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The Canadian Engineer

VOL. VII.—No. 2. TORONTO AND MONTREAL, JUNE, 1899. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

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

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.
OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,
E. B. BIGGAR, R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.
Toronto Telephone, 1392. Montreal Telephone, 2589.

UNITED STATES AGENT:
H. E. BURNETTE, Cor. Fourth and Locust Sts., Philadelphia.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

THE BEGINNINGS OF THE ST. LAWRENCE ROUTE.*

(Continued from last issue).

The first canals of Canada were constructed for military purposes, and by royal engineers. They were the direct result of the American Revolution. During this war there were about six thousand troops in the Great-lake region who depended upon Montreal for supplies, no fewer than 670 boats being required to transport provisions in six months. These batteaux sailed in brigades of ten or a dozen to aid one another in surmounting the sluicing cataracts of the upper St. Lawrence, particularly the Long Sault, which required an entire day to ascend. This was an object lesson not lost upon the authorities, and improvements were begun at these rapids in 1779 by Captain Twiss, R.E. The first canal was begun at Coteau du Lac, the first plan being to make the lock walls of timber, but they were subsequently made of masonry. It was begun in 1779 and completed by 25th October, 1780, with three locks and iron flood gates. The locks were forty feet long, six feet wide and less than thirty inches of water covered the sills. It would have been useless to make them deeper without undertaking a much greater length of canal Mr. de Longueuil, who had built a mill a little above the Cascades, had thereby somewhat improved navigation, but Captain Twiss further improved the canal here, which was designed merely to overcome the current, and he was shrewd enough to make Mr. de Longueuil defray part of the expenses. In 1781 work was begun on canals at the Cascades and Cedars, and the Split Rock channel was deepened. Cornish miners were employed upon the various rock cuttings and blasting work, which was carried on in various dangerous places throughout the series of rapids, dangerous rocks being blown to atoms. The Cascades Canal was at Cascades Point, where a shallow and rapid channel discharges from the St. Lawrence into the Ottawa, known as Les Faucilles, between the main river and Ile le Moyle. It was a batteau canal with two locks, and about 200 yards long. The Split Rock Canal was at a point where the current is greatly accelerated by the projection into the stream of Point au Buisson, on the southern bank. The remains of this lock are still to be seen.

These canals were all batteau canals. The batteau had about the dimensions of the Venetian gondola, but there the resemblance ended. It was built of pine wood, about 5½ feet beam, 35 feet long, was flat bottomed, pointed at both ends, and drew very little water. A batteau containing 25 persons, their baggage and 25 barrels of flour is said by a traveler of the time to have drawn only eight inches. But this must have been a very large batteau, as the average batteau load was 30 barrels of flour and the crew of four or five men. When these canals were constructed the annual traffic on the upper St. Lawrence to Carleton Island amounted to from 240 to 320 batteaux. On the completion of the Coteau du Lac Canal, Twiss imposed, with the cordial consent of the merchants, a toll of ten shillings currency per batteau, increased to twenty-five shillings when the series of canals was completed. Ten barrels of flour being reckoned as a ton, we find that the early canal tolls were $1.66 per ton. The present rate on the Beauharnois Canal, which replaces these canals, is $0.15 per ton.

The canals remained in this condition until 1800, after the formation of Upper Canada, which took place in 1793. The effect of the improvement in the rapids is well shown by the toll receipts, although we must not forget that Upper Canada was being rapidly populated by exiled United Empire Loyalists. In 1781 some 263 batteaux, two canoes and one boat used the Coteau Canal. The tolls for a time declined, probably because no ships were permitted upon the Great Lakes except the King's vessels, but subsequently increased and in 1799 were double what they had been in 1795. By 1800 the traffic was so great that improvements were demanded, and although to detail these here is to trespass upon our third period, it may be well to do so and complete the history of canals at this point prior to the Union. In 1800, Col. Gother Mann proposed to increase the capacity of these canals. The Coteau Canal was to be widened to 9½ feet in the lock gates, the lock itself to be widened four feet and the canal prism two feet. This would make the locks ten feet wide, and the dimensions are from the report of our Archivist, although Mr. Keefer in his admirable monograph on the canals of Canada states that they were enlarged to twelve

*Abridged by the author, Arthur Weir, B.Sc., from a lecture delivered before the Applied Science students of McGill University, Montreal, January, 1899, and published exclusively in THE CANADIAN ENGINEER.

feet. So also the two differ as to the length of the locks, which Mr. Keefer places at 110 feet and Dr. Brymner at 120 feet, the first probably allowing for the opening of the gates. Col. Mann proposed to replace Mill rapid and Cascades canals by one canal across a neck of land from the St. Lawrence to the Ottawa about 900 yards above the Cascades, and 300 yards wide. His suggestions were accepted and work was commenced, the work being completed by 1805. Old documents enable us to estimate the depth of the enlarged canals at 3½ feet, and Mr. Keefer places them at four feet. Rock cutting was here encountered, the first of importance since the ill fated French Lachine Canal.

The Durham boat was introduced after the war of 1812, and compared with its predecessors it was a leviathan. How the habitant must have swelled with pride to see a ship ascend the St. Lawrence with ten times the capacity of the early batteau. The Durham boat was flat bottomed, with keel and centreboard, rounded in the bow and decked at bow and stern with a wide gunwale running its entire length for purposes of poling. Its capacity was 350 barrels of flour, or 35 tons. To accommodate these vessels it was necessary to further enlarge the canals in 1817, to 12 feet between the gates. By that time nearly 900 batteaux passed the canals annually, and in 1833 some 863 batteaux and 612 Durham boats carried the trade of the Upper St. Lawrence. In early days the western country had to be fed from the east. Where now waves the golden wheat of Manitoba the traders were exposed to starvation if the supply boats did not arrive at the grand portage in due season. The first shipment of wheat from Chicago did not take place until 1838. This must be borne in mind in connection with what I now propose to review, the struggle for supremacy on the Great Lakes between the navy and the fleets of commerce. Before describing this struggle, however, it will be desirable to review briefly the history of the great fur-trading days, in order to show the volume of commerce that depended upon the result.

In 1802 the Montreal North-West Fur Company had 117 trading posts, 20 partners, 161 clerks and interpreters, 877 common employees in addition to 100 free hunters and 540 canoe men on the Ottawa. The London sales of 1801 were £371,139 stg. and they paid £22,000 stg. in duties. In 1780, according to Charles Grant, the trade from Montreal was from 90 to 100 canoes, and the furs brought down were estimated at £200,000, or $8 per capita of the population. Each canoe load cost £300 stg. in England. The freight charges across the Atlantic were fifty per cent. To transport it from Montreal to Machillimackinac cost fifty per cent. more on the original price, so that each canoe load was valued at over £700, much over $3,500 as compared with the present day; no inconsiderable treasure to trust to the rush of impetuous rapids day after day for weeks at a time. The work of the voyageur was highly specialized. His skill has not entirely passed from amongst us, but it is not now an integral portion of the trade of the day. He engaged as "devant" or in the bow, or Gouverneuil, that is as steersman, or if not quite so skilled as the others as milieu or in the midships seats. The pole was quite as much in vogue as the paddle, and anyone using it had to keep the bow true against the current or the boat would be swept round and capsized, perhaps where no man could fall and live.

In connection with cost of transportation I may say that the Hudson's Bay route was 25 per cent. cheaper to the interior in those early days, that is it was 75 per cent. of the original price. Some three hundred men were employed west of the carrying place, men who exposed themselves to hostile Indians, to rapids and starvation so keen that cannibalism was not unknown among them. They straggled from the peaks of the Rockies, from the shores of the Saskatchewan and from the far north, even from the Mackenzie River, back to the carrying place between 10th June and 10th July each year, laden with rich furs, but with scarcely a mouthful of food, and if the supply canoes were delayed the results were terrible to think of. It was this that made the conflict for supremacy upon the lakes so bitter, and which ultimately led to the triumph of the merchants.

In 1755 the British built two sloops at Oswego on Lake Ontario, naming them after lake and site respectively, and in the same year General Shirley placed a sloop and schooner, each of ninety tons, on the same lake in addition to a number of whale boats and galleys, which we might call batteaux. After the Conquest merchants began to establish themselves to tap the rich fur routes, and Oswego was for some years the most important fur trading post on the continent. The Lake Superior copper mines attracted the attention of English capitalists and in 1770-71 a sloop of forty tons was built at Point aux Pins and sailed to Ontenagon. There was no difficulty in opening up the fur trade, so far as navigation of the lakes was concerned until the outbreak of the United States revolution, almost immediately after which all private trade on the lakes was prohibited, and merchants' goods were permitted to be transported only on the king's ships. One may grumble, but should not unduly complain at the hardships which war imposes upon trade, and the merchants of Canada, while very much put out by the new regulation, bore it with some equanimity until peace was restored, but while the number of ships of the navy was reduced to two ships on each lake after the war, the authorities refused to accord the merchants their former rights of free navigation. Then the storm broke. The merchants did all in their power to make the authorities see reason. They even offered to have their vessels commanded by a navy officer and pay his salary. Haldimand, on the other hand, thought it sufficient to place a third war vessel on Lake Ontario and Lake Erie. It will save time to quote Haldimand's own words in connection with the matter:

"The navigation of the Great Lakes by the king's vessels only," he said, "is an object so nearly connected with the entire preservation of the fur trade, that I have withstood various applications for building and navigating private vessels and boats upon the lakes; the rivers and outlets from them to the American States are so numerous that no precautions which could be taken in that case, would be effectual in preventing a great part of the furs from going directly into the American States. . . . . I would therefore recommend by all means that a sufficient number of king's vessels be kept up on the lakes, and all other craft whatever prohibited not only for foregoing reasons, but in all events to preserve a superiority upon the waters of that country."

That sufficient of the king's ships were not kept up on the lakes is indicated by the fact that in 1784 the goods intended for the interior trade were so long delayed at Kingston and Niagara that they could not be sent forward, while on the 16th July, 1785, there was little, if anything, short of 100 batteaux loads of goods to cross Lake Erie, besides thirty or forty loads at Kingston. Some of these goods had been awaiting transport for twelve months. Benjamin Frobisher put the case of the merchants in a nutshell when he wrote, sending a memorial: "All the company (N.W. Fur Co.) wishes for is on any terms to be left to the management of its own business." The mer-

chants of Detroit (then under the British flag) declared that they were paying £3,700 stg. interest upon the goods detained at Carleton Island, and that the action of the Government would involve them in ruin. It required five years in those days to begin and complete a transaction in furs in Canada. The goods were ordered from England in one year, they came out the following year, went west the third year, the furs for which they were bartered reached Montreal in the fourth year and were sold in London in the fifth year, during all of which period interest was accumulating. An extra year's delay meant a great deal to the merchants, many of whom went into debt for their goods.

By 1785 a relaxation in the regulation was made by St Leger at Detroit, and merchant vessels were once more spreading their sails on the lakes in 1791. The "York," one of the pioneers of the now gigantic fleet, was launched at the mouth of the Niagara in 1792. One of the historic vessels of the lake trade was the "Beaver," built in Detroit in 1784. She was built for the navigation of Lake Superior, by the North-West Fur Company, but could not be got up the Sault Ste Marie. As the company declared that she was built at inconceivable cost ($7,374), and altogether looked upon her as a phenomenon, you may like to learn her dimensions. She was 34 feet long in the keel, 13 feet beam and 4 feet deep in the hold. On Lake Superior to-day are vessels exceeding 300 feet in keel length, 42 feet in the beam, and drawing 16 feet ; I am speaking of the "Pope," which has carried 126,000 bushels of corn, weighing 3,527 tons. In 1797, by the way, was launched the first United States vessel on Lake Erie, the "Washington," which was after one season bought by a Canadian, taken on wheels—you can imagine her size—around the Niagara Falls, and sailed for Kingston from Queenston in 1798 as the "Lady Washington."

Let us now pass to the consideration of the early coasting and foreign trade of Canada by way of the St. Lawrence. Quebec was then the metropolis, the great seaport. In its narrow streets the drunken sailor staggered, and the press gang snatched him from the siren's lure. Often the merchant vessels had to put to sea dangerously short-handed because His Majesty—God bless him—wanted sailors and took them when he would. The brandy dram of the Elizabethan age had now become rum. It was part of the wages of a sailor. Tommy Atkins must needs have rum also, and the roll of the kegs followed the roll of the drum into the western country, and hard pushed was often the commisariat to satisfy his wants.

(To be continued.)

CANADIAN NICKEL PRODUCTION.

The day has passed by in which the arguments of those who claim that Canada should be altogether, or even chiefly, an agricultural country are patiently listened to. Canada possesses natural resources which give her advantages in certain lines of production which are altogether beyond those usual in a young and partially developed community. In water power alone she possesses a weapon which in these days of electrical development should enable her to conquer a large place in the world's markets. When added to these we see her great wealth in minerals, timber and farm lands, we see how great are her claims to a large share of the world's wealth. There are however, certain other advantages possessed by Canada in which the rest of the world has no share and upon which it has no claim. In the nickel mines of Ontario lie not only vast prospective wealth, but a dominance in the steel industry which cannot be overthrown when once established.

What the resources of the nickel bearing belt are, we have ample evidence in the various publications of the Geological Survey and the Ontario Bureau of Mines, together with the innumerable reports of mining experts who have carefully examined these areas. We have also the statement of one of the chief proprietors of the Canadian Copper Company, (which is a United States monopoly absolutely controlling the Canadian nickel industry) to the United States Senate, that an import duty on Canadian nickel would ruin his very profitable business in New Jersey. In the face of these facts, why is it that Canada produces no refined nickel, that Canadian capitalists stand ready to invest millions in nickel refining, and that the Canadian Copper Company goes on buying up nickel areas and closing them up, binding the sellers in many cases not to engage in the industry within one hundred and fifty miles of Sudbury ?

The Canadian Government could end all this by an order-in-council imposing an export duty on Canadian nickel. The Government has power to issue this order by virtue of an act passed at the last session of the parliament with the hearty approval of both parties. Why is it not passed ? Have we a member of the Dominion cabinet who sits as representative of the Canadian Copper Company, and its parent company, the Standard Oil Company, as John Charlton sits on the International Commission to safeguard the interests of his fellow citizens of the United States, who are like him engaged in the timber trade in Michigan ? This cannot be so, yet the Standard Oil Company enjoys great mercies at the hands of the Dominion Government, including a monopoly of the Canadian oil trade, as absolute as its world-famous tyranny in the United States ; and the Canadian Copper Company pays millions of dollars to New Jersey workmen which should be distributed among Canadian artisans. While there is any hope of the International Commission making a settlement of disputed questions which might be of any advantage to Canada, it would perhaps be unwise to impose any restrictions which might irritate a people well known as the most grasping and tricky in negotiations in the world's history. Yet it is to be hoped that when the labors of the commission are seen to have ended, the Government will act promptly.

Some recent correspondence which has appeared in the Toronto Globe between R. G. Leckie, on behalf of the Canadian Copper Company and S. J. Ritchie, is of much interest in this connection. Mr. Leckie's letter contained the following statements: (1) Canada has no monopoly of the nickel markets of the world. (2) The Society Le Nickel is doing nothing at all, but shipping from accumulated stock. (3) Norway is a great competitor. (4) The Orford Company, which refined the Sudbury matte, is buying New Caledonia ore at the rate of 11 cents per pound, for the nickel contained, delivered in New York. (5) Leckie represents that during the existence of the Copper Company, nickel was selling at 60 cents per pound. (6) He denies the monopoly of the Copper Company. (7) He charges the company was brought to bankruptcy prior to its present management. (8) He points out that all the other companies which have gone into business have failed. (9) He points out the estimate of the ore at Sudbury as Mr. Ritchie's figures and ridicules them. (10) He claims that refining in Canada would be far more expensive than it is in New Jersey. (11) Both the Orford Copper Company and the Canadian Copper Company have asked Congress to remove the duty upon refined nickel.

These are replied to by Mr. Ritchie seriatim, and he quotes from a report of the general meeting of the New Caledonia nickel company—"Le Nickel," showing that it had been very unprofitable in its operations until by reaching a selling agreement with the Canadian Copper Company it had been able to obtain a slightly better selling price. This French company had also been obliged to mine large quantities of ore, as it was under contract to New Caledonia to employ convict labor. This contract now having been completed, and the company being able to employ free labor to greater advantage, its position has somewhat improved. This shows why the company is now exporting accumulated stock of ore The statement that Norway is a great competitor is dismissed as absurd, and the chief argument centres round the cost of the New Caledonia and Sudbury ore and the cost of refining. The Caledonia ores contain 7% of nickel. Three tons of ore are reduced to one ton of matte, which consequently contains 21% nickel. A ton of Caledonia matte, containing 420 pounds of nickel, costs, delivered in New York, $56.20. The Caledonia ores contain no copper.

The Sudbury ore, on the other hand, is richer in copper than nickel. One ton of Sudbury matte, consisting of 420 pounds of nickel and 500 pounds of copper, would cost delivered in New York, $50.80. The value of the copper alone in this amount of Sudbury matte, at 14 cents per pound, is $70.00 That is to say, the value of the copper alone in a given quantity of Sudbury matte would purchase the same quantity of Caledonia matte and leave a margin of $19.20 to the good. If Mr. Ritchie's figures are authentic, it is quite evident that the New Caledonia mines can not successfully compete with those of Ontario. Instead of costing more to refine the matte at Sudbury than in New Jersey, there would be an actual saving. Mr. Ritchie proves this by comparing the cost of bringing the coke to Sudbury with the cost of hauling the ore to New Jersey. The extra cost of coke delivered at Sudbury, as against New Jersey, is more than offset by the cost of carrying a lot of dead weight to the latter place. Mr. Ritchie proves his points very conclusively, viz.: that Canada has a virtual monopoly of nickel, and that it is cheaper to refine the ore or matte at or near the mines than anywhere else. Mr. Ritchie's statistics prove the whole case in favor of Canada's placing an export duty on nickel ore and matte.

MODERN SANITATION IN SCHOOLS.

Just how much we owe of health or unhealth to the modern improvements which are becoming in our minds an essential feature of civilization, is hard to determine. It is claimed, and apparently with some reason, our well ventilated and comfortably warmed houses are much less sanitary than the draughty abodes of our fathers, but facts in support of such claims are not easily obtained. The annual report of the Board of Health of Toronto for 1898 presents some statistics which are worth studying in this connection.

The investigation covers only a period of four years, and the officer making the study, E. B. Shuttleworth, has been able to devote part only of his time to the task, so that his results are merely preliminary to a more thorough study of the subject which, no doubt, the department will at once proceed with. At first glance the facts seem to prove that schools heated by steam and having outside closets are more sanitary than stove-heated buildings, and that both are superior to the combined heating and ventilating system (the Smead-Dowd) which is in use in Toronto. Also, and more extraordinary, it would appear that the Roman Catholic schools are more sanitary than the public schools and to a great degree. The two facts existing side by side suggest that some obscure reason is at the bottom of the difference in sanitary conditions. One point not gone into at all in the report is the fact that the public school children receive the same books over and over again, and this must convey contagion, which is not the case in the separate schools. Incidentally it is shown that the more recently built and higher sections of the city are more unhealthy than the low-lying sections near the bay. The following figures are from the report:

SUMMARY OF RESULTS AS TO HEATING.

	Average attendance.	Cases of infectious disease.	Percentage infectious disease.
Public Schools.			
Smead-Dowd system	16,851	1,143	6 79
Wood or coal stoves	1,662	108	6 49
Steam heating	3,811	169	4 43
	22,324	1,420	6 35
Separate Schools.			
Mixed heating, hot air, Smead-Dowd and steam	1,566	53	3 38
Coal or wood stoves	1,299	17	1.30
	2,865	70	2 44

As great importance is properly given to the methods of disposal of excreta we give the summary of the results observed:

SUMMARY OF RESULTS AS TO EXCRETA COLLECTION.

	Attendance.	Cases contagious disease.	Percentage contagious disease.
Public Schools			
Dry closets, S.-D. ventilation	5 098	393	7 31
Water closets	9,915	660	6.65
" outside school buildings..	3,396	201	5.91
" separate ventilation	4,860	221	4.54
Separate Schools.			
Mixed systems, mostly S.-D. ventilation	940	29	3.08
Water closets, separate vent	1,173	31	2.64
Privy pits outside school buildings	752	10	1.33
Combined Schools.			
Outside water closets or privy pits	4,148	211	4 12
Water closets with separate vent	6,124	252	4.11
Water and dry closets, mostly with S.-D. ventilation	15 866	1,082	6.81

The city has, speaking broadly, a gradual slope to the water front, and for purposes of comparison has been divided into districts according to its elevation above the lake, 10 to 60 feet, 60 to 120 feet, 120 to 160 feet. The more elevated portions of the city are generally the newer, better built sections, and the houses are for the most part detached or semi-detached. In the face of such conditions we find this result:

OCCURRENCE OF INFECTIOUS DISEASES IN SCHOOLS AT VARIOUS ELEVATIONS

	Public Schools.			Separate Schools.		
	Attendance.	Cases.	Percentage	Attendance.	Cases.	Percentage
10 to 60 feet	9,914	549	5 53	1,595	38	2 38
60 to 120 feet	8,404	547	6.50	1,072	27	2.51
120 to 160 feet	3,986	324	8 12	198	5	2 52

A SMELTER FOR TORONTO.

There appears to be some prospect, however remote, of a company being formed to establish an iron smelter in Toronto, Ont. Just what arguments could be used to induce monied men to risk such an investment it is hard to imagine. Whatever may be said favorable to Toronto is much more true of some other place, and some great facts are unalterably arrayed against such a venture. Toronto has neither coal, charcoal, iron, limestone, water power, electric power, natural gas, nor cheap labor. Even with the deepened canals, Toronto will still be at a great dis-

advantage in comparison with such other Ontario points as Sarnia, Midland, etc., in the west and Kingston in the east, which latter has iron and limestone at least of the necessaries almost on the spot, and hardwood for unlimited charcoal production in the immediate neighborhood. If there is any question of supplying local Ontario demand the smelters now established or in process are ample to meet all requirements. If export to other provinces or abroad is contemplated the proposed investors in the scheme should examine carefully the advantages of Cape Breton before deciding that Toronto is a suitable location. Toronto has some vacant lots where a smelter would look well—Cape Breton has coal, iron ore, limestone and deep sea harbors, all within a stone's throw of each other, and will some day, not far in the future, lay down in the world's market iron as cheap and as good as any.

As we said in beginning this note it is proposed to form a company to establish an iron smelter in Toronto. To whom it is afterwards proposed to dispose of the shares is not known.

THE NIAGARA POWER QUESTION.

The greatest natural resource of Southern Ontario is beyond all question the water-power at Niagara Falls Just what the development of this power could do for Canada may be judged by the changes now going on in the industries of Hamilton, Ont., since the introduction of electrical power by the Cataract Power Company last fall. Hamilton is becoming a smokeless town and that means a great deal more in coalless Ontario than in Pennsylvania, for instance, where coal is mined almost at the factory door. After years of idleness, due to the Ontario Government's having granted a monopoly of the Niagara water-power to the company which had the most interest in preventing its development, there seems to be a prospect of actual development being undertaken. The Canadian Niagara Power Company has agreed to abandon the monopoly it holds, in return for a number of concessions. In place of the present annual rental of $25,000 per annum, a tariff of rates has been decided upon. Under the new agreement the company, instead of a fixed annual payment, will pay in proportion to the power which it develops, a new tariff as follows: For the first 10,000 horse-power developed, $15,000 per annum. For the next 10,000 horse-power, $1 per horse-power per annum. For the next 10,000 horse-power, 75 cents per horse-power per annum. For the remaining power developed up to 100,000 horse-power, 50 cents per horse-power. Under the new arrangement the revenue derivable by the Government for the first 30,000 horse-power developed will amount to $32,500. If the company develops up to 100,000 horse-power, it will pay a further sum of $35,000, making a total revenue of $67,500.

The town of Niagara Falls, Ont., has made a vigorous protest to the Government against any agreement being made which would prevent a later company obtaining more favorable terms from the Government. The whole question is a very difficult one, but in the past the Government has shown very little capacity in handling it. So far little but mistakes have been made. It is to be hoped that a very considerable development will at once be undertaken, but at the same time it is essential that the Ontario Government should obtain for the use of the people the highest possible rental from the power companies compatible with the works being conducted on a commercially profitable basis. We must not only develop the town of Niagara Falls, but also at the same time lighten the taxation of the future inhabitants of the James' Bay district. This is not a local issue in any sense.

BUILDING REGULATIONS.

It is a much debated question as to whether it is better to have no law at all than one which is not observed. When the law itself is of such a character as to be quite out of touch with modern conditions, and its enforcement, which works hardship on the public, is at the discretion of persons who may or may not be absolutely unbiased in their decisions, the uselessness of such legislation is unquestionable. Where, as in Toronto, the laws are building laws quite out of date, which are enforced by inspectors who are perfectly competent to apply such obsolete rules, but are entirely unfamiliar with building operations as carried on to-day in other than rural communities, the necessity for reform is evident. The building regulations of Toronto would be valuable at a barn-raising, but are not applicable at all to modern office, store, or warehouse buildings.

We find rules for height and the thickness of brick and stone walls, but none for strength of floors or roofs. Of steel construction the makers of the regulations seem to have known nothing, for the modern steel building is quite ignored and such specimens as have been built already in the city are in direct violation of the departmental regulations. We are informed that the building inspector recently refused to pass the plan for a building because the walls were only one-half the required thickness. It did not seem to matter that the walls were to carry no part of the weight of the structure, which was steel throughout, but were merely to enclose the building from the weather.

The great advance made towards fire-proof construction is unknown apparently in Toronto. As a matter of fact there are fire-proofed buildings in Toronto, but their existence is contrary to the by-laws, and there are many fire-traps which conform entirely to the building regulations, as for example, the new City Hall.

There is urgent need of an entirely new set of building regulations for Toronto which shall conform to the needs of the present day conditions. There is need also of a competent civil engineer at the head of the department who will be capable of criticizing the plans of steel buildings. There is need also of a more businesslike conduct of the department inasmuch as the building regulations are unobtainable by the public, the architects or the builders. There is only one copy in existence, apparently, and into it are laid or pasted the various amendments that have accumulated in the past ten years. The regulations should be codified and printed.

WORKMEN'S COMPENSATION FOR INJURIES ACTS.

Much interest is being taken in the efforts recently made by the British Government to make provision for the compensation of workmen who are injured on their employers' premises. The subject is a very difficult one. If employees are hedged about by too many legal safeguards they become careless and not only perform their labor less efficiently, but cause unnecessary expense. That this is true has been established almost as clearly as that employers when left without legal restraints will sacrifice the health and lives of the workers for the sake of a trifling gain.

The Government of Ontario, wishing to keep in touch with the most progressive legislation on the labor question, has commissioned Jas. Mavor, professor of Political

Economy in Toronto University to go to Great Britain and examine into recent British legislation and make a report which will be considered by the Ontario Government in preparing future legislation. Mr. Mavor's instructions are:

"To make inquiries concerning the Workmen's Compensation for Injuries Act, 1897: (1) As to its effect upon workmen and employers, or in the words of the Act, 'undertakers'; (2) as to the effect upon special and particular kinds of manufacturing establishments, firms and corporations; (3) as to whether the Act gives satisfaction in labor circles, to labor organizations and to labor generally; (4) whether the machinery provided by the Act for the recovery of compensation works satisfactorily to workmen and employers, (5) as to whether faults are found with it, and whether there are complaints of a general or specific character in relation to the law, or to its working by either workmen or employers; (6) whether there has been much or little litigation under the new law; (7) whether amendments have been suggested, and, if so, in what particulars, (8) whether there is any general feeling against the principle of the Act, and, if so, to what extent; (9) whether it has had the effect of reducing wages in any particular industries; (10) or of excluding from employment any particular classes of persons—and generally to make inquiries respecting any other matter which has a bearing upon the law or its working, or upon the recovery of compensation under the law."

For The Canadian Engineer.

WATER.

BY W. M. WATSON.

Water is one of the most useful liquids, and on it depends our existence. For example, in 1848, the French village of Bozel, which used water from wells, contained 1,472 of a population, of whom 900 were goitrous, which is a disease showing glandular enlargement of the neck. To cure this a water supply was laid into Bozel from the town of St. Bon, when the disease decreased so rapidly that in 1864 there were only 39 people having traces of the complaint. In one of the North Yorkshire towns in England low fever and general lassitude was chronic with the population of the place. After a searching enquiry by the Government, the water supply was changed, and afterwards the people brightened up and their general health became good. There are many such cases as these recorded, which proves that it is of the first importance that the water we use for domestic purposes should not only be plentiful and convenient, but also of the softest and purest quality. We often give half a dollar for a good meal; a good bath improves the health and vigor of the body more than two meals, and those who have a plentiful supply of soft water may have their own private bath appliance and enjoy a daily dip for less than five cents each. To be compelled to wash in hard water, or in dirty rain water after it has done duty in washing the filth from the roof of the house, and even then, the only quantity allowed being about three pints to each washing, is cruel and sinful, because the Creator has given abundance, and expects us to supply energy enough to pipe the water to our houses and use it without stint and without waste.

Canada has plenty of good potable water open to view in her lakes, rivers, and fresh water streams, which if kept free from poisonous sewage will probably supply future generations, should the population increase a thousand fold, and even should the population become so dense, or a part of the population be located too far away from any of the fresh water storage, or streams, there is another abundant storage with its reservoirs and streams under the earth's crust, even more plentiful than the storage that is visible above the earth, which can easily be drawn upon at will, and often at a trifling cost per head. There are eminent geologists who state that under the bottoms of both lakes and rivers, there is as much water stored in the earth's strata that leaks through the beds the water rests on, as the lakes and rivers themselves contain, and many of the constant and inexhaustible springs are fed from this source, because it cannot be affected by droughts.

Besides the water that percolates through the earth, under the lakes and rivers, a large percentage of the rainfall sinks below the soil, and often descends several hundred feet and collects into streams, rivers, etc. There are also large caverns, or pockets deep down in the interior of the earth where the water is stored in large quantities, besides many of the earth's strata are capable of holding in themselves large quantities of water that can be extracted from them by using a pump. Chalk and a loose sand will hold about one-third their own bulk of water; oolite, one-fifth; magnesian limestone, one-fourth; while hard compact sandstone and pebble beds hold only one-eighth, and hard granite only one-fortieth its own bulk; impervious weald clay holds no water.

The annual rainfall over the earth's surface may be about 36 inches deep, one-third will be evaporated by the sun, another be used by the herbage, or find its way to the lakes or streams, while at least the other third will descend below the soil, and make its way over the face of the impervious strata, or through the porous rocks and layers of gravel, until it arrives at open fissures in the faults of the strata, which will again lead to rivers that supply the underground reservoirs, or ultimately discharge into the sea, river, lake, or springs at a lower level.

In England over 60 per cent. of the population secure their water supply from the storage below the earth's surface, and but for this kind of water supply part of the dense population would be compelled to move. It is estimated that the supply of water that can be withdrawn from the earth is at last equal to nine gallons per square foot of the earth's surface per year, of course I mean that part of the earth which is not covered by sheets of water. Then, water is about the best carrier of refuse, and is the most sanitary method of removing excrements and foul soluble matter from dwellings. By compelling water to remove our domestic dirt and refuse, we keep the land surrounding our dwellings free from contamination and the atmosphere free from disagreeable odors. We can dispense with the sickening privy pits and disgusting cesspools, and have our modern sanitary conveniences at a trifling extra cost over the antiquated systems. Moreover, water after it becomes dirty with carrying the refuses, can be easily cleaned again. Its nature is such that if proper mechanical appliances are supplied, so that every atom of sewage can be well aerated, the fluid will return to its former brightness and chemical purity. Water is a good servant that is willing to do most of our lifting and carrying, and it undertakes to do all our cleaning free of charge. We cannot use all kinds of water for domestic purposes, therefore a considerable quantity of the world's water supply must be rejected because a considerable quantity passes through strata that are charged with chemicals or minerals which become incorporated with them.

In Europe, experience has proved that many large streams of water having various chemical qualities cross the countries almost in straight lines from sea to sea, sometimes being near the surface and at other places over a thousand feet deep. The town of Leighton Buzzard, England, cut an 8-foot internal diameter well, lined with cast-iron cylinders 64 feet deep. Then they made a boring and lowered a 10-inch diameter tube down 200 feet more. At this depth of 264 feet sufficient water was secured to serve the town. The water was bright and clear until

exposed to the air, when it became slightly discolored and tasted of iron. This defect they removed by a system of aeration. They lifted the water to a tank 62 feet high, where it was broken up into raindrops or spray, and afterwards filtered, which completely removed the iron the water contained when leaving the water tube in the well.

It is a not unusual occurrence for two bright streams of water to become turbid and discolored when amalgamation takes place, because the chemical properties of the one stream act on those of the other and cause slight discoloration, and perhaps when the amalgamated streams have run on for a half mile together it will become bright and clear again, and often become of a purer quality, and more suitable for domestic consumption than either of the streams were when running separately. One of the streams that cross England is named Spa; its water is very soft and is of such a nature that cloth, wool, mohair, or yarns washed and cleaned with it secure an unusual softness and are pleasant to handle. When used to cook with it is simply perfection, and very much improves the material cooked, in excess of other waters. This undercurrent of water runs under and parallel with a fine seam of the best steam coal. Mitchel Brothers, manufacturers, of Bradford, England, happened to have their large factory built immediately over this valuable stream of water and bed of coal, though they were both situated at a great depth and required considerable capital to make a boring that would reach the current, but as they were anxious to capture a foreign trade they completed the boring and found it equal to the best gold mine, because their goods afterwards found a ready sale, at the best prices, and as the supply that boiled up the bore hole was largely in excess of their own needs, they sold the water by measure to the general publi. who would travel several miles to secure enough for drinking and cooking.

Those who have visited the Lake of the Mountain situated in Lake Ontario, near Deseronto and Picton, Ont., will have noted that the face of the sheet of water is almost level with the crown of the mountain, and the lake on this account cannot possibly have any drainage area to supply the waste caused by evaporation. There is no visible stream running into the lake, and the level is many feet higher than the level of Lake Ontario which surrounds it. The water it contains is always fresh and sweet, which proves that it is constantly in motion and changing by circulation, which must be by subterranean channels connected with some submerged reservoir or lake that is equal in level to the mountain lake, and which is probably many miles distant. The immediate strata under the soil and their contour may lead the rainfall that sinks below the soil miles away from the section of territory where the rain falls, in that case a boring made would be useless at that point, except it pierced through the non-water-bearing stratum and entered a water-bearing stratum at a lower depth, that held water in its pores, that could be drawn out by a pump. If a large quantity of water is needed, say a million gallons per day, then a well or pit must be sunk several hundred feet to some good water-bearing strata, and headings driven in various directions. Sometimes a heavy charge of exploding material is used to loosen the rocks all round the bottom to increase the water collecting area. When the pump lowers the level of water in the well to near the bottom, which is very seldom the case, all the water held by the earth for a great distance around the well would fall away from the rocks and gravel beds and gravitate to the foot of the well, so it may be reckoned that such a deep well or bore hole has a very large storage reservoir to draw from that is almost inexhaustible, and may measure several hundred feet deep and a mile in circumference. The well or boring may overflow at the commencement, and the collecting area will in that case be small, but just in proportion that the water is lowered in the well by pumping will the collecting area be increased, which insures a constant supply.

All the local wells I have examined may be reckoned fever traps; they are generally less than twenty feet deep, the sides left either unwalled or walled with loose stone or brick, which allows the dirty surface water and domestic sewage to percolate and enter the well. In fact they are really swamp holes made near the house to keep the yards and surrounding land free from surface water, and the inhabitants of the premises that such domestic wells supply with water are actually drinking the liquid from their own refuses and surrounding soil. The sides of all wells should be strictly watertight until nearing the bottom. The top should extend about one foot above the surrounding land, and have a water-tight cover. The pump should be some distance from the well, the suction-pipe enter the side of the well, and great care taken to make the hole in the wall through which the suction-pipe passes from the pump to the interior of the well perfectly watertight. By so doing, reasonably pure water may sometimes be obtained. No wood should be used in constructing wells. Wells at present in use may be made sanitary, and yet yield the same quantity of water as before by filling up the well to the usual water level with clean, rough gravel, of course leaving the suction-pipe in its former position and taking great care neither to damage the pipe or block up the screen at the bottom, then finish filling up the well to the top with sand, by so doing a first-class filter and a first-class shallow well is secured that cannot be contaminated. I am at present living at a house in a town that receives its water supply from a well thirteen feet deep, sunk in seamy rock, that is void of any wall to keep back the surface water. The cover is level with the land, and consists of decayed boards with a similar wooden pump. Within ten yards there are two sets of privies, with large holes dug into the loose soil, filled with excrement that emits an abominable odor, and the liquids from each of those holes does most assuredly find its way into the well, because the level of water in the well is lower than the bottom of the privy pits, and the sides of neither are water-tight, but simply sieves through which liquids pass.

A European should be excused if he expresses surprise that he finds such gross sanitary ignorance displayed in this enlightened age, and that such dangerous and unsanitary abominations should be tolerated in a market town by our modern governments. Then, can it be conceived that 3,000 people should live in a group having no means of giving their body a proper cleansing. People living isolated, and having no possible means of securing suitable water and appliances are excused, but when they have splendid facilities at hand it is a disgrace not to apply them. No town of over 3,000 population should be without a good swimming bath to freshen and encourage the children of the poor to learn to swim, and should have baths to hire cheap, so that those who cannot afford to rent houses with lavatories can wash their bodies occasionally.

Should I desire to find a supply of water in the earth, and was standing on a large section of flat land, I should note where there was a depression, and if the depression was long and narrow I should chose the place for boring for water because I should think there might be a water channel under the depression. I might be correct, yet not secure a supply of water except by going deep, because I might be over a deep cavern. The extra freshness and

greenness of herbage when the dry seasons are on, will show where water can be found. Films of vapor or mist usually arise over ground that contains a supply of water underneath and will hang on and continue to be of greater density than the vapor rising from the surrounding land for some time after sunrise. If we are on a dry, sandy plain there will also be swarms of insects moving about over the section where water is stored underneath, at the first appearance of the rising sun.

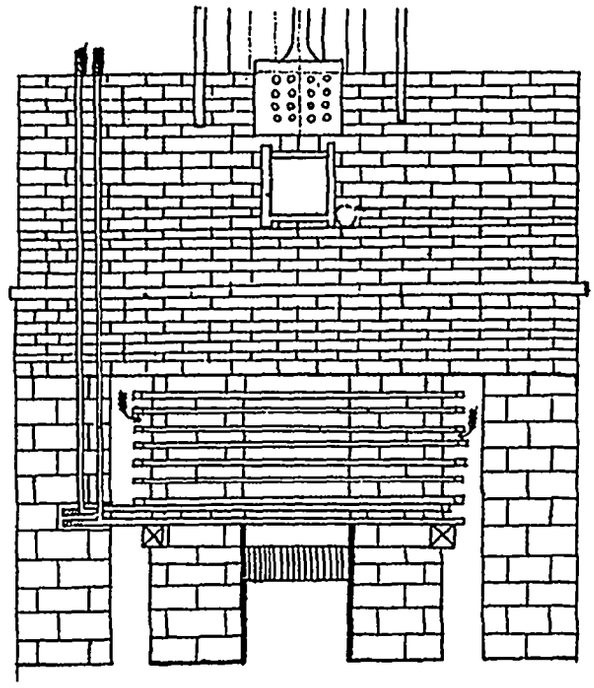
—A new industry which will undoubtedly assume large proportions is the building of steel freight cars. It has been found that the dead weight of a freight train can be greatly decreased by substituting steel for wood in car construction. The steel is much stronger for the weight and hence much larger loads can be carried. What are known as " 100,000-lb. cars " are rapidly coming into use, and a company with a capital of $10,000,000 is said to be organizing in Chicago to build them. Their introduction on our Canadian railways is only a matter of a short time and great changes in the present railway car shops are to be expected. The increased demand for steel in the Canadian market will be welcome to our growing iron industries.

HOT WATER HEATING.*

BY P. TROWERN.

In my first address to you on this interesting subject I directed your attention to the plans, inventions and information given to us by our forefathers within the last 1,000 years for their own comfort, education and civilization. I wish to direct your attention to the plan and furnace of Mr. Perkins (1830). He claims to be the inventor of the apparatus that is used in heating some of the largest buildings in London, England, and France; you will observe in this sketch that the boiler in the brick furnace is made with 1-inch heavy iron pipes, bent square with round corners, two coils, one inside and the other outside; the inside one is about 3 feet square, and the outside 3 feet 6 inches, which takes from 120 to 130 feet; they are bent like a spiral spring so as to stand one row above the other for eight rows, and are kept there with cast stays and distance pieces. The pipes are all screwed together with right and left couplings, tested with a water pump before being put into place, the fire-bars are 26 inches long and 30 inches wide, the walls inside the coils are built with fire-brick, the door is bolted and built in the front wall. The square hole on the top with a sliding cover or door is to put in the coal and to damp the fire, the hole in the cover is the down draught, the lower pipes projecting through the brick is for the return water to come back into the coils. The pipes projecting through the top are for the hot water to pass out of the coils up to the water expansion cylinder, the two pipes, hot and return, are tapped in the bottom, the cylinder, which is 3 feet high by 12 inches diameter, with a brass tap and cover on top; into this cup the water was at first poured; however, I found this to be a bad plan and I used it only to let out the air. I put taps on to the return pipes with connections, and had a pump made so as to fill them in the furnace room, when any water was wanted; the same water I put in in the fall came out in the spring. The quantity of pipe connected with each coil or boiler was about 700 feet or the number of feet for each furnace with coils of this size was about 1,650 feet, and as 29½ feet of this pipe will hold one gallon of water we find the two coils or boilers in the one furnace contained about 56 gallons to be heated with one fire with about 175 lbs. of hard coal for 24 hours or about 18½ tons per season (212 days), and this furnace or pipes heat about 94,048 cubic feet of air to about 75°. Fifty-five people are here kept warm and comfortable, their cooking being done in the kitchen. A very cold night will require some coal in the early morning; the last fire was put in about 8.30 at night, and about every week the water should be gauged in the cylinders which are on pedestals in the corridors with a rod or wire to find if any has evaporated through the joints or pipes.

You wish to ask some questions. How long will those boilers last? Out of the sixty coils I have made, some were



burned in five years, some in ten years; the only four we have left now working are those in the cottages A and B I made 27 years ago. The two pipes, flow and return, are laid around in recesses against the outer walls and partitions above the base-boards; they have been in the main building for nearly 50 years, and in the cottages for 32 years.

The next question is how does the water move, or by what force does it circulate? I have said before there is no force or power in this world without heat, the pipes are all full and the cylinder half full; we will now start the fire and the pipes will soon feel warm, and with every degree of heat the water becomes lighter by expanding, and the cylinder becomes fuller; the air leaves the water and pushes its way to the cylinder on top of the water and becomes of great force if not let out by the tap on top. The water in the return pipe is not warm, and is therefore heavier than the water in the flow pipes and cylinder, before the fire was put in, one side balanced the other like an even-balanced pair of scales, but now the flow side becomes lighter, by the water being warm, and the return water being heavier, pushes itself into the boiler to get warm. Each coil has an expansion cylinder, and those two cylinders are in one ward about 34 feet above the furnace, and in each cylinder and pipes are about 28 gallons or 280 lbs. of water; it will not gain in weight, but it does in measure; 22 gallons of water at 40° will gain one gallon at 212°, therefore, those 28 gallons have gained about 1¼. This is the reason why we do not fill up the cylinder at first with the pump; when the fire was started and the water got warm it began to expand and move out of the coil by the weight of the return water pushing into the coil; this is the cause of the movement and force to keep it in circulation. You may ask me why I use a 1-inch pipe rather than larger. It is because I found a 1-inch pipe made a quicker circulation and was much more convenient to handle for the rooms in a dwelling house.

In our last greenhouse which we built I put in 2-inch pipes, and found them better in every way than the 4-inch pipes I had used in the other houses: their cylinders for expansion have a loose cover so that the air can go in, and the vapor which is needed for the plants come out; but in a dwelling the vapor is not wanted.

*From a paper read before the Canadian Association of Stationary Engineers.

The Winnipeg Electric Street Railway Co., Winnipeg, Man., has ordered 18 additional railway motors, with controllers, from the Canadian General Electric Co., of that company's standard " C.G.E. 1,000" type.

THE ENGINEERS' CLUB, TORONTO.

During the last three months several meetings of the civil engineers, architects and surveyors resident in Toronto, have been held for the purpose of organizing an engineers' club, on the same basis as similar organizations in Detroit, Cleveland, St. Paul, Denver, Rochester and many other cities in the United States. At the last meeting, held at the Rossin House on the evening of May 5th, the organization was fully launched, and the following officers were elected for the current year: President, Kivas Tully; vice-president, C. J. Crowley; directors, C. H. Rust, E. B. Temple and A. L. Hertzberg; secretary, Willis Chipman; treasurer, T. B. Speight. Regular meetings will be held on the first Tuesday in each month, except the months of July and August, and the annual meeting on the first Tuesday in February. All classes of engineers, civil, mechanical, sanitary, hydraulic, electrical, mining and military, professors in engineering and architecture, architects and land surveyors are eligible for membership. The club starts with about forty members. It is proposed to arrange for a down town club room next year. It is not the intention to permit the club to usurp the functions of any of the existing professional or technical societies, the principal object being of a social character.

ARTIFICIAL SAND STONE.

An effort is being made to introduce the manufacture of artificial sand stone into Canada under a process invented by William Owen. Owen-stone, as it is called, is a hard and handsome stone. Quartzose sand is first dried by heat, it is then mixed dry with hydraulic lime in proportion of about 12% of the latter. The mixture, still dry, is packed into moulds of any desired shape, the filled moulds being built up in a steel frame. The latter is conveyed by tramway to a steel cylinder, inside of which it is placed, and the cylinder being closed water near the boiling point is admitted and a pressure of from 60 lbs. to 70 lbs. maintained. The water is kept heated by steam coils. The resulting stone is claimed to be very hard and durable, and to be cheaper than natural of the same grade.

SAND FILTRATION OF PUBLIC WATER SUPPLIES.*

BY R. S. LEA, ASSOC. M. CAN. SOC. C. E.

In thickly populated districts and in the neighborhood of cities and towns the wastes of human life and human industry are a continual menace to the health of the inhabitants. Nature's method of preserving the balance between growth and decay, by utilizing animal waste as plant food, is no longer effectual. The lakes and streams begin to serve the double purpose of sources of water supply and receptacles for sewage. Hence it is evident that among the most urgent of the questions with which the municipal engineer may have to deal are these connected with the securing and maintaining of the degree of purity necessary in water intended for domestic use. The proper methods to be employed in the accomplishment of this object depend as much upon biological as upon mechanical principles, so that a certain degree of familiarity with these principles and with the methods of the chemist and biologist will be necessary to the engineer engaged in such work, in order that he may be able to avail himself intelligently of their assistance. European cities, having earlier felt the necessity, have devoted much more attention to these matters, and are consequently further advanced in their methods of dealing with them than is the case with the cities in America. Nevertheless, by far the most important series of investigations into the subject of the purification of water and sewage are those known as the "Lawrence" experiments, carried on under the direction of the Board of Health of the State of Massachusetts. This board, from its foundation in 1869, always devoted a great deal of attention to the condition of the water supplies of the State. In 1886, the time being particularly appropriate, it appointed a body of experts to the exclusive duty of conducting a series of observations and experiments, with the object of finding the best methods for purifying both water and sewage. These experiments are still in progress, and the annual reports of the department, giving the results of their investigations, are exceedingly valuable to engineers and others interested in such questions. In Berlin and in a few other large European cities having waterworks departments provided with the necessary scientific equipment and management, many careful experiments have been made on the working of the large water-filter beds of the systems. The results of such experiments as these have an especial value from the fact that they are conducted on a large scale, and under conditions which exist in actual practice. On the other hand, these same circumstances render them less reliable as a means of determining the true principles upon which the process of filtration depends.

The object of this paper is to describe, as fully as reasonable limits will permit, first, the circumstances under which water supplies become polluted, and the nature of this pollution; and second, the process of purifying it again in large quantities by sand filtration. Of course pure water is preferable to purified water; or, as has been said, with water "innocence is better than repentance." Unfortunately, however, water whose natural state is above suspicion is often exceedingly difficult to procure, except at a cost which is practically prohibitive. Consequently, many cities and towns, especially the larger ones, are forced to use such waters as may be practically available, and to make the best of them. But this best is by no means to be held lightly. By the methods to be described later it is possible to so change the nature and characteristics of polluted water as to convert it to the appearance, taste, and probably absolute wholesomeness of the most innocent of mountain torrents. Water has the unfortunate capacity of readily dissolving many of the substances with which it may come in contact; so that outside of the laboratory, chemically pure water is practically unknown. Some of these foreign elements may not only be quite harmless, but may actually improve the quality of the water. It is, however, with the others, which make the water containing them unsightly in appearance, disagreeable to taste or smell, or dangerous to health—in other words, with the substances which constitute pollution—that we are especially concerned.

If we divide all waters according to their source, into ground waters and surface waters, the general statement may be made, that it is only in the latter class that are found what may be properly termed polluted supplies. The former are subjected to such a rigorous process of natural purification as to place them beyond the need of any artificial treatment.

Surface waters, or the waters of lakes, ponds, rivers, streams, etc., are liable to receive more or less serious pollution from the following sources: 1. They may be colored by the drainage of swamps. 2. The waters of many streams become turbid with clay and other suspended matters after heavy rains. 3. The waters of lakes, ponds and storage reservoirs are liable, at certain seasons of the year, to contain large growths of algae and other minute water-plants which float about, barely visible to the eye, but which are capable of imparting to the water disagreeable tastes and odors. 4. Any of these classes of surface waters may have discharged into them a greater or less quantity of human sewage; leading, under certain circumstances, to very grave consequences.

In determining the quality of a given water supply, the proper method of procedure is as follows: 1. To make a local examination of the water shed, in order that all probable sources of pollution may be discovered. 2. Then, if necessary, to have chemical analyses made of samples of the water, by which the nature of the contamination, and to a certain extent its amount and origin, may be ascertained. 3. To make a biological examination giving the number and species of the living organisms that may be present. This will be of assistance in interpreting the chemical analysis: and also in detecting the possible presence of organisms which in themselves might constitute an element of danger.

Before discussing the results of these analyses, it may be stated in advance, that it is in connection with the organic matter in water, dissolved or suspended, visible or invisible, that serious pollution from a sanitary standpoint is to be apprehended. And it is in the information which they furnish on this point that the chief value of the analyses consists. But in order to interpret them properly it will be necessary to allude briefly to the constitution of organic matter and to the changes it is liable to undergo.

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

To begin with, it includes all those combinations of the chemical elements whose formation depends upon the processes of life; and which, therefore, occur either in plants or animals. Its history is cyclical, consisting of a constructive phase or period of growth, and a destructive phase or period of decay; the death of the plant or animal forming the dividing line between the two phases. The cycle begins by the appropriation of inert, purely mineral substances from the earth by the green plants, which derive the necessary energy from the sunlight; and ends with the complete disintegration of the more or less complex structures which constituted its organic character, and the return of the elements to the earth. With regard to the nature of the changes it may have undergone, it is only with those in the second or destructive phase that we are concerned. At the beginning of this phase, at the death of the plant or animal, we find that all organic matter is composed mainly of carbon, oxygen, hydrogen and nitrogen. The more nitrogen it contains, the more objectionable it is from a sanitary point of view. This destructive process is essentially one of oxidation. The first step is the oxidation of the carbon by the oxygen of the body itself, or by that from without forming carbonic acid gas, and leaving the nitrogen and hydrogen to unite to form ammonia. As decomposition proceeds, the ammonia is itself oxidized—the hydrogen to form water, and the nitrogen to form nitrous acid. The last step is the reduction of the nitrous acid to nitric acid. The nitrous and nitric acids do not remain free but combine with some base present, as soda or potash, to form nitrites and nitrates, the latter being purely mineral substances; so that the final results of the decomposition process are carbonic acid, water, and nitrates. Thus the dead inorganic materials needed for the formation of organic structures are only borrowed, and ultimately are returned to the earth again as inert as when they were taken from it. Returning now to the chemical analysis, we find the results given in some such form as the following, which is the one used by the Massachusetts State Board of Health:

	—Residue on Evaporation.—		—Ammonia.—			
				—Albuminoid.—		
Sample.	Total.	Loss on Ignition.	Free.	Dissolved.	Suspended.	Chlorine.
A	3.85	1.00	.0032	.0048	.0012	.49
B	40.25	....	.097	.0316	.0222	6.32
C	10.50	2.40	.027	.0156	.0120	2.78

	—Nitrogen as—			
Sample.	Nitrites.	Nitrates.	Hardness.	
A	.0050	.0000	1.6	Average surface water.
B	.3500	.0300	5.3	Private well.
C	.1400	.013	3.6	Mystic Lake.

Now it has been found that a very accurate, and at the same time comparatively easy method of determining the organic matter in water by a chemical analysis is to determine the amount and condition of the nitrogen present. Thus, under the head of Albuminoid Ammonia are entered amounts which are proportional to that part of the nitrogen which is derived from fresh organic matter, i.e., from organic matter which has not yet begun to decompose. These columns, therefore, represent the possibilities of putrefaction still existing in the water. The amounts under Free Ammonia represent decay begun; under Nitrous Acids (or Nitrites) decay still further advanced; while under Nitrates the amounts entered represent the nitrogen derived from that portion of the original organic matter which has passed through all the stages of decay, and which has been converted into purely mineral matter again. The importance of the determination of the chlorine is, that an excessive amount points to contamination by sewage which always contains a considerable proportion of common salt. The actual amounts of the different substances as they occur in water supplies are exceedingly minute, as will be seen by referring to the above table of analysis, one of which samples (B) is a highly polluted one. Hence, in themselves these substances are of very little importance. It is in the history of the water which their presence indicates that their significance lies. Thus the chemical analysis can tell us not only what is in the water, but also a great deal about what is going on in it. It is only within recent years, however, that the methods of organic analysis have been capable of producing such results; when the first attempts at water purification were made, very little was known of the organic matter in solution, and the object aimed at was simply the clarification of the water, or the removal of suspended matter visible to the eye.

This was the condition of things when James Simpson, in 1839, constructed a sand filtration plant for one of the London water companies. Each of the beds of this system consisted of a broad shallow basin or reservoir with water-tight bottom and sides. The depth was about 12 feet, and it was filled to about half this depth with the filtering material, which consisted of uniform layers of small stones, gravel and sand, the stones on the bottom and the finest sand on the top. Through the bottom layer of stones and gravel extended a number of branch drains leading into a larger central drain which was connected to the outlet. The inlet to the filter bed opened above the surface of the sand, and both it and the outlet were provided with gates. The process of filtering consisted in flooding this bed of sand and gravel, and drawing off the water from beneath by means of the system of under drains, which were built with open joints. The rate could be regulated by the gates or other apparatus on the inlet and outlet pipes.

As filtration progressed the surface of the sand became gradually choked up by the formation upon it of a layer composed of material removed from the water. When this layer became so impervious as to prevent the water passing in sufficient quantities, the filter was stopped, the water level drawn down below the surface of the bed, and the deposit layer removed, together with from ½ to 1 inch of sand. When the surface was smoothed and levelled, the bed was ready to be put in action again. The frequency of the scrapings depended upon the condition of the water and the rate at which it was filtered; and when the sand layer had become reduced in thickness to what was considered a proper minimum, the whole amount removed was placed at one time, either by new sand, or by the scrapings after they had been thoroughly washed. The results from the use of these filters were so satisfactory according to the ideas of purified water then in vogue, that in the following years several others were built in England, and a little later on the continent, especially in Germany. Some of the most important of the continental filters built during this period were designed by the English engineers Gill and Lindley. They were all built on the same general lines as the Simpson filter described above, the details varying somewhat with the individual notions of the designers.

In America practically no attention was paid to the matter. The late Jas. P. Kirkwood was employed by the city of St. Louis to report upon the condition of its water supply. His report included the result of his personal observations of the working of several European filters, and was translated and widely read on the continent of Europe. But his recommendations to St. Louis, so far as filter-beds were concerned, were not adopted. And between that time and 1892, only two plants were built in America, one at Poughkeepsie, N.Y., in 1872, the other in 1874 at Hudson, N.Y., both being after designs by Kirkwood. A little earlier, in 1870, the English chemists Wanklyn and Frankland invented new and improved methods of organic analysis which led to more attention being paid to the organic matter in solution in water. A new importance was also attributed to it at this time by reason of the ideas which were then held concerning the processes of fermentation and decomposition. It was supposed that decay could be communicated to sound organic matter by contact with other organic matter already in process of decomposition; this being the theory advanced by the chemist Liebig, who held that ordinary alcoholic fermentations were produced by the dead and decaying yeast cells, instead of by the action of the living and grow-

ing cells as we know now. And so it was considered that the presence of decomposing vegetable or animal matter in water would tend to set up injurious putrefactive changes in the digestive organs and thus produce disease. Hence when analyses of the effluents from the sand filters showed only a moderate reduction of the organic matter—seldom as much as 50 per cent.—the result was considered very disappointing, and as indicating that this method of filtration, while capable of improving the appearance and taste of the water, was of slight hygienic value.

Not many years later, however, these ideas and theories were broken down by the researches of Pasteur, who demonstrated that the processes of fermentation and putrefaction were dependent upon the presence of living organisms; and that some of these organisms were capable of causing disease. A new view was now taken of organic matter in water, the presence of which was to be not necessarily dangerous in itself, except as indicating the probable presence of germs. Yet, while chemical purity was now deemed of much less importance than biological purity, the former remained the standard, owing to lack of satisfactory methods of prosecuting the study of these organisms. Then, in 1881, came the famous discovery by Dr. Robert Koch of his "plate culture" method. Hitherto, owing to the extreme minuteness of these creatures, and the enormous rate at which they increased in number under circumstances favorable to their growth, it was almost impossible, with the methods then available, to make much progress in the knowledge of the subject. But with the advent of Koch's invention these difficulties were to a great extent removed. It now became possible to determine the number of germs, to study their habits of life, functions, etc., and to classify them into species, in a manner which, considering the kind of creature dealt with, seems quite marvellous. Besides placing the germ theory of disease on a firm basis, this discovery of Koch's marks the beginning of the period during which it has been possible to deal with the subjects of the purification of water and sewage in a rational and scientific way. Numerous investigators at once began the study of these questions under the new and vastly improved circumstances. Inasmuch as the results of many of these experiments have a direct bearing upon the subject under consideration, a brief description of the nature and some of the characteristics of the bacteria will be given before proceeding further.

(To be continued).

TRUST FORMATIONS IN THE UNITED STATES.

The month of March witnessed the largest receipts for filing articles of incorporation of any in the history of the State of New Jersey. The total receipts for the month in filing fees were close to $130,000, nearly double the amount received in any single month before. The total capitalization of the month's incorporations reached about a billion and a half dollars. Two hundred and fifty original certificates of incorporation were filed, and about a hundred certificates of increased paid-up capital stock. During the month there were thirty-four trusts and combinations of various kinds chartered by the State. These combinations, with their capitalizations are: American Steamship Company, $1,000,000; American Woolen Company, $65,000,000; American Ice Company, $60,000,000; United States Cast Iron Pipe and Foundry Company, $30,000,000; International Steam Pump Company, $27,500,000; New England Electric Vehicle Transportation Company, $25,000,000; Royal Baking Powder Company, $20,000,000; Havana Commercial Company, $2,000,000; United Electric Company of New Jersey, $2,000,000; American Beet Sugar Company, $2,000,000; United Fruit Company, $2,000,000; Consolidated Street Car Company, $18,000,000; Indo-Egyptian Compress Company, $15,000,000; Compress Gas Capsule Company, $12,000,000; American Brick Company, $10,000,000; National Salt Company, $12,000,000; Park Steel Company, $10,000,000; Continental Cement Company, $1,000,000; American School Furniture Company, $10,000,000; Severy Process Company, $7,500,000; United Zinc and Lead Company, $6,000,000; Pacific American Fisheries Company, $5,000,000; Helvetia Copper Company, $5,000,000; Empire Steel and Iron Company, $5,000,000; National Cash Register Company, $5,000,000; Arcadian Copper Company, $3,750,000; Isle Royal Copper Company, $3,750,000; Columbia Refrigerating Company, $3,000,000; Columbia Automobile Company, $3,000,000; Maritime Improvement Company, $3,000,000; Boggs & Buhl, $2,500,000; Egyptian Tobacco Company of America, $1,500,000; Newport News Abattoir Company, $1,500,000, and Brooklyn Gas and Electric Company, $1,500,000.

MINERAL PRODUCTION OF NOVA SCOTIA

The following summary shows, so far as the Department of Mines has been able to learn, the mineral production of Nova Scotia for the year ending September 30th, 1898, compared with that for the year ending September 30th, 1897:

	Year Ending Sept. 30th, 1897.	Year Ending Sept. 30th, 1898.
Gold, ounces	26,579	31,104
Iron ore, tons*†	44,146	31,050
Manganese ore, tons†	100	75
Coal raised, tons†	2,320,916	2,281,424
Coke made, tons†	45,000	42,000
Gypsum, tons†**	125,000	131,000
Grindstones, etc.***	32,400	38,000
Limestone, tons†	25,000	24,000

*Not including imported ore.
†Ton of 2,240 lbs.
**Amount exported.
***Value in dollars.

A REMARKABLE AUTOMOBILE TRIP.

Promptly at 6 o'clock on Monday morning, May 22nd, Alexander Winton, president of the Winton Motor Carriage Company, started from Cleveland in company with Chas. B. Shanks, of the Cleveland Plaindealer, on a cross-country run to New York, a distance of nearly 800 miles. A large crowd cheered the autocarists as they started. They carried a message from Mayor Farley of Cleveland to Mayor Van Wyck of New York. The carriage used for the trip was built two years ago, and had covered 1,200 miles during that time. It was equipped with a cyclometer, and close reckoning was made all along the route. The route was parallel to the Lake Shore and New York Central Railway tracks, going straight along the lake front to Buffalo and then cutting at right angles across New York State to Albany. The schedule called for 100 miles a day, but this rate was greatly exceeded. Painesville, 30 miles from Cleveland, was reached in a little over an hour—the road for this distance being like a race track. The carriage passed Ashtabula at 9.20 and Conneaut at 10.06. At 1.10 Erie was reached, the journey of 95 miles having been made in 5 hours 3 minutes. Leaving Erie at 2 o'clock the carriage was reported at 3 o'clock passing Harbor Creek, Pa., at a fast rate. At 9 p.m. Buffalo was reached, the cyclometer showing 218 miles in 15 hours—an average speed of over 14½ miles per hour, not a moment up to this point having been lost on the way by reason of mishaps to the motor or machinery. The trip was not without accident, however, one of which—the breaking of an axle at Fairport—made it impossible for the travelers to cover as much ground in two days as they might in one. When the axle broke the carriage was running at top speed, and both the occupants had a narrow escape from injury. They failed to stop as abruptly as the automobile did, and were thrown twenty feet ahead in the road. This however, was the only breakdown of any kind in the trip.

The Winton carriage pulled up in front of the Astor House, New York, at 5.45 p.m., Friday, 26th May. Although the distance by rail from Cleveland to New York is but 623 miles, the cyclometer registered 707.4 miles—the extra distance being due to the fact that the wagon roads were not as direct as the railroads, and that the travelers were often sent miles out of their way by being misdirected. The total actual running time was 47 hours 29 minutes, giving an average time per mile for the entire trip of 4 minutes 2 seconds, or an average speed of nearly 15 miles per hour. Having set out to cover only 100 miles per day, the travelers really did 207.4 miles over the schedule. The route was across a diversified country, over all sorts of roads, and through sections that were extremely hilly. They twice

raced with freight trains that were running at full speed, and beat them. The greatest burst of speed was just west of Albany, where on a fine stretch of road they made 38 miles an hour.

The economy of fuel was one of the remarkable features of the trip. The first day's run of 218 miles was made with less than 30 cents' worth of gasolene. It would not have cost $1 for the entire 707.4 miles if the gasolene along the route had been sold at market prices. The trip was an immense success, the carriage being said to be in as good condition at the end of the trip as at the start. The Winton carriage is not unknown in Canada, Messrs. Moodie, of the Eagle Knitting Co., Hamilton, being possessors of two, and J. Eaton and E. J. Philips of Toronto, having two. The Winton Company of Cleveland has sold about fifty carriages. Mr. Winton is a young Scotchman, a bicycle maker, who for five years and more has been hard at work on his carriage, putting all his bicycle earnings into his invention. He has the satisfaction of knowing that he has now an unlimited market for his product. The fuel consumption regulation, which is under the control of a governor operated by the driver's foot, is one of the novel features of the Winton mechanism. This governor increases or diminishes the volume of explosive compound furnished to the cylinder for a working stroke, the composition of the mixture remaining always the same. Thus a slow or high speed may be obtained at will, by reducing or increasing the power of the engines. There are also mechanical speed-changers, two forward and one backward, the governor being used to vary these gear speeds. The Winton motor has a single cylinder, and carries a heavy fly-wheel. The exhaust is at the rear, and is muffled. The engine can make about 18 miles per hour, with about a gallon of gasolene, costing 10 cents in the United States and 18 cents in Canada.

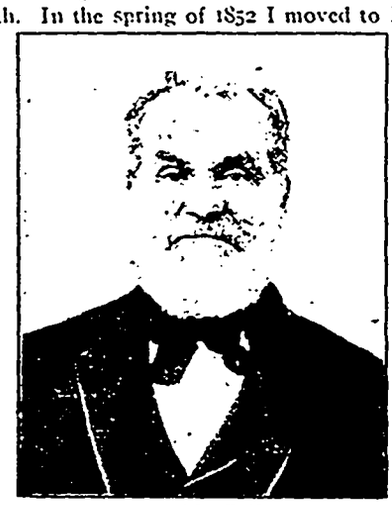
This long and speedy trip of the Winton carriage will not only bring increased business to the Winton Company, but will give an immense impetus to the whole automobile industry, which is bound to develop very rapidly within the next year or two. As The Cycle Age says "When speed contests and long road contests shall have followed close upon one another for a half year, and the results shall have been carefully noted in the press of the whole country, capitalists will fall over each other for a chance to enlarge the manufacture of any vehicle which has acquitted itself creditably. It will be apparent to them then, that the demand will be sufficiently active to pay high interest on their money until the time may come when competition between the various makers shall really begin to be felt as a check and a warning. And they will understand that when that time shall come the general demand for motor vehicles will have grown so large that the particular establishment in which they may have invested their money will have lost none of its value, even if its products shall then have ceased to rank among the best. Any plant equipped to produce gasolene or steam vehicles will increase in value year after year for at least twenty years to come for the simple reason that it may at any time be made available, with very few changes, for the production of that type of vehicle which at any given time is recognized as the best. In other words, it may at almost any time be sold to a more successful competitor that requires increased capacity."

THE ADVANCE IN ALUMINUM.

With copper worth 19 cents per pound, it is found that aluminum at 31 cents is considerably the cheaper for the transmission of electricity. Weight for weight, aluminum furnishes three or more times as much material as copper, while its conductivity is greater than that of copper. It is estimated that one pound of aluminum at 31 cents is as effective as a conductor as an amount of copper costing 66 cents. The result is that a great stimulus has been given to the production of aluminum. The Railway and Engineering Review says that the Northwestern Elevated Railway of Chicago has entered into a contract for 150,000 pounds of aluminum feeders. The great factor in the economical production of this metal is electricity. The cheapness of electric power at Niagara Falls is the reason why the Pittsburg Reduction Company, the largest producer of aluminum in America, located there. It is the intention of this company to greatly enlarge its plant and to double its output of aluminum. If the Ontario Government had dealt with the Niagara Falls power question in a businesslike way, says The Toronto World in a recent issue, we would have been able to-day to take advantage of the present opportunity for producing aluminum. This metal can be produced just as economically in Ontario as in New York—perhaps more so. But there is no power available on this side of the river, so that no one can go into the business. And what is still more disappointing is the fact that there is no evidence that the development of power is to be undertaken in the near future. From all appearances, it looks as if the new deal with the Canadian Niagara Power Company (the American concern) gives that company, as The Niagara Falls Review says, "a surer and cheaper monopoly than they had before."

P. TROWERN, ENGINEER, TORONTO ASYLUM.

The subject of this sketch has supplied us with these interesting biographical details: I was born in Devonport, England, in 1822. My father was engaged in the dock-yard for thirty years, his father was a Huguenot from Brittany, France. My mother was the daughter of Peter Thomas, a miller in St. Ives, Cornwall. When I left the private school I was sent to Cornwall to my uncle to be put in one of the large foundries. The first year I served in the boiler shop, the next in the erecting shop, and was out putting up new engines and repairing old ones in the mines. The following five years I served in the fitting and pattern shops, and drawing office; about the year 1848 I went to the Doulles Iron Works to my uncle, John Trewern, then manager of the works, and from there to London and Plymouth. In the spring of 1852 I moved to Montreal and



P. TROWERN.

worked for Gilbert & Bartlett at repairing river and lake boats, also with Risley & Contaugh's shipyard and machine shop. In 1854 I made the first sewing machine in Canada, Singer's pattern, and sent it to the French Exposition and received the prize; no patent had been taken out for Canada, the place being too small to think of it. I then fitted a brass engine and sent it to Chicago to grind coffee in a grocery store. In the fall of 1854 I moved to Melrose, Sarnia Road, and made three sawmills and grinding engines, the first put to work on the road. I could tell a long story about planting engines in the bush, and sawing the lumber to cover them.

In the spring of 1856 Mr. Trowern came to Toronto and worked for Cook & Blakey, on Adelaide street, and in July he was appointed engineer of the Asylum for the Insane, and he has kept the position ever since, and by temperate habits is enjoying good health.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

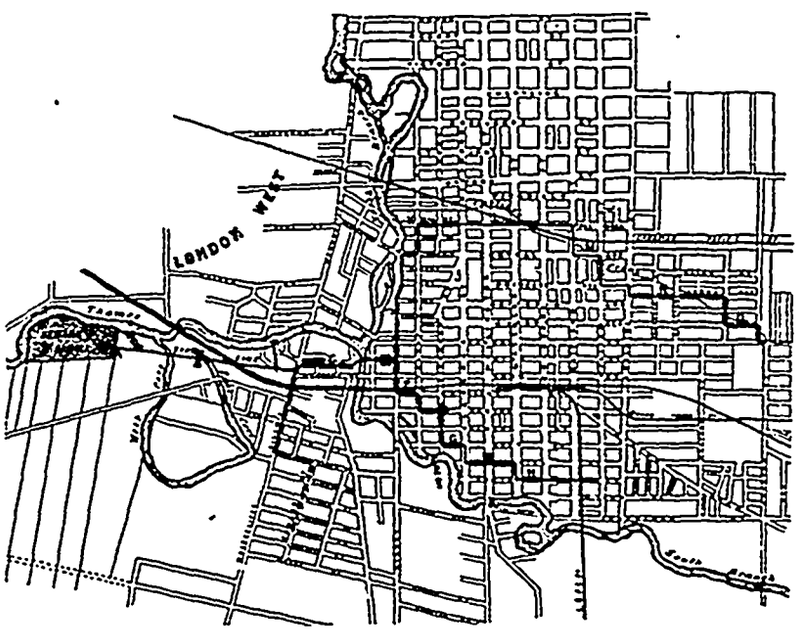
The Canadian Society of Civil Engineers has bought the property, No. 877 Dorchester street, Montreal, a few doors east of Mansfield street, where the present quarters of the society are located, and there the society will have its permanent home. The lot has a frontage of 27 feet and a depth of 100 feet. The house upon it, which abuts upon the street line, has a cut stone front and is three stories in height above the basement. It is intended to alter the whole interior of the house so as to make

it suitable for the purposes of the society, at a cost of $3,000. It is also proposed to build in the rear a one-story hall, inside dimensions 25 x 56 feet, at a cost of $3,000, which amount the council proposes to obtain as an additional subscription to the building fund, from members and friends of the society. To meet the expenditure which it is proposed to incur at present, $11,000, the council will use the whole sum now to the credit of the building fund, amounting to about $4,500, and borrow the balance, $6,500 on mortgage at 4½ per cent. This investment of the society's funds will improve its position, as the rent of the present premises amounts to more than the interest upon the cost of the building and improvements.

THE CONSTRUCTION OF THE MAIN INTERCEPTING SEWERS OF THE CITY OF LONDON, ONT.*

BY W. T. ASHBRIDGE, A. M. CAN. SOC. C. E.

The initial steps leading towards a decided improvement in the sewerage of the city of London consisted in the construction of intercepting sewers designed to carry the present and future sewage flow to filtration beds for purification. The main sewers at present and previously existing on King, Dundas and Wellington streets are of brick, and intercept a large portion of the present sewage of the city. The branch sewers are chiefly of glazed tile, many of which are jointed with clay, and considerable trouble has been caused by tree roots penetrating. Until within a few years, the sewers were but poorly provided with ventilation, and where manholes were built they were usually found at from one to three feet below the road surface. As will be seen by examining the map accompanying the paper, two of the old main sewer outlets (discharging about 25 per cent. of the total sewage flow) empty into the south branch of the river above a mill dam, while the third, viz., King



street, enters the river just above the forks. When the splash boards are in position on the waterworks dam (situated about three and one-half miles below the forks), the river water is backed nearly level to this point. This condition lasts throughout the summer months. During the winter the boards are taken off, thus increasing the fall in that distance by four feet. In London South, nuisances were caused by sewers discharging into watercourses, and also a similar condition existed along the Carling's creek, which received the contents of several street sewers, as also the sewage of the barracks. To remedy the state of affairs, various reports were presented, and on September 2nd, 1896, the ratepayers voted the sum of $150,000, to be applied to the work. This, with some $55,000 (otherwise provided), was the amount believed to be requisite to construct the sewers, purchase the necessary land, and set in operation filtration beds below the Coves, practically as outlined by Willis Chipman, who was retained as consulting engineer. The writer, as assistant to the city engineer, A. O. Graydon, had charge of the work of designing the details, and of superintending the construction.

The system is practically a "separate" one. Cellar, roof and closet drainage will be accommodated, and from the portion of the city now sewered, surface water will also be taken. The regulation as to the amount to be carried during the rainstorms is to be made in "overflow" manholes, which will be described further on. The admission of the surface water as explained was not entirely satisfactory to all concerned, but was conceded. This fact and the difference of opinion of engineers consulted by the civic authorities is responsible for increasing the sizes somewhat over what would be required for "separate system" needs pure and simple. The sewage of the city proper is intercepted by two branches—the one following approximately the bed of Carling's creek, and the other the bank of the south branch of the river—meeting at corner of King and Ridout streets. From this point the flow is carried along King street, across the River Thames (at an elevation of 24 feet above low water), through South London, and across the low lands to the Farm, the South London sewage being intercepted by a pipe laid along the Wharncliffe Road. The least grade is 1 in 1,000, and the greatest 1 in 500. These are arranged to give a cleaning velocity when sewers are flowing half full. The work has all been done by contract, and, in order that it might be pushed forward as rapidly as possible, it was divided into sections ranging in value from $600 to $40,000.

The trenches required usually continuous timbering. This was done by the ordinary methods, using horizontal walings and vertical sheeting. The walings were usually of 2-inch stuff, but some contractors preferred them of 3-inch. Sheeting ranged from 1 to 2-inch, according to the nature of the ground, and the contractor's idea of economy and propriety. Where possible, one waling in the centre has been made to answer for each set of sheeting, but in bad ground, walings were placed at top and bottom of each. Sometimes the single and double waling methods were used in the same trench. On one small but deep section, the sheeting was laced by means of vertical walings well strutted, thus tying the various sets of sheeting together, and making it more difficult for individual sets to sink. In sewer work the proper putting in of shoring is always an important one. On many sections of the London work the banks sank a great deal. This has not always been evenly distributed, as occasionally one side would go down as much as three feet more than the other. The causes of the irregular sinking were not always apparent, but could be generally traced to undue pressure on the sinking side, or to the direction of the flow of the ground water. Frequently water entering the trench from one side would wash in the fine material, and that side would settle, while the other, being dry, would remain firm. Other reasons were the running of machines, dump-cars, etc., close to one side. In one instance the contractor piled all the earth from a 20-foot trench on one side, and the ground being satur-

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

ated with water and being of a mixed nature, a tremendous pressure was brought to bear on the struts, which were bowed from 4 to 6 inches, and the foreman of the work asserted that they were in some cases pushed right through the walings. About 50 feet of this work eventually caved in, and a new method of dealing with the excavated earth was adopted. This settling of trenches made constant watching and attention necessary, the men inserting new raking struts, and tightening up those already in. The work of drawing the shoring in backfilling the deep sand trenches has been frequently dangerous, and much timber was consequently buried. On one section, while taking out sheeting from a 35-foot sand cut, about 25 feet of it caved in, and buried a man below, whose life was saved only by the struts and timbers closing over his head Usually sufficient warning is given by the creaking of the shoring, but this is not always so.

In laying brick sewers the trenches, if in clay or other firm soil, are first trimmed out to the shape of the invert, a template is then fixed in position, true to line and grade at from 12 to 25 feet from the previously finished work, and stretching a line tight along the bottom course, the bricklayers lay the bricks, working from each end towards the centre. The string is then moved to the next course, and the work proceeds as before. The first few courses are laid dry, and the sidewalls then completed to the springing line, the joints being made in no case less than one-quarter inch, and usually made as thin as possible on the face. The invert joints are then filled with cement grout. When bricks have frogs, these are laid up, and all bricks are pressed firmly into place. The springing course is all headers, and is the only one in the sewer. The centres used are four feet long, made with hinged legs. On the arches the key courses are also grouted. Where two-ring work is used, a half-inch collar joint is laid between the rings. This collar joint gives a good bed for the upper courses, and should not be omitted, or laxity allowed where water-tightness is desired. Even then water will find its way through at times, and the writer has one section in mind where the sewer was laid in 15 feet of clay, underlying 20 feet of sand, with plenty of water. After the work had been completed some time, the water was found in places oozing in small drops right through the bricks themselves. As soon as the earth has been rammed over the arch to a depth of two feet, the custom here has been to draw the centres. This allows the work to proceed more rapidly, and in small sewers with good backing no evil results follow from the practice.

The bricks used are made in the city, are of a white or greenish-white variety, the hardest samples being more tinged with green. Their porosity is perhaps their most objectionable feature, as they will absorb from 12 to 18 per cent. of water. Bricks made from the same clay were used in the construction of the old sewers here, some of which have been down 50 years and appear to be sound. All mortar used was mixed in proportion of three of sand to one of Portland cement—the latter being all of Canadian manufacture, very finely ground and giving good tensile tests. Concrete used for backing or foundation was generally made of 1-3-3, but on the sections now in progress, where a single ring sewer is quite surrounded by concrete, the same is being made 1-2-4.

Cradles were used wherever shaky or quicksand bottoms were met with, and were usually made of inch planks, nailed to 1 x 4-inch ribs, 18 inches apart, cut to the proper shape. The ribs were usually fastened on the under side of the planks. The cradles, which were made in the lengths of 4 feet 6 inches, were worked into the bottom by the workmen standing or jumping on them. In using cradle foundations the difficulty has not been one of keeping them up (as seems to be the popular idea), but of holding them down, and it was usually necessary here to strut them down until the brickwork was somewhat advanced. The cradles on one section, however, were made as described above, with the exceptions of having the ribs on the inside and being filled with 4 inches of concrete, which had set at least 24 hours before being lowered in the trench. The reasons for this construction will be explained a little further on.

On many sections of the work, a considerable amount of water was met, but has usually not been more than could be handled by hand pumps of the ordinary diaphragm pattern. Frequently two of these were required. In some cases where the bottom was clay underlying sand, a pump had to be kept working over the completed portion while the backfilling was being done to prevent same being washed into the sewer. A description of the method used on sections L. and M. (which are now being built), will suffice to show how the water when met with in or near the bottom of the trench is kept from the work. This sewer is being laid along streets adjacent to and occasionally crossing the line of Carling's creek, and throughout the entire length of two miles, its invert will be from 5 to 8 feet below the creek level. The cutting is mostly sand, and so far as completed (a distance of three-quarters of a mile), there has been enough water to keep a centrifugal pump (with a three-inch discharge) working steadily. The construction consists of a single ring of brickwork surrounded by concrete of varying thickness. To get this concrete in to the best advantage, the bottom portion (4 inches) is mixed and moulded into the wooden cradles on the bank, and is allowed to set hard before being lowered into the trench. The weight of these is about seven hundred pounds, and they are made in four foot lengths. To enable them to be easily caulked small strips of canvas filled with grass are nailed to one end of each, and when the cradles are being laid they are pressed tightly together. This forms a very good joint, and is only required temporarily to allow the inside ring of bricks to be laid. The pump is set about 50 feet ahead of the completed brickwork, and when in operation draws water from both directions, that portion which is near the sewer being conveyed through 2½-inch land tile, laid on each side of the cradles. This method has proved very successful, and effectually prevents the water and quicksand from boiling up through the bottom. Occasionally entrances into the sewer were left to allow the ground water to drain away. These weepholes are afterwards closed up, but not for some weeks after the work is laid.

Glazed tile sewers were laid up to 18 inches diameter. These were jointed with neat cement—gasket being first used to pack the joints. With all 18-inch sewers and with some 15-inch concrete was used to pack the haunches. The sections show the manner of doing this. Standard pipes were used, except on one deep section, where a thickness of one-tenth the diameter was demanded. Considerable delay and difficulty were the result. Manholes were built at from 300 to 450 feet apart, depending upon lengths of blocks, the principle being to have one at each sewer junction. The greater part of these (the manholes) are rectangular in form, being 2 feet by 3 feet 6 inches inside at the bottom, and drawn in to 2 feet by 2 feet at the top to suit frames, 1 foot 9 inches by 1 foot 9 inches inside dimensions. Each frame and cover weigh (together) about 520 pounds, and ventilation is provided by 81 holes 1-inch square each. Iron steps of ⅝-inch by 1½-inches iron, bent and set in the shafts every fifth course of the brickwork, provide a means of entering the sewer. The walls are of two rings of brickwork down to 16 feet depth, and below this an additional ring is built. On the deepest sewers, however, the manholes were made circular at the bottom, and were drawn in gradually to suit the square tops. Six-inch private drain connections were left at distances apart varying from 25 to 40 feet, according to the property subdivision, and where necessary enough tile was laid to bring connection to within 11 feet of the road surface. On the deepest sections no private drain connections were left, as it was thought more suitable to lay a shallow sewer later on.

Tile sewers are laid straight from manhole to manhole, the bottoms of the latter, where direction changes, being curved suitably. Change of direction in brick sewers has been made by curves of radius of from 30 to 100 feet, with a manhole placed at each end of the curve. Where the north and south sewers join at King and Ridout streets, a bellmouth junction was built, having a stone tongue 8 feet long, and a brick arch thrown over both sewers of greatest radius 3 feet. Where the main sewer is at same depth below the grade of a future branch, a drop connection is made by means of a vertical pipe outside the manhole wall. Occasionally two branch connections have been made joining with one vertical pipe, and in each case the connection is open through wall for inspection and for use if any stoppage should occur in the drop.

Flushing gates (closing against the current) were placed on

certain sewers at intervals of 1,000 to 1,500 feet. They are held shut by a bar of iron with a forked end jammed against an inclined rod, and when sufficient amount of water has accumulated behind the gate the bar is pulled or knocked out—the door swings back or is lifted (if for tile), and the flush is immediate and substantial. Both kinds have been found satisfactory. Along the north sewer, inlets have been made to utilize the creek water for flushing purposes. Each inlet consists of a large and small chamber, the former being 4 feet by 6 feet by 14 feet long, having an outlet to the sewer two feet from the bottom, and being separated from the small chamber by a 14-inch wall at the other end. This latter is really two chambers covered with gratings set in the bed of the creek. One of these small chambers connects with the large one by a grating, and is intended for an ordinary flow (which can be controlled in a similar manner to that by which storm water is). Should a large flush be required, it can be had by opening a gate-valve connecting the other half of the small chamber with the large one. This large chamber has a sand catching capacity of about 3 cubic yards, and will be required to be cleaned out occasionally.

To carry the sewer across the river at King street a bridge was built, and this was made to serve highway purposes as well. The bridge has a central span of 162 feet, and viaduct approaches of 468 feet, making a total floor length of 630 feet. A steel rivetted pipe 36 inches in diameter was carried under the floor throughout the length. This pipe was made of ¼-inch metal, painted with two coats of graphite over one coat of red lead, and its construction (and that of the floor beams supporting it) is clearly shown in the photograph accompanying. Inside the pipe no rivet heads show below the horizontal diameter. The piers and pedestals for the viaduct columns were all constructed of 1-2-6 concrete, with 3-inch facing of 2 to 1 mortar, and covered with six inches of concrete composed of one of cement, one of sand and three of crushed screenings. This concrete became extremely hard, and proved harder cutting than limestone three months after completion. A good hard clay foundation was found for the east river pier at about 6 feet depth, while for the other river pier the clay was ten feet lower, and oak piles spaced 2 feet 6 inches centres each way were driven and covered with a timber platform to receive the concrete. In the construction of the superstructure, attention is drawn to the floor beams, which are shown well in the photograph. They are spaced 18 feet apart throughout the whole length of bridge and viaduct. The steel pipes were brought on the ground in 32 feet lengths (4-8 foot plates), and as much as 200 feet of them were laid in position in one day. To facilitate jointing, the butt-strips on the pipes were made in two parts—on one length this strip being shop-rivetted to the lower, and on the next length to the upper half, thus saving some trouble in fitting. The curves were made to a 74 foot radius, the centre of each cross seam lying on the arc of the circle. The work went easily together, and in only a few cases was it necessary to alter the positions of the saddles on the beams. About five joints were rivetted and caulked in a day.

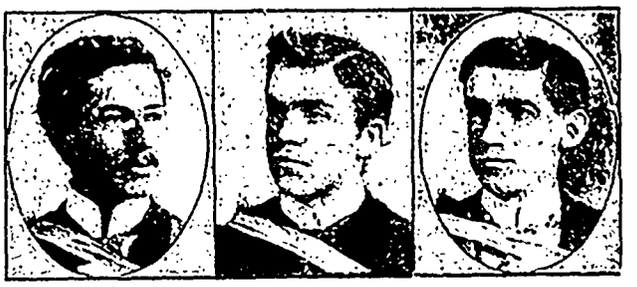
(To be continued).

YALE CHAIN BLOCKS.

These are the only differential blocks made under direct license from the inventor and patentee, Thos. A. Weston. They are durable, smooth and easy working because constructed with Yale chain, which is gauged by patented machinery, tested before using and of special material, and the sheaves are from machine made patterns.

The Yale-Weston triplex blocks are claimed to have an actual efficiency of 80 per cent., and to be the most efficient blocks in the world. This means that only 20 per cent. of the operator's labor is wasted in overcoming friction; showing that this type of block has twice the efficiency of blocks of the screw-gear type and triple the efficiency of those of the differential type. By employing the Yale differential block the load is always self-sustained, and one man can lift 800 lbs. 4 feet per minute; with the Yale duplex block, load always self-sustained, one man can lift 1,700 lbs. 2½ feet per minute, and with the Yale triplex block, load always self-sustained, one man can lift 2,000 lbs. 4 feet per minute. The Fairbanks Co., 749 Craig street, Montreal, has been appointed exclusive agents for Canada for these goods.

MCGILL PRIZEMEN IN APPLIED SCIENCE, '99.



WALTER W. COLPITTS, British Association medal in Civil Engineering.

A. G. GRIER, British Association medal in Electrical Engineering.

W. B MCLEAN, British Association medal in Mechanical Engineering.

STAFFORD F. KIRKPATRICK, British Association medal in Mining Engineering.

W. S. HUTCHISON, British Association medal in Chemistry.

GEORGE T. HYDE, British Association medal in Architecture.

NEW CATALOGUES.

The Ballard Electric and Machine Co., Ltd., dealers in general electrical supplies, machinists and instrument makers, 6 and 8 Adelaide street west, Toronto, have just issued a very neat catalogue of some hundred pages, which lists the electrical supplies of the company, such as telephones and telephone outfits of several different sorts, burglar alarm and other annunciators, automatic indicators, storage batteries of many makes, electric bells and buzzers, push buttons, electro-medical apparatus, such as induction coils, electrodes, combs and brushes, etc.; speaking tube material, telegraph apparatus, electric gaslighters, door openers, motor fans, model motors and generators, electric lighting goods. There are also a number of blank pages for memoranda, and a most interesting series of tables of decimal equivalents, bicycle gear table, table of melting points, specific gravity and conductivity of various metals, comparative table of gauges, table of the number, diameter, weight, length and resistance of pure copper wire (Brown & Sharp gauge). A number of illustrations of standard tools are also listed. These are by such well-known makers as the Stevens Arms & Tool Co., the J. M. Carpenter Tap and Die Co., Brown & Sharpe Mnfg. Co., etc. These catalogues will be sent free on application to the publishers.

The Cummer Dryers is a new catalogue which has just reached us from the F. D. Cummer & Son Co., Cleveland, O., U.S.A., which sets out in an attractive way the advantages of using the Cummer dryers, processes, roasters, hot air apparatus and systems which are now doing duty in the United States, Canada and Australia, Great Britain, France, Belgium and Germany. It is claimed for these dryers that they employ almost every unit of heat in drying as against a usual efficiency of perhaps 25 per cent. These dryers are now drying the following: Sand, asbestos, kaolin, marl, chalk, clays of all kinds, infusorial earth, paint stocks, wood chips, chemicals, nitrate of soda, wool, sawdust, wood pulp, digested hair, fertilizers, by-products, muck, rubber, phosphate, blood, tankage carbonate of soda, yarn, brewers' grains, bones, distillery slop, starch-feed, all grains, brick, terra cotta, cement briquettes, tile, pottery, salt, cotton, gypsum, cloth, impalpable silica or quartz, ores of all kinds, concentrates, all very wet and sticky materials, coal, peat, guano, tobacco, moss, copra, cocoa.

MICA IN QUEBEC.

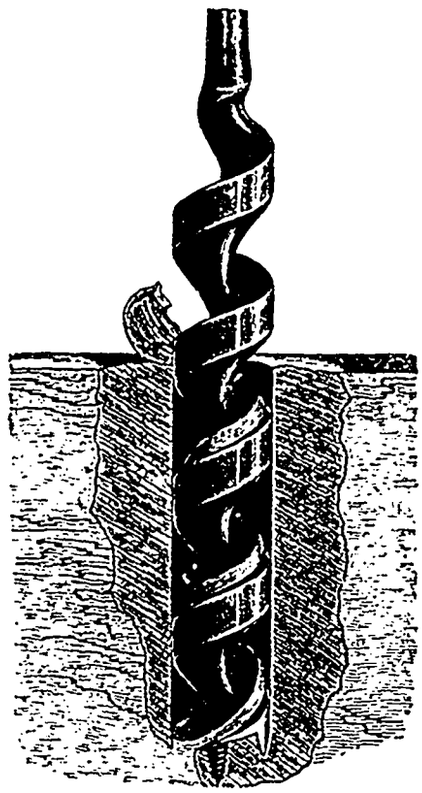
There has been considerable development in the mica industry in Quebec in the past year, as is shown in J. Obalski's report to the Department of Mines, where he states that in 1897 from 50 to 100 men only were employed in the mines while in 1898 the number employed in them and in trimming the mica exceeded 250 with seven or eight important mines in operation, and some twenty prospects producing a little mica. In the course of the year, a large number of prospecting licenses in the counties of Ottawa and Pontiac were taken out. In the latter, some discoveries were made, so far of little value, but which may lead to more important finds.

The demand for amber mica, which is almost exclusively shipped to the United States, is good, and we must believe that the Canadian mica is well appreciated, seeing that it finds a regular market notwithstanding the high duty of 20 per cent. ad valorem and 6 cents per pound, on thumb-trimmed mica and 12 cents on the knife-trimmed article, and it may even be remarked that the consumers, while being very hard to please as regards the fashion in which the mica is prepared, are less so with respect to the quality itself; certain dark colored micas, which were formerly difficult of sale, now finding purchasers more easily. The demand also appears to be better for small mica and less for the large, which results in the first place from the great difference in price, which may range from 5 cents for one by three inches, to $1 per lb., for mica of large dimensions. These large dimensions were formerly necessary, but they are now replaced by plates of micanite (prepared by E. Munsell & Co., of New York), or of micabeston (prepared by W. H. Sills, of Chicago), which are nothing but thin plates or sheets of small mica glued one upon the other, and afterwards pressed to the thickness of one-sixteenth of an inch, thus forming plates which are cut any desired size. The United States customs duties are paid by the consumers and weigh more heavily on the small than on the large mica. Thus, mica of 5 cents per lb., or $100 per ton, has to pay 20 per cent. or $20, besides 6 cents multiplied by 2,000 or $120, thus $20 + $120=$140 or 140 per cent., while mica of $1 per lb., or $2,000 per ton, has to pay 20 per cent of $2,000 plus 6 cents multiplied by 2,000, namely, $400 + $120 = $520 or 26 per cent., freights being the same. The tariff of 12 cents on knife-trimmed mica also explains why thumb-trimmed mica especially is shipped, upon which there is only a duty of 6 cents, besides the 20 per cent. ad. valorem. The mica is sold in barrels weighing 350 lbs. net.

AN IMPROVED BIT.

We illustrate the Ford patent bit, a tool which has been subjected to thorough testing upon different kinds of wood and which has a distinguishing peculiarity over other bits, which lies in the twist. Its shape is determined by and defined as that of a single concaved twist. This gives it a single cutting edge and a single projecting lip. The thread of the screw point is a continuation of the twist of the upper part, so that one merges into the other. The concave shape of the upper surface of the twist has the effect of drawing the borings towards the centre or axis of the bit, thus preventing friction of borings against the sides of the hole, and thereby also preventing choking, says The Scientific American. For this bit, the necessity of constantly withdrawing for removing the chips does not exist. The cut shows the self-cleaning action of the tool, and also presents its general shape. The drawing was made from an actual boring with the bit, the hole being made one-half in each of two separate pieces of wood, which were then separated to give the model for the artist and to show its action. The bits were tried in different kinds of wood vertical to the grain, diagonal thereto, and in other ways. The straightness of the hole was also remarked, and the absence of any tendency to split the wood was an evidence of the good clearance. The screw point held its grip very well, no pressure whatever being required for the feed, even in end grain boring. The action of the edge is a true cutting one, not a scraping one. The Aikenhead Hardware Co., of Toronto, will send prices on receipt of enquiry.

The Ford Bit Company has perfected a tool that has taken the lead over all makes of auger bits, says the American Review, December, 1898. This bit differs from other makes in the twist, its shape being a single concaved twist forged from the bar into shape between dies under heavy trip hammer blows, which process makes the grain in the steel much finer and tougher than can be made by the old process of twisting. This peculiar twist gives it a single cutting edge and a single projecting lip. The thread of the screw point is a continuation



of the twist of the upper part, so that one merges into the other. The concave shape of the upper surface of the twist has the effect of drawing the borings toward the centre or axis of the bit, thus preventing friction of borings against the sides of the hole, and thereby also preventing choking. For this bit, the necessity of constantly withdrawing for removing the chips does not exist. Another peculiarity of the Ford bit is that the screw point holds its grip so well that no pressure whatever is required for the feed in end grain boring. It is equally effective in all kinds of wood in any angle, and will make a hole cleaner and straighter than can be done by any other tool, which is fully demonstrated by the fact that this bit can be used successfully inside a hollow mortising chisel, the action of the edge being a true cutting one, not a scraping one. The Ford improved bits are made in various sizes and for various kinds of work. Their regular car bits are for fine work and deep boring; ship auger car bits for rough and rapid boring in hard wood for car shop work, also ship auger bits, ship augers, etc., either with or without screw for shipyard work. They are put up in half dozen and dozen sets of assorted sizes, packed in neat cherry boxes. A full display was made at the Mechanics' Fair in Boston during October and November, 1898.

OTTAWA VALLEY CANAL.

McLeod Stewart, chief promoter of the Montreal, Ottawa and Georgian Bay ship canal, has returned from Great Britain, where he has been engaged in floating a company to take up the enterprise. The result of his visit is, he says, the formation of a company and a guarantee that if the needed encouragement is forthcoming, the work on the canal will be commenced in August of this year, and completed by July 1, 1902. If the necessary encouragement is given by the Government, he says, the scheme will be financed without difficulty. The sum of $2,000,000 has been subscribed, and $200,000, an essential guarantee before legal organization could take place and the work proceeded with, has been paid into Lloyds' Bank, with instructions to transfer it to the Canadian Bank of Commerce in Ottawa. The engineers, including Kenneth Mackenzie, son of Sir J. Mackenzie, Bart., are coming out to complete the sur-

veys of the route. Subsidiary to this scheme, Mr. Stewart says he has formed the New Dominion Syndicate, for the purpose of developing the resources of the Ottawa valley, especially along the route of the canal. It is the intention of this company to develop the resources of lumber, timber in pulp, nickel and other industries, and convert into electrical energy the available water powers along the route of the canal.

R. J. DURLEY, B. Sc. (LONDON).

The chair of mechanical engineering, McGill University, vacant by the resignation of Dr. J. T. Nicolson, has been filled by the appointment of R. J. Durley, B.Sc. (London), at present assistant professor of mechanical engineering. The appointment of Professor Durley to the chair gives a step also to H. M. Jacquays, M.A., M.Sc., who will be offered the lectureship in mechanical engineering. R. J. Durley obtained his early education at the Modern School, Bedford, England, a school whose history goes back for considerably over three centuries. Obtaining an exhibition on leaving, he entered the engineering department of University College, Bristol, and worked there during the session of 1884-85. While here he secured one of the college scholarships. He gained a Gilchrist scholarship at University College, London, in 1885, and studied there under Dr. Alex. B. W. Kennedy during the sessions of 1885-86, and 1886-87, spending a considerable portion of this time in experimental work in the engineering laboratory of the college. At the conclusion of the course he took a very high position in all the college examinations in professional subjects, and in 1887 he passed the examination for the degree of Bachelor of Science of the University of London. On leaving University College, he entered the works of Earls' Shipbuilding and Engineering Company, Ltd., of Hull, and served a term of four years' apprenticeship as a mechanical engineer. During this time Mr. Durley spent some time working on board those ships of the Royal Navy then being engined by Earles' company, in H.M. dockyards in Pembroke and Davenport. From 1890 to 1894, he remained in the employ of the same firm, and was employed in designing marine and other machinery of varied types. In 1894 Mr. Durley was appointed chief lecturer on mechanical engineering in the Hull Municipal Technical Schools, which were then being established, and he was responsible for the arrangement, organization and equipment of the workshops and laboratories of his department. In 1897 he accepted the appointment of assistant professor of mechanical engineering in McGill University. Mr. Durley is a Whitworth scholar, and has on two occasions received Miller prizes for papers presented by him to the Institution of Civil Engineers, England, of which society he is an associate member. He is also an associate member of the Canadian Society of Civil Engineers, and has been a not infrequent contributor to the proceedings of that body. The work done for McGill University by Mr. Durley, as Dr. Nicholson's assistant, received academic recognition last year, when the degree of Master of Engineering was conferred upon him by McGill.

A DISMISSED ENGINEER.

Judge McDougall's finding upon the charges preferred against Robert Pink, chief engineer at the main pumping station, Toronto, touching the honesty and authenticity of his reports on the Green economizer tests has been presented to the city council. The judgment goes carefully and with much detail into the three tests made, and the conclusions are decidedly against Mr. Pink. Of the first test the judgment runs in part "I have carefully checked the calculations and figures showing the coal consumed and water pumped at the first test made by Mr Pink in November and December, 1897, and I find the figures of this first test given by Mr. Pink in his report dated January 7th, 1898, and addressed to Mr. Keating, to be incorrect and misleading." The following comparison will show to what extent:

	Mr. Pink's figures.	Correct figures.
Nov. 21 to Dec. 20, 1896—		
Water pumped, gals.....	499,347,700	467,875,247
Coal consumed	621 tons 1,220 lbs.	583 tons 782 lbs.
Nov. 21 to Dec. 20, 1897—		
Water pumped, gals.....	436,432,257	507,582,330
Coal consumed	531 tons 455 lbs.	650 tons 990 lbs.

His Honor goes on to say that Mr. Pink reported of this test: "I have made a careful calculation as to the comparative amounts of water pumped, and conclude that the saving of fuel by the use of the economizer amounts to 12.65 per cent.," and that Mr. Fellowes had shown that the actual saving in coal was 2.27 per cent. The judge goes somewhat further into the details, and shows that from November 21 to December 20, 1896, without an economizer, 40,091 gallons of water were pumped per 100 pounds of coal burned, and that in the 1897 test, with the economizer, 39,015 gallons of water were pumped per 100 pounds of coal. That is to say, there was a 2.68 per cent. of loss in 1897 from the use of the economizer.

Commenting upon Mr. Pink's confession that from the figures of the coal consumed and water pumped, Mr. Gower, the agent for the Economizer company, had figured out for him the percentage of gain, and that he had accepted the result without verification, Judge McDougall says: "I regret to say Mr. Pink seemed utterly unable to appreciate any moral delinquency in the foregoing conduct."

His Honor continues: "I find upon the evidence as to the so-called first test of the Green economizer, that Robert Pink, the chief engineer of the main pumping station, sent in to the city engineer a false and misleading report of the working of the said economizer, and that he falsely and wrongfully in the said report stated that after careful personal calculation of certain data prepared for him by his clerk (Mr. Harston), the said Green economizer was effecting a saving of 12.65 per cent. in the consumption of coal required to pump a given quantity of water. I further find that Robert Pink, most improperly and contrary to his duty to the city, allowed the agent of the Green Economizer Company to examine the data prepared for a report to his employers relating to the saving in fuel effected by using the Green economizer before such report was sent in to the city engineer; and, further, the said Robert Pink allowed the said agent to prepare for him the most important part of his report, that purporting to show the percentage of coal saved by the use of the economizer, that such percentage as stated was false and untrue, and that I can only conclude that the object of such false statement was to deceive the city engineer, hoping thereby to induce him to report favorably to the council upon the merits of the Green economizer, and also in expectation that the said city council, upon the faith of his (Pink's) false report, would purchase the said economizer."

The judge goes into the statistical details of the second test, and concludes: "Making, then, a comparison of the two periods chosen by Mr. Pink, I find that in 1896, without the economizer, engines Nos. 4 and 5 for a period of 30 days pumped 41,184 gallons of water per 100 pounds of coal, and in 1898, for a similar period of 30 days with the economizer, they pumped 42,306 gallons per 100 pounds of coal, or a gain of 2.72 per cent. in favor of the economizer. Deducting from Mr. Pink's alleged saving of 11.8 per cent. his arbitrary allowance of 5 per cent. for excess of ash, there would be left 6.87 per cent., his net alleged saving." Regarding the ash allowance, the judge characterized it as "being utterly unwarranted by the facts, and as being manifestly dishonest on the part of Mr. Pink."

The judge deals with the third test, which he concludes was, owing to the tactics in the engine-room adopted by Mr. Pink, and permitted by Engineer Hughes, such as jockeying with the furnaces and wasting steam, to be "utterly worthless and unreliable." Judge McDougall concludes finally: "I find therefore upon comparing the two thirty-day tests (one with the economizer in November, 1897, and the other in June and July, 1898) with the pumpage per 100 pounds of coal for the three months of August, September and October, 1896, without an economizer, the first test shows there was a loss of 3.47 per cent. suffered by using the economizer. And in the second thirty-days' test the comparison shows that the economizer effected a saving of 4.66 per cent. The economizer therefore since its installation, and under the conditions of the written contract with the city, has not shown as the result of any thirty days' test a saving of fuel exceeding 4.66 per cent.

"I find that the strictures contained in Mr. Fellowes' report of February 16th, 1899, to Mr. Rust relating to the economizer tests and to Mr. Pink's reports thereon, are amply sustained by the evidence. The utterly untrustworthy and misleading nature of Mr. Pink's reports pointed out by Mr. Fellowes have been

fully established before me by independent testimony and Mr. Fellowes' report satisfactorily verified. I have thought it unnecessary, in view of the results of my enquiry into the character and reliability of the various tests reported upon by Mr. Pink, to put the city to the trouble or expense of making a further test as suggested by your resolution of 6th March last To my mind it is quite manifest that whatever may be the merits of the Green economizer, the results stipulated from the agreement of the Green Economizer Company with the city as a condition precedent to a purchase of the economizer cannot be obtained at the main pumping station under present conditions or without extensive structural alterations."

Upon the reception of this report of course the engineers were dismissed by the city engineer. This was considered by some to be very severe usage of the second engineer, who has merely carried out the orders of his senior. The Executive Committee of the city council asked the city engineer to replace the dismissed men, but of course this has not been done. Comment upon these facts is hardly necessary.

THE INFLUENCE OF MECHANICAL DRAFT UPON THE ULTIMATE EFFICIENCY OF STEAM BOILERS.*

A discussion of the influence of mechanical draft upon the ultimate efficiency of steam boilers may very properly be introduced by a presentation of the apparatus, and the methods employed in its production. In its generally accepted form the apparatus consists of a fan blower enclosed in a case and provided with the necessary means for its operation.

The fan wheel itself consists of a number of radial blades carried upon T steel arms, cast into the hub. Although a mechanical draft fan may be readily driven by belt, it is rendered much more effective if equipped with a special engine directly

FIG. 1. TYPICAL FORCED DRAFT PLANT.

connected to its shaft. Mechanical draft may be applied under either of two general methods, the plenum or the vacuum. Which is to be employed must depend upon the circumstances, for it cannot be asserted that either is unqualifiedly superior under all conditions. As ordinarily applied, under the plenum or forced draft method, the air is delivered to the closed ashpit under pressure, and thence finds its escape through the fuel on the grates above. Its success depends largely upon the manner of introduction of the air to the ashpits. For this purpose a special form of damper is desirable, which may be such as shown in Figs. 1 and 2. In the former illustration is shown a typical forced draft plant. The fan is so designed that the air may be discharged into an underground brick duct, extending

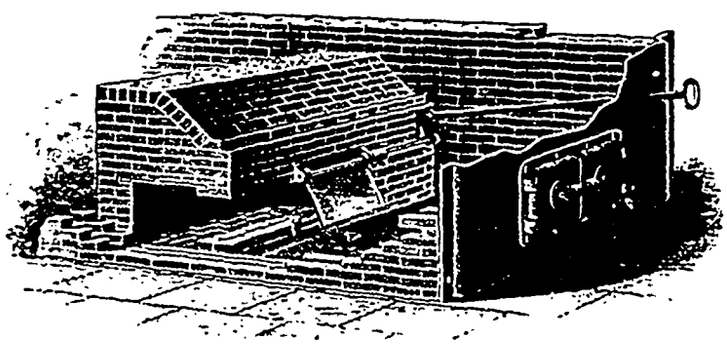


FIG. 2. ASHPIT DAMPER IN BRIDGE WALL.

along beneath the boilers whence it passes through individual dampers in the ashpits. In a new plant the bridge wall may be left hollow, and utilized as an air duct; a damper of the form shown in Fig. 2 being employed and operated from the front by means of the notched handle bar. The effect of both forms of damper is to spread the air evenly over the entire bottom of the ashpit, whence it rises in even volume, and at low velocity. Under the vacuum or induced method, the fan is introduced as a direct substitute for the chimney, creating a vacuum in the furnace, and drawing therefrom the gases generated in the process of combustion. As the draft is thus rendered positive and practically independent of all conditions, except the speed of the fan, it is only necessary to provide a short outlet pipe to carry the gases to a sufficient height to permit of their harmless discharge to the atmosphere. Various arrangements of induced draft are usually possible with an ordinary boiler plant. As a rule the simplest arrangement consists in placing the fan or fans immediately above the boilers, leading the smoke flue directly to the fan inlet connection, and discharging the gases upward through a short pipe extending just above the boiler-house roof. A duplex, induced draft plant, having two fans, each of sufficient capacity to produce the required draft, is shown in Fig. 3. Each fan is provided with a direct connected engine, and either or both may be operated at will.

The ultimate efficiency of a steam boiler is dependent upon three principal factors: First, the primary cost of the entire plant and the fixed charges thereon. Second, the quantitative efficiency of the plant as a means of burning the fuel supplied and transferring its heat to the water evaporated. Third, the operating expense including the fuel. In so far as mechanical draft has a direct influence upon any of these factors it is the purpose to here consider its ultimate effect upon the efficiency of the steam boiler plant to which it may be applied. Naturally, the question of primary cost first enters into the consideration, and secondly, that of maintenance and operation, while both of these items are to be viewed in the light of the efficiency secured. In the matter of first cost comparison is fundamentally made between the cost of a chimney and that of a mechanical draft plant, which may be introduced as a substitute.

In the accompanying curves, Fig. 4, are presented the relative costs of chimneys and of equivalent mechanical draft equipments in a number of boiler plants widely different in character and rated capacity. In certain of these the cost of the existing chimney is known, and that of the complete draft plant is estimated, while in others, the cost of the mechanical draft installation is determined from the contract price, and the expenses of a chimney to produce equivalent results is calculated. Costs are shown for both single forced and induced engine-driven fans and for duplex engine-driven plants in which either fan may serve as a relay. An apparatus of this latter type is evidently most complete, and is necessarily the most expensive. It finds its greatest use where economizers are employed. An average of the costs for these nine representative plants shows the total expense for installing a forced draft plant to be only 18.7 per cent. that of a single induced fan, and accessories 26.7 per cent., and that of a complete duplex induced-draft plant 42 per cent. of that of a chimney. In each case a short steel-plate stack is included. In other words, if a chimney be estimated to cost $10,000, there could be saved, on a basis of these averages, the respective amounts of $8,130, $7,330 or $5,800 in the first cost according to which system of mechanical draft is substituted.

For a good steam boiler plant it is fair to assume the following as average fixed charges:

Interest	5 per cent.
Depreciation and repairs	4½ per cent.
Insurance and taxes	1½ per cent.
Total	11 per cent.

Experience has shown that these figures also hold good for a well designed mechanical draft apparatus, and are, therefore, accepted here. On the other hand the fixed charges on a chimney may be fairly assumed as:

*From a lecture by Walter B Snow, before the Applied Science Graduate Society, McGill University.

Interest	5 per cent.
Depreciation and repairs	1½ per cent.
Insurance and taxes	1½ per cent.
Total	8 per cent.

The fact that the mechanical draft apparatus can usually be placed overhead or on top of the boilers where it occupies no valuable space, and that the space otherwise occupied by the chimney is at the same time rendered available, makes possible a further saving which is necessarily dependent upon the land values. Within city limits, it may readily amount to $1,000 in a plant of a thousand horse-power.

FIG. 3. INDUCED DRAFT PLANT AT HOLYOKE STREET RAILWAY CO., HOLYOKE, MASS.

The comparative costs and charges on a $10,000 chimney and its substitutes are as follows:

Method of Draft Production.	—First Cost.— Amount.	Ratio.	Annual —Fixed Charges.— Amount.	Ratio.
Chimney	$10,000	1.00	$800	1.00
Induced draft plant (2 fans).	4,200	.42	462	.58
Induced draft plant (1 fan)..	2,670	.267	294	.37
Forced draft plant (1 fan)...	1,870	.187	206	.26

A concrete case illustrating the possibilities of mechanical draft is presented in the accompanying drawings, Figs. 5 and 6. These show a plant of 2,400 h.p. of modern water-tube boilers, 12 in number, set in pairs, and equipped with economizers. Fig. 5 indicates the location of a chimney 9 feet in internal diameter by 180 ft. high, designed to furnish the necessary draft. In Fig. 6 is shown the same plant with a complete duplex induced-

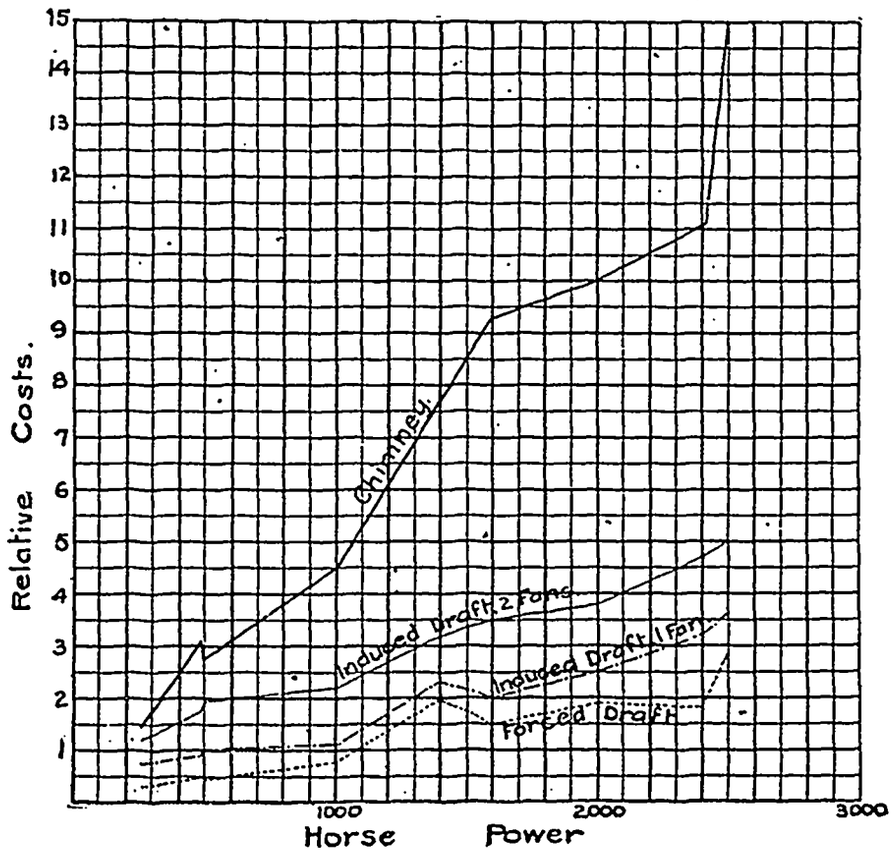


FIG. 4. COMPARATIVE COSTS OF CHIMNEY AND MECHANICAL DRAFT

draft apparatus substituted for the chimney and placed above the economizer connections. Each of the two fans is driven by a special engine, direct-connected to the fan shaft, and each is capable of producing draft for the entire plant. A short steel plate stack unites the two fan outlets and discharges the gases just above the boiler house roof. All of the room necessary for the chimney is saved, and no valuable space is required for the fans.

COST OF BOILER PLANT WITH CHIMNEY.

12 boilers	$37,000
2 economizers	10,500
Boiler and economizer settings and by-passes	9,000
Automatic damper regulators and dampers	400
Chimney, including foundations	10,700
Boiler house	11,500
Total	$79,100

RELATIVE COSTS.

CHIMNEY DRAFT.

Cost of chimney	$10,700
Cost of damper regulators and dampers	400
	$11,100

MECHANICAL DRAFT.

Cost of mechanical draft plant, complete	$ 4,700
Saving by using mechanical draft	6,400
	$11,100

matic control, will be somewhat less than that with the chimney, while if the economizers remain the same, their capacity relative to the heating surface of the boilers will be greater, so that the ultimate waste by heat in the escaping gases will certainly not be increased.

RELATIVE COSTS.

2,400 NOMINAL H.P. PLANT, WITH CHIMNEY DRAFT.

12 boilers	$37,000
2 economizers	10,500
Boiler and economizer settings and by-passes	9,000
Automatic damper regulators and dampers	400
Chimney, including foundations	10,700
Boiler house	11,500
	$79 00

2,000 NOMINAL H.P. PLANT, WITH MECHANICAL DRAFT.

10 boilers	$30,833
2 economizers	10,500
Boiler and economizer settings and by-passes	8,500
Boiler house	11,000
Mechanical draft plant complete	4,700
Saving by using mechanical draft	13,567
	$79,100

The original costs under the two conditions will be about as indicated. A total possible saving of $13,567 is thus shown, of which $7,167 is due to the reduction in nominal horse-power made possible by the introduction of mechanical draft.

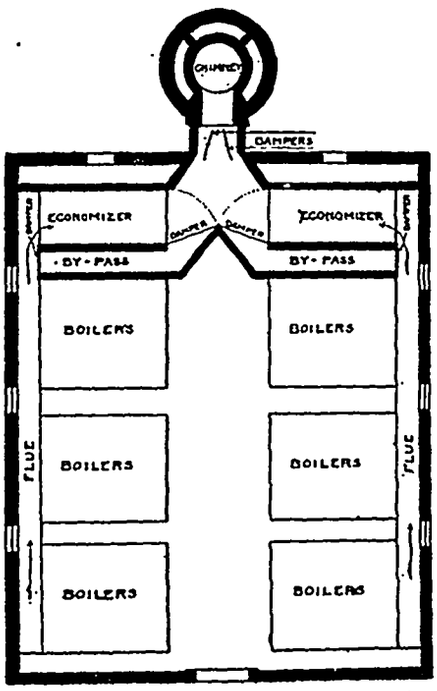


FIG. 5, 2400 H.P., BOILER PLANT EQUIPPED WITH CHIMNEY DRAFT.

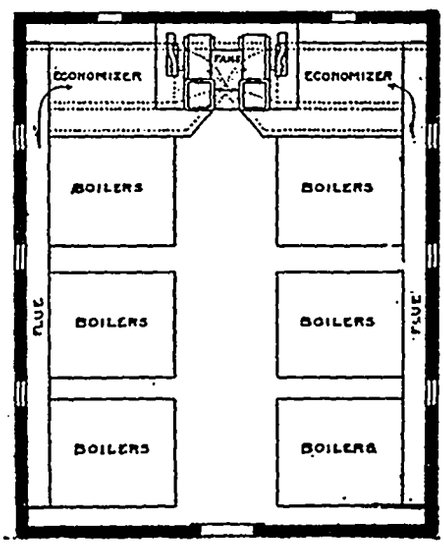


FIG. 6, 2400 H.P., BOILER PLANT EQUIPPED WITH MECHANICAL DRAFT.

The comparatively low rates of combustion which have heretofore obtained are largely due to the inability of the ordinary chimney to overcome the increased resistances incident to the maintenance of a higher rate. Boilers have naturally been proportioned to meet these conditions, but it is manifest that by changes in design or by the introduction of heat-abstractors, they may, under the influence of mechanical draft, be readily operated at considerably above their original ratings, with substantially the same efficiency. As a result it is possible to obtain a given output with a plant of less size and first cost than is possible with a chimney. This is particularly true where the steam consumption is liable to sudden fluctuations for comparatively short periods. The typical boiler plant already presented will serve as an excellent illustration. Suppose it is determined to omit two of the 12 boilers, say one from each pair at the end farthest from the economizers, and to force the remaining boilers up to the original rating, which can be easily done by mechanical means, as a substitute for the chimney. This will decrease the rating to 2,000 h.p. or by 16 2-3 per cent. The volume of air required per pound of coal, with the higher combustion rate, deeper fires and mechanical draft under automatic control, will be somewhat less than that with the chimney, while if the economizers remain the same, their capacity relative to the heating surface of the boilers will be greater, so that the ultimate waste by heat in the escaping gases will certainly not be increased.

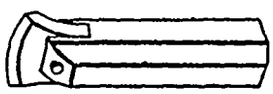
A problem that has to be faced sooner or later in most boiler plants is that of increased capacity. This differs from that just presented in that the chimney already exists, and it becomes a question whether the desired result shall be obtained by forcing the existing boilers or by adding to their number. The former method demands an increase in intensity of draft, which with a given chimney, operating well up to its capacity can only be obtained by considerable increase of height at excessive expense, while with either method a larger volume of air is required. As a result, increased output frequently demands not only more boilers, but a new or higher chimney. Here mechanical draft steps in and presents a simple solution of the problem.

(To be continued).

A NEW DRILL.

The accompanying engraving represents an invention, which has recently been patented by the Hon. Henry Aylmer, Richmond, Que., in the principal countries of the world. It is a very simple device, and as shown the stock of the drill has a

dovetailed groove to receive a corresponding bit. A tapered pin through the stock and bit firmly holds the latter in position. At first glance it is difficult to estimate the importance of this invention, but to those interested in mining and other rock work it will readily be seen what an advantage this drill has to those now used. The bits are made of a fine grade steel, and, therefore, have a good cutting edge, and from tests already



made, are said to be at the rate of two to one of the ordinary drill. The great point in favor of the Aylmer drill is that the bits are interchangeable, doing away with the cutting and sharpening of the bar of steel, as a fresh supply of bits can be purchased at any time and the stocks will last a man a great length of time. Prospectors will also find this drill a great boon, as there will be no necessity of carrying with them appliances for sharpening drills or wasting time at such work, as a pocket full of bits will last them a considerable time. We understand Mr. Aylmer has also invented and patented a socket and bit for steam drills, which is unlike anything at present in use and will, like the hand drill, prove of value to those interested in that class of work. We are informed that some prominent capitalists, being themselves mine owners and contractors in a large way, have interested themselves in Mr. Aylmer's drills, and intend placing them on the market as soon as possible.

A NEW GRAND TRUNK RAILWAY LOCOMOTIVE.

Some special features of the monster locomotive just turned out at the Point St. Charles shops of the Grand Trunk Railway, Montreal, and of which a picture appears on this page, may be mentioned. The engine is the largest ever made in Canada. The object was general utility, and endurance, hence care was taken to see that all the features should be of a character the value of which had been proved by time. The engine

A NEW G. T. R. LOCOMOTIVE.

in all its parts, is the effort of Grand Trunk workmen at Point St. Charles. It is the first of a series of monster engines, destined to make for a more economical working of the system. The total weight of the boiler over the driving wheels is 124,990 pounds. The engine and tender together, when loaded, weigh 277,990 pounds; the boiler pressure is 200 pounds to the square inch. Seven engines exactly similar to this are now under construction in the company's shops.

DODGE MANUFACTURING COMPANY OF TORONTO.

The Dodge Manufacturing Company, of Toronto, power-transmission machinery manufacturers, state that their wood split pulley has revolutionized the world on the pulley question, and the Dodge system of tope transmission of power has worked wonders in the way of economical distribution of powers to various points from a common centre. The Dodge patent split friction clutch pulley and cut-off couplings is giving satisfaction in cases where other clutches have failed. The "Orton" disc clutch for small pulleys is a comparatively new production of the Dodge Company, but it is believed to be satisfactory wherever put in. The Dodge Company's new line of ball and socket adjustable drop hangers, with self-oiling boxes, are rapidly becoming known, and are very popular, as are their hangers and shafting, pulleys and belting. The company inform us that manufacturers and mill-owners can now send in specifications of shafting, hangers, pulleys and belting to them, and count on having them shipped at once from stock. They have recently put in a modern shafting lathe, as well as a lot of other special machinery for their new lines. They issue a catalogue, in which is illustrated all their different patterns with dimension-sheets and price lists. This company has recently supplied an outfit of seven large friction clutches for the Winnipeg Street Railway and Electric Company. The Dodge Mnfg. Co.'s works are at Toronto Junction, and general offices at 74 York street, Toronto.

DAM BUILDING.

Editor CANADIAN ENGINEER:

Re Chas. Baillairge's last letter as published in your issue of May, I notice that he invites Prof. Bovey to give his view of the matter. Now, for my part, I would be very glad to have Prof. Bovey, or any of McGill faculty take the matter up. Mr. Baillairge has been kind enough to let some of my broadest statements as contained in my April letter, go uncontradicted, and from the general tenor of his remarks in his letter for May, I feel justified in believing that he will support my views in any future discussion. I will be very glad to have his co-operation in proving what I have stated to be a fact, viz., that dams are subject to moving loads, and that they should not be tapered off at the top as is the usual practice, and further, that they should be given a width in proportion to their length. I am prepared to go into this matter very fully, and to uphold this view, although I know it is diametrically opposed to the text books, and have been unable to find one author who even hints at such a thing as unequal loading on dams.

Ancient writers upheld the idea of a dam transmitting loads to the abutment, and acting as a beam throughout its entire length, but did not know how to build to secure such a result, and recent writers and builders have argued themselves into the belief that the earlier writers were wrong in even looking for such a result. Now, whichever of these two people is right, one thing is certain, viz., that the method of to-day is indefinite and indecisive, and that no more positiveness as to stability can be claimed for a dam of recent construction than could as justly be claimed for a dam of much earlier design and construction. This is not as it should be. There is no reason in the world why an engineer who builds a dam should ever be called upon to express an opinion as to its stability or to ever lose one minute's sleep over the safety of the structure which he has erected, any more than a bridge engineer should fear the collapse of a railway bridge built to modern specifications. While assistant engineer with the Hamilton Bridge Works, under C. Teiper, more than a dozen years ago, I visited Mr. Baillairge's city and took the abscissas and ordinates of the curved pipe and old wooden structure over the St. Charles River, and returned to the office at Hamilton, and prepared the drawings for the steel structure to replace the old one. I have never had any fear but that this steel structure would do just what was required of it; and have built a great many bridges since then, and have never hesitated to follow the usual rules of the profession, and rely upon them implicitly. Now, the reason of this is, that bridge engineers agree so nearly as to what is the right thing to do, that any one of them feels supported by the universal opinion prevailing amongst them. Now, when we come to build a dam, we find that although the dam builders started first they have up to the present time agreed upon about two things, viz., the weight of a cubic foot of water, and the rule of $21.25h^2$ being the correct formula for ascertaining the pressure. I might also add the rule of the centre of pressure concentrating at 1-3 of the height of the wall. Now, the reason they cannot agree beyond these three rules, is that none of them are so clearly right as to secure the undivided support of the others. Everyone who has given the matter any attention must have been impressed by the great diversity of opinions held by members of this section of the engineering profession. When it comes to the actual section of the dam one engineer says it should curve in a certain way, another says it should curve quite differently, and there are all kinds of curves suggested.

When we come to the co-efficient of friction, one engineer would examine the river bed with a microscope, and choose a co-efficient accordingly. Another would adopt any co-efficient anywhere from .40 to .75. The same diversity of opinion prevails all the way through, and what I believe is, that they have overlooked something, that if given its proper place in the problem would make these other questions of such lessened importance that they could more easily come to an understanding about them. That which they have overlooked is the question of moving loads, unequal loads, and consideration of length to size of dam.

JOHN S. FIELDING.

Semple and Boquet streets, Pittsburg, Pa., U.S.A., May 23, 1899

LITERARY NOTES.

Journal of the Western Society of Engineers, Vol. iv., No. 1, is full of interest, as are all the publications of this society.

In a recent booklet of some dozen pages the Mechanics' Supply Co., Quebec, calls attention to some of its wares under the title, "How Best to Beautify and Make Our Homes Comfortable."

We have received a copy of The Transit, the annual publication of the engineering society of the State University of Iowa, Iowa city, Iowa. A number of interesting papers are included.

The Summary Report of the Geological Survey of Canada for 1898 is full of interesting details of Canada's great wealth in mines and minerals. Perhaps the most interesting portion of the report is the letter from A. P. Low describing his explorations in the Hudson Bay. A great deal is added to our knowledge of this valuable but inaccessible country by this letter.

We have received No. 6 of the first volume of The Gas Engine, a monthly published in the interest of this rapidly developing source of power.

The Geological Survey of Canada has just issued the annual report for 1897. There are here some 230 pages of interesting statistics. The figures of production have already been published in The Canadian Engineer as issued in the advance sheets kindly furnished by the Department. E. D. Ingall, M.E., is to be congratulated on the fulness of the report which he makes to the Department.

Papers read before the Engineering Society of the School of Practical Science, Toronto, is a handy volume of 200 pages which contains some valuable papers on timely subjects. Among these are: The Process of Manufacturing Mechanical Wood Pulp, W. A. Hare; Modern Systems of Interior Wiring, L. B. Chuffack; Silica Portland Cement, M. J. Butler, C.E.; Pavements, A. W. Campbell, C.E.; Railroad Location in the Crow's Nest Pass, Donald A. Ross.

The Curtin Directory Co., 99 Nassau street, New York, are now compiling a reference book of American manufacturers, designed especially for the use of the U.S. consuls and U.S. commercial agents. These consuls and consular agents number about 1,000, and such a work thus distributed should possess great value to American manufacturers as a means of making known their products throughout the world. The book is to be issued about the middle of July.

The annual report of Chas. Baillairge, C.E., city engineer, Quebec, has reached us. The report covers the period during which Mr. Baillairge has served the city, 1866-1899, and includes numerous illustrations. During this time many original ideas have been worked out by the city engineer, and a number of them have been carried out to great advantage. Some of Mr. Baillairge's inventions have not yet been brought into practical use, and these he proposes to illustrate at the Exhibition in Paris next year.

The first two numbers of Bridges and Framed Structures, an illustrated monthly magazine for engineers, architects, inspectors, superintendents, manufacturers, etc., are certainly an indication of a bright future. The latest engineering practice is discussed and profusely illustrated. Though published in Chicago the subjects of the articles are found in the four corners of the earth, the aim of the editor evidently is to discuss general principles and avoid provincialism. The publishers are the D. H. Ranck Publishing Co., Chicago.

We have received a copy of Mechanical Movements, Powers, Devices and Appliances used in constructive and operative machinery, and the Mechanical Arts for the use of engineers, inventors, mechanics, draughtsmen, and all others interested in any way in mechanics, by Gardner D. Hiscox, M.E., author of "Gas, Gasoline and Oil Vapor Engines," 1,649 illustrations, 400 pages. This covers the whole field of mechanics and the latest developments in motor vehicles, acetylene gas apparatus, compressed air, etc., are all described in the briefest possible manner.

A new Canadian periodical which we can heartily recommend is the Prince Edward Island Magazine, which has been started at Charlottetown, and the subscription to which is only 50 cents a year, or 5 cents per copy. Its articles are chiefly by P.E. Islanders, and number such men as Senator Ferguson, who, by the way, has given us some charming pictures of life in the early days of British rule in this "blest isle." Local history is ably treated of, and what these writers have presented shows the island is rich in the materials of romantic history. The editorial comments are bright and bristling with points, and the whole make-up is redolent of the sea breeze. The illustrating and typography are both excellent.

The sacrifices and sufferings of the United Empire Loyalists have formed the theme of many romances, as well as many historical sketches, but the actual experiences and adventures of these courageous pioneers, if fully told, would exceed in thrilling interest all the tales of fiction concerning the early days of Canada, fruitful as our history has been in materials for romance. A plainly told but most interesting description of the settlement of the Loyalists who made their way to the shores of the Bay of Quinte, on Lake Ontario, is just now appearing

from the pen of Caniff Haight. Those who have read Mr. Haight's charming book, "Country Life in Canada Fifty Years Ago," will believe that these sketches are not only entertainingly, but truthfully written. The first pamphlet of the series is entitled "Before the Coming of the Loyalists," 24 pages, and the second under the title of "The Coming of the Loyalists," records the adventures of this swarm of pioneers in a most vivid manner in the compass of 20 pages. Mr. Haight has further sketches in preparation under the titles of "A Loyalist's Home," and "A Loyalist Township." These records should be treasured in every Canadian household, for they show of what stuff our forefathers were made, and explain the characteristics which have become so strongly stamped upon our national life. Published by Haight & Co., 28 Adelaide street east, Toronto.

Wm. T. Lancefield, Hamilton, Ont., is the enterprising publisher of what we hope will be a long continued series of "Canadian Historical Leaflets." One just issued is entitled, "Burlington Bay, Beach and Heights in History," by Mary Rose Holden, who goes over the events which have made this region so prominent a field of Canadian history since the time it was first visited by the adventurous French explorers. For an unknown period before the head of Lake Ontario was discovered by French pioneers it was a great meeting place of Indian tribes, and continued to be so down to its permanent occupation by the white settlers. In the war of 1812 Burlington Heights was an important fortified post, and it was from here that Col. Harvey set out near midnight on the 5th June, 1813, with 704 men to make his impetuous night attack on 3,500 Americans whom he routed and put to such confusion that they soon evacuated the whole Niagara Peninsula. The courage of this brave man saved the province of Ontario, as may be evident to those who have studied the events of the war. The author has done her work exceedingly well. Another leaflet of more than local interest is by J. H. Coyne, of St. Thomas, president of the Ontario Historical Society. Mr. Coyne reviews the progress of the arts and sciences during the present century, taking a brief survey of each field. Prof. Robt. Bell, of the Geological Survey of Canada, has contributed a very instructive paper in the current report of the Smithsonian Institution (1897) on the rising of the shores of James' Bay. It is well known that the waters of James' Bay are peculiarly shallow, and were it not for the channels cut through the bay by the large rivers there would be little use in any railway terminus at any port south of the main coast of Hudson Bay. This shallowness Dr. Bell attributes to a gradual rising of the land under and around James' Bay, and he points to the cuts in the "till" along the steep eastern shore and to the successive lines of driftwood, etc., above the highest tide levels in the comparatively flat western shores. Dr. Bell thinks this rising of the land is still going on, though at what average rate is not certain. The author's theory is controverted by other geologists, but he makes out a very strong case.

THE PRACTICAL MAN.

To Lessen Friction in Machinery.—Grind together black lead with four times its weight of tallow. Camphor is sometimes used, 7 lbs. to the hundredweight.

Sal ammoniac and iron shavings or filings make rust joints.

Tempering Liquid.—Saltpetre, sal ammoniac and alum, of each 2 oz., salt, 1½ lbs., soft water, 3 gallons. Never heat over cherry-red; draw no temper.

Put hard soap on lag screws, wood screws or any screw for wood. They will go in much easier.

Soldering or Tinning Acid.—Muriatic acid, 1 lb.; put into it all the zinc it will dissolve and 1 oz. of sal ammoniac, then it is ready for use.

To Soften Steel.—Cover with clay, heat to a cherry red in a charcoal fire, and let cool over night in the fire.

To Avoid Brittleness.—To avoid brittleness in soft, non-hardening steel, says C. H. Risdale, of the British Iron and Steel Institute, there should not be too high an initial temperature, nor should there be a "soaking" at a high temperature for a long time. Work should be continued down to red heat, but not to blue heat. If work has been continued unavoidably to near blue heat, there should be no chilling, but slow cooling, and where possible, subsequent heating, if only for a short time, to cherry redness. Also there should be absence of jar or vibration while cooling through the blue heat.

Industrial Notes.

The Water Department, Montreal, wants a new $55,250 pumping plant.

Bishop's College, Lennoxville, Que., will spend $20,000 in new buildings.

A loan of $10,000 was voted to the Durham, Ont., Furniture Co., Ltd., recently.

The Government of Newfoundland is about to appoint a permanent boiler inspector.

McGaw & Winnett are to spend $100,000 in improving the Queen's Hotel, Toronto.

The by-law granting $6,500 to the Toronto Rubber Shoe Company, at Port Dalhousie, Ont., was carried.

Sir William Van Horne and others have organized a company in Montreal to make a bug-poison called Helpeper.

The Guelph, Ont., Pavement Co. is to lay a cement sidewalk in Aylmer, Ont., this season, at 11 cents per square foot.

J. Parks, F. R. Elliott, J. H. Elliott and E. Woodworth, Port George, N.S., have been incorporated as the Port George Canning Company, Ltd.

A new factory is to be built at once by Semmens & Evel, coffin builders, Hamilton, Ont. The building will be brick, 50 x 150 feet, three stories. Architects, W. & W. Stewart.

T. H. Tracy, Victoria, B.C., has prepared plans for waterworks systems for Vancouver, B.C., $100,000, and Nanaimo, B.C., $45,000. Vancouver is considering the adoption of the Septic tank system of sewage disposal.

J. Samson, E. S. Spashett and J. E. O'Connor, Windsor, Ont., have been incorporated as the Windsor Bent Goods Co., Ltd.; capital, $20,000; to make bent goods, hubs, spokes, etc.; chief place of business, Windsor, Ont.

The rolling mills in Guelph will be in operation again in a few weeks. The London Bolt & Hinge Works and C. Kloepfer, Guelph, the new owners of the mill will each take one-third of the output and the remainder will be placed on the market. J. O. Jolley, Wilmington, Deleware, is to be superintendent.

J. Seymour, Brampton; F. A. Moore, Deer Park, Ont., and E. E. Slaght, W. J. Clark and T. McLaughlin, Toronto, have been incorporated as the Seymour Meter Company, Ltd., to make gas, water and electric meters and motors; capital, $40,000; chief place of business, Toronto.

M. Williams, J. McBain, G. McLean, J. I. Johnston and R. Whiteman, Port Perry, Ont., have been incorporated as the Madison Williams Turbine Company, for the manufacture and sale of turbine water-wheels, sawmills and other machinery; capital, $20,000.

T. W. Horn, Wm. Mackenzie, E. B. Osler, H. C. Hammond, W. D. Matthews, O. F. Rice and Fred Nicholls, Toronto, are the directors of the Luxfer Prism Co., Ltd., Toronto, whose capital has been increased to $400,000. This increase in capital is necessary to meet the rapidly increasing business of the company.

The Woodstock, Ont., Cereal Co., Ltd., has been incorporated with a share capital of $30,000. Head office, Woodstock; provisional directors of the company to be David Robert Ross, of Embro; Alfred Lee, of East Oxford; Gerald de Courcy O'Grady, John Horatio Neve and John White; objects to store, grind and deal in grain and feed, and to make bags, boxes and barrels.

A test of tar macadam roadway has been made in Hamilton, Ont., recently, and the city council has decided to extend this class of pavement rapidly. A by-law to set apart $150,000 for this purpose was voted down, but the council will use the funds available for road building generally for this special purpose. About $29,000 will be expended. This pavement can be laid in Hamilton for 65 cents per square yard,

The new Presbyterian church at Amherst, N.S., is to cost $15,995.

A central school to cost $11,000 is proposed in Welland, Ontario.

Preston, Ont., purposes to spend $6,000 on a market and two bridges.

Lennoxville, Que., is borrowing $5,000 to begin building a sewage system.

The Robb Engineering Co. shipped three car loads of engines to Australia, May 10.

H. D. Suess, architect, is preparing plans for the new buildings for the Ontario Silver Co., Thorold, Ont.

The strike among the Toronto bricklayers has been settled by the builders agreeing to a rate of 37½ cents an hour, dating from May 1st.

A new steel bridge to cost $2,500 will be built over the Conestogo creek at Wallenstein, Ont. H. J. Bowman, C.E., Berlin, Ont., has charge.

A. A. Stewart, chief engineer of the Degnon-McLean Construction Company, has taken charge of the work of rebuilding the piers for the south bridge of the N.Y. & O. Railway. The Canadian Construction Company has the contract for the stone work.

The International Association of Machinists met in Buffalo last month and elected the following officers for the ensuing year: President, J. O'Connell, Oil City, Pa.; vice-president, Douglas Wilson, Chicago, and secretary-treasurer, George Rector, Chicago. It was decided to hold the next meeting in May, 1901.

Application has been made to the New Brunswick Government for incorporation of the New Brunswick Oil and Gas Company. The capital stock is one million dollars in one dollar shares. Among the applicants are J. P. Sherry, Memramcook; Henry C. Read and W. F. George, Sackville, and Hon. A. D. Richard, Dorchester.

W. H. Murray, W. Malcolm McKay, John H. Thompson, James Pender, John E. Moore, Charles McDonald, W. W. White, Howard D. Troop, M. B. Edwards, A. B. Barnhill, Charles Miller, all of St. John, and Messrs. T. White and S. H. White, of Sussex, are seeking incorporation as the St. John Iron Works, Ltd. The office of the company is to be in St. John, and the capital stock is to be $600,000, dividing in 600 shares of $100 each.

R. Prefontaine, R. Bickerdike, A. A. Thibadeau, D. A. McCaskill, E. Goff Penny, Montreal, are applying for incorporation as the British America Pulp and Paper Company, Ltd., to establish and operate pulp and paper mills principally at the falls on the Peribonka, Mistassini and Chamouchouan rivers in the Lake St. John district of Quebec; to build railway lines to connect this section of country with the Saguenay river at Ha Ha Bay; to build telegraph and telephone lines; capital, $3,000,000; chief place of business, Montreal.

Truro News reports that the Nova Scotia Steel Co.'s output last year was as follows: During the twelve months the company produced in its works at Ferrona and New Glasgow, 21,627 tons of pig iron, 23,541 tons of steel, and 2,276 tons of forgings, in the manufacturing of which they consumed 107,000 tons of coal, 19,000 tons of native ore, 15,000 tons of Newfoundland ore, 6,000 tons of Spanish or Cuban ore, 32,000 tons of coke, and 18,000 tons of limestone. They employed on the average 750 men, and paid out in wages $280,000 during the year.

J. S. Williams, Paris, Texas; T. A. Darby, Wilmington, N.C., U.S.; W. J. Poupore, H. A. Bate, N. A. Belcourt, Ottawa; D. Ryan, St. Paul, Minn., U.S., are applying for incorporation as the Yukon River and Atlin Lake Improvement Co., to improve navigation in Lakes Bennett, Tagish, Taku, Marsh, Laberge and Atlin and their tributaries, and the whole of the Yukon River and its tributaries from the International boundary on the Pacific coast to the International boundary between Alaska and the Yukon Territory. The company asks for power to levy tolls; capital, $2,500,000; chief place of business, Ottawa, Ont.

A. T. Wood, M.P., A. E. Carpenter, C. S. Wilcox, J. Milne, W. Southam, A. M. Wilcox and C. E. Doolittle, Hamilton, Ont., are being incorporated as the Hamilton Steel and Iron Co., Ltd., to carry on the smelting works and rolling mills already in operation in Hamilton; the capital is $2,000,000.

Thurso, Que., has by a vote of 47 to 0, carried a by-law to raise $18,000 to buy and complete a waterworks and electric light service, put in by the Stadacona Electric & Water Power Company. Last year the village entered into contract with the Stadacona Company to put in a service, to be completed in three months. The company failed to complete the work in time, and a dispute ensued.

Former creditors of the hardware firm of Adam Hope & Co., Hamilton, Ont., were surprised to receive cheques for balances of their accounts with interest recently. The firm paid $26 000 thus, it is said, and interest, which it was not required to pay legally. When in May, 1897, the firm called its creditors together, they showed liabilities amounting to $53,616.55. The company offered 50 cents on the dollar, payable in nine months, and the offer was accepted. It is creditable to the firm that it pursues the course, so unusual in these days, of paying in full when creditors had agreed to accept a compromise.

A charter has been granted for the Maritime Clay Works, Ltd., at Pugwash, N.S. The company will manufacture building and fire brick, terra cotta, etc. The plant which is now being put in when in operation will be capable of turning out 60,000 brick a day, employing 76 men. The promoter and manager is R. W. V. Brownell. The main building is to be 60 x 61 feet. The dryers, fitted with steam tunnels, are 60 x 100 feet. The plant will have 15 kilns. On the engine and boiler room is a steel smoke stack, 130 feet high and about seven feet in diameter.

Electric Flashes.

An electric lighting plant seems probable for Huntington, Quebec.

The Bear River Electric Light & Power Co. has decided to float bonds for $65,000, and to extend its system to Digby, N.S.

The Canadian General Electric Co., Ltd., is installing a 100 light plant for the Beaver Portland Cement Co., Montreal.

The contract for engine and boilers for the Barrie, Ont., electric light plant has been given to the Goldie McCulloch Co., Ltd., Galt, Ont.

Durham and Mount Forest, Ont., are anxious to secure connection with the proposed Hamilton-Guelph electric railway. Water power is obtainable at Durham.

The Montreal Island Belt Line Railway Co., of Montreal, has bought four additional "C.G.E. 1,000" railway motors from the Canadian General Electric Co., Ltd.

Herr Pollack, the well-known engineer and electrician, has discovered, says the Vienna correspondent of the London, Eng., Daily Chronicle, a means of telegraphing sixty thousand words per hour over a single wire.

The Dominion Bridge Co., Montreal, has ordered from the Canadian General Electric Co., Ltd., a G.E. 1,000 motor equipment with special resistances, to be used for operating the heavy plate rolling machinery.

The London Electric Co. is still engaged in the work of remodelling its power house, and has placed an order with the Canadian General Electric Co., Ltd., for a complete marble panel switchboard, consisting of sixteen panels.

The Canadian General Electric Co., Ltd., has just received an order from M. E. Keefe, of Halifax, N.S., for a standard 25-k.w. direct driven unit for the lighting of the new elevators which he is erecting for the Intercolonial Railway.

Wm. W. Grant, of the engineering and sales department of the Westinghouse Electric & Manufacturing Company, has been transferred from the New York office of that company to the office of the Canadian agents of the company at Ottawa.

The Canadian General Electric Co., Ltd., is installing a 25 k.w. 550 volt generator for the Strathroy, Ont., Electric Co.

The Land Security Co., Toronto, has ordered a motor for hoisting purposes from the Canadian General Electric Co., Ltd.

The British Electric Traction Co., of London, Eng., has applied to the Nelson, B.C., council for a street railway charter.

The Canadian General Electric Co., Ltd., has just received an order from the Rubber Tire Wheel Co., of Springfield, O., for a complete tire welding plant.

The Victoria Telephone Co., Lindsay, Ont., has been incorporated. Among the provisional directors are Arch. Campbell, Lindsay, Ont., and J. J. Cave, of Beaverton, Ont.

The British Columbia Sugar Refining Co. is increasing its lighting plant and has ordered another 500 light dynamo from the Canadian General Electric Co., Ltd., of its latest multipolar type.

The Canadian General Electric Co., Ltd., has an order from the Canadian Pacific Ry. Co. for two standard 40-k.w. direct connected generators with Ideal engines, which are to be used for the lighting of their new passenger station at Vancouver, British Columbia.

The Toronto city council has awarded the contract for electrical apparatus to be used for lighting the new city and county buildings to the Canadian General Electric Co., Ltd. The plant consists of one 100-k.w. direct connected unit together with switchboard instruments.

The British America corporation which controls the well-known Le Roi and other valuable mining properties at Rossland, B.C., has decided to equip these mines electrically, and has placed their initial order with the Canadian General Electric Co. for three 150-h.p. three-phase induction motors.

F. S. Pearson of New York, consulting engineer for the Cuban Electric Co., has awarded the contract for two 230-h.p. engines to the Robb Engineering Co., Amherst, N.S. They are for an electric railway from Regla, on the opposite side of the harbor from Havana, to Guamacoa about eight miles distant.

The Canada Tool Co., Dundas, Ont., is in receipt of a large order from the Dominion Bridge Co., Montreal, for special machinery. The large punches are to be operated electrically by means of motors directly attached to the machines, and for this purpose an order has been placed with the Canadian General Electric Co., Ltd., for four enclosed slow speed C.G.E. motors.

A boiler insurance company in England has added the insurance of dynamos, motors, etc., to its other business. The plan is certainly a good one, as it secures the owner of an isolated plant, for example, a competent inspection at regular intervals and reimbursement in case of damages. Why, asks The Electrical Review, should not this scheme be worth the attention of some of our American boiler insurance companies?

The Trenton Electric Co., Trenton, Ont., expects to have its transmission lines to Belleville, Ont., completed very shortly, when it will be in a position to furnish power to the various manufacturers of that place. R. J. Graham is one of the first to avail himself of this power, and has already contracted for about 50 h.p. He has also placed an order with the Canadian General Electric Co., Ltd., for one 30-h.p. and one 10-h.p. three-phase induction motor for operating refrigerating machinery, hoists and fans, etc., in his cold storage establishment.

The Montreal Cotton Co., Valleyfield, Que., is making some very extensive additions to its electric plant. It has at present installed four 600-h.p. three-phase generators, manufactured by the Canadian General Electric Co., Ltd., and has just placed an order with the same company for a large 2,000 h.p. generator of the revolving type, together with switchboard panels complete. It has also ordered two 85-k.w. exciters, these having sufficient capacity for furnishing exciting current to the full equipment of generators. Upon the completion of this additional installation the Montreal Cotton Company will have the largest and most up-to-date isolated power plant on the continent.

A new electric lighting by-law, to raise money for the institution of a plant for domestic lighting and power, as well as for civic lighting is about to be submitted to the ratepayers of Winnipeg.

As a first instalment of cheapening the cost of electric lighting, the Cataract Power Co. has submitted a proposition to the Hamilton council which will save $2,500 on the present street lighting of the city.

Barrie, Ont., has put in a municipal telephone system, which connects the various municipal officers with their offices, places of residence, etc. It is expected that the system will be extended to include the citizens.

The Grand Trunk Railway system is arranging to light its new freight sheds and shops at Toronto with electricity, and has placed an order with the Canadian General Electric Co. for two 500 light multipolar dynamos with switchboards complete.

The adjourned annual meeting of the Ancaster & Chedoke Electric Railway shareholders was held May 20th. The old directors were re-elected. The projectors still lack $20,000 of the $60,000 capital required before a start can be made on the road.

The Gorge Railway from Niagara Falls to Lewiston, was sold by Sheriff Kinney at the Court House, Lockport, N.Y., on May 23rd, to Herbert P. Bissell, of Buffalo, for $6,184, subject to a mortgage of $1,000,000, held by the Knickerbocker Trust Company.

J. Gunn, J. M. Smith, H. E. Harcourt Vernon, A. J. Sinclair, R. S. Gosset, A. W. Mackenzie and E. W. McNeill, Toronto, are the provisional directors of the Sao Paulo Railway, Light and Power Co., Ltd.; capital, $6,000,000; to develop power in any way, and operate railways outside Canada.

The report that the purchase of the Hamilton & Dundas Railway by the Cataract Power Company was completed is untrue, John Patterson states. The Hamilton Radial Electric Railway has been bought by the Cataract Power Company, which has deposited $5,000 as a forfeit in case the agreement to purchase is not carried out by July 15.

The Railway Committee of the Dominion Parliament has thrown out the Ottawa and Quebec Bridge Company's application for incorporation. A charter is sought for a bridge across the Ottawa River, between Ottawa and Hull, within a few hundred yards of the Nepean Point bridge. This was done in the interest of corporate interests in Ottawa, which feared competition from the Hull railways.

The Canadian General Electric Company, manufacturers of electrical machinery and supplies, of 65-71 Front street, Toronto, has leased the building at present occupied by the Hyslop Bicycle Company, King street east, for ten years, with the privilege of a renewal for ten years at the expiration of that time. The new offices will be ready by July 1. The ground floor will be given over for the offices of the company, and the salesrooms will be placed up-stairs.

The Shawinigan Water and Power Company has let the contract for the construction of their proposed plant at Shawinigan Falls on the St. Maurice river. The contract is for the canals, foundations and the like necessary for the development of 30,000 h.p. The contract has been given to the Warren Scharff Company, of New York. This contract includes also the building of a railway to connect with the Great Northern Railway, 4½ miles away, and calls for the expenditure of about $300,000.

The plant first erected by the Union Carbide Company at Niagara Falls, N.Y., for the manufacture of calcium carbide, despite all its enlargements and additions, says The Metal Worker, has been found inadequate to meet the increasing demand for carbide, and a fine new plant is being erected by the company on the lands of the Niagara Falls Power Company, east and north of the old works. This new carbide plant is about the largest electrical plant yet constructed at the Falls. It will consist of two buildings, each 864 feet in length and 80 feet wide on the exterior, also an office building. When completed and in full operation this plant will use 25,000 electrical h.p., and have an output capacity of over 100 tons of carbide a

day. Both of the factory buildings are now being erected, and it is hoped to have the new plant in operation by July 1. Of raw material and product the Union Carbide Company expect to handle about thirty or forty cars a day.

R. G. Reid, Montreal, has just concluded all arrangements for the immediate construction of an electric railway in St. John's, Newfoundland. Contracts have been made with builders in Montreal for six cars, with the Westinghouse Co. for electrical apparatus, with the Canada Switch Company for the necessary trucks, and with the Stillwell-Bierce & Smith-Vaile Co., Dayton, O., for the power plant. The power will be generated at about eight miles from St. John's. The first cars are to be delivered in July or August, and the railway will, it is stated, be opened in the early fall.

The Ottawa Electric Company has made a proposal to the city council to dispose of its lighting plant to the city. The nature of the proposition is that the company offers to dispose of its plant, goodwill, business and perpetual franchise to the city at par; or, in other words, that the corporation take the entire stock at par value The stock amounts to nearly $1,000,000. The Electric Company agrees to hold its offer open for twelve months from May 1, 1899, on the express condition that the city shall not grant, in the meantime, an extension to the franchise of any existing competing company, and shall not issue a franchise to any outside company. The Metropolitan Electric Company is seeking a 20 years' extension.

At a meeting held recently of the committee appointed to make the local arrangements for the approaching annual convention of the Canadian Electrical Association at Hamilton, a draft programme was considered and adopted. The dates selected for the convention, subject to the approval of the executive, are the 28th, 29th and 30th June. The business sessions, as well as the annual banquet, will probably be held in the new Royal Hotel. A sufficient number of papers on a variety of subjects of interest to those engaged in the various departments of electrical work have been promised, and are in course of preparation. Among the features of entertainment will probably be a trip to the Beach over the Hamilton Radial Railway and an evening excursion on the lake, a trip to Grimsby Park over the Hamilton, Grimsby & Beamsville Electric Railway, and a visit of inspection to the stations of the Cataract Power Company at St. Catharines and Hamilton. The Hamilton Street Railway Company have very kindly offered free transportation to members of the association during the convention. Everything points to a successful and enjoyable meeting.

The Official Gazette, Quebec, announces that the water power of that part of the River Ottawa, opposite the township of Onslow, four miles from Quyon station, of the Pontiac and Pacific Railway, comprising the rapids and falls of "Les Chutes des Chats," as well as the islands and islets in connection therewith, situate within the limits of the province of Quebec, will be offered at public auction sale in the salesroom of the Department of Lands, Forests and Fisheries, in Quebec, on Thursday, the 8th day of June, next, at 11 o'clock in the forenoon, upon the following conditions: The upset price of the said water power shall be $20,000 (twenty thousand dollars), and the purchase price shall be payable in cash. A deposit of $5,000 (five thousand dollars), by accepted cheque, will be required as a preliminary from each intending bidder. The purchaser must bind himself to disburse in the way of improvements and development of the said water power, within a delay of three years from date of sale, the sum of $300,000 (three hundred thousand dollars). The sale of the said water power is made subject also to the following conditions, viz.: That the Upper Ottawa Improvement Company will remain in the enjoyment and possession of all the works, slides, dams, piers and booms which they have constructed for the purpose of holding and floating logs and timber, at Sturgeon Falls, and the use of the channel north of the "Black Chute," together with the right to repair said works and have access to them when required; these conditions, however, are alterable on the day of sale. The property is also within a few miles of the O.A. & P.S. Railway at Galetta, Ont.

Mining Matters.

Rich veins of mica and phosphate have been opened recently on the farm of C. Davis, near Perth, Ont.

A rich find of gold is said to have been made on the farm of Wm. Chatson, in the township of Denbigh, North Addington.

There is a deposit of arsenide of nickel, which also carries a large amount of cobalt, on Calumet Island, Que., in the Ottawa river.

The McNaughton gold mine, Rawdon, Hants county, N.S., has been sold to Archibald G. McDonald and John L. Johnson. The price paid was $40,000.

The Moncton, N.B., Times is informed that an American syndicate is making extensive preparations for working what is believed to be a valuable copper mine near Wentworth, N.B.

The Government assay office at Belleville has received instructions from the Bureau of Mines to make a collection of minerals from Eastern Ontario for the Paris Exposition. The collection must be completed by 30th June.

The Fernie Free Press says: The Coal Company have sent the first shipment of coke to Helena. Regular shipments continue to the Le Roi smelter at Northport as well as to Trail and Nelson, and an occasional car to Butte and Great Falls. The production of the 50 ovens is steadily maintained at 70 tons daily. One hundred ovens will be built this season.

At War Eagle Mine, in British Columbia, on May 22nd, a hoist containing five men fell, in consequence of the breaking of the machinery, a distance of 350 feet to the bottom of the shaft, whereby four men lost their lives. W. F. Schofield, H. A. Honeyford, James C. Palmer and Thomas A Neville were killed, three being smashed almost beyond recognition, but the fifth, M. Cook, escaped almost uninjured.

Hon. J. M. Gibson, Commissioner of Crown Lands, intends to have a base line explored in Northern Ontario, beginning at a point on the boundary line between the districts of Nipissing and Algoma, near Night Hawk Lake, on the 120th mile post north of Proudfoot's line. Alex. Niven, O.L.S., will have charge of the survey, and he will be accompanied by W. A. Parks, lecturer on geology in Toronto University. The new line will be run about 150 miles through the district of Algoma, to or near the meridian of 84 degrees, and the region to be traversed is the source of the Moose River. It will cross numerous tributaries of the Mattagami and Misanabie Rivers.

Prof. A. P. Coleman, geologist to the Bureau of Mines, will leave about June 18 on an exploration trip to the north. Prof. Coleman will examine the country along the north shore of Lake Nepigon, including the islands in Nepigon river and Lake Nepigon, and the district southwest of Port Arthur, taking a general area of Cambrian rocks in these localities, which are known to carry copper, silver and iron. The professor will examine the country for iron and copper ores, for which at present there is a very extensive enquiry. He will also explore the country along the line of the Ontario & Rainy River Railway as far as any construction work extends, as the new cutting will afford very favorable opportunities for a study of the rock formation.

A smelter is to be built in Grand Forks, B.C., by the Granby Consolidated Mining & Smelting Co. The smelter will employ 200 men and will have a capacity of 500 tons per day, with provision to enlarge to a capacity of 3,000 tons. The smelter will be located on a high bench on the north side of the north fork of the Kettle river. Power will be obtained by damming the river at a narrow canyon a mile above. The water will be conveyed in a flume a mile long to the power house. The buildings will include a main blast furnace, a main blower, a machine repair shop, a blacksmith shop, sampling works and a roaster. The main flue will be 300 feet, 10 feet high and 12 feet broad. The smokestack will be 180 feet high. The ores to be treated are those of the Knob Hill, Old Ironsides, City of Paris, and Majestic mines, as well as those from the properties of the smelting company in Greenwood camp. The Knob Hill and Old Ironsides are now in a position to jointly ship 400 tons a day. The C.P.R. engineers are making surveys of the proposed spur from the main line to the smelter site.

Railway Matters.

The C.P.R. will remove its divisional shops from Havelock to Smith's Falls, Ont.

A preliminary survey has been made by D. S. Noble, Annapolis, N.S., for the proposed Granville & Victoria Beach Railway.

Steel bridges are building for the Coast Railway at Shag Harbor and Fresh Brook, N.S.; also some 20 ft. spans for small streams.

One hundred miles of the Dauphin Railway is to be built this season, and it is announced that the extension to Hudson Bay will be pushed to completion in three years.

One of the latest improvements in the I.C.R. is a gasoline automobile tricycle, which has been provided for A. E. Killam, inspector of bridges. It is guaranteed to carry three men, including the driver, and will run twenty miles an hour.

The engineers, the firemen and the trackmen of the Grand Trunk Railway asked an increase in wages as they claim that the wages for similar employees on other roads are considerably in excess of the Grand Trunk figures. The trackmen went out on strike in consequence of a refusal of the demand.

The contracts for the completion of the Great Northern Railway were signed May 5th. The principal sub-contractors are, Thomas Power, of Levis; McQuaid, of Arnprior; Sherwood, of Iroquois; Carroll & Gibson, of Toronto; McQuaid, Nicholson & Fae, of Iroquois; J. Rodgers, D. R. McDonald, of Glengarry, and Robert Scott, of Doucet's Landing.

D. D. Mann of Mackenzie & Mann, has signed a contract with the Nova Scotia Government to construct the Inverness Railway from Port Hastings to Broad Cove, C.B., a distance of 57 miles. This line will be the first to draw the increased railway subsidy of $4,000 per mile granted by the Provincial Government under an act at the last session of the Provincial Legislature. The company has already entered into an agreement with the Federal Government, under which it will secure the Dominion subsidy of $3,200 per mile for this line.

Three hundred yards of railway cars loaded with earth were recently unloaded over the embankment at Victoria bridge, Montreal, in less than ten minutes. A two-inch steel rope, stretching from the furthest truck to the nearest was attached there to a traction engine, the other end being fastened to a heavy iron scraper. The scraper was dragged by the engine over all the cars in succession, in a few minutes depositing thousands of tons of earth on the embankment.

An Act has been passed by the New Brunswick Legislature incorporating a company to build the Shediac and Coast Railway. It is composed of the following persons: C. N. Skinner, Barnhill, Allen and Trueman, of St. John, N.B., and E. J. Smith, E. A. Smith, J. A. McQueen, I. Avard, E. R. McDonald, Fidele Poirier, Nap. S. LeBlanc and A. T. LeBlanc, of Shediac, N.B. It is stated that work will commence within one year and when completed the P.E. Island steamer will probably be run between Summerside and Cape Tormentine.

Marine News.

A day steamer between Montreal and Quebec is spoken of for the R. & O. this summer.

The Quebec Government has granted 5,000 acres of shore lands at Bay Ellis, Anticosti, to M. Menier, who agrees to spend $150,000 in wharves, etc.

The R. & O. has established a semi-weekly service this season between Hamilton and Montreal. The "Algerian" has been put on with the "Hamilton."

Alex. Milloy, for many years traffic manager of the Richelieu and Ontario Navigation Company, Toronto, died at his residence in Montreal, June 1st, aged 77.

The Montreal & Cornwall Navigation Co.'s new steamer "City of London," which was exchanged for the "Rocket," is capable of carrying 500 passengers, and will be placed on the Valleyfield-Montreal route.

The Canadian Canoe Company recently shipped from Peterborough a new steam yacht, which has just been completed for Wm. Snodgrass & Son, of British Columbia. The boat, which is 42 feet in length, and 8 feet beam, will be used for carrying mail and other packages on Lake Okanogan, B.C.

An agreement has been entered into between the Richelieu and Ontario Navigation Company and the American line by which competition between the two companies between Clayton and Alexandria Bay and Montreal will not be continued this year. The Richelieu Company will in return withdraw its boats from the islands.

The New Brunswick Government will aid Geo. Robertson's scheme to provide a dry dock for St. John. It agrees to give $5,000 annually for forty years, provided the Dominion and Imperial authorities give the measure of assistance that is hoped for. The provincial subsidy not to begin, however, until the work is completed and ready for business.

G. F. Benson of W. T. Benson & Co., Montreal, has sold his steam yacht "Ingomar" to Elder, Dempster & Co. The sale was made by Murray & Williams, the Montreal Yacht Agency.

In searching for the wreck of the tug "Walker," sunk last fall near Nicholson's Island, Lake Ontario, the Donnelly Wrecking Company has discovered the wreck of the propeller "Zealand," which was lost about twenty years ago, with a valuable cargo and entire crew. No trace of the propeller was ever discovered until now.

A launch 25 feet long and 6 feet beam, building for D. Breeze, Peterborough, at the works of H. B. Rye, Peterborough, Ont., is to be fitted with 3 x 5 slide valve engine and tubular boiler. It is planked with oak to the water line and pine above. It will have awnings and curtains. The same firm is also turning out a similar launch for Best & Wetherel, fitted with Best's patent oil engine. The engine is claimed to be one of the simplest and most efficient on the market, and can be run at the cost of 25 cents per day, and occupies 20 in. by 20 in. square. This boat is to have oil tanks sufficient to run 200 hours at one charging.

Even if no further accidents occur there is no prospect of the Soulanges canal being opened this season. So far A. Onderdonk has taken out 180,000 cubic yards on his contract, leaving 20,000 yards still to remove. It is mostly blue clay. The foundations for the electric power-house, which is being built by W. Stuart, of Ottawa, have just been laid. The hydraulic machinery has been set in place, and preparations are under way for starting the brickwork. Randolph McDonald's section No. 12, one of the most difficult, will probably be finished by Dominion Day. Poupore and Fraser have practically finished section 11. On section 9, where the blue clay gave trouble, much work is still to be done. The worst slide took place on November 8, and most of the excavating has to be done over again.

Personal.

J. E. Skidmore, late waterworks manager in Berlin, Ont., will remove to Cobourg to take charge of the waterworks plant in that town.

L. H. Tache has taken out a writ of mandamus to force the Canadian Society of Civil Engineers to admit him as a member of the said society.

Theodore Beauchamp, C.E., formerly of St. Hyacinthe, Que., has gone to Rossland, B.C., where he will continue to practise as a civil engineer and land surveyor.

Many regrets have been expressed at the departure of Professor and Mrs. John T. Nicolson, of McGill University, who sailed with their family for England on the 3rd of June.

Francois Codere, a well-known merchant of Sherbrooke, Que., and head of the firm of Codere Sons & Co., the largest wholesale hardware merchants east of Montreal, died May 15th.

William Cane, sr., head of the William Cane & Sons' Manufacturing Company, lumber and woodenware, Newmarket, Ont., died May 16th, after a lingering illness, at the age of 78.

Robert A. Ross, electrical engineer, Montreal, has gone to China for three months to consult with Sir Charles Ross regarding railway concessions, power transmission and lighting in that country.

W. B. McLean, Pictou, N.S., who took one of the scholarships in mechanical engineering at McGill University last session, has joined the draughting room staff of the Robb Engineering Co., Amherst, N.S.

H. T. Bovey, Dean of the Faculty of Applied Science at McGill University, Montreal, has had the honor conferred upon him of being elected a member of the Council of the Institute of Civil Engineers, of England.

The Bruce Carruthers scholarships in the School of Mining, Kingston, Ont., have been awarded for the year 1899-1900 to F. George Stevens, Halifax, N.S., a fourth year student, and George H. Dickson, Kingston, a third year student of the school. Mr. Dickson held one of the scholarships during the session just closing.

It is announced that J. Sheedy, Toronto, superintendent of bridges of the Grand Trunk for the middle division, has resigned, and that J. Wilson, district inspector, London, has been appointed in his place. W. Kirkpatrick, Hamilton, has been appointed district foreman, with headquarters at London, and J. Kennedy has been appointed local inspector.

F. T. Walton died at Thorold last month. He was born in Hamilton 61 years ago. In 1861 he settled in Niagara Falls, where he engaged as contracting builder, and built a number of large buildings in Niagara Falls, Toronto and London. In 1879 he moved to Thorold, and for 18 years he occupied the position of foreman of the government gate yard and assistant superintendent of the old Welland canal. Since 1897 he had been superintendent of the Cataract Power Company's canal at Decew Falls.

Lieut.-Col. Caverhill, of the firm of Caverhill, Learmont & Co., died recently at his home, Montreal. The deceased, who was head of the well-known hardware firm of Caverhill, Learmont & Co., was born in Beauharnois, Que., in the year 1854. He was a descendant of one of the old Scottish families, who were amongst the first settlers in this country. Young Caverhill was sent to Edinburgh, Scotland, to receive his education, and later completed his studies in the University of Glasgow. Returning to Montreal in 1872, he commenced a commercial career in the employ of the firm of Crathern & Caverhill, in the capacity of clerk. Upon the death of his father and of his uncle, in the year 1882, in conjunction with the aforementioned partners, he took over the shelf hardware portion of the firm's business. Amongst other things Mr. Caverhill has given a great deal of his attention to military matters. He entered the Royal Scots in 1876, and finally rose to the command of that regiment, which he held for five years. He retired in 1891, retaining the rank of lieutenant-colonel. He had been a member of the Board of Trade since 1888, and was a director of the Montreal Loan and Mortgage Company. He was connected with the St. Andrew's and Caledonian Societies, and was appointed a justice of the peace for the city and district of Montreal.

—Andrew Holland, of Ottawa, has estimated the various water powers in the Ottawa Valley in the neighborhood of the city of Ottawa as follows: Ottawa river, 664,000 h.p.; Rideau river, 1,300 h.p.; Mississippi river, 14,700 h.p.; Madawaska river, 20,600 h.p.; Bonnechere river, 3,400 h.p.; Petit Nation, 2,000 h.p.; Blanche river, 2,000 h.p.; Lievres river, 98,450 h.p.; Little Blanche, 300 h.p.; Quyon river, 1,000 h.p.; Coulogne river, 27,600 h.p.; Black river, 24,000 h.p.; Gatineau river, 31,675 h.p.; making a total of 890,225 h.p. A map showing the location of the various powers with full details in each case will very shortly be issued.

Brief, but Interesting.

The Electrolytic Marine Salts Co., which was organized to operate the Rev. P. F. Jernegan's "process" of extracting gold from seawater, has received a report, it is stated in The Engineering News, from Prof. Henry Carmichael, the expert, appointed by the liquidation committee to make an investigation after Jernegan's abrupt departure. Prof. Carmichael reports that the process was fraudulent. The directors are said to have recovered a considerable sum from Jernegan, which, together with the sale of machinery, etc., has realized enough to pay a 20 per cent. dividend to the stockholders.

New Yorkers have been waiting patiently for the compressed air trucks, says The Horseless Age in a recent issue, which we were told would be relieving the draft horse of his burdens long before this. Though no trucks are yet visible to the naked eye, we are informed that two of them are receiving final tests at the Worcester shops of the company, and may be expected soon The promoter is always a long way ahead of the mechanic, because things are easier said than done. However, let us hope that our curiosity will be satisfied at an early day, and our knowledge of motive powers augmented by some actual working data of compressed air motor trucks.

The Wet-Bulb Thermometer for determining moisture in the air, is made and used as follows, says The Monthly Weather Review: "Provide two thermometers and tie a bit of the thinnest muslin neatly around the bulb of one of these and keep it soaked with water. Lift this thermometer out of the water and whirl it briskly through the air for two minutes, if the air is very dry, and for three or four minutes if the air is very moist. Read it quickly, and it gives the temperature of a thin layer of water evaporated under the influence of the wind produced by the whirling. The dew-point of the air in which the thermometer is whirled is about as far below the wet-bulb as this is below the temperature of the dry-bulb similarly whirled and read rapidly. The two thermometers may be hung side by side on a short piece of string for convenience; and this is then called the 'sling psychrometer.'"

Electric Traction in the Keeling mine at Pittsburg, Pa., is described in a paper recently presented before the American Institute of Mining Engineers by F. Z. Schellenberg, Pittsburg. Two Westinghouse-Baldwin locomotives are used, weighing about 25,000 lbs., and are each equipped with two 50 h.p. motors. There are seven miles of track of 39-inch gauge, laid with 40 lb. rails, the entries being 8 feet 6 inches wide, and 5 feet 6 inches high. Each locomotive hauls a train of 30 loaded cars (or 60 tons) up a maximum grade of 1 per cent., and makes a speed of about 8 miles per hour. Of the 25,000 lbs. on the driving wheels 15 per cent. is exerted at the drawbar. The pull on good level track is 10 lbs. per ton for the locomotive and 18 to 20 lbs. per ton for the mine cars, but with inferior roadbed and track and common mine cars in bad repair, a pull of 40 lbs. per ton on level track is the initial rating before considering the effect of the grade. The power plant consists of two Fischer engines, belted to two Westinghouse direct-current, multipolar dynamos of 100 k.w. capacity each, at 250 to 300 volts. The current is used also for electric lighting and is being tried for operating coal-cutting machines.

Asphalt for joints in vitrified sewer pipe is being used quite extensively in Germany, and evidently with satisfactory results. A long paper on the subject, in which the objections to clay and cement joints were reviewed, appeared in a contemporary a short time ago. The paper was prepared by A. Unna, city engineer of Cologne, whose experiments with plumbing apparatus were fully described in The Canadian Engineer some time ago. The materials used are either a compound of pure Trinidad Goudron and mastic asphalt, or pure Trinidad with a suitable bulking addition. Mr. Lindley, of Frankfort-on-Maine, recommends two parts Goudron to one part Vorwohler mastic asphalt, but Mr. Unna prefers one to one of the same materials. The preliminary step in the calking process is the use of the tarred rope, great care being taken that no holes are left

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