and adjoining Canada we would have had on file the records of the borings made to locate the piers in the first place and a statement of the manner in which the concrete in the pier hardened as it was put in. With this and other data the public would be much more fully informed, and if these facts were published during the construction of the work many believe that the accident would never have taken place. Publicity in these matters is a good thing.

A SHORT HISTORY OF SEWAGE DISPOSAL AT THE ASYLUM FOR THE INSANE, LONDON, ONTARIO.*

BY R. M. BUCKE, M.D.

London asylum was ready for the reception of inmates in the autumn of 1870, and by the end of that official year 457 patients had been admitted chiefly from the Malden and Orillia branch asylums, which were thereupon closed. The sewage of the new asylum was thrown into a small creek three miles above the opening of the same into the south branch of the Thames, the said opening being three miles above the city of London. Every summer the creek became nearly or quite dry, and it was not very long before the farmers and others who lived along its course complained bitterly of the nuisance caused by the asylum sewage. Complaints and threatened prosecution were met by the establishment of a charcoal and gravel filter at the lowest point of the asylum land. The said filter was operated intermittently with more or less (chiefly less) success for some fifteen years. It would do its work fairly well when fresh charged: but it proved impossible, by any reasonable expenditure of labor and charcoal to keep it in a state of continuous efficiency. The protests of the property holders along the creek, which had been partially silenced by the establishment of the filter, broke out anew and were naturally intensified by certain cases

*A paper read before the Ontario Association of Executive Health Officers, at the Ottawa Convention.

of typhoid fever, which occurred among them. It became clear that some more radical remedy for the evil would have to be adopted, and it was finally decided to adopt that method of sewage disposal which goes by the name of Intermittent Downward Filtration.

A piece of sandy land, four acres in extent, was selected for the purpose. This, in the first place, was graded perfectly flat, and was then laid out in alternate beds and trenches, the beds being ten feet and the trenches eight feet wide. The difference in level between the surface of the beds and the bottom of the trenches is twenty inches. The length of the beds and trenches is 220 yards. The number of the trenches is eighteen. The whole plot was provided with an elaborate system of tile drainage, many thousand feet of two inch tile being used. These were supposed to carry the purified water of the sewage to a well situated at the southwest corner of the field, which well was expected to overflow into a surface drain, and its water to run to the head of an adjacent small creek. Experience showed, however, that this tile drainage was almost or quite unnecessary and useless Of late years the tiles have been dug up here and there for the purpose of examination, and it has been found that no water ever passed into them—they were in precisely the same state as when they were put down -that is, they were apparently quite new and unused In one part of the field, however, in which the soil is not so sandy, some water does pass into the tile in wet seasons. On the whole, however, water seldom runs into the well, and I have no doubt the field would do its work as well without the tile as with it.

The sewage field is on a slightly higher level than that on which the asylum itself stands; it is therefore necessary to use a pump. The sewage from all parts of the institution (including of course all laundry and other impure water), is run into an underground tank 80 feet long, 40 feet wide and 15 feet deep. From this tank it is thrown once a day by a centrifugal pump through a six inch iron duct into a small well at the northeast angle of the sewage field. This well, after being filled, overflows into a long trough made of three two inch planks spiked together. Opposite each trench there is a short spout made with similar two inch plankings. Each spout is fitted with a sliding gate and just beyond each spout the trough is fitted with a similar gate. By means of these gates the sewage is turned into any trench desired. The whole arrangement is exceedingly simple, cheap and efficient. The centrifugal steam pump churns up the sewage so that when it comes to the field it resembles dishwater in appearance and is so dilute that it has very little odor.

The population of London asylum is in round numbers 1,000 patients and 200 sane people. The quantity of sewage made in a day averages about 75,000 gallons. It requires two and a half hours each day to throw this on to the field, and within from half an hour to six hours (according to the season of the year and the moisture or dryness of the earth), after it is thrown into the trenches, it has been absorbed by the soil. It is never seen again by us, doubtless it reappears at the surface somewhere as pure spring water. Only two to four trenches are used each day, so that the soil as used is always ready to absorb the sewage. There is no pollution of the soil; it is as sweet to-day as before it was used at all for the purpose in question. The disposal of the sewage then is absolute, as complete, indeed, as if it had passed out of existence. But it will be asked, how is it when the ground is soaked with long continued rain, or when it is frozen hard in very cold weather? Neither of these conditions trouble us. The sewage always disappears in the soil, the process only somewhat checked by previous soaking, and only slightly checked by frost; for the sewage, even in winter is always many degrees above the freezing point, and it thaws the soil sufficiently to make way for itself. Granted then a sufficiently porous soil, which can be found within moderate distance anywhere, this mode of sewage disposal is simple, certain and cheap. No expensive plant is needed, and there are no chemicals or other supplies to purchase to carry it out.

But this is not all, these are not its only recommendations. For the first few years, after adopting this method at London asylum we used the field for sewage disposal only: we simply kept it clean of weeds and grass, and maintained the level and form of the trenches. But seven or eight years ago the temptation to experiment with the field as a garden took possession of us. All that we did in this direction prospered. We watered the plants grown on the field with the sewage, being careful not to use it at such times as it could taint such a crop as (for instance) strawberries. We found from the first that in the beds between the trenches (although the soil in them was poor), we could grow by aid of the sewage immense crops. For six years now we have cultivated this field to its full capacity with the result that we grow upon it year by year crops of fruit and vegetables to the value of over $200 per acre. So that over and above the disposal of our sewage in a cheap and cleanly manner the sewage itself is so used as to bring us in several hundred dollars a year more than the field in its original condition could possibly (without the sewage), be made to produce. The crops we have grown upon the sewage field in the last six years have been as follows: Water and musk melons, squash, pumpkins, celery, peppers, cucumbers, tomatoes, peas, radishes, chilies, lettuce, beans, cabbage, beets, carrots, corn, onions, turnips, salsify, sea-kale, asparagus, parsnips, strawberries. Every one of the crops grown on the sewage field has done well. One of our most successful crops is melons, both musk and water, which we grow there every year. The yield is immense and we have grown better melons on this field than I have ever eaten grown elsewhere. We have had immense crops also of cabbage and celery, and the quality of the crops has been much above the average. I need hardly say that the fruits and vegetables grown on the field are as wholesome as those grown elsewhere. Neither is the health of those who work upon the field in the least affected, there are no healthier people about the institution than they. Why not? The field is simply a beautiful garden which is kept well manured and irrigated.

To sum up. The advantages of this mode of sewage disposal are many and great. It is cheap, simple, cleanly, not liable to get out of order, wholesome It would seem to be nature's own plan of refuse riddance. It seems clear that solid excrement, including dead bodies, should be returned to the earth whose chemistry is competent to deal with it and utilize it without itself receiving taint or injury, and not to the waters which have no use for it, and which are tainted and grievously injured by it.

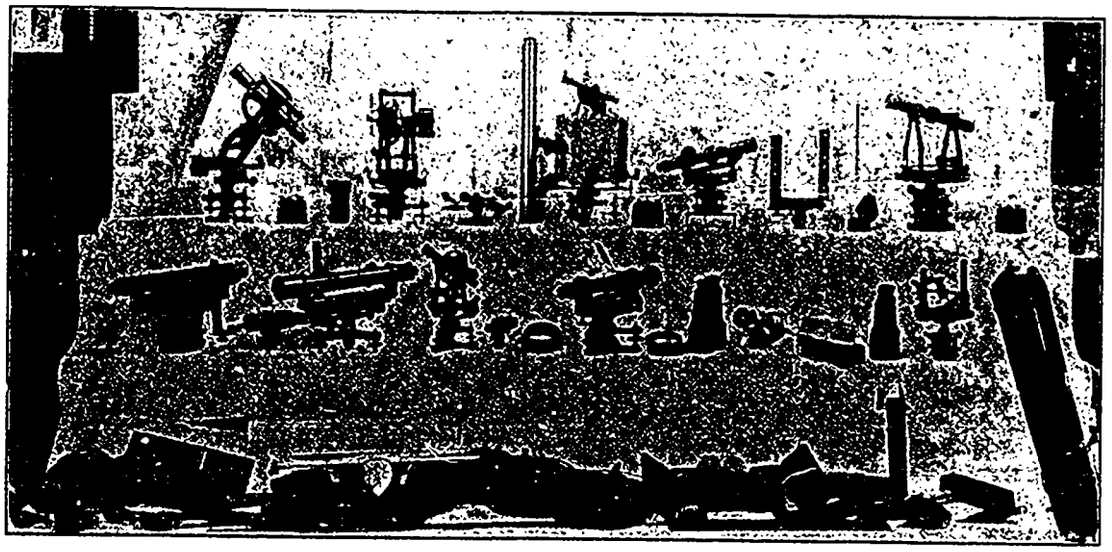
THE SURVEYING EQUIPMENT OF McGILL COLLEGE.

In consequence of the rapid growth of the Mining Department of McGill College consequent upon the completion of the McDonald mining laboratories, it became necessary to largely increase the equipment of the Surveying Department. This was made possible by the generosity of the same benefactor, W. C. McDonald, of Montreal. The accompanying engraving shows a number of the instruments added under this donation. It was made from a photograph taken in the east room of the Architectural Department.

The full list of instruments purchased is as follows: From Troughton & Simms, London, Eng., 14-inch Charlton Model, Dumpy Level; from L. Casella, London, Eng., 3-in. Transit Theodolite, Brydges-Lee, Photo Theodolite, Box Sextant with Supplementary Arc; from W. F. Stanley, London Eng., Box Sextant, Box of Drawing Instruments; from L. Lesdorpf, Stuttgart, Germany, Wagner Pocket Level, Precision Level, 4-in. Transit Theodolite, Goldschmid Aneroid Barometer, Prismatic Reflecting Circle, two sets Beam Compasses; from Martin Veig, Christiania, Norway, Wrede Pocket Level; from Chesterman & Co., Sheffield, 30-in. Straight Edge, 3 100-ft. and 1 66-ft. steel bands, half dozen linen tapes; from G. Cooper, London, Eng., Sidereal Watch; from Young & Sons, Philadelphia, U.S.A., 6¼-inch Railroad Transit, 6¼-in. Mining Transit with three tripods and interchangeable lamp targets; from Buff & Berger, Boston, U.S.A., 14-in. Dumpy Level; from Keieffel & Esser, New York, U.S.A., combined Architect's Level and Transit, 100 ft. steel band, 300-ft steel band for mining work, slide rules, scales, plum bobs and other minor equipment; from Lufkin Rule Co., Saginaw, U.S.A., 2 Steel Bands, ½ dozen Linen Tapes; from W. & L. E. Gurley, Troy, U.S.A., 4 Plane Tables, 2 Surveyor's Compasses, Solar Compass, Pantograph, Price Current Meter; from Hearn & Harrison, Montreal, Rochon Micrometer, 2 Aneroid Barometers, 3 Hand Levels, 2 Lemaire Field Glasses, Box Sextant, Parallel Ruler, Scales and minor drawing implements.

The effect of this donation has been to increase the number of instruments available for field work by fifty per cent. and to place ample opportunities for practical work at the disposal of

every student. In order to give the students full time to profit by this addition the session has been lengthened by one month in all the departments taking the surveying course, and the entire month of September has been set aside for field work. Some time in addition to this is given to underground surveying during the spring mining excursion. The course in full is designed to give the student all the technical knowledge necessary in order to qualify as a Dominion Topographical Surveyor in addition to the regular methods of practice in railroad hydrographic and topographical surveying. The instruction is given by field work, lectures and plotting, and office work; the work in these latter being based upon the notes taken by the students in the field work. The field work will be given this year in and around the village of St. Andrews, Que., and will commence with preliminary practice in the use and adjustment of the instruments to be followed by the carrying out of the following surveys by the several years:



INSTRUMENTS IN THE SURVEYING DEPARTMENT OF M'GILL UNIVERSITY.

Fourth Year Work.—Base line measurement, triangulation by geodetic methods, precise levelling, magnetic observations, and the determination of latitude, longitude, azimuth and time both in the day time and at night.

Third Year Work.—Topographical surveys of selected areas by plane table stadia and photo theodolite, a hydrographic survey of part of the Ottawa river, including the determination of its discharge, a location survey for a railroad between Carillon and St. Andrews.

Second Year Work.—Chain Survey of part of the village, compass and chain survey of farm lands, micrometer surveys.

In the making of these surveys the years are divided into small parties not larger in number than would be employed in practice, and each party carries out its complete set of surveys independently, each student being required to have a full set of notes of the work done by his party. The students are thus compelled to learn to carry out the duties which will be given them in practical work, and the necessity of full and accurate notes is impressed upon them in the plotting of their own surveys, which is done in the winter months after field work has become impossible. From the plans thus made quantities and estimates are calculated.

The field work and mapping has been organized in this manner so that the students may fully appreciate the practical importance of the facts concerning theoretical and practical surveying that they hear in the course of lectures upon this subject, and will learn to depend upon their own judgment and to understand that an acquaintance with the literature of a subject does not qualify a man completely for the practice of it. The organization and conduct of the surveying department is under the charge of Prof. C. H. McLeod and his assistant, J. G. G. Kerry.

W. W. Ogilvie is building what will be the largest grain elevator in Montreal. The plans are already completed for its construction, and it will have a capacity of 2,000,000 bushels. It will have a frontage of 240 feet and a depth of 290 feet.

RECENT METHODS OF SEWAGE DISPOSAL.

BY CHARLES G. HORETZKY, C. E., OF THE ONTARIO PUBLIC WORKS DEPARTMENT, TORONTO.

The following paper on the most recent methods of sewage disposal now in operation in the United States, being to some extent the outcome of experiments made by the Massachusetts State Board of Health, with remarks upon their adaptability (in whole or in part) to cities in Canada, was read before the Association of Executive Health Officers of Ontario during the meeting in Ottawa in September, and also at the meeting of the American Public Health Association.

At the tenth annual meeting of the Association of Executive Health Officers of Ontario held at Belleville, Ont., in 1896, I read a paper upon Methods of Sewage Disposal then used in some of the Provincial Institutions of Ontario. In December, 1895, I was one of the consulting engineers with reference to the disposal of the sewage of the city of London, Ont., and then recommended a system of land disposal or filtration; my recommendation being largely based upon the successful working of the Brockton, Mass., plant then in operation, and upon the very doubtful success of several chemical systems visited upon a tour of inspection through the United States in October of that year. Since 1893, further, and most important discoveries in this direction have been made by the Massachusetts State Board of Health at their Experimental Station at Lawrence, Mass., where the last few years have been devoted to researches upon the capabilities of gravel and coke filters aided by forced aeration. A description of these experiments would be interesting, but out of place here, and can be seen in the different annual reports. It will suffice to say that the conclusions arrived at offer a great incentive to the practical ingenuity of all those interested in the construction and maintenance of sewage disposal plants.

It has been demonstrated that filters of gravel of an effective size * of 5.40 MM. can produce a most satisfactory effluent, and remove from 60 to 85 per cent. of the organic matter of strong city sewage, at the rate of 400,000 gallons daily per acre. Coke breeze (screenings from commercial coke) has also been found of immense value as a filtering and straining medium, and possesses the advantage of being fully as valuable for purposes of combustion after its use as a sewage strainer and sludge retainer, as before. This will be discussed further on. As regards the forced aeration applied to these experimental filters, pipes were passed through, and within 6 inches of the bottom. A fan blower driven by electricity was attached, and, while the fan made 3,600 revolutions per minute, an air current capable of sustaining 3 inches of mercury was forced through the filters. By frictional loss the force of the current was reduced fully one-third.

In the experiments with the coke filters up to January 1st, 1895, the average rate of filtration was 260,000 gallons per acre

*(Note: In a sample of sand or gravel, the effective size is the maximum diameter in millimeters of the finer ten per cent of the sand grains, or gravel).

daily for six days in the week, while the average removal of organic matter (albuminoid ammonia), and bacteria was 95 and 98 per cent., respectively. In 1894 Col. Waring instituted experiments upon sewage purification aided by forced aeration, at Newport, R. I. These were continued during five months from May till October, and the results set forth in a pamphlet which also contains a synopsis of the chemical work and investigation carried out simultaneously by Geo. W. Ralfe, A. M. (Harvard). The Willow Grove Park (15 miles from Philadelphia) sewage disposal plant was constructed shortly after upon the principles evolved by the Newport experiments. It is simply composed of a set of strainer and aerator beds, one-eighth acre in extent in all. The sewage applied daily is assumed to be from 60,000 to 100,000 gallons. The resulting effluent at date of my visit on 6th Sept. was very good, clean and odorless, and the most of it was in daily use for sprinkling the lawns and roadways at Willow Grove. I found, however, that the receiving well was clogged with hard compact sewage to the depth of 4 feet. This will have to be removed eventually by hand, as it cannot be pumped up. The man in charge informed me that the plant had been one year in operation, and that the strainer beds have to be overhauled every season (six months), and the material washed and returned to its place. This, he says, occupies three men during a week.

As to the conclusions arrived at by the chemist in charge during Col. Waring's Newport experiments, they indicate that a strainer tank can remove 40 per cent. of the nitrogenous matter in ordinary sewage, if this sewage, roughly strained and free from mud, is applied continuously, at a minimum rate of 3,000,000 gallons daily per acre; and that an aerator bed one acre in extent, with nitrification properly established, and proper manipulation, will remove 95 per cent. of the organic nitrogen of a strainer effluent, applied at a rate of at least 800,000 gallons daily. It will do so for an indefinite period, under, of course, proper conditions of working. This means that ¼ acre of strainers, and 1 acre of aerators (1¼ acre in all), will suffice for the treatment of the sewage of 10,000 people at the rate of 80 gallons per capita. I have been unable to obtain the cost of the Willow Grove plant, now about one year in operation, which includes the pump house, pump, blower, masonry and concrete work, filtering material, and all accessories; hence, it is difficult, may impossible, to compare it in the large and practical way with other methods which will be discussed further on; but, from my own actual observation, and the statements of the man in charge, I am of the opinion that the conclusions reached by the experimenters are quite in accordance with the actual working of this very valuable system of artificially aerated bacterial filters as claimed by the inventor, whose theory regarding "Bacterial oxidation" of sewage is pretty generally understood.

Reverting to the Massachusetts State Board of Health experiments with coke, I now quote an extract from page 480, report 1896, which sums up the immense value of this material as an aid to sewage purification, and especially as a sludge retainer: "When Coke Breeze can be obtained, and the sewage given a preliminary treatment before sand filtration, by being passed through this breeze at a high rate in gallons daily per acre, the organic matters can be removed from the entire body of the sewage as completely as chemical precipitation removes them from the main body of the sewage. There is no resulting sludge liquor from this coke straining process, and the clogged coke can be removed from time to time and burned, the sludge being of course held by, and burned with it.

"During some of the experiments 13.8 cubic yards of coke per million gallons of sewage filtered were removed, dried and could have been used as ordinary fuel. By straining through coke we have removed during 1895, 54 per cent of the sludge (albuminoid ammonia) of the sewage. The latter has been strained at an average rate of one million gallons per acre daily, and the coke strainer contained from 6 to 8 inches in depth of coke. The coke is known as breeze (screenings from ordinary coke). At the Lawrence Gas Works where it is obtained, it is used under the boilers, and estimated to be worth one-fourth as much as the steam coal, or, from $1 to $1.25 per ton; the amount used has been 10 cubic yards per million gallons of sewage strained, and, as a ton of coke occupies about 2.3 cubic yards, the sewage has been purified, to the extent given, at a cost for coke of $5.43 per million gallons of sewage strained, estimating the coke to be worth $1.25 per ton. By this method we remove the sludge from the entire body of liquid, and get rid of the concentrated sludge liquor which results from sedimentation, or any chemical precipitation process, and, it seems that the coke is as valuable for combustion after use in the strainer as before."

I may add that in the coke filter experiments of 1895, the removal of organic matter and bacteria, at a rate of 260,000 gallons per acre daily, for 6 days in the week, was 95 and 98 per cent., respectively. Now, sludge resulting from sedimentation or chemical precipitation contains 90 per cent. of water, the latter being separated from the solids by a most expensive and dirty method of pressing. Even then, the resulting cake contains 50 per cent of water, and, using the lime and alum precipitation process (probably the best), the pressed sludge will amount to eight tons per million gallons treated, equal to 40 tons as swept from the tanks. As one-half of the pressed cake consists of water, the dry solids are equal to 4 tons per million gallons of sewage. In the Lawrence experiments above quoted, the sludge was removed by burning at a cost of $5.43 for coke per million gallons treated, while, in any chemical process, 8 tons of semi-fluid, evil-smelling cake are produced at a heavy expense for filter presses, cloth and labor, and afterwards the problem of getting rid of this foul asset has to be faced, since it is utterly futile to think of selling this cake to farmers, and the further expense of carting it away must undoubtedly be taken into consideration. In England the cost of producing sludge cake may be taken, at the majority of works (according to Santo Crisp), at 2s. 6d. sterling per ton; and the same authority states that although it is sometimes sold for a trifle, or taken away by farmers, the latter are as often paid to remove it. In the vicinity of large cities it has been dug into the ground, or spread out to dry, but, however, handled or disposed of, it is an undoubted nuisance; hence any method of sewage disposal whereby the sludge difficulty can be eliminated entirely, must recommend itself to practical men. In estimating the cost of sludge removed (per million gallons of sewage treated), by coke strainers, as against sludge pressing into cake, we have roughly, taking the Lawrence prices of materials used:

BY COKE STRAINERS.

Say 4½ tons of coke at $1.25	$5.62

BY SLUDGE PRESSING.

Pressing 8 tons sludge cake at 60c	$4.80
Carting away 8 tons, ditto	....
1,000 lbs. crude alum at $25 per ton	12.50
1,000 lbs. slaked lime at $9 per ton	4.50
Required for precipitation of one million gallons of sewage	$21.80

Therefore, is there much to be said in favor of coke as a strainer, as compared with any precipitation process; while the cost of buildings, tanks, and the other accessories required in the last named process, will certainly counterbalance that of a furnace, drying ovens and chimney necessary for clogged coke combustion. The Pennsylvania Sanitation Company of Philadelphia have taken advantage of the foregoing facts as regards the valuable properties of coke breeze and aerated sand and gravel filters, in their sewage disposal plant erected at Reading, Penn., which has been in very successful operation for the last year and a half.

The population of Reading is about 80,000, as I am informed, but so far only about 25,000 people contribute to the sewerage system. The average daily flow of sewage treated by the Philadelphia Sanitation Co.'s works during August last was 1,586,463 gallons. These works comprise a very handsome pumping station situated at 6th and Canal streets. This station includes two large receiving reservoirs in which the coke strainers are placed, two large pumps of 5,000,000 gallons capacity each, three 65 h.p. boilers, drying ovens and tall chimney stack, which ventilates the receiving chambers. A force main 7,200 feet in length conducts the strained sewage along the banks of the Schuylkill River to the filter beds. These filter beds comprise an area of 25,000 square feet, or fifty-seven hundredths of an acre. One-half of this area is supported by an iron structure, and is at a level 8 feet 6 inches higher than the lower half. The upper beds are divided up into ten compartments, each 25 feet by 50 feet. Iron pipes resting upon beams and girders, supported by iron columns, carry the filtering materials which con-

sist of three different layers of broken stone and rather fine sand; the whole being two feet in depth. The surface of the filters is protected from wind and the erosive action of the falling sewage by a slatted floor removable for cleaning purposes.

There is usually one foot head of water on the upper filters while in operation. The open grid-iron like bottom affords access to the outside air, and is, in fact a modification of the forced aeration experiments of the Massachusetts State Board; further aeration is obtained by the 8 foot 6 inch rain-like drop of the effluent to the surface of the second filter, which is of coarser material, and about three feet in depth, and is aerated throughout by pipes and gutters. The effluent from the last filter emerges as a clean, bright fluid, quite sufficiently purified to enter any large stream or river, and certainly of a better quality than that of the Schuylkill into which it finally empties.* Bacterial and chemical analyses of the effluent from this plant have been made in Philadelphia, and these show high results, as the accompanying statement indicates. Usually about one-half only of the filtering area is in operation, the other half being rested, aerated and cleaned. The cleaning operation involves the daily removal of about two tons of the sand on the top of the filters which has become clogged by the organic matter still remaining in the coke strained effluent. This daily loss of sand costs about $2 for the material alone. Reverting to the preliminary operation undergone by the crude sewage in the receiving chambers at the terminus of the main sewer, there are two suspended layers of coke, 12 inches thick, through which the sewage must pass. The upper one holds back the coarse sludge, while the lower effects a partial filtration or straining of the sewage before it is taken hold of by the pumps. Every week the sewage is shunted from one receiving chamber to the other, and the clogged coke of the upper strainer is entirely removed, hoisted to the drying ovens, and finally consumed under the boilers as ordinary fuel. The weekly removal of clogged coke from the upper strainer is about 5 tons. In my opinion the clogged coke should be removed at more frequent intervals, and the coke should be, not commercial coke such as I saw, but breeze, or ordinary coke broken up into very small fragments. I believe the specifications of the Sanitation Company demanded "breeze," but, since the plant has been turned over to the corporation of Reading, several changes for the worse seem to have been made. During last August the cost for steam coal was $72 for 48 tons. In addition to this 16 tons of coke from the receiving chambers were burned. The total quantity of sewage pumped during that month was 49,180,368 gallons. The cost of this plant has been given to me as under:

Pumping station complete with 1 pump and 2 boilers	$59,000
The pipe line	31,000
Site for disposal works	7,000
Right of Way	1,700
Iron structure for filters complete, including viaduct over creek and all accessories	62,300
	$161,000

As one-half of the upper filtering area is said to be generally out of operation for cleaning purposes, it follows that the daily flow of sewage treated (1,586,463 gallons), passes through the upper filter at the rate of about 2,286 gallons per square yard, or 11 million gallons per acre. Although this seems an enormously rapid rate, it must be borne in mind that the second filter below will pass the effluent from the first filter at only half the above rate, and that, with the large amount of aeration obtained, not only by falling through the 8 foot 6 inch air space, but through the last filter, very good results can certainly be looked for. As a matter of fact a very fair sample of effluent was collected by me on the 4th instant. As regards cost of labor, it is safe to say that four men and a foreman could very well attend to the filters, although at present three foremen and eight men are employed by the corporation of Reading. Careful examination and enquiry as to the operation of the Reading sewage works have convinced me that this practical application of coke straining and aerated filtration is worthy of the very serious consideration of the London, Ontario, authorities, who still have the vexed (and to them doubtless most perplexing) question of their sewage disposal before them.

On account of several conditions essential to successful intermittent filtration through land, which are not always obtainable, this plan is certainly far in advance of land disposal pure and simple, over large areas, as it is generally understood in Ontario, and which I unequivocally recommended three years ago. But this is in reality a land disposal system in a much condensed form, with but a fractional portion of the duty imposed upon it as in ordinary cases, by reason of the prior removal of the bulk of the sludge by coke combustion as already described. Upon this account, and that of the reduced cost of construction and future maintenance, as compared with other proposed plans, I unhesitatingly recommend it now. The Pennsylvania Sanitation Co., of Philadelphia, have offered to construct a disposal plant at the outlet of the Cove Road Main Sewer, much upon the same lines as that of Reading (the London works of course to be a gravitation system), for the sum of $28,000. This is upon a basis of one million and a half gallons of sewage to be treated daily. I have carefully gone into the plan proposed by them for London, and feel confident that, with certain modifications, which include receiving chambers, coke ovens, furnace and chimney, besides provision for burning the rakings from the upper filter, an excellent system can be constructed for the sum of say $33,000. The company would, I have no doubt, be glad to operate the works for one year, and guarantee a given, satisfactory standard of purity in the effluent.

The whole work necessary in caring for the filter beds, handling, and finally burning the clogged coke, could be performed by four men and a foreman. The weekly cost for coke (the only material requiring renewal, besides less than a couple of tons of sand daily), would be about 5 or 8 tons, the total weekly expenditure for materials for one week being, 8 tons of coke, and say 12 tons of sand. The cost of chemicals alone, per week of 7 days, would be for the International System, using 7 grains of ferozone per gallon of sewage (7 grains ferozone per gallon of sewage are not sufficient, as I have found by actual experience, 10 grains are necessary), and estimating the cost of ferozone at ½ cent per pound (which is 50 per cent. less than I ever obtained it for): 10,500 lbs. at ½ cent=$52.50 per week, or $2,730 per annum. So much for maintenance; now for the cost of construction by either of the three plans proposed for the City of London:

LAND DISPOSAL.

40 acres of land at $175	$7,000
Preparing ditto	24,000
Syphon and other items	10,000
	$41,000

INTERNATIONAL PROCESS.

Cost of construction as given	$41,300
Plan now proposed	$33,000

The latter, besides being less costly, possesses the inestimable advantage of being entirely freed from the sludge nuisance. The interests of the city of London can be protected by the company's guarantee to keep up a certain standard of purity in the effluent during the period the works are operated by them. The location of these works at the end of the Cove street sewer would of course obviate the necessity for a syphon as now proposed.

The city of Worcester, Mass., may safely be taken as a typical illustration of chemical precipitation for large cities, and the report for 1896 may be referred to, in which it is shown that, for maintenance, and purification of one million gallons of sewage, the cost has been $10.52, 53.9 per cent. of the organic matter having been removed; and yet Worcester is now engaged upon the construction, at great expense, of a filtration plant as an auxiliary to their present method. The sludge from the Worcester works has always been found very difficult to get rid of, and when there in 1895 I saw very large areas covered with it to a depth of 12 or 18 inches, small quantities of which the neighboring farmers could scarcely be prevailed upon to take away as a gift. Enough has now been said on this head, and the method of precipitation as applied to large towns with

*These works have been extremely well designed, and appear to me to be an excellent practical illustration of the Massachusetts experiments with coke and "forced aeration." The filtration area is rather circumscribed—a defect easily remedied. Too much credit cannot be accorded the designer and engineer—John Jerome Dercy, of Philadelphia.

its sludge concomitant, may be dismissed with a quotation from Col Waring: "The precipitation treatment buys and manipulates chemicals, coagulates the sludge, drains it, pumps it, handles it, and still has it."

It must not, however, be gathered from the foregoing remarks, that the writer has receded from his many previously stated convictions regarding precipitation methods. There are and always will be cases arising, where, in the absence of coke or suitable land, chemical precipitation will be found a powerful aid to the final filtration of sewage, either through natural or artificial media; and this applies particularly to the sewage disposal of small communities, e.g., as in some of our provincial institutions, or other small centres of population.

Since reading the above paper in Ottawa I have suggested a still further modification in the method proposed for London, which is to use 20 acres of land for the final filtration of the sewage, after straining through, and retention of the sludge by coke. This is a combination of the Reading plan with simple land filtration, and would effect a saving to London in cost of construction of nearly $20,000, as compared with the original "all land disposal" plan and the chemical "International system."

DR. KINGSFORD.

Dr. William Kingsford, C. E., the Canadian historian, died at Ottawa, Sept. 29th, in his 79th year.

He was born in the parish of St. Lawrence, London, England, in December, 1819, was educated there and spent some years in the army, coming to Canada with the 1st Dragoon Guards. On leaving that regiment, in 1841, he obtained professional employment in the city surveyor's office, Montreal, and was subsequently for three years deputy city surveyor. He resigned his position to join the late Murdo McIver, on the Montreal Times, being with that gentleman part proprietor and joint editor of the paper. After two years the paper was discontinued and Mr. Kingsford returned to his profession. He was appointed to the engineering staff of the Public Works Department, remaining there for two years, during which time he completed an important survey in connection with the Lachine canal, determining the boundaries of the Crown property. Proceeding to the United States, in 1849, he was engaged there on the construction of the Hudson River Railway. Later he went to Panama, where he became assistant to John C. Campbell in laying down the line of the Panama Railway from San Pablo, on the Chagres, to within a mile of Panama.

On his return to Canada he was appointed by the Commissioner of Public Works on the location surveys of the Grand Trunk Railway. He surveyed the line from Montreal to Cornwall, and also examined a back line from Brockville to Rideau. Subsequently, he surveyed and located for construction a line on the south shore of the Ottawa from Vaudreuil to Montreal, now the C. P. R. short line. Resigning his position on the Grand Trunk, he accepted the city engineership of Toronto, which, however, he held only for a few months, going back to serve under the late A. M. Ross, engineer-in-chief of the Grand Trunk Railway. In 1860 he returned to England. Subsequently he was employed in Italy in the examination of several works. He also reported to Mr. Brassey, on the condition of the Sardinian railways. Six years later he returned to Canada and again entered the public service. For several years he was engineer in charge of harbors in the provinces of Ontario and Quebec. Afterwards he was employed on the Canadian Pacific Railway. When his engagement on this road terminated, Mr. Kingsford, whose tastes had always been literary, and who had contributed much to periodical literature, resolved to undertake the preparation of a history of Canada from its settlement to the union of Upper and Lower Canada. The first volume of this work appeared in 1887, since when a new volume has appeared every year. His other contributions to literature in book form include: "History, structure and statistics of plank roads in the United States and Canada." 1852; "Impressions of the West and South." 1858; "The Canadian canals, their history and cost, etc.," 1865; "A Canadian political coin: a monograph." 1874; "Canadian Archaeology: an essay," 1886; "The early biography of Ontario." 1892; "Some considerations on the advantages we may hope to derive from education." 1898. The degree of LL.D., was conferred upon him by Queen's and Dalhousie Universities in honor of his history of Canada. He was a Fellow of the Royal Society of Canada.

PURIFICATION OF SEWAGE BY MIXING WITH PURE WATER.

BY W. M. WATSON.

I have been asked the question, "Is it injurious to discharge sewage into large sheets of fresh water similar to the Georgian Bay, or rivers similar to the St. Lawrence at Montreal?" My answer is, "Yes." And those like myself who have seen the effects of discharging raw sewage into the rivers and lakes, and even into tidal waters of the ocean, surrounding Great Britain, will have no difficulty in bearing similar testimony. It is possible to purify sewage through the agency of pure water, but to do this the sewage must be mixed with at least three times its own volume of fresh water, and both be well shaken together so that every molecule of the sewage liquid comes into close contact with at least three of the pure water. When this is done the cleansing microbes contained in the pure water are able to destroy the dangerous microbes that the foul sewage contains, and herein lies the difficulty, because the mechanical appliances needed to supply the quantity of pure water, and properly mix it with the sewage, will usually cost more than cleaning the sewage by artificial filtration. When sewage is discharged in bulk into rivers and sheets of clean water it moves through and passes along with the currents in a compact body, and being slightly heavier, on account of the solids it contains, it settles to the bottom as soon as the temperature has been reduced to the temperature of the water surrounding it. It then sets up a rapid putrefaction, breeding and multiplying dangerous germs, which in course of time become so numerous that however large the sheet of water may be, they become masters of the situation, and either foul the whole body of water and cause it to discharge a foul odor as do Toronto and Hamilton bays, or the poisonous gases generated belche up in volumes through the clear water, and cause a nuisance similar to the gases discharged from the sawmill refuses lying at the bottom of the river at Ottawa. In many cases large patches of the microbe-bearing filth will float to the surface, and be cast on to the banks, jeopardizing the health of the inhabitants. This can be seen in many places where raw sewage is discharged into tidal rivers, bays and large lakes of fresh water.

It may be possible that a rapid running river will purify its contents, but it is very improbable that it will purify raw sewage. I have often read of attempts to prove that the sewage of a town got purified after running for about six or seven miles down stream, and the analysis of water taken from the surface has appeared to prove this to be the case. But experience, and the hundreds of fouled rivers in Europe prove decidedly that the scientists are wrong. As I have stated, the sewage falls to the bottom and so leaves the surface of the river clean and pure, and it is on this account that taking samples of water and analysing them is misleading, for the evil is still in the river, but resting on the bed at the bottom. It is from the sludge at the bottom, in quiet places, and under rocks where the currents are not felt that the sample for analysis should be taken.

The argument that a town or private residence can run its sewage into clean water without injuring their neighbors and future generations is stale and untrue, and it should not be entertained for one moment, for there are thousands of examples in the older countries that will refute it. Only this morning I read a letter published in The London Times, written by the Archdeacon of Gloucester, England, complaining bitterly of the fouling of the fresh water streams of England, and killing the fish they formerly contained. He showed the folly of pretending to purify sewage by irrigative land. Here is an extract from the reverend Archdeacon's letter; let him speak himself:

* * * * * *

"Let me ask your help in promoting such welfare in one momentous direction—the disposal of sewage. There are few evils, in my opinion, more pressing or even scandalous than the pollution of rivers. Water is one of God's most precious gifts (poor East London will testify to this). To turn a fair river into a foul drain, seems to me, not only a hideous blunder, but a hideous crime. Will you let me open a correspondence on the cremation of sewage, for our pest may thus be turned even to our advantage? I plead for the erection of huge furnaces at the outfalls of our drains. No doubt they would require loity chimneys, and chemical ingredients to neutralize the noisome gases; but this, surely, cannot be beyond the reach of

science. In these furnaces the solid matter would be burnt, and form artificial manure; the liquids, being properly filtered and deodorized, might then be allowed to flow away. Let us sum up our present position. Our beautiful West Riding rivers are only awaiting their time for being turned into foul channels of manufacturing centres. 'Sabrina fair,' is rapidly becoming 'Sabrina foul' to the great discomfiture of the salmon. Limpid Thames is condemned to bear the ignoble burden of London sewage. Have we not heard of a huge sewage island being piled up on the borders of Essex? Have not the oyster sellers been half ruined by sewers disgorging themselves near the oyster-beds of Kent? Have we not heard of the 'Ealing Styx'—the Brent? Fifty-seven years ago my father had his kitchen garden surrounded by that pretty river at Hanwell. I am now staying on the coast of South Hampshire. A nice little trout stream empties itself past the village into the sea. Up the stream trout are caught abundantly, below the houses large fish are caught, but ought not to be eaten, for a disgusting freight of sewage is carried to the sea, and Oceanus has to dispose of the accumulated poisons as best he may. Shame to say, it is the same story for all our watering-places.

"Now, what are the palliations on which we place our reliance? Miserable subterfuges indeed—sewage farms. At first we heard much of the enrichment, now we hear of the poisoning, of the soil. At best it is the spread of noisome exhalations over fair fields instead of fair rivers. I do not envy the olfactory senses of the man who walks anywhere near the sewage farm. The huge sewage marsh at Saltley, near Birmingham, had to be thickly covered by masses of sand and gravel, I suppose to be in their turn as much poisoned as the stratum which lies below them. No doubt we must come to cremation sooner or later; but why not sooner than later? I throw out this suggestion, to be taken up, I trust, by practical and scientific men. I am sure he will be a public benefactor who can turn a curse into a blessing."

This is the view of a gentleman ripe in years, who has watched the irrigation of land, and the mixing of sewage with large quantities of clear water for half a century, and he tells us that they are useless and a mistake, and breeders of filth and foul odors. The slow going government of Great Britain has at last come to see that the two systems are of no value, and have lately begun an exhaustive enquiry into every known system of sewage disposal, and intend examining all expert engineers and managers of sewage purification works on oath, and if possible find out the proper system of cleaning and extracting all poisons from sewage fluids. They commenced in August, but adjourned to October, when the holiday season would have expired. They will then continue with closed doors, as the commission is determined not to allow the papers to report the proceedings until it publishes its own report and opinions, which cannot be until probably next spring, as the enquiry will be lengthy. It is hoped that the enquiry will bring to light a system that will be both efficient and permanent, at a reasonable cost, and so supersede the many worthless processes now in use.

ROPES AND ROPE DRIVING.*

BY L. H. KENYON, DUKINFIELD.

To trace the history of rope driving, we should have to go far back beyond the days when Hero of Alexandria applied his discovery of steam power to rotary motion, which but for fanaticism, that great impeder of all progress, would centuries ago have deprived Watts of the glory of first invention. We must search amongst the mounds of Nipur (which have recently proved that civilization is older by 7,000 years than the world was supposed to be), and among the ruins of ancient Egypt to find the clumsy first forms of the potters' art. Comparing these with later but still early productions, when grace, beauty and utility first joined hands, we come to the time of the potters' wheel. Still later the Hindoo wood turner begins to ply his trade, and may even to-day be seen sitting, as his ancestors have done for unknown ages, with tool in hand ready to catch the backward turn of his lathe, as his half naked attendant "see saws" at the ends of a rope whipped several times round the hub. Or again come down to still later times in our own country, when we have the spinning wheels. Arkwright after repeated experiment found it advisable to still adhere to this principle for driving the spindles of his spinning machine, a method which modern development has only sought to improve. Strange to say, some thirty years ago when the machinery of the mill occupied by this genius was undergoing re construction, a system of rope transmission was found to be in full operation. How long this had existed we can only conjecture, but doubtless some obscure mechanic had conceived the idea of applying band driving to higher powers from the models around him, or it might have been the offspring of the master mind. At any rate the fact remains, notwithstanding the many who claim to be the foster parents of the system.

For all practical purposes rope transmission may be regarded as positive, all things being equal, and in making calculations for speeds the supposition that slipping and consequent diminution of speed must of necessity enter into the equation, may be dismissed as scarcely worth consideration. Cases have come under the writer's observation where ropes have supplanted spur gearing, and the machinery indicated loss of speed, but after the most careful investigation the main driving proved dead true to the decimal, and, in one instance, the pulleys were altered throughout the room affected, to meet the difficulty arising out of a misunderstanding of the initial speed. Beyond this, and of supreme importance to power transmission, is the elasticity of rope driving, for the ropes themselves are very sensitive to any irregularity and act as a buffer between the initial and ultimate power, making back-lashing, the bane of gear driving, an unknown quantity. This quality is displayed to a remarkable extent in driving from gas engines, where the ropes may be seen readily yielding to every impulse, and just as readily recovering their normal tension without transmitting the shock to the machinery. If even a slight loss of power be admitted, the general effectiveness of ropes more than compensates for this, which is too often magnified beyond its merits, and can be reduced to such dimensions as will enable the engineer to ignore it entirely in actual practice. It often happens that reports are received of ropes slipping, which on investigation prove to be quite groundless. Should there be any slip it can easily be detected by the heating of the pulley. Unless, then, pulley rims are unbearable to the touch from frictional heat, it may be taken for granted that there is no perceptible slipping. Stress should be laid upon this, because frictional heat appears to be rarely associated with slipping, and the evil is often declared to exist without its natural result.

In our works we have tried a ⅝-in. diameter rope running over a loose pulley 18-in. diameter, with grooves of an angle of 90 degrees, making 160 revolutions per minute, or a rope speed of about 720 feet per minute. This 18-in. pulley was brought to a dead stand, and as the driver was only 12-in. diameter, caused the rope to run only about one-fourth its proper speed (say 180 feet), and in rather less than two minutes the paint on the inside of the rim blistered and smoked with the heat. In the above-mentioned experiment, the heat was generated upon a portion only of the surface on account of the pulley being stationary, but when in motion the heat is more evenly distributed, so that it would not require a great amount of slip on a large driving pulley to set up heat sufficient to scorch the ropes. What would be the result with a pulley 3 feet diameter, an acute groove, and a number of ropes of larger size, side by side, slipping at the rate of 60 feet per minute? And yet we have a case in hand at the present time, where an engineer has proved over and over again to his own satisfaction, that of four engines running side by side, the ropes are slipping on two of them at the rate of 60 feet per minute. This was said to be going on continuously, without producing the slightest heating of the pulleys or injuring the rope in the least degree. If then, there is loss of speed on the machinery and no heat on the rim, the cause must be looked for elsewhere than in the rope chamber.

To those who lay so much stress on wedging action, back tension, etc., the following problems might prove interesting:

Say, the wedging of a rope into its groove is stated as 50 lbs. (an excessive estimate) and the centrifugal force for 1¼-in. diameter travelling 4,700 feet, is 192 lbs. What amount of power can be absorbed on extracting the rope after accomplishing its purpose? Or how can these opposing forces co-exist?

The resilience of a well made cotton rope is such that perfect impact into the groove is impossible, even when the rope is forced into it under far greater pressure than is ever exerted

*A paper read before the Manchester Association of Engineers.

in actual practice. This causes it to spring away immediately the tension is withdrawn, even from a groove with sides at an angle of 25 degrees, and with the pulley stationary. How much less then would this presumed wedging action apply to grooves of 40 degrees with the pulleys running at a high rate of speed?

As in every other method, there are many points to be observed and enforced before the high tide mark of efficiency may be reached. First and foremost, the construction of the groove; and let it be said that simple as it may appear, the contest between one style and another has been keen in the extreme. The most effective style of groove is that with straight sides resting at an angle of about 40° and of sufficient depth to prevent the rope reaching the bottom, or the curve with which the groove terminates. On no account should grooves with curved sides be used, as it is impossible for ropes to bed themselves, and they roll round, do not last near as long, and are not as effective. It need scarcely be said that the grooves of both driver and driven pulleys should be turned to the same template. Although there are numerous instances where ropes have been expected to do well when they were running in grooves of totally different make and size.

It is generally acknowledged that ropes should not be run upon pulleys of less than 30 times their own diameter. Although good cotton ropes will coil in considerably less compass, yet it is always wise not to go below this limit, and err, if at all, in the direction of large size pulleys, as the repeated effort of compression and extension produces what is well expressed as "fatigue of material," when the elasticity is worked out. Ropes suffer more from this cause than any other. The writer has come across numbers of cases where the relative diameters have not been more than half this, and ropes have been expected to do just as well as under more favorable circumstances.

The best results may be anticipated when the smallest pulley is 50 times the diameter of the rope.

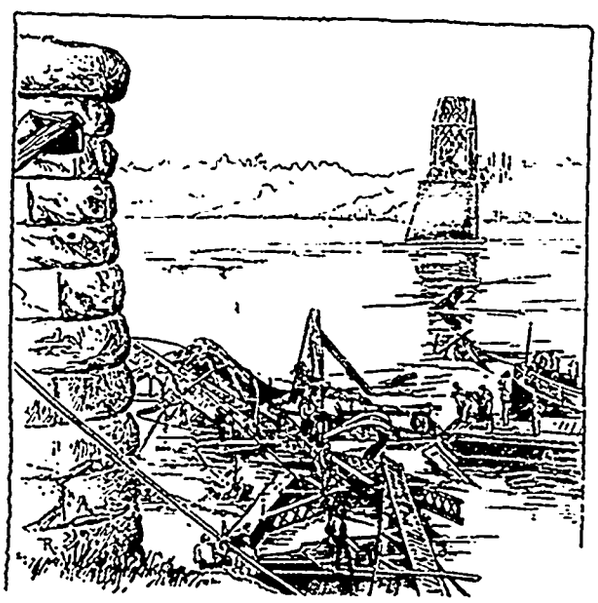
Whilst it may be safe to advocate forward driving generally, i. e. with slack over the pulleys, the writer fears he will be compelled to renounce his faith in its supremacy for all conditions, and advocate another method for horizontal and down driving particularly, since recently comparing notes upon the many methods under consideration. He can bring to mind quite a number of cases where back driving has been adopted perforce with the best results. So smoothly do these ropes run that the idle side maintains the same equal curve without any perceptible deviation, whilst under similar conditions forward down driving has been anything but steady, and there has even been a difficulty in keeping the ropes in the grooves. Therefore, to secure effective down driving, back motion becomes almost a necessity. The great reason for this is that the centrifugal impetus given off by the driving pulley would, but for the check from its own endlessness, throw the rope far above the horizontal plane. These two opposing forces combine to create a wave-like motion which is intensified in proportion to its slackness or the erratic power applied, until, as before mentioned, there is danger of the ropes leaping the grooves and so threatening the safety of both machinery and attendant. In forward driving, a rope curves in two opposite directions in descending from and ascending to the pulleys, whereas, in back driven ropes, the curve is in the same direction, and therefore renders no assistance whatever to undulatory motion. It is of course necessary to make the usual allowance for loss of frictional power upon the pulley between over and under driven ropes. In upward driving, such as largely prevails in our cotton mills, this tendency is effectually bridled by forcing the rope to run against, instead of over the pulley.

(To be continued).

THE CORNWALL BRIDGE DISASTER.

The fall of two spans of the New York & Ottawa Railway bridge over the United States channel of the St. Lawrence river, near Cornwall, Ont., has roused a great deal of interest both from the magnitude of the disaster and its unusual nature. The number of men killed in the accident is 15, while 16 were seriously injured. At the time of the accident the erection of both the fallen spans had been practically completed, and under one the falsework had been removed. On the other span the workmen had begun to take down the traveler, but most of them were working on the floor of the bridge when the accident occurred.

Principal interest, of course, centres in the construction of the pier which went down with the two spans. As the accident occurred on the United States side of the river, the Engineering News, New York, has made a thorough investigation of the subject, and we reproduce the data it gives: The river at the site of the pier is about 35 feet deep, and has a swift current, said to be about 5 to 8 miles per hour. The river bottom is a clay hard-pan in which are imbedded boulders, many of them of large size. The pier was founded by sinking a timber crib 18 feet wide, 62 feet long and 38 feet in height, and filling it with concrete deposited under water by buckets arranged to empty automatically on striking the bottom. The anchoring and sinking of this large crib in the deep water and swift current was a task of great difficulty. To accomplish it a small crib filled with stone was sunk up-stream to serve as an anchorage and a 3-inch steel cable was led from this to the pier crib, which was also supported by a barge on each side. Cables led to the river bank were used to swing the crib in the stream till it was in the correct position.



The swift current made it impossible to examine the bottom by divers before sinking the crib. Soundings were taken over the site of the crib, however, and the crib bottom was scored to correspond to the depth thus obtained. After the crib was down divers went down inside and obtained samples of the bottom, which was deemed satisfactory by the engineer, and the work of concreting began. The first concrete laid, to the amount of about 50 cubic yards, was deposited in bags, all of which were placed by divers around the sides of the crib. The remainder of the concrete was then deposited from a bucket holding about 1 cubic yard, arranged to dump automatically on contact with the bottom. The concrete was deposited in successive layers of about 18 inches over the whole area of the crib, and divers reported it as setting satisfactorily. The concrete was mixed by hand in the proportions of 1, 2 and 5, using Glen's Falls Portland cement. It may be said here that the crib itself was built of 12-inch timbers, drift-bolted together, crossties of the same size were inserted at 10 feet intervals, the vertical spacing being about 4 feet.

The concrete was carried up to a point 4 feet below water level, and was then pumped dry, the top of the crib projecting above the water forming a coffer-dam. The top of the concrete appeared in good condition, and upon it the masonry was started. Two courses were laid and then work was shut down for the winter, all the above-described work having been carried out last fall. During the winter the pier was subjected to heavy ice pressure, which, as most engineers know, is a severe test of any pier built in the swift current of the St. Lawrence; but it was not moved. Early in the spring, we are informed, it was struck by a heavy timber raft, which was broken up by the collision, and the pier showed no injury.

Work on the piers was resumed in the spring and they were built up to their full height of about 35 feet above the water, making the total height about 70 feet from the river bed to the

pier coping. The masonry of the piers was rock-faced ashlar, with a backing of Portland cement concrete.

The specifications and working drawings for the bridge were made under direction of F. D. Anthony, chief engineer of the New York & Ottawa Railway Co., and were approved by A. A. Stuart, M. Am. Soc. C. E., now engineer of the Degnon-McLean Construction Co., of New York, who was consulting engineer to the railway company. They were also approved by the Canadian Government engineers.

The accompanying illustration reproduced from The Engineering News will be examined with interest. The north end of each span is in each case the fixed end. Thus on Pier 2, which fell, the channel span rested on expansion rollers, while the shore span, which still had the falsework under it, was anchored to the coping. The channel span turned partly on its side in falling, and its end-shoe is now about 25 feet south of Pier 3, on which it formerly rested. The shore span carried the falsework down with it, and, falling into shallow water, made a tangled mass of wreckage, as shown in the illustration.

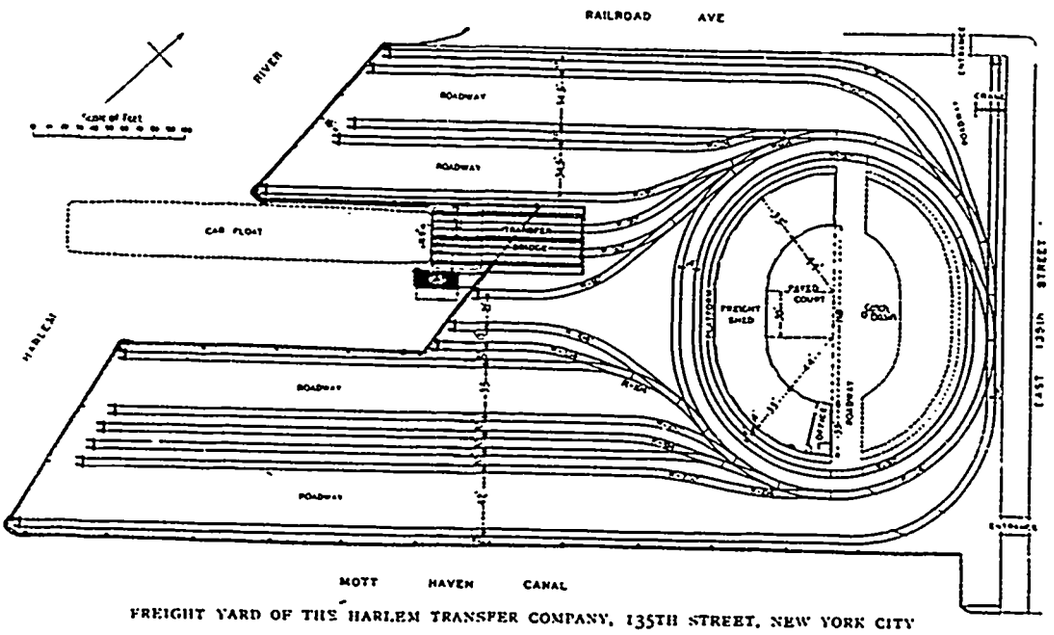
A NOVEL CITY FREIGHT YARD.*

The illustration of the terminal freight yard of the Harlem Transfer Co., at Harlem River, New York City, shows a novel and efficient solution of the difficult problem of developing a railroad freight yard with suitable switching facilities within the narrow confines and comparatively small space of a city block. This unique and original plan was designed by Walter G Berg, M. Am. Soc. C. E. Construction began last April, and the terminal was formally opened July 5, and is in successful operation.

The problem offered was to develop the property for receiving and delivering carload or package freight, the cars to be transferred on the usual railroad car transfer boat, operating in connection with transfer bridges, to or from any of the railroad trunk line terminals on New York harbor. The standard three-track transfer car float, built for the Harlem Transfer Co., is 35 feet 6 inches by 240 feet in size, and has a track standing capacity for seventeen cars. In order to keep the outer end of the boat, when tied up to the bridge, within the proper limits beyond the bulkhead line, the shore end of the bridge had to be placed within 280 feet of the line of 135th street. Thus the development of the track system was confined to a space 280 feet ahead of the bridge and about 330 feet in width.

The leading feature of the design is the loop track, or full-circle switching track, from which all side tracks and connections start. All switching operations are absolutely positive, as there is no possibility of the engine getting pocketed. In some operations the engine takes hold of the cars only once; in other cases the engine cuts loose from the head of the string of cars and runs around and takes hold of the tail of the train.

A short tangent inserted in the loop track allows a switch to be taken out on the inside of the curve leading to an interior circular track as a standing track for a circular or annular freight house with an interior courtyard for teams. By this method the space inside of the circle is not only fully utilized, but ground space is actually saved. In the usual freight house layout there is considerable lost space between the wagon doors on the wagon delivery side of the house, as the spacing is generally made to correspond to the spacing of the car delivery doors on the opposite side of the house. In the plan presented,



FREIGHT YARD OF THE HARLEM TRANSFER COMPANY, 135TH STREET, NEW YORK CITY

The Harlem Transfer Co. is a corporation formed by several New York capitalists to establish a railroad freight receiving and delivery station for the Harlem River district of the city, following the general tendency to bring the cars nearer to the shipper and receiver of freight. While the company has made close traffic arrangements with the Erie Railroad, it is a strictly independent company and freight is to be handled from and to other railroads. Lighterage and wharfage business will also be handled to a limited extent. The scheme for the establishment of this yard was originated by and the work carried out under the supervision of J. C. Watson, the present general manager of the company. The yard is situated on the northeast side of the Harlem River, about half way between the Third Avenue and the Madison Avenue bridges, and covers the block bounded by East 135th street, the Mott Haven Canal, the Harlem River, and Railroad Avenue east of the New York Central. The block has a general width of about 330 feet and an average depth of 540 feet from 135th street to the river. The property was bulkheaded and filled in at different times in the past prior to its purchase and had a slip 100 feet wide and 200 feet long, as shown on the plan.

the car delivery doors correspond to a spacing of 40 feet between car doors, whereas the corresponding spacing of the wagon delivery doors is only about 20 feet. There is also an increase in track frontage of the building for a given floor surface. Thus, the half-circle freight house in the plan, as now built, has a car frontage of eight cars, whereas the actual average length of the house is only 240 feet, corresponding to only six cars.

The circular switching track and the interior radial freight house, with the inside courtyard for teams, in connection with the apparent simplicity of the track system, are the prominent features of the design. Otherwise the details are the usual ones for similar first-class work. The freight shed is an iron frame single story building, 35 feet wide, on brick piers, sheathed with corrugated iron and roofed with tar felt and gravel. The transfer bridge is a regular three-truss wooden railroad transfer bridge, 100 feet long, the shore seat resting on a pile foundation and the sea end on a wooden pontoon, 40 feet by 32 feet by 8 feet. All the wagon roads are paved with block pavements and the trackwork is of the usual grade. The rails are 70 lbs., switches of the Wharton split spring pattern, 10 feet long, ground-throw switchstands, frogs of the bolted and filled pattern, oak ties at switches and on curves, yellow pine ties on

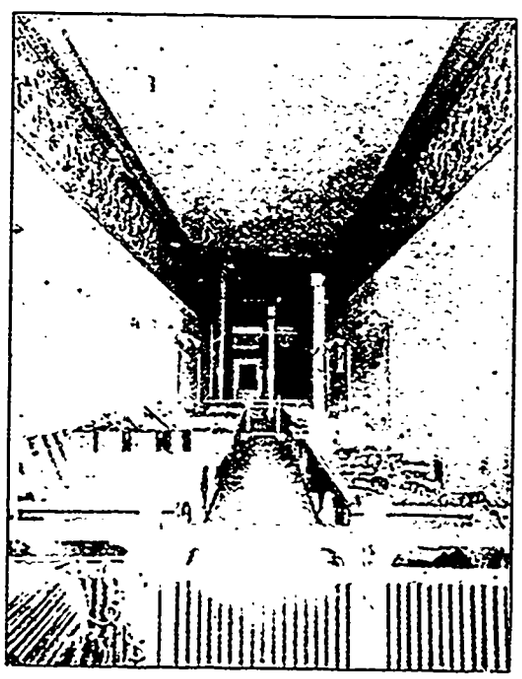
*Printed from Railroad Gazette, New York, July 29, 1898.

tangents. The ballast for the track and the bed under the paving is hard coal cinder. Finally, attention should be called to the important feature of the sharp curves utilized. The sharpest curves have a radius of 90 feet, while the "light" curves have 101 feet radius. These radii correspond, approximately, to No. 3 and No. 3 1-3 frogs The gauge of track on curves is spread to 4 feet 9 inches, and the outside rail elevated 2 inches. The switching engine is a Baldwin 4-wheel enclosed tank dummy locomotive, 6 feet 6 inches wheel base, 44 inch wheels, 17 inch by 24 inch cylinders, and weighing, fully loaded, about 90,000 lbs. It is 27 feet long over all.

The use of these heavy curves at this terminal and the fact that heavier curves (even as small as 76 feet radius) are in use at the Brooklyn terminals of the Brooklyn Wharf & Warehouse Co. and at the Greenpoint terminal of L. M. Palmer, may perhaps serve as an object lesson to railroad companies, as to what can be done, if necessary, when confronted by confined and cramped conditions. Cars, especially with different kinds of couplers, will not couple readily on the heaviest curves mentioned, but special long links are provided for this purpose. As far as cars are concerned, however, there is no difficulty in passing them around these curves, naturally at slow speed, the elevating of the outside rail being an important track detail. Of course, a special switching engine with short wheel-base is necessary. The contractors for the work at the Harlem yard were George W. Rogers & Co., of New York City, for the transfer bridge and dock work; and Sandford & Stillman Co., of Jersey City, for the freight house, grading, paving and track work. Mr. George F. Morse prepared the detailed plans under Mr. Berg's supervision.

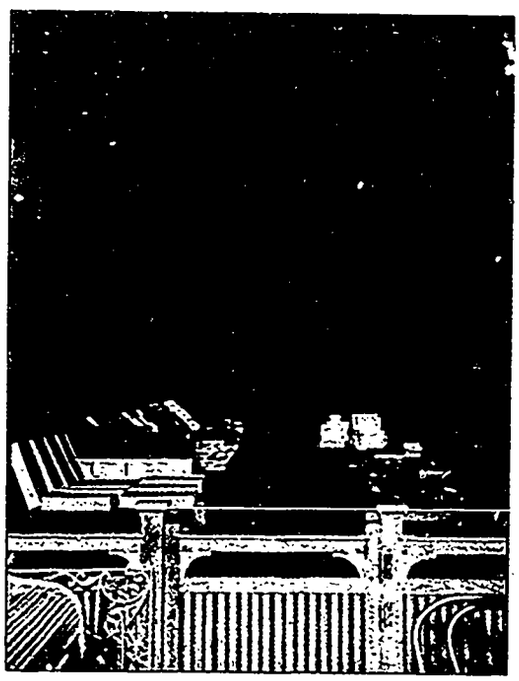
FIRE-PROOF CONSTRUCTION WITH LUXFER PRISMS.

One of the most valuable features developed in the manufacture and use of Luxfer Prisms is the discovery, which the owners have just announced, that a window of Luxfer Prisms glazed in copper by the electrolytic process, is absolutely fire-proof. By an experiment carried on in the presence of a number of Fire Underwriters and city officials in Chicago recently, panels of Luxfer Prisms were heated in an open fire until they were red hot throughout, then the hose was turned on, and the fire extinguished, and the red-hot prisms drenched with water, the result was that the glass prisms were crackled into millions of pieces, but were securely held in place by the copper ribbons throughout the panels. It might be



explained that the Luxfer Prisms are made of sections of glass, 4x4 inches, glazed together with copper ribbons between the sections, and the whole panel cemented together and strengthened by an electro-deposition of copper. In this way it was shown that a panel of Luxfer Prisms may be exposed to intense heat; in that condition further exposed to drenching with water, and still retain their strength and operate as a complete barrier to flames passing through a window.

Another feature of the use of Luxfer Prisms is the fact that light can be carried into large interiors from windows, instead of through skylights and light wells. Light wells are a great hazard in any building, and any device that will enable a builder to do away with them is of immense value. As a practical exemplification of this, we can instance the case of the building occupied by Michie & Co., grocers, Toronto. In their store—the central portion was lighted by a large light well and skylight—a fire broke out on an upper flat and the flames were carried downwards, strange to say, through the light well, and destroyed valuable goods on the lower floors. Naturally they were anxious to remedy such a hazard, and on looking into the merits of Luxfer Prisms decided to have them placed in the front and rear windows, and see if they could get enough light without the light well. The installation was made and the



light well closed up completely by a steel clad ceiling. The store is better lighted in every respect, and the risk of the light well is entirely removed. A feature of this character is of great practical value and well worth consideration on the part of engineers and architects in designing buildings, to have a minimum of risk from fire. Apart from their value as above described Luxfer Prisms are stated to be very useful in carrying light into dark places—as may be seen in the accompanying cuts. These are made from two photographs of the interior of a large sample room, 100 feet long, lighted only by a large plate glass window at the front. The dark cut shows the appearance of the room without the prisms, and the light cut shows the effect of the prisms in lighting the back part of the room. A demonstration like this tells its own story.

TARRED MACADAM FOR ROADS.

A. H. Campbell, city engineer of Canterbury, England, is an advocate of tarred macadam roads, and has recently been giving his experiences to the British Association of Municipal and County Engineers. Broken lime-stone is warmed either by building it up in alternate layers with coke or by building it in a cone closed at the top and fired in the middle. About 54 bushels of coke are consumed in a stack of 60 cubic yards. Both these methods cause loss as some stone is too violently heated and so disintegrates. An oven or kiln is to be preferred as the heating is more equable.

The temperature of the stone when the tar is applied should be such that the palm of the hand can bear it with comfort. If it is too hot the tar will be destroyed as a binder, and if too cold it will be used so thick as to soften in very warm weather. The hot stone, when ready for mixing, is screened into material of three sizes, 1 to 2 inches for the body, ½ to 1 inch for the intermediate coat, and ¼ to ½ inch for the top dressing. The coarsest material is used in a layer 3 to 4 inches thick, the in-

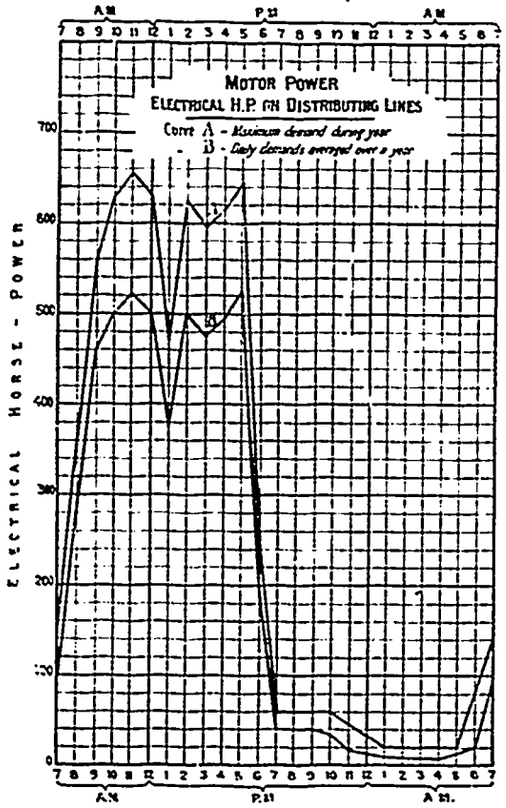
termediate size forms a coat of about three-fourths of an inch, and the top dressing is used in the thinnest layer possible, with a view to filling all interstices. Afterward a dressing of ¼-inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a 10-ton roller. It should not be laid in cold weather. The tar used should be of good quality, and heat should be applied long enough to secure great tenacity, but ought not to be carried so far as to make the pitch brittle. Mr. Campbell's practice is to boil the tar in kettles holding 50 imperial gallons for three or four hours, and then add half a bucketful of pitch and boil a short time longer. The cost of such a roadway varies with the price of material and the cost of labor. Mr. Campbell says his experience has been that a four to four and a half inch layer costs, for material alone, 36 cents per square yard, to which he adds 18 cents for excavating for the pavement, 20 cents for broken brick ballast, 18 cents for labor, 6 cents for rolling and 10 cents for contingencies, making the total cost $1.08 per square yard. This road is capable of bearing the heaviest country traffic, with an outlay of probably 4 cents a square yard for repairs, and is regarded as good for seven years.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A ROSS, E.E., M. CAN. SOC. C.E.

(Concluded from June Issue).

The load for all classes of demands is given to the last curve, which is formed from the others, and shows the period of the greatest station activity to be about six p. m. It is evident that apparatus must be installed to meet this maximum



demand, while the average output could be met by a much smaller plant. The interest and depreciation charges on plant, which forms such a considerable percentage of the cost of the output, is a constant, no matter what that output may be, so that, when it is possible to fill up the hollows in the curve by the sale of additional power during periods of light load, which shall not be operative during the period of heavy demand, the cost of this addition is only that of additional coal in steam stations, and in water powers is nothing, and for this reason may be disposed of at low rates. The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between them.

*From a paper read before the Canadian Society of Civil Engineers.

	Incandescent	Arc.	Motor Power.	Street Ry.	Total.
Average E. H. P., per hour	604	650	218	2,430	3,902
Max. E. H. P. required . .	2,925	1,300	656	6,450	11,331
Ratio output to capacity. .	20.6%	50%	33.3%	37.7%	34.4%

It will be seen that the output is only about one-third of that possible with the plant that must be installed. To dispose of the remaining two-thirds is the ambition of every station manager. It is just here that the storage battery finds its best field in steam station, but in waterpower plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of. As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants. Having determined the amount required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes it fails owing to the fact chiefly that single phase motors while practicable are not found suitable in operation as they are not readily started from rest. The question therefore hinges upon the point of relative superiority of the two and three phase systems. So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25%. This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase. For this reason the three phase will be adopted in the case under consideration as being probably the cheaper in first cost and equal in efficiency.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance, the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage. On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used. The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers. The highest generated directly on the machine without the aid of transformers is 12,000 at the Chambly plant. There are several now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve. It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load, to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard. The lowest possible, where incandescent lighting is to be done, is 25, for at this alternation the fluctuations are just visible in the light. The effects of lowering the periodicity are to decrease induction effects, which are always objectionable, simplify and cheapen the motor equipment and to increase somewhat the

cost of transformers. It would appear that for general transmission work, which involves the use of much power for motors, that a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent it will probably be maintained for some time.

(To be continued.)

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Continued from last issue).

All ironwork, columns and pillars, beams and girders, should be "fire proofed," i.e., covered with at least 4 inches of incombustible material, terra cotta or brick. At the floor, and for a height of 4 feet in mercantile buildings, a metal guard should be employed to prevent the column from being stripped by collisions with rolling trucks for moving merchandise. It ought to be unnecessary to suggest that wooden lagging should, under no circumstances, be used to cover iron, were it not for the fact that in one of the largest and most costly dry-goods stores in New York, the "fire-proof" covering of the iron columns, which had been seriously damaged by trucks, was being systematically removed in order to substitute wooden lagging, when the fault was, fortunately, detected by an inspector of the underwriters. Four inches of good brick work is a good covering, but porous terra-cotta, or even wire lath and plaster, may prove effective. Where wire lath and plaster is used, the column should first be wrapped with quarter-inch asbestos, bound with wire. This would prove reliable and inexpensive.

A notable instance, showing the necessity of protecting ironwork with incombustible material, and the danger of expansion in long lines of iron girders or beams, was that of the destruction of a fire-proof spinning mill at Burnley, England, recently. This mill was 210 feet long by 120 feet wide, six cast-iron girders of the Hodgkinson type, each 20 feet long, spanned the 120 feet width, being bolted to cast-iron columns, and carrying, in turn, cross girders of wrought iron. The expansion of these 120 feet girders (they were unprotected) resulted in the disruption of the floor and the destruction of the mill. The cast-iron columns, being unprotected, collapsed under fire and water. The floors were 10 feet, 6 inches bays. As already stated, beams should not be spaced over 5 feet on centres. Wider spacing results in weak arches, liable to be buckled out by heat or punched through by the falling of safes or of other heavy articles from upper floors. The probability is, that if the 20 foot girders in this building had been arranged with provision for expansion, and all the ironwork had been thoroughly protected with "fire-proof" material, little damage would have been done. The effect, if the floors had been loaded with combustible merchandise, would have been more rapid. There was little wood to burn in the contents of the spinning mill, and yet the destruction was thorough. Such buildings with uncovered ironwork are more dangerous than those of heavy wood construction, in which the timbers are 12 inches or more in diameter, and not more than five stories in height. A properly constructed building with protected iron, however, is of course superior to any other form of building. Experienced firemen are afraid to enter buildings supported by iron columns unless they are thoroughly "fire-proofed," as they are liable to snap without warning under the influence of fire and water, whereas wooden posts burn slowly and give notice of collapse. They will stand a severe fire without being charred for more than two inches of their surface. In mercantile buildings and factories, beams, as already stated, ought not to be spaced more than 5 feet apart, no matter what kind of arch is employed; and while many experts claim that a heavy iron I-beam, thoroughly encased in "fire-proof" material on three sides, and having only its soffit or under side exposed, would not be expanded enough by the heat of a fire to cause its collapse, it is best to take no chances, but to protect the under side with "fire-proof" material, which can be cheaply applied with wire lath and plaster, or by having the skew-backs of the terra-cotta floor fillings extended below the soffit or bottom flange of the beam, and made with lips for protecting the iron

It is a mistake, in my judgment, to dispense with tie-rods, even with the kinds of arches which employ wire cables or other metal ties. The claim is made that these act as tie-rods, but it should be remembered that they cannot be relied on during construction, when derricks for hoisting iron beams and other materials are resting on the girders. Dangerous lateral movements and twistings of the structure may be the result of want of rigidity, which can only be obtained by using tie-rods.

It is my opinion—but there are many who entertain a different one—that the old-fashioned brick arch is the most reliable for resisting fire; that next to this in safety stands the porous terra-cotta segmental arch, with end construction, i. e., the blocks or separate pieces placed end to end between the beams, instead of side by side, in what is known as "side construction." This is said to be stronger than side construction. It is claimed by many experts that porous terra-cotta is a better non-conductor than brick on account of its interior air spaces. The arch should not be less than 4 inches thick, having a rise of at least 1¼ inches to each foot of span between the beams, and there should be a covering of good Portland cement and gravel concrete over this to ensure a waterproof floor. Cinder filling will burn—crushed slag from blast furnaces is better, but the Portland cement concrete should not be omitted for waterproofing purposes. There are many patent floor arches for filling between I-beams which have great merit when properly put in, but I doubt if any of them are equal to the two I have named, and it should always be borne in mind that when employed they should be inserted with the same care with which they are prepared for tests. This is almost equally true, however, as regards brick and burnt-clay arches, also. There is less likelihood of poor installation work, however, with brick arches or segmental arches of porous terra-cotta or burnt clay. Arches should be laid in Portland cement, not lime mortar. Under no circumstances should they be laid in freezing weather, and where concrete is used the broken stone or gravel should be carefully washed, and the cement should be of the best quality.

It is of great importance that the floors of all buildings should be waterproof, in order that the volume of water thrown by the fire department to extinguish a fire may be carried off without injury to merchandise on the floors below. Neglect of these precautions is criminal in view of their simplicity and inexpensiveness. After the arches have been set between the I-beams they should be covered, for at least a thickness of 1 inch, with the best Portland cement concrete, carefully laid, so that all water will run to the sides of the building and be carried off by water vents or scuppers, which may be arranged with pipes through the walls, having a check-valve which would prevent the influx of cold air and yet admit of the out-flow of water. All ducts for carrying steam, gas, and other pipes and electric conduits should be protected with a metal sleeve going above the surface of the floor, and the space between and around the pipes should be filled in closely with mineral wool, asbestos, or some other expansive and "fire-proof" material to cut off draughts and flame. Floor boards should be dispensed with, if possible, and asphalt or concrete employed instead. It is hardly practicable in office buildings, however, to dispense with wooden floors. Wherever used they should be so laid, especially in mercantile or manufacturing buildings, that there is no air space to supply a passage for flame and to form a harborage for rats and mice, to which these vermin can carry matches, oily waste, or other combustible material, liable to be ignited by steam pipes or by spontaneous combustion. Various processes, "electric," so-called and otherwise, have been patented for "fire-proofing" wood. They undoubtedly increase the fire-resisting properties of wood for interim trim, window casings, etc. Whether or not they impair the durability of wood is a matter as to which I am not yet informed, and I doubt if sufficient time has elapsed for a proper test. The United States navy has made trials of "fire-proof" woodwork—with what success I am not informed.

The enclosures of all ventilating shafts, for water-closets, etc., light shafts, and dumb-waiter shafts should be constructed in the same substantial manner as freight elevator shafts. It is a mistake to use thin plaster board or plaster with dovetailed, or other metal, lath, etc. No enclosure should be relied upon less than 4 inches in thickness, well braced with an angle iron, but brick walls are best, especially in buildings over 60 feet high. The lights should be of wire glass, set in metal framework, and ventilators should have metal louvers arranged to secure ventilation, but not to increase a draught. Slats should be

riveted, not soldered, to metal framework, and the metal framework should flange well over the "fire-proof" material of shaft on both sides. It is possible to finish tin-covered "fire-proof" doors with wooden trim so as to be ornamental, with bead panel-work, etc.

(To be continued.)

CORUNDUM.*

The band of rocks of Laurentian age in the northern part of the county of Hastings and the southern part of the county of Renfrew, in which corundum has been found, may be said to be made up of three important kinds, gneiss, syenite and quartz pegmatite. What appears to be the oldest rock in the belt is dark colored and more or less gneissoid in structure. It is in all probability a metamorphosed igneous rock and might now be called gabbro-gneiss. In megascopic character it is pretty uniform throughout the belt. The dark colored minerals which predominate in it are horn-blende and biotite, of which the former is in greater quantity. The other generally most abundant constituent is plagioclase felspar, but in some cases the felspar, or the more basic varieties of it, is decomposed. The percentage of silica in the rock agrees with the view that it is an altered gabbro or gabbro-diorite. Several examinations were made of specimens from different parts of the belt and these range in percentage of silica from about 47 to 53. This gneiss, the oldest rock in the belt, is cut through by a series of dikes or masses, which consist largely of felspar or felspathoid minerals in which occurs the corundum. In some cases these dikes are light pink in color, while in other cases they are gray or white, depending on the color of the felspar, but the pink colored rock is less abundant than the other. These dikes are interesting in several respects.

Along the greater part of the strike of the dikes the rock has sometimes the character of coarse syenite, but in some cases it passes into nepheline syenite In both varieties of rock corundum is found at times Nepheline, a mineral which plays the part of a felspar in rocks, is a comparatively rare substance in many parts of the world Some nepheline holding rocks when weathered have much the appearance of crystalline limestone, and are apt to be mistaken for this rock.

The most abundant constitutent in the group of igneous rocks in which corundum occurs is felspar, but this is replaced to a greater or less extent in some cases by the felspathoid mineral, nepheline. The other important constituents of this group of rocks, outside of corundum, are black mica, hornblende, which is sometimes represented by its very basic variety, hastingsite, and white mica. Quartz has never been observed by the writer in any hand specimen of rock taken from these dikes or masses. These dike rocks, if we leave out of consideration the occurrence of corundum in them, which of course lowers their acidity, may be described as syenites. Three or four varieties may be made of these. In some cases the rock is composed largely of felspar; at other times it contains mica or hornblende, and could then be called a mica or hornblende syenite; while, where the nepheline comes in, we have nepheline syenite Magnetite is quite abundant at times Pyrite is present in rare cases, and there is considerable variety of secondary minerals more or less mocaceous in character, which have not as yet been worked out. Where the syenite occurs in association with garnetiferous rocks, as in the northeastern part of Raglan, it carries garnet. Crystals of zircon, some of which had a diameter of one-eighth of an inch, were found in the syenite at one locality in Dungannon. Sodalite is sometimes present in the nepheline syenite. As the syenite on analysis appears to contain only a trace of magnesia, the poorness of the rock in spinel, which so frequently accompanies corundum in other districts, is accounted for. In general it may be said that the corundum occurs more abundantly in the ordinary syenite than in the nepheline syenite, but the crystals of corundum are usually much better formed in the latter than in the former. The corundum-bearing dikes vary much in width, which is usually some feet. In one case the writer observed a clear and well defined dike on the side of a hill in the thirteenth concession of the township of Carlow, whose width was only 1¼ inches and which had corundum studded pretty thickly through it. Other well defined dikes had a width of five or six inches. There are many dikes similar in character to those in which corundum occurs which do not contain this mineral. It may be present in one part of a dike and absent in another. It is frequently seen to have segregated in lines or patches through the rock, causing the rock to be richer in some parts than in others. Both the nepheline syenite and what has here been called the ordinary syenite often occur in broad dikes or masses, and it would be possible for one not making a careful study of the district to conclude that these two rocks belonged to different periods of eruption, or possibly came from different magmas. Sometimes the one rock passes somewhat sharply into the other in the same dike or mass. In this case if the line of passage is obscured one would be apt to conclude that the rocks belonged to different periods of eruption. But we have an "ear-mark" as it were in the occurrence of corundum in both kinds of rocks which at once attracts attention and causes one to look further into the relations existing between them. Having found that the nepheline syenite passed into ordinary syenite, and vice versa, in some cases following along the strike, the writer made use of this knowledge in prospecting for corundum. If a mass of nepheline syenite containing no corundum were found, the dike or mass in which it occurred would be followed up with successful results in some cases, the corundum coming in when the nepheline became less abundant or absent. In the case of one broad dike or mass in the township of Lyndoch, coarse nepheline syenite was found outcropping at the road side. After following the dike for about a mile, until nepheline was no longer observed on the weathered surface of the rock, corundum was found. In the case of other dikes search was rewarded with success in the same way. In somewhat close association with the syenite dikes of the corundum belt in parts of the district is a light colored granite in which corundum was not found.

In addition to the syenite dikes and masses, which cut the dark colored gneiss, there is another set of dikes whose relation to both of these rocks is easily made out. These dikes are quartz pegmatites, or coarse granites, and are younger than the corundum-bearing dikes, which is shown by the fact that these latter dikes are often cut by them. The quartz pegmatites are usually light pink in color and resemble in general appearance some of the coarser pink varieties of the corundum-bearing dikes. These coarser varieties of the latter dikes may also be spoken of as pegmatites. The quartz bearing dikes contain as essential constituents in addition to quartz, felspar, which is usually the most abundant mineral present, and hornblende, which is usually pretty badly decomposed. Magnetite is a frequent accessory mineral in these pegmatites. Two or three trap dikes were observed which appear to be of later origin than the corundum-bearing dikes, and probably also than the quartziferous dikes. Crystalline limestone, generally in small areas, was found in different parts of the district, but in no case was this rock seen to be cut by the corundum-bearing rocks. These areas of crystalline limestone may be considered as outliers over the fundamental gneiss, and were no doubt at one time connected and formed areas of considerable extent, but have been disconnected by denudation.

Corundum has been found occurring under different conditions in crystalline rocks. In some cases it is an original constituent of the rocks, i.e., it was formed at approximately the same time as the mass of the rocks in which it occurs. In other cases the mineral is of secondary origin, having crystallized out in the rocks at a later date than most of the material with which it is associated. Corundum occurs as an original constituent in different igneous rocks. In eastern Ontario it occurs, as has been stated, in syenite. In other countries it occurs in granite, basalt, andesite, trachyte and other igneous rocks. Corundum is found as a secondary constituent in various metamorphic rocks, having been produced in them through the agencies of alteration to which they have been subjected. In Eastern Ontario and other parts of the world, e.g., Burma, etc., it is found in crystalline limestone. Some of the best gem varieties of the mineral have been found in this rock. Rocks of all kinds carrying corundum are broken down through the action of the atmosphere and other agencies into gravel and sand, and hence the mineral is often found in loose deposits in the beds of streams and elsewhere. In these water deposits it is found associated with other mineral of high specific gravity, such as native gold and magnetite. Some of the foreign localities where the mineral occurs in economic quantities are

*Extracted from the report of the Ontario Bureau of Mines 1898, Vol. VII., Part III.

those of North Carolina and Georgia, (corundum), Chester, Mass, (emery), and Montana, (gem varieties). A great part of the emery of commerce comes from Turkey and the Grecian Archipelago. Gem varieties are obtained from Burma and other parts of the world.

The mineral corundum is one of the hardest natural substances known, being excelled in hardness only by the diamond. Its position in the scale of hardness arranged by Mohs, is between that of the topaz and diamond. As corundum is often more or less altered or changed into secondary minerals, mica, etc., care should be taken in selecting a specimen of this mineral for a test of its hardness to make use only of a specimen which shows no sign of alteration, and which appears to be free from impurities. As corundum is also somewhat brittle, care should be taken not to be deceived by the breaking of the mineral. A crystal of quartz with smooth surfaces is useful in distinguishing other hard minerals. As most minerals which have a hardness greater than that of quartz are comparatively rare, one has generally little difficulty by its use in determining whether a given specimen is corundum or not. A crystal of topaz is still more useful, and small crystals of this mineral can be obtained from mineral dealers at small cost. The prospector for corundum should also possess some typical specimens of the mineral for the purpose of comparing hardness and other characteristics.

Corundum is composed of the oxide of aluminium (Al_2O_3) but traces of the oxides of other metals are generally present as coloring materials. As in the cases of other minerals of non-metallic lustre, the color of corundum varies considerably. Sometimes the mineral is colorless or white, and at other times it is found possessing a blue, pink or red, brown, gray or other color. The relative weight of corundum compared with equal volumes of many other minerals is high. It has a specific gravity of about 4, i.e., it is four times as heavy as an equal volume of water, while felspar has a specific gravity of from 2.4 to 2.7 and quartz of 2.5 to 2.8. Its weight in hand specimens thus aids in its determination. Corundum crystallizes in what is known to mineralogists as the rhombohedral division of the hexagonal system. Well developed crystals are often somewhat long and narrow, tapering towards a point at either end A cross section of a crystal is six sided. When the crystals are well developed they possess a number of planes at either end. Crystals of the mineral, however, from different localities differ considerably in form The crystals of this mineral generally possess a well defined parting, or show a tendency to split readily in certain directions On some of these parting surfaces two sets of very fine lines are generally distinguishable, dividing the surface into small four sided areas Corundum is infusible before the blowpipe but is slowly dissolved in borax and phosphor salt. It is not acted upon by acids If finely pulverized the mineral takes on a blue color after heating with cobalt solution There are three subdivisions of the species, to which the name corundum is given, recognized in the arts These are: (1) Sapphire, which embraces the purer kinds of fine colors, transparent or translucent, which are useful as gems These gem stones are given different names according to the colors as sapphire (blue), and ruby (red). (2) Corundum, which includes the non-transparent kinds of dark or dull colors (3) Emery, which is a granular corundum, black or grayish black in color, and more or less intimately mixed with magnetite or haematite. Some varieties of corundum are among the most costly and highly prized gem stones Corundum has been produced artificially in various ways, different compounds of aluminium being used for the purpose. In most cases these compounds are subjected to the action of other substances at a high temperature. It has been formed by the decomposition of aluminium chloride through the action of magnesium and water vapor in a closed tube; by the decomposition of potash alum by means of charcoal, and in other ways. Many other minerals and even rocks have been produced artifically in the laboratory, but in most cases the results obtained have been of little economic importance. An interesting artificial production of corundum, considered in connection with the occurrence of the mineral in eastern Ontario, in nepheline syenite, is that in which the mineral has been produced by dissolving allumina in melted nepheline, and allowing the molten mass to crystallize.

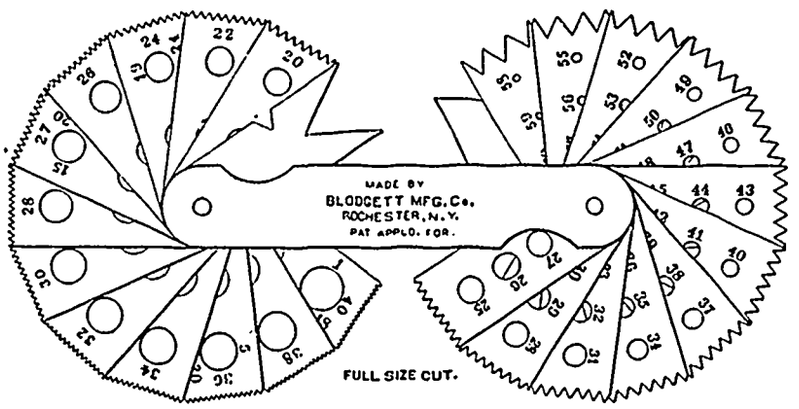
In commerce corundum and its varieties are divided into two classes, viz.: Gem stones and abrasive materials. The gem stone varieties have already been referred to. They are of comparatively rare occurrence, and when of high quality they are of great value. By the term "abrasive material" is understood a substance which is used for grinding or polishing purposes. Corundum proper and emery are used for this purpose. The powdered substance is made into "emery" wheels, the grains being cemented together by some suitable substance. The use of emery wheels in grinding down steel or other instruments is well known. Some of these wheels are moistened with water when being used, but others have to be used in the dry state, their cement not holding together after being wet. Emery is also used in the form of grains and powder. Corundum has been used in the production of aluminium, but as it is in such demand as an abrasive material it is too costly to be used as an ore of this metal. If its price were lower there would no doubt be a demand for it as an ore, on account of its generally being pretty pure and possessing such a high percentage of the metal. The uses of aluminum are being constantly extended. Many interesting results have been obtained with it in connection with alloys, one of which is of particular interest in Ontario. It is stated that of the alloys so far examined the one which seems to give the best present results and the greatest promise, is that with nickel. The addition of a few per cent. only of nickel to aluminium greatly enhances the strength and toughness of the metal, and adds to its brilliancy without adding materially to its weight. The metallurgy of aluminium offers a very inviting field for research. Alumina in a suitable form for the extraction of the metal is said to sell at about 4½ cents per pound, or two tons of alumina, which represent about one ton of the metal, are worth about $180. As aluminum sells at $700 per ton there would seem to be a considerable chance for the discovery of methods of extraction whereby the metal could be produced more cheaply. Moreover it does not seem altogether unlikely that methods of extraction will be discovered whereby a less pure alumina than that demanded by manufacturers at present can be used for the production of the metal.

Different varieties of corundum were known to the ancients, who made use of it as a gem and as an abrasive material. The emery of the Grecian islands has long been known. It is thought by some that the native races of America, judging from certain carvings on rocks, have made use of the mineral. In the Geology of Canada, 1863, reference is made as has been already stated, to the occurrence of the mineral in the township of North Burgess, and to its occurrence with other minerals in the auriferous sands of the Chaudiere. No other occurrence of the mineral in Canada was made public until the report of its occurrence in the township of Carlow in October, 1896. This may be accounted for by the fact that most people are attracted only by minerals of a metallic lustre, and so pass over those of a "stony" nature. If a part of the energy expended by prospectors in this Province in search for the precious metal had been employed in hunting for other substances, it seems not unlikely that many more valuable and interesting minerals would have been found. It is difficult to get reliable statistics on the production and consumption of corundum. In the Mineral Resources of the United States, 1895 and 1896, a Government publication, it is stated that "The producers of both emery and corundum are averse to giving publicity to their business, and in order to maintain the confidential nature of the statistics the production of the two minerals is stated together." The present selling price of North Carolina corundum quoted in The Engineering and Mining Journal of New York is from $140 to $200 a ton, being at the rate of 7 to 10 cents per pound. Emery is quoted at 1½ to 5½ cents per pound. The corundum and emery produced in the United States in 1895 is stated to have been 2,102 short tons, valued at $105.256, and in 1896 the production was 2,120 short tons valued at $113.246. "The corundum used in the United States is exclusively of domestic production. Emery is imported from Turkey and the island of Naxos, one of the Cyclades group in the Grecian archipelago." The imports of emery in 1895 were valued at $133,-038, and in 1896 they had a value of $148.231. The imports of emery into Canada for the last ten years have averaged about $15.000 annually.

The latest advices from Michipicoten, Ont., are to the effect that there is a rush of miners and prospectors in that region again this fall. Several rich strikes have recently been made on the north shore of Lake Wawa.

BLODGETT'S COMBINATION TWIST DRILL, THREAD PITCH, CENTRE AND TAP DRILL GAUGE.

It is with pleasure we present this brief description of one of the most convenient machinists' tools modern ingenuity has developed. This gauge contains the sixty sizes of twist drills from No. 1 to 60; twenty-four thread pitches from 6 to 40; ten tap drill sizes from 2-56 to 18-18; also the centre gauge, and is so constructed that its weight is less than two ounces, making it no larger or heavier than the ordinary pocket knife. This is claimed to be the only convenient pocket drill gauge on the market, as the old style is too heavy to carry. It is made of the best obtainable steel for this purpose, and is case hardened to prevent the holes from wearing by use. The holes are broached to Brown & Sharp's standard and will be found



FULL SIZE CUT.

accurate. The blades of this gauge are utilized for two purposes: the holes being made in the blades for the drills, and the thread pitches cut on the ends, thereby preventing the necessity of carrying an extra tool for that purpose. The numbers indicating the pitches are stamped on the back side of the blade, crosswise, against the thread, so that the desired pitch is easily found. Machinists, like other people, cannot remember every detail, and are often at a loss to know what size hole to drill for a machine screw tap, to get a full depth thread, and, at the same time, to give a sufficient amount of clearance to prevent breaking the tap, for they have learned that a tap will not drill. Ten sizes, ranging from 2-56 to 18-18, are stamped on the back side of the blades, against the proper size drill for that purpose. This gauge is divided into two parts, male and female, which are placed in the back of the gauge and are easily found when wanted. The ordinary centre gauge cannot be carried in the pocket with safety, as the points will soon puncture, and work its way out. No pains have been spared by the manufacturers to make it a perfect, complete and condensed tool. This gauge will be appreciated by those using small tools, as some one of the combined features is in almost constant demand in the large variety of fine machinists' work. For price, etc., see the Aikenhead Hardware Co.'s advertisement on page v. of this issue of The Canadian Engineer.

THE MARINE ENGINES OF THE GREAT LAKES.

Some 1,300 steamers on the lakes have been examined for the Great Lakes Register of Chicago in the past two years. J. C. Coffin has just published a summary of the results of the work, from which we make a few extracts: Of the 1,300 odd vessels surveyed, says Mr. Coffin, we have found 1,150 to be propellers, and a trifle over 50 to be paddle, or side-wheel propellers; the balance being schooners and tow barges, which were equipped with boilers and steam pumps, or hoisting and steering machinery. Of those fitted with screw propellers, we have found that 960 had solid cast wheels, 6 of them being of bronze, 8 of steel and 946 of cast iron; 185 of them had sectional wheels, one of them being bronze, 6 steel and 178 cast iron. Of the entire number, 1,060 of these propeller wheels were fitted on the tail shaft with straight bore and key, while only 74 were fitted on a taper end with feather and nut, the latter arrangement being more modern and considered by most engineers to be the best way of fitting propellers on the shafts. Of the paddle-wheels, we have found 23 to be fitted with feathering floats, and 29 with solid floats. The h.p. non-condensing engine, our earliest type, held the supremacy in numbers up to the end of the decade, 1889 to 1890; this is accounted for in some degree during the latter part of this period, by the fact that there were many tugs and small boats built. The h.p. condensing engine appears but little upon the lakes, there being a total of only 25 in existence. The steeple compound engine had an early start, 22 of them now in existence, having been built earlier than 1870, 62 during the next ten years, and 89 during the period from 1880 to 1890. This type then gave way to the fore and aft compound type and triple expansion type. Of the fore and aft compound type we have five engines built earlier than 1870. This type also reached the height of its popularity during the years 1880 to 1890, and then gave way rapidly to the triple-expansion type, which makes its first appearance during this term with 67 examples, and which has held its supremacy with 147 engines built since 1890. The first quadruple expansion engine was built in 1889, and since that date there have been six vessels equipped with this type of engine, and there are several of this type now under construction. Of the paddle-wheel boats, you will note that 33 engines are of the common and well-known walking-beam type, while 19 are either horizontal or inclined engines.

It is interesting to note the changes which have taken place in the types of boilers. The marine fire box boiler is the most common type, though the Scotch boiler has replaced it rapidly of late years; 731 boilers of this type are in use to-day, 18 of them having been built earlier than 1870, 97 of them between 1870 and 1880, 392 between 1880 and 1890, and only 224 since 1890. The Scotch type of boiler has one example built earlier than 1870, 8 between that and 1880, 193 between 1880 and 1890 and 348 since 1890, a very rapid increase during the last seven years. The marine water-tube boiler is of more recent date, only one having been built previous to 1880. There are now none of this type on the lakes built between 1880 and 1890, but there are 35 vessels built since 1890 equipped with this type of boiler, and there are several vessels under construction which are to be equipped with this type of boiler, and it is the opinion of many engineers that the water tube boiler is the coming boiler for marine use. It is also interesting to note the gradual increase in pressure in boilers built during these several periods. Of those built earlier than 1870, 100 pounds per square inch is the highest pressure, and there is only one vessel of this period carrying 100 pounds, and only one carrying 90 lbs., most of the boilers built during this period carrying from 40 to 55 lbs. Most of the boilers built during 1870 to 1880 carry either 80 lbs., 90 lbs. or 100 lbs. pressure, although there are a few built during this period carrying a much higher pressure, and one carrying as much as 200 lbs pressure. During the period, 1880 to 1890, 276 boilers carry 100 lbs. pressure or less, and 318 carry more than 100 lbs., but there is only one boiler built during this period carrying as high as 200 lbs., 29 carrying 160 lbs., 39 carrying 150 lbs., and the balance ranging from that down to 100 lbs. pressure. Since 1890 the tendency has been to increase the pressure, only 91 boilers being built during this period carrying as low as 100 lbs., while 517 carry higher than 100 lbs. Of this number 75 carry 120 lbs., 82, 125 lbs.; 45, 150 lbs.; 83, 160 lbs., and from that on up to 300 lbs., there being one boiler carrying this highest pressure, 2 boilers carrying 265 lbs., and 12 carrying 250 lbs. pressure.

On Sept. 13th the Mink W. Hanna & Co.'s supply boat was burned to the water line at her moorings, Port Carling. The cause of the fire is unknown. Loss about $1,200; no insurance.

WATER AND HEAT.

AN ADDRESS TO C. A. S. E., TORONTO NO. 2, BY P. TROWERN, TORONTO.

To-night I wish to draw your attention to a tank of water 12 inches square and 12 inches deep, a cubic foot, 1,728 cubic inches or 62.32 lbs. at the temperature of 39 degrees Fahr., which is at its greatest density, that is the molecules or particles of which the water is composed are smaller than at any other degree of heat, and this degree of water is weighed and measured. We will now watch the process of the water freezing and swelling or expanding, not by heat but by the heat leaving it and the cold taking its place; the thermometer standing at 32 degrees, and yet the ice becomes more solid and swelling above our measure, and the mould would burst if it were not allowed to rise—what natural law has been at work to do this? The heat which left the ice is called latent or hidden heat; the thermometer has not revealed it to us for it still stands at 32 degrees. We will now take it out of the mould, and drop it into water at 32 degrees, and find it will float 10 per cent. above the surface. We will measure the cubic foot of water put into the mould and now become ice and find that it measures 1,904¼ inches instead of 1,728 inches. It has gained 176¼ inches or equal to the space of 6.35 lbs of water, a pound being equal to 27.72 cubic inches, or each cubic inch has increased to 1,102 inches. We will now bring the ice back to water and find that we have not lost much, only by evaporation in the air. What was the cause of the ice getting larger than the water we put in the mould as the heat left it. The air kept the molecules apart and enlarged it and yet the thermometer stood at 32 degrees, the same as the water we put in at first.

I here present to you a sketch of the four different states we find water in and we have to handle it to the best of our ability to give motion to our machinery. In one of these compartments we have ice, in the middle one we have water at 39 degrees, the third has water in a boiling state giving off steam into the fourth space, which should be 1,728 times as large as the pound of water in each compartment, while the cold water swells 10 in every 100 lbs. Not by weight, but by measure, the boiling water will measure 1 in 21 or 5 in nearly 100 lbs. or gallons. We will take a pound of water at 32 degrees, put it in a vessel, and put it in, under it a good steady burning lamp, and watch the thermometer standing in it, and find it rises 10 degrees in one minute, this is our unit to work by. We now remove the vessel and put another vessel over the same lamp with a pound of small lumps of ice with a thermometer in it standing at 32 degrees, although the ice is below that degree, equal to our cubic foot of ice—we watch the thermometer, and find that the lamp is sending its heat into the ice, it begins to melt and the temperature remains at 32 degrees until it is all melted, which has taken 14 minutes, at this time we want to know how much heat has the ice received from the lamp to melt it, or how much heat came out of the water, and before it became water again; 10 degrees in one minute will give 14x10 equals 140, yet the thermometer stands at 32 degrees—this 140 degrees is what is called latent heat in ice. We will now proceed to produce steam and find the latent heat in it; let this vessel with the pound of melted ice, now water at 32 degrees, remain over the lamp burning about the same as before; watch the thermometer, and see how it rises, and in 18 minutes it will rise to the boiling point, 212 degrees; 18 minutes by 10 degrees equals 180, plus 32, equals 212. Without disturbing it we will watch and see how long it will take for the water to evaporate, or boil away into steam. We find it has taken 95 minutes or 5½ times as long to leave the vessel in the shape of steam as it did to rise from 32 to 212 degrees, and yet the temperature of the steam gives no indication of rising above 212 degrees; a large amount of heat must have been given off in the 95 minutes; according to our first unit of 10 degrees in one minute. 18 min. by 10 deg. equals 180 deg., 180 multiplied by 95 and divided by 18 is equal to 950 degrees of heat, which have been hidden away in that one pound of steam to make it rise up into its natural element, and to form the clouds which are so useful to us and to the world at large. Had it not been for this beautiful arrangement we would be burnt, and perhaps everything in this world, because clouds are like veils to screen us from such intense heat, and without heat the two gases which form water would remain together as water.

What are these two gases called? Oxygen, 8 lbs., hydrogen, 1 lb., will form 9 lbs. water pure. Unless a great force or energy has been used by some law in nature the water would not have left the vessel, which we left over the lamp. The atmosphere was pressing on the water and keeping it there with a pressure of nearly 15 pounds per square inch, and as soon as sufficient heat had got into it so as to reach 212 degrees, and to cause it to boil and force these two gases to separate or get farther apart, the water or steam rose and passed into the air by means of the visible and latent heat. If we take a vessel with 5½ lbs. of water at 32 degrees, and put a steam discharging pipe with a pound of water changed into steam at 212 degrees, we will find we have 6½ lbs. of water at 212 degrees. Strange to say you cannot weigh heat, it does not seem to have any weight, and the amount that went with the 1 lb. of steam into the 5½ lbs. of water, which changed the 5½ lbs. of water from 32 to 212 degrees became visible heat, but if you take a pound of water at 212 and mix it with 5½ lbs. of water at 32 degrees, we will have 6½ lbs. water at 60 degrees, which shows the amount of heat stored away in the steam. From these figures it appears that 212-60 equals 152 degrees multiplied by 6½ lbs. equals 988 degrees were hidden in the steam. This large amount of heat cannot be destroyed or annihilated, but it is rendered sensible again when the steam is condensed and brought back again to water. The British unit of heat is the quantity of heat that will raise one lb. of water at 39 degrees (on the level of the sea), up 1 degree, that is to 40 degrees. The mechanical equivalent of this heat is of energy or work to raise 772 lbs. weight one foot high, this we are told is the unit of energy of one degree of heat, and before I close this paper I wish to show how some experimenters went to work to find this energy. They made a water-tight box and fitted a paddle-wheel to it with the shaft of the wheel passing through a stuffing box with a pulley on it. The water was weighed and temperature taken, the motion given to the wheel in the box by a weight on a rope around a drum; by the time the water was raised one degree in the box by the motion of the wheel being kept up by the weight it took 772 lbs. weight. This plan was tried and tested in various ways until they became quite satisfied that their figures were correct. The foot pound term has been introduced to express in a convenient way the lifting of a pound to the height of a foot; this is the quantity of heat necessary to raise the temperature of a pound of water one deg. Fahr. being taken as a standard 772 foot pounds, the mechanical equivalent of heat, or by a pound weight to fall 772 feet against the earth, or it would raise 772 lbs. one foot high. It was tried by one of the men to let drop 2 lbs. of water from a height of 386 feet, and when the water had struck the tub to receive it, it had raised ½ deg., or 1 deg. for 772 lbs. The British unit or foot pound was calculated by an engine, the piston having 500 square inches, velocity 200 feet per minute, 500x200x7 is equal to 700,000 or 21 horse units, 1 lb. per minute, one foot high. Suppose 1 lb. of water be taken up in the air 772 feet by evaporation, and it fall into the tub we put to receive it, by the time it has fallen, it has gained one degree; it gives what we require, natural force; it went up by heat, and came down by potential work, and increased in heat.

ACETYLENE ON RAILWAYS.

Some time ago The Canadian Engineer published an article on the use of acetylene gas on railways, describing some developments in which Canadian engineers were in advance of the rest of the world. The following letter from Lt.-Col. J. H. Western, late R. E., inspecting engineer for Government railways of Egypt to P. W. Resseman, Esq., Pontiac Pacific Junction Railway Co., Ottawa, together with Mr. Resseman's reply, which we append, continues the story of the progress of Canadian ideas abroad:

Lt.-Col. Western, writes:

"I am desired by Major Girouard, R. E., president of the State Railways, Egypt, to inform you that he wishes to introduce the acetylene light on his system, and that he has after due enquiry learned that your railway is practically the only one that uses this light. He will, therefore, be exceedingly obliged if you would favor me for transmission to Cairo with full particulars as to system and method employed, results obtained, and where the necessary apparatus can be secured. He learns from the Bulletin of the International Congress that your system up to a year ago was considered most successful, and abso-

lutely free from danger, and being a system of single coach lighting will be eminently suited to his road. Yours faithfully,

"(Signed.) J. H. WESTERN.

"Broadway Chambers, Westminster, London, S. W.

"August 31st, 1898."

The reply of Mr. Resseman was as follows:

"I beg to acknowledge the receipt of your favor of the 31st ult., and am pleased to give you such information as I have in connection with railway car lighting with acetylene gas.

"We have been using the Holland system on the two roads of which I am general superintendent—the Pontiac Pacific Junction and the Ottawa and Gatineau Railway—for nine months. There is really no comparison between the effectiveness of acetylene gas and coal oil for car lighting, with coal oil at 14c. per gallon, and carbide at 5c. per lb., the cost of acetylene gas lighting for railway use is somewhat cheaper than the same lighting by coal oil. I consider that it is the coming light for railways. We have in Canada a problem to face, however, that would not have to be met in any warm country. Owing to the severe frost in winter we have to place the gas generators inside the car to prevent them from freezing. The disadvantage of this lies in the fact that acetylene gas is most difficult to control, and the slightest leak in the generator causes a disagreeable smell in the car. This we hope to overcome, and have been experimenting with better connections from generator to pipe. The gas has no evil effects on the health of a passenger, but, like garlic, the odor is offensive to most persons.

"I find that an ordinary passenger coach, such as we run here, and previously lighted by 14 coal oil burners, can be brilliantly lighted with five 25-candle power burners, consuming each ½-foot per hour. The carbide supplies 5 cubic feet of gas per pound, making the total cost of the lights 2c. per hour, or for a run of hours 20 to 21c. per pair. Of course, there is incidental waste that we cannot get fully controlled. The gas is lost by the vibration of the car, but on the whole the light is efficient and inexpensive. It is absolutely safe as far as fire or explosions are concerned. The gas is generated in small quantities, confined beneath a 7-inch column of water, and any that may escape is so speedily diffused in the surrounding atmosphere that its explosive nature is at once neutralized. In the event of a car turning over the lights go out immediately, and the gas escapes so quickly that fire cannot affect it. So far we have had no accident from acetylene gas, and I cannot conceive how an accident can occur. Say the coach lighted was a sleeping car, 60 feet in length, regulation width, but with all the windows closed, the plant required to light it would generate enough gas to feed 8 to 10 burners of 25 candle-power each, or a consumption of 4½ to 5 feet of gas per hour. If the passengers were all to sleep solidly for ten hours, and the jets were all open discharging unconsumed gas into the car, in ten hours the ratio would be 50 feet of acetylene gas to 4,320 feet of air, sufficient to make a bad smell in the car that would be driven out in half a minute by the opening of a car door. In Egypt or South Africa, where the generators could be placed on the roof or underneath the car, no difficulty would be apprehended from the acetylene gas smell. A railway equipped so that at certain stations, on the arrival of a train, sufficient generators could be taken off and freshly charged ones coupled on, the light could be made continuous. The whole train could be lighted from the baggage car more conveniently than any other way, but for the cutting out or switching of cars. A small closet would hold the plant and connection be made between the cars with hose cocks and rubber hose. This, of course, we cannot use on our lines here. We have three small generators in each car, placed directly over the top inside of the car, of the toilet room. We have experienced very little trouble other than the escape by improper connection, and we hope to entirely overcome this objection in the very near future by obtaining a suitable connection. Low pressure gas is not affected by heat or cold. There are at present scores of patents being issued every month in Canada and the United States for acetylene gas and lamps, and I have no doubt whatever but that in the early future a generator will be invented for railway car use that will be absolutely gas tight, and with the capacity to generate a week's supply of gas for a car without any danger. In the meantime the express trains on the roads of which I have the superintendency have the honor of being the first on the continent, if not in the world, to be lighted regularly with acetylene gas. The generators cost here $12. The carbide is sold here at $4.50 per 100 lbs. What the cost of piping a car in Cairo is you can judge better than I can. In this city it costs about 8c. per foot for the pipe in place; fixtures extra. Pipe used is ⅜-inch for main, and the ¼-inch for connection. Side lights give us the best results. We are using the ordinary gas fixtures, ¼-inch L cocks, porcelain globes with 5-inch rings. I have every confidence in the future of acetylene gas, and advise every railway man to keep posted on its future development. Yours truly,

"(Signed.) P. W. RESSEMAN,

"Ottawa, Sept. 13, 1898." "General Superintendent."

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during August and the eight months ending August, 1897, 1898 :—

	Month of August.		Eight months ending August.	
	1897.	1898.	1897.	1898.
Hardware	£5,876	£2,260	£43,031	£10,550
Cutlery	..	5,098	..	36,404
Pig iron	251	1,027	4,053	8,132
Bar, etc.	796	320	6,595	7,559
Railroad	1,068	..	38,722	23,007
Hoops, sheets, etc	11,159	12,173	42 162	36,642
Galvanized sheets	2,743	7,346	28,201	39,807
Tin plates	7 834	12,774	102 776	98,372
Cast, wrought, etc., iron	2,793	1,779	22,070	20,416
Old (for re-manufacture)	677	..	3,254	3,574
Steel	5,266	2,555	34,803	35,452
Lead	2,933	3,866	13,892	20,3:6
Tin, unwrought	1,232	720	11,411	13,143
Alkali	2,625	3,228	20,274	27,825
Cement	3,365	2,671	11,854	14,993

Industrial Notes.

W. Sterling, brass founder, St. John, N. B., is enlarging his premises.

Galt, Ont., has carried a by-law appropriating $12,000 to building a new town hall.

The Goldie & McCulloch Co., Galt, Ont., will supply the machinery for the new C. P. R. elevator at St. John, N. B.

The Pacific Portland Cement Co., Vancouver, B. C., will, it is said, shortly increase the output of its plant to 100,000 bbls. annually.

Peterborough, Ont., has been supplied by the Wm. Hamton Mnfg. Co., with a stone crusher, which is to be run by electricity.

The Fredericton waterworks have just completed the installation of a large steel boiler of 100 h.p. from the works of E. Leonard & Sons.

Bond & Smith, architects, Toronto, are making alterations and additions to a house on Hayter street, Toronto, which includes heating by hot air.

The offer of the English bondholders to sell the present waterworks to the city of Winnipeg for $275,000 has been rejected by the city council.

The laying of the new 24-inch water main in St. John, N. B., is being rapidly proceeded with under the direction of W. Murdoch, C. E., city engineer.

The McLaughlin Carriage Co., Oshawa, Ont., has ordered a 100-horse power Robb-Armstrong engine from the Robb Engineering Co. Amherst, N. S.

Very satisfactory progress is being made with Mooney Bros'. new pulp mill at Mispick, ten miles from St. John, N.B., as the machinery is now being installed.

James Robson & Sons, Oshawa, Ont., are establishing a large tannery in the Cedar Dale premises formerly occupied by Wm. Chaplin, St. Catharines, as a scythe factory.

The Swansea Forging Company is now delivering to Mann, Foley Bros. and Larson, for use on the Columbia & Western Railway of British Columbia, an order for 500 tons of bolts. This is probably the largest order for bolts ever placed with any Canadian manufacturing firm.

D. Miller, Washago, Ont., intends building a saw mill and stave factory this fall.

E. Hanson Greene, P. L. S., Montreal, is making surveys for the projected waterworks for the village of Sutton, Que.

The McLaughlin Carriage Co., Oshawa, Ont., is building an additional building of brick, 150x50 feet, three stories high.

J. D. Ronald has resumed control of the engine building business which he had until a year ago so long carried on in Brussels, Ont.

London, Ont., finds that the cost of its new hospital is increasing as the building progresses; already there is a $20,000 deficit in sight.

The Robb Engineering Co. is building a 60-h.p. boiler for Wm. Curry & Son, Windsor, N. S., and a 30-h.p. for W. C. Hatfield, Parrsboro, N. S.

The village of Andover, N. B., is installing a system of water supply for fire and domestic purposes. The contract has been let to J. B. Porter for about $8,000.

The contract for the concrete substructure of the new bridge over the Ouse in Asphodel township, Peterborough county, Ont., has been given to Wm. Langford.

Bond & Smith, architects, Toronto, have just started to build a church for the parish of Saint Clement, Toronto. The corner stone will be laid on October 8th.

W. J. Campbell, Boston Mills, Ont., has lately bought the Oshawa, Ont., Roller Mills, and is replacing all the old machinery with new and up-to-date appliances.

A large number of Sterling Hack Saw Blades are being sold by the Aikenhead Hardware Co., Toronto. Samples can be had and prices will be quoted on application to them.

An explosion in the mixing room of one of the Hamilton Powder Co.'s mills at Beloeil, Que., totally destroyed the building, Sept. 16. No lives were lost, nor was any damage done to surrounding buildings.

The foundation stone of a new five-story building to be added to the buildings of George E. Tuckett & Son Co., Ltd., has been laid. The building is to be used exclusively in the working of Canadian-grown tobacco.

We understand that T. H. Watson is retiring from the firm of Leather & Watson, Hamilton, and will devote himself entirely to the interests of the Swansea Forging Company, of which he has been manager for several months past.

The officers of Brantford, No. 4, Canadian Association of Stationary Engineers are: A. Ames, president; T. Pilgrim, vice president, O. S. Merrill, secretary; C. A. Walker, treasurer; A. McKinnon, doorkeeper; J. Nichol, conductor.

The boiler in a brickyard owned by F. W. Entricken, on the 16th concession of Zorra, Oxford county, Ont., exploded Sept. 7th, and instantly killed a young man named Aikens, 19 years of age. The building was badly damaged, and another workman was slightly injured.

The good roads propaganda carried on by A. W. Campbell, Provincial Road Instructor for Ontario, has had excellent results, and this season streets have been built on the most approved plan in the following towns: Berlin, Chatham, Collingwood, Owen Sound, Brockville, Kemptville, Woodstock, Ingersoll, Stratford, Galt, St. Catharines and Lindsay.

We hear that Samuel Siggins, bicycle rim manufacturer, at Woodstock, is in difficulty, and that his banker has taken possession of his assets, which were mortgaged. He began as a carriage maker in 1882. About six months ago he claimed a surplus of $16,500 over habilities of $3,500, but his assets consisted largely of real estate and machinery, hence his present trouble.

The closing session of the Ontario Association of Executive Health Officers was held in Ottawa, Sept. 27th, and the officers for the next year were elected as follows: President, Dr. J. J. Cassidy, Toronto; vice-president, Dr. Hutcheson, London; secretary-treasurer, Dr. J. J. Mackenzie, Toronto. Council—Dr. W. F. Vanbuskirk, Stratford; Dr. Fee, Kingston; Dr. Robillard, Ottawa; Dr. Wardlaw, Galt; Dr. Hall, Chatham; Dr. McCrimmon, Palermo; Dr. Sheard, Toronto. Good Roads Committee—Chairman, A. W. Campbell, C. E., Toronto; A. McGill, Ottawa; E. B. Shuttleworth and J. J. Mackenzie, Toronto; Capt. Vanbuskirk, Stratford; Dr. P. H. Bryce.

Peterborough, Ont., will lay 6,000 feet of 12 and 15 inch sewers.

The thriving village of Grande Mere, Que., is to have a waterworks to cost $40,000.

The Waterville, Que., Furniture Co., which was recently burned out, is looking for a bonus and a location.

F. A. Hibbard, C. E., Ottawa, is superintending the building of the new bridge over the Madawaska at Arnprior, Ont.

Bothwell, Ont., will build a firehall, lockup and council chamber as an addition to the town hall to cost about $2,000.

The main drainage by-law carried in Ottawa, Sept. 8th, by a majority of over 250. The amount involved is $425,000.

The W. R. Gardner Tool Co., Sherbrooke, Que., is finishing up what orders are on hand, after which the works will be closed down.

An effort is being made by English capital to control the manufacture of carriage wheels, hubs, spokes and bent wood stuffs in Canada.

The Sackville Machine & Foundry Co.'s shops, Amherst, N. S., are now running under the management of L. G. Holder of St. John.

F. C. Freeman, C. E., has made an estimate of $100,000 for a water supply system for Chatham, Ont., proposing to take the water from Morrison brook.

The waterworks commissioners of Rat Portage, Ont., have taken over the works from Secretran & O'Boyle, the contractors, and will complete the work themselves.

The Coulthard & Scott Co., Limited, Oshawa, Ont., manufacturers of agricultural implements, have this summer had a large two-story brick addition built to their works.

The progressive village of Verdun, Que., is to have a system of sewers and a water supply. McConnell & Marion, civil engineers, Montreal, are getting out the plans, and will superintend the work.

Stratford, Ont., is still undecided as to the method of sewage disposal to adopt. On one hand the town is threatened by the Provincial Board of Health, and on the other by the adjoining municipalities, and so must very soon install a system of some sort.

E. N. Page, G. H. Page, Cohoes, N. Y.; D. H. Friedman, Albany, N. Y.; R. Hersey, J. C. Hodgson, W. W. Near, Montreal, have applied for incorporation as the Page-Hersey Iron and Tube Company, Ltd. The chief place of business is to be St. Henri, Que.; capital, $50,000.

W. W. LaChance, architect, Hamilton, Ont., has prepared plans and specifications for a steel and concrete dam at Stoney Creek. The proposed structure has double retaining walls. Pipe will be laid and connection made with the reservoir formed for fire protection.

It is reported that the Sturgeon Falls, Ont., Pulp Co., has acquired from the Ontario Government the right to take pulp wood along Sturgeon river for 20c. per cord. A further consideration is the agreement by the Pulp Co. to spend at least $1,000,000 on buildings in connection with paper and pulp mills.

The Imperial military authorities at Halifax have completed the purchase of a large piece of water front land at McNab's Island at the entrance of Halifax harbor, and will commence at once the construction of a large fort. It will be one of the largest in the Dominion of Canada, and mounted by the most modern and powerful guns.

The Deseronto Iron Co., Ltd., of which F. B. Gaylord, formerly manager of the Gaylord Iron Co., Detroit, is general manager, is making excellent progress with the works now building in Deseronto. All the charcoal produced by the Standard Chemical Co. will be used in smelting, and the chemical company will very greatly extend its operations.

Among institutions teaching by correspondence are the International Correspondence schools, Scranton, Pa., well organized and well equipped with a large staff of instructors. The schools have met with extraordinary success since their establishment in 1891 in teaching machine design, steam engineering, electricity, architecture, mechanical and architectural drawing, mining, plumbing, heating, and ventilation, chemistry, bridge, railroad, municipal, and hydraulic engineering, sheet-metal pattern drafting, English branches, book-keeping and stenography.

William Lavers, contractor, Montreal, has the contract for the public hall, Westmount, Que. Work will be commenced at once.

On Sept. 23, Stirling, Ont., gave the waterworks by-law for $20,000 a majority of 51. Gravitation will bring water from Somerset Lake, elevated nearly 300 feet and distant two miles.

The building trade in Toronto has had a revival this year after several seasons of depression. In 1896 the building returns showed only $657,168, and last year the business was only $938,619. Up to August 25, 1898, the returns amounted to $1,176,890.

S. C. Skinner, F. J. Skinner, A. Louise Skinner, Gananoque, Ont.; J. F. Chapman, E. Chapman, Deseronto, Ont., have been incorporated as the Skinner Company, Ltd., to manufacture carriage hardware and do a general iron and brass foundry business; capital, $75,000; chief place of business, Gananoque, Ont.

The International Silver Company has been formed under the laws of the State of New Jersey, with a capital stock of $15,000,000 preferred and $15,000,000 common stock. The combination is said to have absorbed the leading manufacturers of silverware on the continent including the Standard Silver Plate Co., Toronto.

Stratford, Ont., has decided to grant the Whyte Packing Company of Mitchell, Ont., exemption from taxation for 20 years and guarantee their 4 per cent. debentures to the amount of $30,000 for 20 years, on condition that they erect a pork-packing and curing factory at a cost of $40,000 to $50,000, and employ 75 to 100 men.

Aemilius Jarvis, architect, Toronto, has returned from New York, and announces that the lease for the site of the large new hotel on King St., east, Toronto, has been signed, and that he has interested New York capital in the venture. The plans have been prepared and the promoters state that the building will be at once gone on with.

Dr. Sheard, medical health officer of Toronto has issued a report on sewage, which is very interesting and quite comprehensive as far as it goes, but the many new ideas brought forward in the past eight years are overlooked. No doubt we shall have a second report from Dr. Sheard bringing his really valuable publication up to date.

The incorporation of the great steel trust, to be known as the Federal Steel Company, has been completed in New Jersey. It is the largest company ever admitted under the laws of New Jersey, its paid up capital being $200,000,000. An incorporation tax of $40,000 was paid to the Secretary of State. The location of the principal office of the company is stated to be in Jersey City.

The Maritime Sulphite Fibre Co., Chatham, N. B., has ordered a 500 h. p. cross compound condensing engine from the Robb Engineering Co., Amherst, N. S., to replace the present 250 h.p. simple engine, and to provide for contemplated enlargements of the plant. The new engine is expected to effect a large saving in fuel over the type now used as well as to give much better speed regulation.

A point of special interest in the export of iron plates from Chicago to Belfast, Ireland, is the fact that Harland & Wolff, ship-builders of Belfast, were boycotted by the steel manufacturers because that firm agreed to the terms of the striking engineers some time ago. As no steel could be secured in Great Britain the firm ordered from America. It remains to be seen whether a trade begun under such favorable circumstances can maintain itself under changed conditions.

W. F. Tasker, business manager of the Don Valley Brick Works, stated recently that the works are the largest and most efficient brick-making plant in America. While all kinds of brick are manufactured at this immense plant, pressed brick, enamelled ware, terra cotta, porous terra cotta, flooring, tiles, in all over 300 patterns and street-paving brick are made. This year they have already made 10,000,000 brick, and are now running night and day to fill orders. The prices range from $6.50 for the ordinary brick up to $400 for some of the finer work. A considerable amount of brick was sold in Toronto, and more has been shipped to points from St. John's, Newfoundland, to Vancouver, B. C. The plant is kept running the year round, and employs on an average 80 men. It is situated on the west side of the river Don, just on the eastern limit of the city, and comprises 1,700 acres. The material is practically inexhaustible. In the plot is a shale bank, from which all the red brick is made, three-fourths of a mile in width, two miles in length and 900 feet deep.

Electric Flashes.

The city of Winnipeg has decided to appoint an official electrician.

Brantford, Ont., had its new electric lighting plant put into operation on the 10th of last month.

A second generator is being put in at the Cataract Power Company's works at Decew's Falls, Ont.

The Maritime Electrical Association held its first annual convention on Sept. 27th and 28th in Halifax, N. S.

The town council of Thorold has decided to postpone the submission of the by-law for the $7,000 lighting plant till January next.

The C. P. R. telegraph copper line was completed Sept. 21st from Montreal to Vancouver. This is the longest telegraph line in the world.

The Vankleek Hill Electric Light Co., Vankleek Hill, Ont., is increasing its lighting capacity by the installation of a 50 k.w. S. K. C. two-phase generator.

Fire broke out simultaneously in Nos. 305, 306 and 310 Peel street, Montreal, one night recently. The fire was started by the burning out of part of a lighting fixture.

Municipal ownership of the electric lighting plant in Pembroke, Ont., is being actively canvassed, and there appears to be a strong probability of its being carried out.

The Montreal Street Railway Co. lost over $200,000 by a fire on Sept. 16th, which destroyed a car shed containing 60 cars and seven sweepers. The insurance very nearly covered the loss.

The Canadian Pacific Railway have purchased from the Royal Electric Co., a 50-light 2,000 candle-power arc dynamo, together with 52 arc lamps, for use in their car shops at Hochelaga.

The Warwick Clothing Manufacturing Company of Warwick, Que., is lighting its works throughout by electricity. The order for the necessary apparatus has been given to the Royal Electric Company.

Wm. Kennedy, jun., C. E., of Montreal, is preparing plans for the hydraulic portion of the proposed scheme for bringing power from Ragged Rapids to that town, a distance of about 12 miles. It is thought the entire enterprise would cost about $70,000.

The Citizens' Electric Light Co., of Smith's Falls, Ont., is increasing the electric lighting plant, and has purchased from the Royal Electric Co., a 1,500 light royal incandescent dynamo, with station apparatus complete. This is to be installed at once.

The carborundum works at Niagara Falls, Ont., are now steadily turning out a product of the highest class. It is the intention of the company to very materially enlarge their premises by the erection of an additional building, about twice the size of the present. It is to be one and two stories high.

A United States company which is going to develop the water power of the Jacques Cartier river for electric light and power purposes for Quebec city in opposition to the Montmorency Company, has acquired the chartered rights as regards Quebec of the Standard Light and Power Company, Montreal. It has a capital of half a million, and its president is Emerson McMillan, of New York.

The Niagara Central Railway has been bought by Haines Bros., New York. The road will be converted into an electric road, and it is said there will be a 40 minute service between St. Catharines and Niagara Falls. The trestle work at Merritton and Thorold will be done away with, and the road run on the ground, the motor cars being able to overcome grades which steam cars could not do. The Grand Trunk at Merritton will be crossed on the level by means of interlocking switches. The plans also include the extension of the road.

Galt, Ont., has carried a by-law to buy out the Galt Gas & Electric Light Company, and operate it as a municipal plant.

William Barber Bros., Georgetown, Ont., recently ordered from the Canadian General Electric Company, a 6 k.w. 500 volt motor.

H. Vick & Sons, Orillia, Ont., recently ordered from the Canadian General Electric Company a 50 light incandescent dynamo.

The Midland Elevator Co., of Midland, Ont., is having placed in its elevator a fifty light T.-H. dynamo, from the works of the Royal Electric Co.

New Westminster, B. C., has ordered from the Canadian General Electric Company a 100 light incandescent dynamo, and a 6 h.p. 500 volt motor.

The Deseronto Iron Company, Deseronto, Ont., has closed a contract with the Canadian General Electric Company for a 200 light dynamo with marble switchboard.

The Bells Asbestos Company, of Thedford Mines, Que., has ordered from the Canadian General Electric Company a 100 light dynamo to be installed at Thedford Mines.

The Provincial Asylum at Fairville, N. B., has placed an order with the Canadian General Electric Company for a 6 k.w. motor, and one 8½ k.w. motor of the Edison bi-polar type.

Boivin, Wilson & Company, Montreal, have recently ordered from the Canadian General Electric Company a 100 light incandescent dynamo for their premises at Berthier, Que.

The Hamilton Electric Light and Power Co., has lately placed in its lighting station one 2,000 light Royal alternator, and one 100 h.p. 250 volt direct-current Royal power generator.

The British Columbia Sugar Refinery Company, Vancouver, B. C., has recently ordered from the Canadian General Electric Company, a 25 k.w. generator of the well-known multipolar type.

The Montreal Cotton Company, Valleyfield, Que., in addition to the very large increased order placed in August, has given a further order to the Canadian General Electric Company for a 150 h.p. induction motor.

The British Columbia Electric Railway, in order to meet the increased traffic over its road, recently placed an order with the Canadian General Electric Company for additional car equipments of the well-known C. G. E. 1,000 type.

The Canadian Electric & Water Power Co., Perth, Ont., is installing a 5-h.p. two-phase S. K. C. motor. This is the third installation within a short time, and shows what can be done with the poly-phase system, for developing a power trade for electric light companies and assisting to make the much desired day load.

The West Kootenay Power and Light Company, which is building a parallel line of wires between Rossland, B. C., and the generating plant at Bonnington Falls, has the right of way cut, and poles on the ground for most of the distance. The right of way has been cut clear of everything for a width of 100 feet, and all the tall trees outside of that area, which, if they fell, would injure the line, have also been cut down. The insulators will be housed so as to keep out the snow in winter. The idea in constructing the second line is so that if one line goes down the other can be used and interruption of the service prevented.

The September number of the Street Railway Journal has been made a souvenir of the Boston convention of the American Street Railway Association, and is a quite unusual publication in size, in typographical appearance, and in the character and quality of its reading matter. Among the special features are: "Street Railway Conditions and Financial Results in Metropolitan Boston," which is devoted to a financial analysis of thirty-one street railway properties in and about the city of Boston. These are suburban and interurban in character, and a comparison of their financial characteristics is of interest to street railway capitalists. The Boston Subway is described in considerable detail, the latest plans of the subway and subway stations as finally carried into effect. Proposed New Electric Elevated Railway in Boston is a brief article on the proposed construction. There are also several special contributed articles in which many will be interested, together with descriptions of many new improvements in electric railroading.

Munderloh & Co., Montreal, recently ordered from the Canadian General Electric Company a 12 k. w. incandescent dynamo.

J. H. Head, Hagarsville, Ont., has recently ordered from the Canadian General Electric Company, a very compact lighting plant. The generator will have a capacity of 50 lights.

Tromanhauser Bros., Goderich, Ont, have placed an order with the Canadian General Electric Company for a 200 light incandescent dynamo, which they propose to install to light their elevator buildings.

The Canadian Pacific Railway smelter at Trail, B. C., recently placed an order with the Canadian General Electric Co. for a 50 light 2,000 c.p. brush arc dynamo, together with the necessary lamps. These are to be used at the smelting works at Trail.

John Ballantine & Son, Preston, Ont., have given a contract to the Canadian General Electric Company for a lighting plant, including a 100 light dynamo with instruments. The order includes the wiring up of their premises for use of incandescent electric lighting.

The Linde British Refrigeration Company, Montreal, has recently ordered from the Canadian General Electric Company a 15-h.p. three-phase induction motor. The power will be supplied to this induction motor from the circuits of the Lachine Rapids Hydraulic & Land Company.

The Peoples' Electric Company, Windsor, Ont., owing to the very large and satisfactory increase in its lighting business has recently placed an order with the Canadian General Electric Company to supply it with a 2,000 light iron-clad ventilated armature type single-phase alternator.

The city engineer of Toronto has refused to draw up specifications for a 6,000 h.p. municipal power plant as ordered by the council, and has recommended that $1,000 be appropriated to secure the services of an expert consulting electrical engineer, who would draw the specifications.

The Royal Electric Company has sent to its friends a very fine photo, 14x21 inches, of the group taken on the occasion of the visit of the Canadian Electrical Association to the power-house at Chambly, Que. The picture is taken in front of the power-house, and makes a very interesting souvenir.

The War Eagle Consolidated Gold Mining Company, Rossland, B. C., has ordered from the Canadian General Electric Company, two 2-h.p. induction motors, and one 10-h.p. induction motor. The power to operate these induction motors is to be furnished by the West Kootenay Power & Light Company.

The Peterborough and Ashburnham, Ont., street railway was sold by the sheriff, Sept. 12th, under an execution for fifty odd thousand dollars. The purchaser was Arthur Stevenson, and the price paid $20,000. It is understood that Mr. Stevenson acted for some of the largest stockholders in the present directorate. The sale will not affect the operation of the road at present, as it will be run as heretofore until some further arrangements are made.

The T. Eaton Company, Ltd., Toronto, has given an order to the Canadian General Electric Company for the installation of a 130 k.w. direct connected generator, with marble switchboard, containing the necessary instruments for the generator. When this generator is installed the T. Eaton Co. will have three 130 k.w. generators, and two 50 k.w. generators of the Canadian General Electric Company's well known direct connected direct current lighting generators.

E. S. Jenison is promoting a scheme of power development on the Kaministiquia river to supply Port Arthur, Ont., and Fort William. The proposal is to build a water-power canal from above the Ecarte Falls on the Kaministiquia river to the boundary of Port Arthur, where a storage reservoir will be built. The water will be delivered with 300 feet head. The intention is that the towns of Port Arthur and Fort William shall get their water supply from this source, which will likewise give them a fire pressure by gravitation. Both towns are to be supplied with water sufficient to generate electricity to supply the Port Arthur electric railway, and the lighting plants. The company is to have the right to furnish water-power, compressed air, and electric power to the manufacturing institutions in the two towns.

The Canadian Oiled Clothing Company, Toronto, has recently found it necessary to increase its factory premises, and has removed from Port Hope, Ont., to Toronto. An order has been given to the Canadian General Electric Company for the installation of a 100 light incandescent lighting dynamo.

The Hamilton Blast Furnace Company, Hamilton, Ont., has given a contract to the Canadian General Electric Company for the installation of a 150 light incandescent dynamo with switchboard and the necessary instruments, and is also having the factory wired up for the use of incandescent lights and long burning direct-current arc lamps.

An evidence of the improvement in business conditions attending the manufacturing and other interests throughout Canada is markedly indicated by the large number of isolated electric lighting plants being installed this season and the many increases in the generating capacity for both lighting and power work, which are being made in central station plants.

D. A. Gordon, Wallaceburg, Ont., who has secured a franchise for the installation of an incandescent electric lighting plant in the town of Tweed, Ont., has recently given an order to the Canadian General Electric Company for one of their 500 light single phase alternators. The order also includes the necessary material for the erection of a complete lighting plant.

Jay P. Graves, manager of the Big Three Gold Mine Company, Rossland, B. C., has just placed an order with the Canadian General Electric Company for a 75 k.w. synchronous motor. This motor is to be used in the development of the mine at Rossland, and the current for its operation will be derived from the power circuits of the West Kootenay Power & Light Company.

Judge Tellier has recently rendered judgment in the case of Mrs. Dominica Delvero against the Montreal Park and Island Railway Company. The plaintiff, who resides in Italy, claimed, in her name, and in the name of her five children, $5,000 damages on account of the death of her husband, who was killed while working in the service of the defendant company. Delvero was employed with a gang of other men in the construction of one of the company's lines. A platform car was used to carry rails from one point to another, and the men were in the habit, although against the rules, of getting on this car and allowing it to slide down the grade, when going for rails. On the day when the accident occurred, a big branch had been cut down from a tree, and was lying across the track, and as the men coming down on the platform car could not prevent a collision, having no brake, they jumped off. In doing so, Delvero sustained injuries from which he died two days after. His widow then took out the present action. In rendering judgment, the Court held that it had not been proved that the deceased had been made aware of the rule forbidding the men to get on the platform car. Moreover, this order seemed to be pretty much a dead letter, and the use of the car for the convenience of the men themselves seemed to have been tolerated. Under these circumstances the company must be held responsible for the accident. In the absence of sufficient proof, the Court assessed the damage at $1,000 and rendered judgment in favor of the plaintiff for that amount.

Mining Matters.

The Canadian Gold Fields Co., Deloro, Ont., has ordered a 50-h.p. tandem compound engine from the Robb Engineering Co., Amherst, N. S.

Notwithstanding the closing down of the mines on Labor Day the ore shipments from Rossland, B. C., for the week were very heavy— Le Roi, 2,277 tons, War Eagle, 1,233; Iron Mask, 66.

H. H. Eames' process for treating arsenical ores was tested at Actinolite, Ont. The experiment is said to have proved a success and the results are so satisfactory that operations will be immediately commenced on an extensive scale.

A. E. Carpenter, Hamilton, and Jno. Patterson, are developing a mine of magnetic iron ore on the Kingston and Pembroke. W. G. Walton, Hamilton, Ont., has also discovered a vein of magnetic ore. Both have been tested and favorably reported on by the experts of the Hamilton, Ont., Blast Furnace Co.

Rich finds of gold are reported from the Hootalinqua River, Yukon Territory.

There is considerable excitement in British Columbia over a find of placer gravel on Rover Creek near Slocan Junction. Gravel is said to have been found giving 75 cents to the pan, and during the first day or two after the discovery no less than eleven claims were located.

Andrew Bell, C. E., Almonte, Ont., has prospectors at work in the iron mining regions of Darling, Lanark county, Ont., and is preparing a map, showing the sections which are of value, with the ultimate object of shipping the ore to the new smelting works at Deseronto, Ont.

The recent discoveries of hematite in the Madoc district, Hastings county, Ontario, have led to a proposal to re-open the G. T. R. branch line from Madoc to the C. O. R., which has been disused since the Wallbridge mine, in the neighborhood of the recently discovered mines, became exhausted.

Zinc is advancing from $30 to $33 per ton, coming within $1 of the highest price on record, which was reached a month ago. The present advance is attributed to the increasing demands for zinc ore. New mines are being opened all over the districts and many old abandoned mines are again being worked.

The Bruce Mines, Ont., the great copper property out of which $1,000,000 worth of metal was formerly taken, has been purchased and paid for by a syndicate formed by Lord Douglas of Hawick. The work has been pronounced by experts to be sufficient to demonstrate the fact that very large and rich copper veins run from Bruce Mines in a northwesterly direction towards Lake Desbarats.

At a meeting of the Board of the Iron Miners' Association of Ontario, held recently, R. C. Clute, Q. C., was elected president in the place of Hon. Senator McLaren, who could no longer continue to perform the duties of the office. Mr. Clute is interested in one of the few Ontario mines that have done an export trade, but it is closed at present on account of lack of transportation facilities. The secretary of the association reports that almost daily enquiries are being received from Great Britain as to the prospects of iron mining here and our ability to supply the British market. He also reports that mining properties are in more active demand and several fine properties have recently been acquired by members of the association.

The new Atlin gold fields in British Columbia are said to be more extensive than those of the Klondyke. No creeks as rich as El Dorado have been found, but on six or seven creeks claims are paying $20 per day per man, above expenses. The results are being obtained above bedrock, which has been reached only in few instances. Since July mining has been in progress on Pine and Spruce creeks, emptying into Lake Atlin. Within the last few weeks rich discoveries have been made on Boulde or Musket Wright, Birch, Moose and Surething creeks, and on large glacial moraines. Near Pine Creek wonderfully rich bench claims are being opened on moraines, which are the piles of gravel and sand brought down by the glaciers from the higher ground.

Though it might be very unwise to place too implicit reliance upon the reported extent and value of the recent gold find in Queen Charlotte Islands, of British Columbia, yet it is well to recall the fact that the first authenticated discovery of gold within the limit of what is now the Province of British Columbia occurred at Mitchell's, or Gold Harbor, on the west coast of these islands, in 1857. According to Dr. Dawson, at least $20,000 worth of gold was obtained at this point, but the amount has been estimated as high as $75,000. The same authority states that no paying gold placers have been discovered on the islands, but the precious metal has been found not merely in the nugget form, but existing in numerous quartz veins of small extent in various localities. It is also present in fine scales in deposits of magnetic iron ore, in the neighborhood of Cape Fife. As a matter of fact, the mineral producing possibilities of these islands cannot be regarded as satisfactorily ascertained.

A tunnel 3,000 feet long is to be driven on the Columbia & Western railway, now a part of the Canadian Pacific system, about three miles from Brooklyn, B. C., and at an altitude of about 2,000 feet above the Columbia river. Its dimensions are 3,000 feet long, 21 feet high and 16 feet in width, and it will require the excavation of about 28,000 cubic yards or 85,000 tons of syenite, which is the prevailing rock of the mountain. It

will take about ten months to drive this tunnel, although the other portion of the line will be completed before that time. During the driving of the tunnel, trains will be transported over the divide by means of a series of ten switchbacks, which will be abandoned when the tunnel is completed. McLean Bros have the contract under Mann, Foley & Larson, and have purchased a large Ingersoll Sergeant plant from the James Cooper Manufacturing company of Montreal, consisting of two large compressors, 14 air drills, boilers, pipe line, etc., the cost of which when installed will be about $22,000. The tunnel will be driven from both ends and the driving should progress at the rate of from 8 to 10 feet per day on each end.

The Regina mine in the Rainy River district, which is owned by a close English corporation of which Sir Henry Wilkinson is the head, is the deepest mine in Ontario, the main shaft being down 434 feet. In addition to the shaft, says The Rat Portage Miner, the mine has over 2,000 feet of drifting, the longest drift being 400 feet. On the seventh level drifts are being run on each side of the shaft, and at present both heads are in fair ore. The bottom of the shaft was in good ore, when sinking was discontinued for the present, as ground enough is now opened to keep the mill running for a long time. A drift is being run under the lake on the sixth north level with good success. Stoping is now being done on the upper levels, and last week some phenomenally rich stuff was struck. The company have recently put in a battery of seven Tremain stamp mills, equal to about 35 stamps of the gravity pattern, which supplanted the old 10-stamp mill. The new plant is said to be giving good satisfaction, and is treating from 1,800 to 2,000 tons of ore a month. The production of gold bullion, while not stated, is said to be entirely satisfactory to the owners, and the mine is on a paying basis. A considerable percentage of the ore is of the concentrating quality, which condition has necessitated the putting in of concentrating machinery, consisting of two 3 compound Hartz gigs, which do very good work. The mine is also equipped with a 16-drill Ingersoll-Sergeant compound condensing compressor plant. The shaft is simply a development shaft, and the company now think that in a very short time they will sink a new vertical and permanent shaft, which will mean the expenditure of many thousand dollars, but the output of the mine warrants the undertaking.

Brief, but Interesting.

A new and highly important invention was tested at the German manoeuvres this autumn. It was in the shape of a Greek Phoenician fire, invented by a Berlin engineer. It ignites on contact with the air or water and cannot be quenched by either water or other things. It burns with a brilliant flame, and it can be sunk under water or under ground and when brought to the surface instantly bursts into flame at any desired point. It was tested during the night, off the island of Heligoland and off Kiel and proved most efficient in detecting the presence of the enemy.

At the annual conference of the Association of Municipal and County Engineers in Edinburgh, a short time ago, Donald Cameron, city surveyor of Exeter, Eng., the inventor of the septic tank system of sewage treatment, read a paper, in which he said that one of the most notable points observed in the Exeter tank had been the hitherto unrecognized energy stored in sewage, as evidenced by the production of marsh gas. The works and public paths adjoining Exeter had been lit with the gas. He had not had more than ten such lights burning at one time, but it was apparent, even under the conditions of leakage existing, that more than twice this number could be kept constantly alight, and this estimate was made during the cold, wet weather of last winter. The gas was innocuous, and could only be detected ordinarily by applying a light.

It now appears that some bodies, even without special stimulation, are capable of giving out rays closely allied, if not in some cases identical, with the Roentgen. Uranium and thorium compounds are of this character, and it would almost seem from the important researches of Dr. Russell that this ray-emitting power may be a general property of matter, for he has shown that nearly every substance is capable of affecting the photographic plate if exposed in darkness for sufficient time. No other source for Roentgen rays but the Crookes tube has yet been discovered, but rays of kindred sorts are recognized. The Becquerel rays, emitted by uranium and its compounds, have now found their companions in rays—discovered almost simultaneously by Curie and Schmidt—emitted by thorium and its compounds. The thorium rays affect photographic plates through screens of paper or aluminum, and are absorbed by metals and other dense bodies. They ionise the air, making it an electrical conductor, and they can be refracted and probably reflected, at least diffusively. Unlike uranium rays, they are not polarized by transmission through tourmaline, therefore resembling in this respect the Roentgen rays. Quite recently M. and Mme. Curie have announced a discovery which, if confirmed, cannot fail to assist the investigation of this obscure branch of physics. They have brought to notice a new constituent of the uranium mineral pitch-blende which in a 400-fold degree possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body, to which the discoverers have given the name of Polonium, needs neither the excitation of light nor the stimulus of electricity; like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount. It has long been to me a haunting problem how to reconcile this apparently boundless outpour of energy with accepted canons. But as Dr. Johnstone Stoney reminds me, the resources of molecular movements are far from exhausted. There are many stores of energy in nature that may be drawn on by properly constituted bodies without very obvious cause. Some time since I drew attention to the enormous amount of locked-up energy in the ether; nearer our experimental grasp are the motions of the atoms and molecules, and it is not difficult mentally so to modify Maxwell's demons as to reduce them to the level of an inflexible law and thus bring them within the ken of the philosopher in search of a new tool.

The "gold from sea water" enterprise of the Electrolytic Marine Salts Co., of North Lubec, Me., has suspended operations and the "inventor" of the process and manager of the company, "Rev." P. F. Jernegan, has absconded, it is reported in The Engineering News, after having received $338,000 of the "profits," which were derived not from sea water but from the stockholders. He sailed for Europe under an assumed name after having converted about $100,000 cash into government bonds in New York city, and his arrival at Havre on his way to Paris has been reported by cable. Steps have been taken to have him shadowed by detectives in France until papers can be sent charging him with embezzlement, on which his extradition may be secured. It is said that about $300,000 out of the $10,000,000 capital stock of the company was subscribed for in Newburyport, Mass., by bank directors and leading business men, who were led to subscribe through their confidence in the judgment of A. P. Sawyer, a local capitalist, and W. R. Usher, a large shoe manufacturer of that city, both of whom were directors in the company. One report says that $2,400,000 of the stock has been sold at par, that 45 per cent. of the money received went to the promoters, 20 per cent. to the "financial agents," and the remaining 35 per cent. into working capital, some of which was expended in the construction of the works at North Lubec, upon which 600 men have been engaged. The New York Herald of July 31 gives an interesting account of the preliminary experiments of the "inventor," near Providence, R. I., by which he obtained his first contributions of capital. It appears that a small shed was built at the extremity of a long slender wharf projecting from the shore of Narragansett Bay, and through a hole in the floor there was lowered by means of a windlass a large box containing a pan of mercury. An electric battery supplied by the "inventor" was applied during a whole night in the presence of some capitalists from Middletown, Conn., who had brought with them the mercury. The next morning the mercury was lifted from the water and given to a chemist who assayed it, and found in it $4.50 of gold, and thereupon the capitalists, much pleased, paid the first instalment on their investment. The deception in the experiment, according to the detective, consisted in a diver's proceeding under water during the night to the box, pouring out the mercury, and substituting for it another lot of mercury containing gold. Upon this basis was floated the $10,000,000 company. Its suc-

cess in obtaining gold at North Lubec was attested by its sending frequently to the New York Assay office "gold bricks" containing each about $2,000 of gold, and the exhibition of similar bricks at the company's office in Boston. The "gold from sea-water" scheme thus appears to have been one of the most gigantic swindles of recent years. It was similar in many respects to the Electric Sugar Refining swindle in New York city in 1884, by which many prominent business men, including even sugar refiners, were victimized. One of the operators in that scheme was convicted and sentenced to nine and a half years' imprisonment. It is to be hoped that a like fate will meet the Rev. Jernegan and his accomplices.

Railway Matters.

Truro, N.S., has voted $30,000 to the Midland Railway Co., on condition that the road enter Truro by way of Clifton instead of joining the C. P. R. at Brookfield,

The surveyors engaged in locating the Southeastern Railway have reached the War Road harbor in Minnesota, and expect to be at Rainy River within five weeks.

The contract for the superstructure which is required to permit the removal of the obstruction at the Sault Ste. Marie canal has been awarded to the Dominion Bridge Company.

Emile and Jean Stehelin, proprietors of the Weymouth and New France Railway, Digby county, have ordered another locomotive from the Robb Eng. Co., Amherst, N. S., for their pole railway.

Arthur White, assistant general freight agent of the G. T. R., has recently inspected the disused Madoc and Eldorado branch of the Grand Trunk, and states that the company will not reopen it to aid the development of iron mines unless they can obtain Government assistance. The line has been closed for years, and will require a good deal of reconstruction.

The C. P. R. is building at Calgary, N. W. T., the following buildings: An engine house to hold twelve locomotives, machine shop, car shop, blacksmith shop, stores building, coal pockets, ash pits and turntable. All the buildings will be of Calgary sandstone. The machine shop and car shop will be 200 feet by 66 feet, the blacksmith shop 60x66 feet, and stores building 24x30 feet.

The Grand Trunk Railway Company has recently added to its new equipment four baggage cars, 60 feet in length, and a large number of new refrigerator cars on the well-known Wicke's patents for refrigerator cars. The cars are about thirty-five feet long, and thirteen feet high, with a carrying capacity of 60,000 lbs. each. They are also equipped with automatic draw-bars, and Westinghouse air brakes, and designed to run at a high rate of speed. The Wells and French Car Company, of Chicago, have just commenced the delivery to the Grand Trunk Railway of 500 new thirty-ton box cars, of the standard Grand Trunk design and finish.

The Kootenay Railway & Navigation Company is being floated in England, and has been formed to consolidate and extend the railway and steamboat service in British Columbia controlled by J. J. Hill. This company will acquire the Kaslo & Slocan railway and the steamers of the International Navigation & Trading Company, which at present run between Kaslo and Nelson and connect with the Spokane Falls & Northern Railway. A new line is to be built 53 miles long from the southern end of Kootenay Lake to meet the Great Northern at Bonner's Ferry, and the Northern Pacific at Sandpoint, and in future, it is said, the line of steamers will run from Kaslo to the southern end of Kootenay lake instead of to Nelson.

There have been some doubts as to whether the deepening of the St. Lawrence canals to 14 feet can be completed by the opening of navigation next year. In the mind of the canal experts here those doubts have now been set at rest. Collingwood Schreiber, the chief engineer of canals, returned recently from an inspection of the works, in company with Walter Shanly, C. E. The latter has been very skeptical up to date as to the early completion of the work. However, both these gentlemen state that they are satisfied that, if the present rate of progress is maintained during all the available time in the interim, the canals will be completed to a uniform depth of 14 feet by the opening of navigation next season. The only possibility of failure arises from the fact that the contractors may relax their energy.

The convention of railroad trackmen have elected the following officers: James Logan, Ottawa, president; J. Hogan, Ottawa, first vice-president; J. W. Trickey, Sudbury, second vice-president; H. F. McKinney, Hintonburg, recording secretary; J. Hogan, Ottawa, treasurer; W. Powell, Moncton, chaplain; A. Hawkins, Fletcher, guide; C. Noyes, Peterboro, sentinel.

The Grand Trunk Railway is said to have secured a contract for the transportation of a hundred thousand tons of steel plates from the Illinois Steel Company, Chicago. These plates are to be shipped to Belfast, Ireland, and are being brought to Midland, Ont., handed over to the Grand Trunk, and shipped to Montreal for export to Belfast.

Marine News.

H. McLennan, J. Crathern, G. Hyde, A. Kingman, H. E. Murray, Montreal, and A. Buntin, Toronto, have been incorporated as a steamship company doing business as the Beaver line; capital, $250,000.

J. T. Ha[illegible]n, H. M. Hart, G. Musgrave, C. W. Outhit, R. T. Fraine, T. Dixon, W. J. Butler, F. J. Phelan, L. Hart, W. N. Wickwire, J. A. Johnson, Halifax, N. S., have been incorporated as the Briardene Steamship Company, Ltd.; capital $60,000.

The special committee appointed by the Toronto City Council to report on the best means of providing communication between the city and the Island other than the present ferry service has decided on a chain ferry at the Queen's Wharf to cost $8,000.

At a meeting of the board of directors of the Richelieu & Ontario Navigation Co., held in Montreal, Sept. 7th, contracts for new boilers for several vessels of the fleet were awarded, and it was decided to build three additional steamers for next summer's business, two for the Montreal and Quebec route, to be built in Montreal, and a third boat for the western trade.

The last link between the Crow's Nest Pass Railway and Nelson, B. C., will be completed when the C. P. R. places upon the Kootenay lakes service a vessel specially adapted for the traffic. It will be of the enlarged tug type and very powerful. The length is 128 feet, 25 foot beam, and it is designed to draw 10¾ feet of water. The engines are compound jet condensing, and the cylinders 18 and 32 inches, with a 22-inch stroke. The reason for the exceptional power is that the new craft is to haul the car barges which will ply between Kushonook on the completion of the C. N. P. R. to that point and river points with terminal connections.

M. R. Davis, Kingston, Ont., will superintend the building of a new boat for Capt. D. Noonan. It will be a twin screw steamer, costing about $20,000, having thirty staterooms, and designed to carry about 300 passengers. It will be built at Westport, Ont., and is intended for service on the Rideau canal.

Midland, Ont., is doing a vastly improved business this season and is rapidly coming to the front as a lake port. The depth of water in the harbor admits vessels of deeper draught than can enter most lake ports, and early in the season the Superior City arrived at Midland from Chicago with a cargo of 266,550 bushels of corn. This enormous cargo was delivered in Montreal in 48 hours.

Work will soon be over for the season on the survey which is in progress for a canal line from Hungry Bay, on the St. Lawrence, to Lake Champlain. The United States Congress authorized a commission to report on the practicability of improved waterways between the Western States and the seaboard, which, after making a preliminary report, was authorized to go to the expense of surveys of every practicable route sufficiently full to base estimates of cost upon. This summer surveys have been in progress for a canal on the United States side between Lakes Erie and Ontario and between Lake Ontario and the Hudson river, and between Lake St. Francis and Lake Champlain.

The Government dredge Cape Breton is at work in the harbor of St. John, N. B. The construction of the deep water terminus for the I. C. R. is being pushed.

The Grand Trunk Railway Co. has a contract with the Leyland Line for a tri-weekly steamship service during the coming winter between Portland and Liverpool. Five of this company's vessels, which are now plying between Liverpool and New York, will be transferred to the Portland route. These vessels will replace the ships of the Dominion Line, which, last year gave the service between Liverpool and Portland. The new arrangements will come in force only next year, and, in the meantime, the Allan and Leyland lines will work together on that service. It is also reported that the Leyland line next summer will make an effort to retain the Canadian business secured during the winter months by running into Montreal instead of New York.

Personal

W. A. Clement, C. E., the Toronto city roadway engineer, is very seriously ill with typhoid fever.

Wm. Reid was accidentally killed by the fly wheel at the Metropolitan Rolling Mills, Montreal, last month.

F. R. F. Brown has opened an office at 22 Street Railway Chambers, Montreal, as a consulting mechanical engineer.

R. Barrow, son of the Hamilton, Ont., city engineer, has entered the engineering course at the School of Practical Science, Toronto.

James McKenna, a delegate to the firemen's convention in Toronto, was killed at Morrisburg, Sept. 10th, while attempting to board a moving train.

S. Aikens, fireman, was on Sept. 14th instantly killed by the explosion of a boiler in Frank Entrichen's brickyard on the 5th line of Zorra, Oxford county, Ontario.

James McArthur, land surveyor, Aylmer, Que., who was nearly boiled to death while taking a bath at Eastman's Springs, died a few days later. He was 78 years old.

N. Bruchesi, an engine driver on the Grand Trunk Railway, died suddenly in Montreal a short time ago. Mr. Bruchesi was the driver on the first engine that passed over the Canada Atlantic Railway.

Thos. Graham, proprietor of the Banner File works, Almonte, Ont., died at his home there. He was born in Ecclesfield, England, in 1834, and was twice married, being the father of twenty-one children. Mr. Graham was at one time at the head of a very large hand cutting file works in Toronto.

Dr. John Hopkinson, an English electrical engineer, and his son and two daughters have been killed, while ascending the Dents de Vaulion, in the Canton of Vallais, Switzerland. A summary of Dr. Hopkinson's report on the transmission of electric power from Niagara to Toronto was published in The Canadian Engineer some months ago.

C. H. Sutherland, a well-known draughtsman in the motive power department of the Grand Trunk Railway, died suddenly at his residence, Montreal, recently. He had not been in the best of health for some days, but no serious results were anticipated. Heart disease is supposed to have been the cause of death.

W. C. Clark, an engineer in the employ of the C. P. R., was found dead on the floor of his room at the village of Cedars, near Montreal, last month. He was partially dressed, and is supposed to have died while preparing for bed. He was 27 years of age. An inquest was held and a verdict returned of death from indigestion and cerebral congestion.

James Brown, C. E., died in Amherst, N. S., a short time ago, aged 57 years. Deceased was born in Aberdeen, Scotland, and came to this country in 1876. He was a practical engineer of great ability, and besides being for a term manager of the Londonderry mines, held responsible positions on the Intercolonial and Canadian Pacific railways, at Joggins Mines, Springhill, and Glace Bay. Mrs. Brown, who was Miss Sybella Gilbert, sister of Lord Belhaven, and one daughter, May, survive him.

Ed. Cooper, late manager and part proprietor of the Cooper Machine Co., Toronto, manufacturers of the Imperial Gas Engine, has taken a position as traveling representative of the Goldie & McCulloch Co., Galt, Ont.

While attempting to stop the fly wheel of a wood sawing machine, with a piece of wood, Peter Grice, Victoria, B. C., was instantly killed, death being caused by the fly wheel breaking, pieces of which penetrated the body, tearing out the heart and liver, both of which were afterwards picked up by the police.

The department of mathematics in McGill University will be strengthened by H. M. Tory's transference from the Physics Department, in which he has hitherto done part of his work; and he will be more at liberty, in the future, to undertake lecture and tutorial work in the first years of the mathematical curriculum. Mr. Tory's work in the physical laboratory will be taken over by R. O. King.

At the annual general meeting of the Great Northwestern Telegraph Company, Toronto, the following officers were elected: H. P. Dwight, president and general manager; Adam Brown, of Hamilton, vice-president; H. N. Baird, James Hedley A. S. Irving, W. C. Matthews, of Toronto, Richard Fuller, of Hamilton, Hon. William McDougall, C. B., of Ottawa, and Charles A. Tinker, of New York, directors; George D. Perry was reappointed secretary and auditor, and Arthur Cox, treasurer. The statement of the year's business showed a considerable improvement over the previous year, and the opinion was expressed that with the new connections and extensions of the company they might reasonably look for a still further improvement during the coming year.

Thomas Fuller, late chief architect of the Department of Public Works, died at his residence in Ottawa, Sept. 28th, aged 76. Mr. Fuller was born in Bath, Eng., and came to Canada in 1857. In 1859 in competition for parliament and departmental buildings, Ottawa, his design for the parliament building was adopted, and he was awarded second prize for his designs for departmental buildings, which included a residence for the Governor-General. Mr. Fuller superintended the erection of the parliament buildings. In 1867 he was the successful competitor for a design for the new capitol building for the State of New York at Albany, and removed to that city, where he superintended the erection of the building. In 1831 he returned to Canada, and was appointed chief architect of the Public Works Department, a position he held until about a year ago, when he was superannuated, but retained an advisory position in the department. His health has been failing for some time. Mr. Fuller was well-known throughout the whole of Canada, and has designed the greater number of all the public buildings erected in the last fifteen years.

Dr. James Wallace Walker, the new professor of organic chemistry at McGill University, was educated at the University of St. Andrews, Scotland, and graduated there as Master of Arts in 1889. After a short time spent in teaching mathematics at the Madras College, St. Andrews, he was appointed lecture assistant in chemistry at the university and afterwards engaged in original research in organic chemistry. In 1892 he entered the University of Leipsic, and was shortly afterwards elected to an 1851 Exhibition Scholarship. In Leipsic he studied chemistry in the laboratories of Professors Wislicenus and Ostwald and was awarded in 1896 the degree of Ph.D., with highest honors. On returning to England Dr. Walker worked for a short time in the laboratory of Professor Armstrong at the Central Technical College, in London, but soon afterwards, in 1896, was appointed lecturer in organic chemistry under Professor Ramsay, in University College, London, and was last year also appointed examiner in chemistry for the Arts, Science and Medical degrees at the University of St. Andrews. Dr. Walker has published the results of his researches in a number of papers. He is a clear and lucid lecturer and he has proved himself to be an attractive teacher, both with elementary and advanced students.

The Board of Governors of McGill University has appointed Professor R. B. Owens, E.E., of the University of the State of Nebraska, to the W. C. McDonald chair of electric engineering at McGill University, lately held by Professor Carus Wilson. Professor Owens is a native of Maryland, and was educated at Johns Hopkins University, Baltimore, obtaining a high standing in mathematics and physics. Proceeding from Johns Hopkins University to Columbia University, he

there obtained in 1891 the post-graduate degree of E.E. In the intervals of his college course the young student acquired a fund of practical knowledge with several well-known electrical companies. Shortly after receiving his degree Mr Owens was appointed assistant professor of electrical engineering in the University of Nebraska, and in 1894 he was made professor. In the meantime he served as one of the judges of electrical exhibits at the World's Fair. Professor Owens has recently been elected to a Tyndall fellowship by Columbia University, and was director of the Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the Council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of electrical engineers. He has contributed important articles to engineering societies and to the electrical press on the subject of Electricity and of Technical Education.

Prof. Ernest Rutherford, who has been appointed to the W. C. McDonald chair of physics in McGill University, recently vacated by Prof. Callendar, was a student at Canterbury College, Christchurch, New Zealand, for five years, obtaining the degree of B.A. in the University of New Zealand, in 1892; the degree of M. A. by examination in 1893, with double first-class honors in mathematics and physical science; and the degree of B.Sc. in 1894. During 1894 and 1895 he was engaged in research work, and in the latter year was awarded an 1851 Exhibition Science Scholarship to enable him to continue his researches in England. Proceeding to Cambridge, he has carried on investigations in experimental physics in the Cavendish Laboratory for the past three years under the direction of Prof. J. J. Thomson, and in June, 1897, was awarded the degree of B.A., and in the following December the Coutts-Trotter Studentship, in recognition of his researches. Prof. Rutherford's experience in teaching has been gained in New Zealand and by acting as demonstrator of physics in the Cavendish Laboratory. In addition to a research upon Uranium and Thorium Radiation, which has occupied his attention during the past year, Prof. Rutherford has completed several important researches. Among them may be mentioned: An investigation on the use of a magnetic detector for the investigation of electrical waves; with this detector he was able to send signals by means of electric waves, and without wires, across about ¾ of a mile of the mostly densely-populated part of Cambridge. This was done nearly three years ago, and before the recent attempts at wireless telegraphy. A series of papers in The Philosophical Magazine, on the electric properties of gases under the influence of Roentgen rays, Uranium rays, and ultra-violet light. These papers are characterized by Prof. Thomson as being distinguished by the importance of the results obtained by the ingenuity displayed in the design of the apparatus, and by the grasp of the physical principles shown in the interpretation of the results. Prof. Rutherford's work is well known on the Continent of Europe as well as in England.

LITERARY NOTES.

The October number of The Canadian Magazine maintains the standard of that publication. The brilliantly and artistically colored cover announces seven short stories and seven leading articles. These are duly found within, together with a couple of poems by Canadian writers.

The C. W. Hunt Company, West New Brighton, N. Y., has just issued three new catalogues from the press. They are: No. 9,805—"Industrial" Railways; No. 9,807—Mast and Gaff Fittings, Coal Tubs, Hoisting Blocks, Wheelbarrows; No. 9,811—Manila Rope for Hoisting and Power Transmission.

The Canadian General Electric Co. has just issued a catalogue, which is neat and attractive in a high degree. The different departments are fully taken up and the various apparatus fully described. Among other interesting features of this catalogue is the department devoted to electric heating. There are innumerable appliances which are for the comfort of mankind, from flat irons to chafing dishes, and are fully described and illustrated.

The Street Railway Journal for September, 1898, is largely devoted to matters of interest to the delegates to the fifteenth annual convention of the American Street Railway Association, held in Boston, September 6th to 9th. The street railways of Boston are fully described. From cover to cover the issue is a triumph of journalism. From a business standpoint the 284 pages of advertisements are sufficient tribute to the skill and success of the management, while the 119 pages of reading matter are contributed by the most able writers and are magnificently illustrated. The full report of the proceedings of the convention is found in the October number of the Journal.

Hand-book of Corliss Steam Engines, by F. W. Shillitto, jr., is a very interesting and instructive work of over two hundred pages, which describes in a comprehensive manner the erection of engines, the adjustment of the Corliss valve gear, and the care and management of Corliss steam engines. Under the head of erecting the following subjects each receive discussion in a separate chapter: Preparing foundations, reference lines for locating, templates, foundations, placing main parts in position, lining and leveling, assembling the moving parts. Under the head adjusting Corliss valves the following chapters are found: The valves, valve gears, squaring the valves, dash pot rods, eccentric rod, rocker arm and reach rod, centring the engine, setting the eccentric, adjusting the governor, indicator diagrams, a few pointers on double ported valve and long range cut-off, tables and memoranda, etc., as well as seven chapters describing different varieties of the Corliss engine.

THE DISPOSAL OF SEWAGE IN EUROPE.

At the meeting of the American Public Health Association recently held in Ottawa, Thomas Macfarlane, chief analyst, Inland Revenue Department, read a paper entitled, Remarks on the Systems of Refuse Disposal in Various European Cities. The cities in question were London, Birmingham, Manchester, Oldham, Rochdale, Glasgow, Hawick, Berlin, Leipsic, Freiberg, Bremen and Braunschweig, all of which the author visited in the summer of 1896. The essential features were described of the ten different systems of disposal in use in these cities, and their disadvantages and merits were commented on from the point of view of the agricultural chemist. Nearly all of these systems leave a great deal to be desired, and Mr. Macfarlane tries to indicate the direction in which he thinks improvement would be possible. In large cities where access to the sea is impossible, and where the water carriage system for excreta has been adopted, it is suggested that storm and surface water should be excluded from the sewage, thorough comminution effected of the solids in the latter, and utilization of the fertilizing constituents on sewage farms of sufficient extent. For other cities, towns and villages the author recommends the introduction of the Mop-Litter system as practiced in Bremen, and other German towns. As examples in Canada of these two methods of treatment it is pointed out that the first is in use at the asylum for the insane in London, Ont., and the second at Grand Hotel, Caledonia Springs.

EUROPEAN METHODS OF TESTING SEWER PIPES OF CEMENT AND CLAY.

The International Association for the Testing of Materials, in 1896, appointed a committee to investigate the methods of testing sewer-pipes of cement and clay, as up to that time there had been no uniform method of testing, and practice varied widely. Mr. Gary, chief of the section for the tests of materials, at the test laboratory at Charlottenburg, was directed to take charge of this investigation, and his preliminary report is published in "Les Materiaux de Construction," Nos. 23, 24, the official organ of the association. Mr. Gary, in 1895, had already investigated, for the German Association of Manufacturers of Portland Cement, the methods employed by governments, municipalities and individuals in testing the strength of cement pipes. He found that these tests varied in each case, and none were regarded as complete for the purpose intended. Similar conditions existed in other countries than Germany.

In the investigation to be made Mr. Gary concluded that the points to be determined were as follows: The resistance to internal and external pressure; impermeability; resistance to the attack of acids; and the wear upon the interior by sand passing with the water. The tests should then mainly determine the bursting and crushing strength, and the texture and

composition of the paste used. The resistance to exterior pressure is the most important property in a cement or clay pipe; for, with a few exceptions, such pipes are simply covered with earth or sand, and are not placed in masonry. The pressure upon them will differ as these pipes are laid under traveled streets, under railway embankments, or under the foundation walls of buildings; and it is necessary, in passing judgment upon the fitness of these pipes, to distinguish between the loads to which they are to be subjected in use. Mr. Gary then details the practice of a number of German cities in the test of cement pipe, as follows. The Department of Public Works of Liegnitz requires that a cement pipe one meter (3.28 feet) diameter should resist the pressure of a layer of earth 3 meters (9.84 feet) thick; at Rosenheim, pipes covered with 12 to 16 inches of earth should resist the pressure of a heavy vehicle; and at Colmar, when there is any doubt of the solidity of a pipe, a loaded wagon is passed over the laid pipe. At Schwerin, in Mecklenburg, cement pipes must resist, without cracking, a pressure equal to 50 kilograms per linear meter and per centimeter of diameter. This test is made by placing railway rails on the top of the uncovered pipe. The city of Freysing prescribes that the pipe should support a "load of 6,000 kilos, concentrated upon the top of the pipe," and Passau demands that the pipe resist a pressure of 895 lbs. per lineal foot. At Zeitz, where the pipes are buried 6 to 8 feet beneath the surface, a steam road roller is passed over them before acceptance. Clay pipes, 1 meter diameter, have been tested at Mannheim, by burying them in the earth, with a covering layer about 18 inches thick. Over the pipe was then placed a double plank platform, about 3 inches thick in all, and 3.28 feet square, and on this was placed the test load. The rupturing load was found to be about 28,600 lbs.

For the test pipes of "armed-cement," or cement reinforced by a double iron mesh on the Zisseler system, the engineer of bridges, at Breme, prescribes the following test: The pipe is buried in sand in a solid wooden box, then by means of a cover fitting inside the box a pressure of 7,500 kilos. per running meter, or about 500 lbs. per lineal foot, is applied to the pipe. The pipe is required to stand this pressure without deformation or cracking. For pipes of oval section, 120x95 cm., and sides 6.5 cm. thick, armed with three layers of metallic mesh, a uniform load of 9,000 kilos. per meter, or a little over 600 lbs. per foot is prescribed. At the Hague the resistance of beton pipes is determined by placing them in a trench and then loading them uniformly on the square meter of horizontal projection. One pipe in each 50 is submitted to this test; and this load is carried up to 12,000 kilos. for pipes 1.5x1 m. and 1.2x0.8 m. At Copenhagen, Emanuel Jensen employs a process for testing pipes of clay and of "armed cement" which has given very satisfactory results. A heavy timber is embedded in the soil carrying upon one end a heavy counterweight of cement, and near this are two bars of iron, pierced with holes, attached to the sides of the timber. The pipe to be tested is placed in a strong wooden box, nearly filled with sand, and resting upon the timber, and pressure is applied to it by a lever and saddle with the lever support on a pin passing through the holes in the iron bars. The advantage of this process is that the commencement of cracking in the pipe can be noted; though this is of little advantage in the test of clay pipes, as after the appearance of the first crack the pipe will support but little more. But in the case of the Monier and Zisseler construction, where the iron skeleton augments the cohesion of the material, the appearance of the first fissure precedes by some time the final crushing load.

At the test laboratory at Malines, the resistance of pipes to exterior pressure is tested by a Kirkaldy machine; the pipe being placed between two wooden saddles which each embrace one-third of the circumference of the pipe. But as it is difficult to insure contact with all the inequalities of the pipe, the process is not satisfactory. From the report of Mr. Gary it seems, The Engineering News concludes, that about the only sewer pipe tests so far employed relate to the resistance against exterior pressure; and he well remarks that a uniform, systematic and reasonable test of sewer pipe, of various materials, has yet to be devised; or at least, to be introduced, into general practice.

—A valuable product for the color industry is the soot of acetylene flames. It is absolutely black without any tinge of brown, and has very little weight. By reason of its bulk it is specially fitted for India ink as well as for colors used in printing and photography. No tarry admixtures, or other substances contained in lampblack, are found in it, and the yield when acetylene is burned with a smoking flame is three to four times as large as from the same quantity of mineral oil. A Frenchman has recently secured a patent on three methods for producing the color.

FIRES OF THE MONTH.

Sept. 6th. The new mill of the estate Masson at Terrebonne, Que., was destroyed, together with a grist mill, and the Terrebonne Electric Light Co.'s plant; loss, estate Masson, $10,000; fully insured; Electric Light Co., $1,500, insurance, $700.——Sept. 13th. D. A. Ghent's carriage factory, Burlington, Ont.; loss, $8,000.——Sept. 15th. The Belleville, Ont., Gas Works were damaged to the extent of $500.——Sept. 16th. The Montreal Street Railway Co.'s car sheds; damages, $200,000; fully insured.——Sept. 18th. W. G. Harris' mill stock and metal premises, Toronto, were burned down; loss, $8,000.