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CONTENTS OF THIS NUMBER:

THE BEGINNINGS OF THE ST. LAWRENCE ROUTE.*

(Concluded from last issue).

While glad to throw off the colonial yoke, the United States was not willing to relinquish colonial advantages, and it may seem strange to you to be told that United States traders made a strong effort to continue enjoying the advantages of the Navigation Act. The Navigation Act was an act under which trade to British ports was permitted only in British ships, and when at last the United Statesians found themselves formally and by legal opimon declared foreigners and not eligible to come into Canada under the act, they resorted to forging the registers of their vessels, some two hundred being issued between 1788 and 1790, being chiefly Mediterranean certificates, with which region Canada had for many years a fairly extensive trade. The Navigation Act was repealed for Canada in 1849.

Canada's trade with the rest of the continent towards the close of the eighteenth century was not very extensive. From 1768 to 1783 inclusive, the entries at Quebec averaged only twenty four per annum, the average burden being 64 tons. The largest number of arrivals was 76 in 1774, and the largest average tonnage was 97 tons in 1780. The average annual clearings during that period was 26, and the average tonnage cleared was eighty tons. The largest number of clearings was 38 in 1778 and the largest average tonnage was 136 in 1781. In 1782 there were only two arrivals and in 1780 only twelve vessels cleared. The average tonnage in 1769 was 41 tons and the lowest yearly average of tonnage cleared was 49 tons in 1771 and 1773. Such were the cockle shell coasters of a century ago. These vessels brought in the bulk of the rum used in the country, and a very large portion of the coffee, sugar and molasses, although the last two were most extensively brought from the West Indies. Large quantities of pease were exported between 1770 and 1775, with much lumber, wheat biscuit and flour. The exports of flour between 1768 and 1783 averaged 2,334 barrels per annum. In 1802 Canada exported 1,010,033 bushels of wheat, all countries, 28,301 barrels of flour and 22,051 cwt. of biscuit. The average tonnage of the ships that entered at Quebec from Great Britain from 1768 to 1780 was 145 tons and the average crew was ten men. In 1793 two fairly large vessels, one of 299 tons and the other of 301 tons cleared from that port, but there was one mere jolly boat of 72 tons and the average had risen only to 176 tons. Great Britain was Canada's chief port for potash, fish oil and lumber. Before the United States revolution thirty-four ships and four hundred men satisfied the commerce of Britain with Canada annually. The West Indian trade and trade to ports other than British or American was not large in those days, and was confined chiefly to codfish, salmon, boards, planks and wheat exported; and imports of molasses, sugar and salt. Wines and teas were brought usually from England. Canada did a good trade in masts in those early days, these being usually sent to Gibraltar.

The position of Governor-General of Canada was by no means a sinecure in those early days. Canada was cut off for six months in the year from all communication with the Motherland, except via Halifax by couriers to Acadia. Mails were not frequent even in summer, and the Governor was a Governor indeed. One of Haldimand's first proposals was the establishment of a line of fast vessels, to sail once a month or every six weeks for the conveyance of the mails to and from Europe. It was not, however, until 1787 that a monthly mail was established between London and Halifax. The European news of the Quebec Gazette in 1764 was seventy days old. The trade fleet usually left Great Britain for Canada towards the end of March, and a second fleet followed in July. It may be inferred from the register of shipping at Quebec that the season of the port opened 1st July and closed 1st October, a period of three months, now doubled. Mention has already been made of the early efforts of the French to chart and landmark the St. Lawrence. Under early British rule further progress was made. It is not generally known that the celebrated Captain Cook was with Wolfe at the capture of Quebec and aided that commander very greatly by taking soundings in and about the harbor of Quebec, being so nearly captured on one occasion that his foes had leaped into one end of his boat as he sprang out of the other. He also charted the river below Quebec in places that had been found intricate and dangerous, and, so said his biographer in 1788, "his work was so accurate

*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.

that it hath not since been found necessary to publish any other." He surveyed Miquelon and St. Pierre and the coast of Newfoundland in 1763-7, and held from the latter year the title of Marine Surveyor of Newfoundland and Labrador. Captain Bayfield, who charted the river very extensively, was no unworthy successor.

As early as 1785 the London Merchants trading to Canada offered to place buoys in the Traverse, if the authorities would maintain them, and the proposal was received with favor. As early as 1783 the buoying and lighting of the river had been proposed, and attached to the recommendation was a report showing that sixty vessels had been wrecked in the river between 1776 and 1783. In 1788 the Council declared that it could not afford the expense of lighting Green Island, and it was not until 1809 that a light shone upon that dangerous strand, which is almost opposite the Saguenay. This, I believe, was the first lighthouse in the St. Lawrence.

We come now to a period which we cannot treat in such detail as has hitherto been done. Improvements began to come rapidly. The influx of exiles from the United States had begun to give the upper country an air of civilization, and in 1793 the province of Upper Canada was created. Its wonderful prosperity had all to do with the development of the St. Lawrence route, up to Confederation at least, and we will begin our consideration of the third period by describing the advance of shipping on the Great lakes up to the Union of the provinces in 1841. The first canal on the lakes was built by the North West Fur Company, at Sault Ste Marie about 1800, Mr. Keefer says, in 1798. The United States had a canal in 1800 from the Mohawk river to Wood's Creek, the first effort to establish communication with the Hudson river, that is to say forerunner of the Erie canal. The canal of the Fur Company was built at the lower end of the rapid on the northern or Canadian side, and supplemented a road by which the goods of the company were transported to the landing on Lake Superior. The commerce on Lake Superior was developed later than that on the other lakes. Canadian companies navigated it from about 1800, one of the first vessels being the "Recovery," owned by the British Northwestern Company. She was of 150 tons burden and a brigantine. The "John Jacob Astor," the first United States vessel on this lake, was launched in 1835.,

Coming to the next obstruction in navigation on the lakes, there is the historic Niagara portage, which was in a good state of development in the French regime and which in spite of all competition remained in the hands of Canadians until the United States passed the embargo and non-intercourse acts of 1807 and 1809. This portage was usually leased to one firm, which had a fixed tariff. There was another portage from Toronto to Georgian Bay, avoiding the navigation of Lake Erie.

For many years there were no roads worthy the name in what is now Ontario. All travel was by water, and in time a class of packet schooners arose which reached a high state of development. Then came steam, first used in Canada at Montreal, by Hon. John Molson in 1809, and used on the great lakes by Canada before it was used by the United States. The "Frontenac," built in 1815, and the "Queen Charlotte," built in 1816, both antedate the United States vessel the "Ontario," which was so poorly constructed that her paddle shaft was thrown from its bearings during the first trip. But the heat of the furnaces, the clank of the engines, and the smell of the whale oil lamps in the cabins of the early steamboats were not conducive to hearty appetites, and it was not until the thirties that the competition of a line of steamers from Toronto to Prescott was able to place the schooners in the background. The speediest of these steamers made four miles per hour against a stiff breeze, and her walking beam was as broad as it was long. She was subsequently transferred to the lower lakes on the St. Lawrence proper, and the "Sir Robert Peel" took her place on the route from Cobourg to Toronto.

In 1841 the propeller came into use on the lakes through the instrumentality of a Canadian, who had read of Ericson's invention, and urged an Oswego friend, then in New York, to look into the invention and let him know the result. The friend took one Van Cleve, of Lewiston, N.Y., to see the invention, and Van Cleve left the place with the monopoly of propeller traffic on the lakes in his pocket, the result of which was the "Vandalia"—such is the consequence sometimes of consulting one's friends on matters of importance.

In the early years of the century there was not a light house on the great lakes and the harbors were still in a state of nature. Some charting had been done, and it had been ascertained that the harbor of Toronto was rapidly shoaling. Measures to prevent this were proposed by Captains Richardson and Bonnycastle, but nothing was done until after 1841. Towards the close of the twenties some of the harbors, such as Port Stanley, Port Hope, Cobourg and Oakville, had been supplied with wharves, chiefly by private enterprise. The Queen's wharf at Toronto had been constructed prior to 1841, 1,091 feet long, with a depth of water varying from 9 to 12 feet. There was not a lighthouse on the lakes until after 1825, and the total expenditure of Upper Canada upon lighthouses, beacons and buoys, prior to the Union was less than $100,000.

In 1816 the firm now known as that of David Torrance & Co. purchased from John Handyside & Co. the tug and passenger steamer "Hercules," and placing Captain Brush in command began a competition with the Molson line. This was the origin of the Richelieu and Ontario Navigation Company.

Steam navigation speedily spread beyond Quebec and Montreal. Above the latter city on Lake St. Louis, a steamboat was placed as early as 1824, and there was one on the Ottawa above Carillon in 1819, followed by one on the lower Ottawa in 1826. The first steamer to run the Lachine Rapids was the "Ontario," Captain Hilliard made the perilous trip 19th August, 1841. The name of this vessel was subsequently altered to the "Lord Sydenham." In 1814 Lower Canada had a population of 335,000 and Upper Canada had 95,000, increased by 1825 to 479,188 and 157,923 respectively, an increase of nearly 70% for Lower Canada and quite 60% for Upper Canada. Side by side with this increase in population came an increase in trade, which added to the need of good communication experienced during the war of 1812, led to the devotion of a good deal of attention to the improvement of the St. Lawrence route and of the connections between the upper lakes.

The first important improvement in the St. Lawrence route was the construction of the Lachine Canal. Adam Lymburner in 1791 had proposed a canal from Montreal to Lachine, and as a compromise, in 1805 a vote of $4,000 for the improvement of the river had been applied by the Commissioners to improvements in the Lachine rapids. In the following year a similar sum was applied to further improvements as well as to work between Montreal and Laprairie, at Point St. Charles and in the rapids above Lachine. In 1815 a company was incorporated to construct the canal, but failing eventually to secure the requisite capital, the Legislature took over the work in 1821, ground being broken 17th July by Hon. John Richardson.

The canal was opened as far as the outskirts of Montreal by August, 1824, and the first vessel passed through in 1825. The canal was a barge canal with five feet depth of water and locks 100 feet by 20 feet. The advisability of canal construction by Government instead of a private company is well shown in the history of the Welland canal, which was begun in 1824, and completed after much mismanagement and many difficulties, including the falling in of the Deep Cut, in 1829, but so poorly that much subsequent work was requisite.

We now approach the period when Quebec lost to Montreal the proud and lucrative position of the ocean port of Canada. This came about through the construction of the lake St. Peter channel, which is one of the most unique canals in the world. Its length is about eighteen miles, and it affords a depth of twenty-seven and a half feet, its submarine walls being sometimes sixteen feet deep, and ranging from one hundred to one hundred and fifty yards in width. The history of its construction is interesting. In 1826 the merchants of Montreal presented a petition that aid be granted in clearing the St. Lawrence at Ile Plat and in Lake St. Peter. The matter was referred to a committee of the Legislature, who examined pilots and ship captains, all of whom thought that any channel which might be dredged would be almost immediately refilled by the quicksands. In 1830 Capt. H. W. Bayfield surveyed the lake, and in his reports of 1831 and 1835 expressed the opinion that it was doubtful whether a channel for vessels of deep draught were possible. Montrealers, however, do not acknowledge that anything is impossible to them, and in 1838 the Committee of Trade again brought the matter forward and asked for a sixteen feet channel in place of the natural one of only eleven feet and a half. A new survey was ordered immediately after the Union of 1841, and the engineer, D. Thompson, declared a sixteen feet channel practicable. In that year the Legislature appropriated fifty-eight thousand five hundred pounds sterling towards the undertaking. The machinery and dredges required for the work were completed by 1843, and work was begun in the following year, a straight channel 150 feet wide and 14 feet deep being projected through the flats. This appears to have been an injudicious proceeding, as the currents drifted large quantities of sand into the excavations. Work was, however, continued until it was ascertained in 1845 that the appropriation would not be sufficient. A committee visited the work and decided that it would be better to abandon it and enlarge the natural but crooked channel, a proposal in which Capt. Bayfield concurred, only that he thought it more economical to complete the straight cut now that it had been so nearly finished. He advocated increasing the width to a hundred yards. The work was resumed, and discontinued in 1847 for want of funds, some seven miles out of nine having been dredged and seventy-one thousand pounds sterling having been expended.

Montreal would not accept its defeat. Its citizens kept up their agitation, and an act was passed in 1850 empowering the Harbor commissioners of the city to excavate a channel through the lake to a depth of sixteen feet, they being authorized to raise the necessary funds by a toll of not more than one shilling per ton on vessels drawing ten feet of water and upwards, and by borrowing thirty thousand pounds currency. The commissioners abandoned the straight cut and adopted the natural channel eleven and a half miles long, which by the following year they had dredged to a depth of thirteen feet, an increase of two feet, at low water. It was with pride and keen anticipation of a bright future that the people of Montreal in that year watched the "City of Manchester" pass down the river en route for sea, drawing fourteen feet. In 1852 the commissioners were authorized to effect an additional loan of $160,000, supplemented in 1855 by a further authorization for $400,000. In 1852 the depth of the channel was 15 feet 2 inches at low water, and by the end of 1855 an additional foot had been gained, bringing the channel to the depth which had been contemplated. But ocean vessels had been growing larger, and the commissioners had determined not to stop there. In 1855 they had received authorization to excavate a twenty feet channel, and proceeded with the work with energy. In 1859 the Government advanced them $60,000, on their plant. By 1860 a channel of seventeen and a quarter feet at low water had been reached, and the Harbor commissioners had contracted a debt of $680,000, not including the $60,000 due the Government. It is with some surprise that the writer notes a considerable difference in the statistics given by the Board of Trade and the Government on this subject. He has followed the Government report, although the Board of Trade declares that there was an eighteen feet channel by 1857. In 1860 the Government determined to reduce the toll imposed by the commissioners, and assumed the debt of $680,000, an action confirmed by Act of Parliament in 1864. When the channel had been brought to the depth mentioned, it was decided to make it twenty feet, the Government consenting to wipe out the $60,000 indebtedness and pay a further sum of $160,000 on the completion of the works, leaving the plant, which they had loaned the commissioners, in the hands of the latter. The twenty feet canal was completed by the autumn of 1865. But again it was determined to deepen the channel, and by 1878 it had reached 22 feet 6 inches. A depth of twenty-five feet was reached in 1882, and by 1888 a great celebration was held in honor of the passage of a vessel drawing twenty-seven and a half feet from Montreal to Quebec, making Montreal by the energy of her citizens the most inland seaport of the world. In that year the Government took over the works.

Canadians are too familiar with the history of the "Royal William" for me to more than refer to it here. Let it suffice to say that this was the first bona fide ocean steamship to cross the Atlantic, that she was built at Quebec, engined at Montreal, and performed her memorable voyage in 1833, sailing from Pictou on 18th August and arriving at Gravesend, seventeen days later. She was subsequently sold to the Spanish Government. The first company to run a regular line of steamers between Montreal and Great Britain was chartered in 1853, being granted a subsidy of $19,000 per annum by Government to carry a fortnightly mail. It also received $4,000 from the St. Lawrence & Atlantic Railway and $1,000 from Portland, which city it made a port of call. On 10th May of that year the "Geneva," 350 tons, arrived in port, the pioneer of Montreal's ocean steamships, if we except the "Royal William." The "Geneva" was followed by the "Lady Eglinton" and the "Sarah Sands." The Canadian Steam Navigation Company did not, however, succeed, and was replaced as a mail carrier in 1856 by the Allan Line.

This famous Canadian line was founded by Captain Alexander Allan, of Saltcoats in Ayrshire, whose ship "Jane" carried stores to the Duke of Wellington in the Peninsula in 1815, and shortly after the peace began running between Montreal and the Clyde. His business prospered, and packet after packet was added to his fleet. When the deepening of the channel to Quebec had been partly accomplished, the Allans began to build steam vessels, the

first in 1853, and were carrying a weekly mail to England by 1856. Their sailing fleet had reached sixteen in number. From 1857 to 1864 inclusive, the line suffered the loss of nine vessels by wreck, but the cloud passed away, and there is perhaps no line more fortunate in this respect to-day and for years back than that of the Allans, whose commanders never assume the risks which United States liners take. The line owes its rapid advancement to the labor of Sir Hugh Allan, son of the old sea captain, who came to Montreal about 1826 and there received his business training.

Prior to the development of steam navigation on the Atlantic, the sailing vessel had been brought to a high state of development, in the form of clipper ships, whose races with one another across the ocean were as much subject for excitement then, as a big ocean race to-day. I understand that Montreal has owned the fastest sailing ship ever built, the "Thermopylae." She was built by Walter Hood & Co., of Aberdeen, and ran from the Lizard to Melbourne, Australia in sixty days, a distance of 13,222 knots. On one day she made 380 statute miles. Her run from Foo Chow, China, to London, 91 days, has been beaten by sail only by the "Sir Lancelot," which accomplished the voyage in 89 days.

I have already occupied too much of your time. We must hasten to a conclusion. The Union of the Provinces took place in 1841 and attention was at once turned to the completion of the various canals projected by the two provinces. During the period of the Union, notwithstanding the political deadlock which ultimately rendered Confederation necessary a very great deal was accomplished. At the time of the Union the Erie canal and the Rideau navigation were overshadowing the St. Lawrence route from the lakes. The Rideau was the freight route to the great lakes. But work upon the St. Lawrence canals was pushed forward. The Lachine canal had been opened in 1824 with seven locks 100 x 20 x 5 feet. In 1843 an enlargement was begun with locks 200 x 45 x 9 feet, five in number, the lowest two of which by urgent request of Montreal were altered to 16 feet of water on the sills, to admit ocean vessels. The canal prism was 120 feet wide at the surface and 80 feet wide at bottom, when Confederation took place.

The necessary plans for the Beauharnois canal were prepared in 1842, work was begun in 1843, and completed in 1845. It had at the time of Confederation a length of 11¼ statute miles, 9 locks 200 by 45 feet by 9 feet, and the prism was the same as that of the Lachine canal. The Cornwall canal to overcome the Long Sault was begun in 1834 and completed in 1842, the first vessel through being the steamboat "Highlander." The canal was formally opened in June 1843. The depth of water on the sills was the same as in the Lachine and Beauharnois canals, 9 feet, but the locks, seven in number, were ten feet wider, and the canal prism 100 feet at bottom and 150 at the water surface. The Farrans Point canal lock completed in 1847 had the same dimensions as that of Lachine and the Rapide Plat canal, opened in 1847, the Galops canal, opened in 1846 and the Point Iroquois canal opened in 1847, were of the same demensions also, the canal prism in all three cases being, however, only 50 feet at bottom and 90 at top. Thus at the time of Confederation there was a channel for ocean steamers to Montreal 20 feet deep, the two lower locks of the Lachine canal had a depth of sixteen feet, and the rest of the navigation on the St. Lawrence was only on a 9 feet basis. The Welland canal was on a 10½ feet basis, and the only canal in use from Lake Huron to Lake Superior was that of the United States.

In 1793 114 vessels, of 15,758 tons and 933 men, arrived at Quebec. By 1841 this shipping had increased to 1,221 vessels, 425,118 tons, and 16,443 men, of which 13 ships and 5,057 tons were steamers. The "Unicorn" navigated between Quebec and Nova Scotia from 1840 to 1844 inclusive. In 1866 the shipping was 1,041 ships, 590,120 tons, and 15,695 men, 73 of the ships being steamers. The dangers of the route may be exemplified by the statement that between 1840 and 1849 inclusive 238 ships were wrecked of those engaged in the Quebec trade. In 1854 258 seagoing vessels arrived at Montreal, with a tonnage of 70,910 tons, and the river vessels in the port were 3,047 of 234,866 tons. In 1866, 516 seagoing ships of 205,775 tons arrived and 4,016 river ships of 417,349 tons. The million ton mark was first passed in 1892.

From comparatively early days it has been the ambition of the interior provinces and states to secure a direct route to Europe without trans-shipment, an ambition which the future may see realized. As early as 1858 a vessel passed from Chicago to Liverpool. This was the "Dean Richmond," which left Chicago on 17th July and arrived at Liverpool by the St. Lawrence route and the Straits of Belle Isle on 17th September, in sixty-two days and a half, about 12 of which were consumed in lightering and other delays. Her trip from Quebec to Liverpool consumed 29 days. The canal tolls on the St. Lawrence route during the Union may be taken as sixty cents per ton, a reduction of over 64% from the period of the Twiss canals, still further reduced 75% in these modern times. I am taking the tolls upon flour and wheat.

The improvement of the St. Lawrence route opened up a fertile territory. The canals were to early Canada what the railroads have been since Confederation. In 1838 the exports of wheat from Canada were 296,000 bushels; in 1852 this had risen to nearly 5,500,000 bushels. Instead of the bulk of the trade going up the river, the shipments downward began that preponderance which have since characterized them. In 1854 the following was the relative standing of our exporting cities: Quebec, Montreal, Toronto, Coaticook, Dalhousie, Kingston, St. John's (Que.) and Whitby. In imports Montreal led, followed by Quebec, Toronto, Hamilton, Kingston, Stamford, Prescott and Port Stanley. The period closing with Confederation witnessed the establishment of the railway in Canada, which has since been an important rival and support of the water route. The earliest railway and railway station, that at Laprairie, was opened in 1836 to connect with St. John's, Quebec. It closed down in winter, there being no traffic. There was also very shortly after a railway from Montreal to Lachine, and the Grand Trunk railway had united Montreal and Toronto with their present winter port at Portland. In 1868-69 the trade of Canada amounted to $127,876,000, exports and imports entered for consumption. As already stated there was only one lighthouse in the St. Lawrence in 1809. By Confederation there were no fewer than two on Labrador, 22 between the Gulf and Quebec, 27 between Quebec and Montreal, and 80 others above Montreal on the river, the great lakes and the Ottawa, a total of 131, of which 11 belonged to private individuals and companies. During the Union, over $1,000,000 was spent on lighthouses, beacons and buoys.

Before Confederation Canada possessed within her own boundaries no winter port, nor any satisfactory communication with her sister colonies in Acadia. Civilization stopped at the head of Lake Superior. The far west was in the hands of the Hudson Bay Company. At the time of the Union, Quebec and Ontario had a population of

2,500,000 souls, yet with the exception of the canal at Sault Ste. Marie, they had developed the St. Lawrence route to a point which left it necessary only for the new Dominion to carry out the plans and develop the trade of our fathers.

CANADIAN IRON AND STEEL.

We have often complained of lack of enterprise on the part of Canadian moneyed men, who have allowed our great natural resources to lie undeveloped. Such carelessness seems to be passing away and on all hands we hear of great enterprises which are either in progress or well on the way. Among these none has been hailed with greater satisfaction than the formation of the Dominion Steel and Smelting Company, which was announced last month to develop the iron resources of Cape Breton. The officers are: President H. M. Whitney, Boston; Vice-President, R. B. Angus, Montreal; Treasurer, John S. McLennan; Secretary, T. B. Prenson. The Board of Directors includes Senator Cox, Toronto; Senator McKeen, Nova Scotia; Sir William Van Horne, James Ross, and Robert McKay, Montreal; Michael Dwyer, Halifax; and J. Paget, London, Eng. The site for the proposed works has already been located by the company's engineer near Sydney, C.B., but work will not be commenced until Mr. Fielding's bounty legislation, now before Parliament, becomes law.

The company will issue $8,000,000 in thirty-year gold bonds bearing five per cent. Of these bonds $2,000,000 will be retained in the treasury. The common stock will amount to $15,000,000. The natural advantages of the location will make the success of this company a certainty when joined to the large capital and great business ability of its members.

There seems to be a prospect of a large shipbuilding plant being established in connection with the smelting works, which would have a very good prospect of success. As the rate of wages prevailing in the Maritime Provinces is not high, the iron and steel can undoubtedly be produced more cheaply than anywhere else, and the natural facilities of the harbor of Cape Breton are most advantageous.

THE HORSELESS VEHICLE BOOM.

To those who read the leading dailies of the lesser great cities of the American Continent, there has appeared recently a new star in the advertising firmament. It has all the splendor of a proprietary globule of the first magnitude, and is visible generally thus, as in the "Toronto Globe," June 5th, "Toronto's New Era" or wherever it may be, "St. Louis," "Minneapolis," "Rochester's Glory," or "Pride" or "Progress," or whatever it may please the advertising manager to label it. The Globe article made a number of statements which would lead the uninitiated almost to believe that he might go to the corner and whistle for an electric carriage, and to fully convince him that shares in the new local company were to be had of all dealers. But such is not the case, neither in Toronto, Rochester, St. Louis or Minneapolis can you ride at will in a Whitney-Widener-Elkins syndicate electric carriage or buy shares in its companies, but if a little time is given, the syndicate will achieve these desirable ends—especially the latter. "In its hurry to enlist local capital for its local sub-syndicates, the Whitney-Widener-Elkins combination of electric interests is neglecting the artistic touch which would give verisimilitude to its philanthropic endeavors," says the Cycle Age, Chicago, in its issue, June 15th. "Its press committee probably forgets that Minneapolis, St. Louis and Toronto have rapid means for intercommunication, for it attempts to stimulate the investors in these three cities by inspired articles, labeled as "special dispatches," which are absolutely identical except for the substitution of the city's name. When these articles are perused by the prospective investors in the various cities, they must have a disquieting, purse string-tightening effect."

—All advertisers sending their latest catalogues to our Toronto office, will secure the advantage of having them placed on file where they may be consulted by interested visitors at our office. We have catalogued those already on our shelves, and are thus able to turn up any required manufacturer or line of goods at a moment's notice.

—Canadian engineers will notice with some not unnatural feeling of jealousy that Hamilton, Ont., is doing more for the Anglo-Saxon alliance than for the interests of the native born. S. B. Wingate, a United States citizen, has been appointed city engineer of Hamilton in place of E. G. Barron C.E., who has been appointed consulting engineer and manager and chief engineer of the water works department. The unwisdom of such a division of authority will, of course, demonstrate itself in a very short time, but it seems almost too much to hope for rational conduct of a public works department by Canadian aldermen. The leading Canadian applicant for the position of city engineer was Cecil B. Smith, C.E., who is a native of the neighborhood, and has distinguished himself not only in the practical conduct of engineering works, but has filled an academic chair in the department of engineering at McGill University with great acceptance. We have no doubt that Mr. Wingate's abilities and training fit him for the discharge of the very difficult duties of a city engineer and we offer him our congratulations upon the appointment, while regretting that he was not of our own country and comes from a country where such recognition of an outsider's merit would not be tolerated.

—As already mentioned, the Canadian Society of Civil Engineers recently decided to purchase a home of their own, and have acquired a substantial stone structure on Dorchester St., near the corner of Mansfield St., Montreal, and are now preparing to remodel the building to suit the needs of the institution. The space now occupied by a yard at the rear will be converted into a meeting hall, about 60 x 25 ft., while the main part of the ground floor of the present building will be altered to form the library that is now fast being accumulated. The present upper rooms will be turned into reading, smoking and recreation rooms, with dormitories for visiting members and the caretaker. The aspirations of the Society to possess their own headquarters have already been warmly encouraged by a gentleman whose benefactions to the cause of higher education in Montreal command the admiration of his fellow citizens, namely, W. C. Macdonald, to whom McGill University is indebted for his unexampled gifts. Mr. Macdonald has given $500 to the Society's building fund, and James Ross, C.E., president of the Montreal Street Railway, has given another $500. Mr. Ross rose from the ranks of poor, but hard-working civil engineers, and now in the days of his prosperity he has ennobled his profession by this act, which shows he has not forgotten the days of his early struggle. Such examples will be a wholesome inspiration to young students, and no doubt the lead of Messrs. Macdonald and Ross will be followed by other members, who need not hesitate because they cannot afford to be so munificent.

METERS AND METER RATES.

BY A. A. DION, OTTAWA.

There are a few things of more importance to owners of electric light plants, or having a more potent influence for the financial success or failure of electric supply undertakings generally, than meters and meter rates; and all those interested in the satisfactory solution of the problem "how to increase profits from electric supply," should give the subject of this paper thorough and serious consideration. In these days of close competition in lighting, in common with all other industries, when we feel the need of constant study and investigation in order to find, if possible, means of reducing the cost of production, should we not devote ourselves with equal energy and perseverance to the task of increasing the earning-power of our plans? Upon this question, meter rates have a direct and important bearing.

It seems hardly necessary at this time to make a plea for the use of electric meters. Experience has established, beyond question, the fact that the use of meters increases the earning-power of a plant. A change from flat to meter rates invariably lowers the peak of the station load curve to such an extent, that the lamp installation may be doubled before the peak regains its previous value; the average earnings per lamp installed will be such as to show an increase in the total revenue, unless indeed the flat rates previously charged were so high as to confine the use of the lights to a narrow circle of long-hour consumers. The use of meters also places the owner of a plant in a position to compete successfully with gas and other illuminants for all classes of consumers, thereby facilitating the extension of his business. This cannot be done under a flat rate system, except by making all sorts of special rates, to meet special cases; a proceeding which is certain to produce dissatisfaction among consumers, and often works injustice to the supplier. No attempt will be made to give in this paper a history of the electric meter; not even to enumerate the many forms that have been produced in the process of evolution, to which we owe the modern recording meter. Too much valuable time would be taken up and no very useful purpose would be served by the recital, as far as this association is concerned. Those who feel any interest in the subject may be referred to a paper read by George W. Walker, before the American Institute of Electrical Engineers, May 21st, 1891. Later meters have been described and illustrated from time to time in the electrical press.

It is necessary to the full success and popularity of the meter system of charging for current, that the meters should be direct reading, in other words that the record of consumption should appear in plain figures on dials available to the consumer, as he has long been accustomed to in gas meters. The Canadian Electric Light Inspection Act prohibits the use of any but direct reading meters, therefore the choice of meters lies between the different forms of these meters, generally known as "motor meters." These meters are essentially electro-motors, operated by the current to be measured and whose rotating member actuates a train of registering wheels and dials. They may be divided into two general classes, namely:

First, those operating on the inductive principle, wherein an armature, consisting of a ring, disk or cylinder of metal, generally iron, is carried around by a rotating magnetic field. This field results from the current to be measured passing through a coil or coils of wire, and the current induced in a closed secondary coil, of low resistance, set at angle with the first; and, second, those embodying the well-known principle of the direct-current motor: a wire-wound armature rotating within a magnetic field. Meters of the first class are suitable for alternating currents only, and must be calibrated for the frequency at which they will be operated. They have no commutator nor brushes. Those of the second class may be used for either direct or alternating currents of any frequency. They have a commutator and brushes. That is their weak point, as dirt and moisture will affect the commutator, and the meter will in time run too slow unless it is cleaned occasionally, which is a troublesome proceeding, now that meters are sealed by the Government. They require delicate and careful handling. Meters of either class may be "current meters," recording in ampere-hours, or "energy meters," which register in watt-hours.

In meters of the first class, which are generally current meters, the torque is approximately proportional to the square of the current, and the speed is proportional to the torque. Such are the "Schallenberger," "Duncan," etc. In meters of the second class, generally energy meters, such as the "Thomson," the torque is directly proportional to the power applied and the speed is proportional to the torque.

All meter armatures left free to revolve, run so fast at high loads as to seriously impair the accuracy and durability of the meter, and means had to be provided to restrain their speed. This was done in two ways. Small vanes or air fans were attached to the end of arms rigidly fixed to the armature shaft. These fans lie at right angles to the direction of rotation, and the retardation is due to the resistance of the air against them, which is approximately proportional to the square of the speed, so that this device may only be used in those meters where the torque is proportional to the square of the quantity to be measured. The other way is to attach to the armature shaft a copper disk revolving between the poles of permanent magnets. These exert a drag on the eddy currents generated in the disk by its rotation in the magnetic field. This magnetic drag is proportional to the speed, and is employed in meters where the torque is proportional to the quantity to be measured. The majority of meters will not start with less than three per cent. of their full loads, and tend to run slow at light and high loads. This is a serious drawback, but there appears to be no effective remedy for it at the present time. In choosing a meter the first point to be settled is whether to use a "current" meter or "energy" meter. At first sight it would seem that the energy meter would best suit our purpose, as it records the actual expenditure of energy, but where energy is supplied at a constant voltage, the record of the current meter is proportional to the energy in volt-amperes. With alternating currents, and especially with inductive loads, the record will be slightly in excess of the energy, but will be proportional to the machine capacity employed, which is a perfectly reasonable charge against the consumer, since it is the maximum load in volt-amperes that determines the size of the plant and the fixed station expenses. The current meter has the advantage of simplicity, ease of adjustment and less cost. It lends itself admirably to the lamp hour-rate of one cent, as its record shows the lamp-hours. Rates may be varied to suit all conditions by a system of discounts from the one cent rate.

The desirable characteristics of a meter are: Initial accuracy, constancy, simplicity of mechanism and indicating dials, durability, ability to exclude dirt, insects, etc., and to withstand tampering. Examination and test will determine how far these characteristics are possessed by a meter, except those of constancy and durability, which can only be established by a test of time in regular practice. Both, however, depend on good design and workmanship, especially in the jewel-bearings, which should be of the best quality, accurately ground and thoroughly polished. The writer has for some years used the "Schallenberger" current meter, which has met all the conditions of actual service in quite a satisfactory manner with only ordinary care. He had some experience with a certain type of meter in which so much heat was developed at normal full load as to roast the varnish on the outside of the wire coils. It is needless to say that such a meter should, under no circumstances, be used.

The importance of a well-organized meter department and properly equipped meter room, wherein testing, adjusting and repairing of meters may be intelligently carried on, cannot be too strongly urged. This department should be given in charge to one man, who may be carefully instructed in his duties and educated to perform his work in an efficient and systematic manner. When meters are received from the factory they should be examined, tested and adjusted if required before they are sent for Government inspection. Records of these and all meter tests, of meters certified by the Government, installed or taken out, and of meters repaired, should be kept in the meter room in a day-book for that purpose where entries may be made from day to day, designating such meter by the serial number, size and make. There should also be a ledger, into which day-book entries should be posted. A page to be

headed, for each meter in use, by the serial number, size and make. In this way each page will contain a complete history of one particular meter, and this will be found very useful for reference. No meter should be installed, removed or tested without orders from someone in authority. It is a mistake to allow any employee in the office to order meters changed and tested.

This room should not be accessible to any employees except those of the meter department. There should be in a well-lighted corner of this room a work bench with such tools and appliances as will be required in repairing and adjusting meters. A substantial wooden rack should be erected against a solid wall, quite free from vibrations, where the meters may be hung up in rows, by means of hooks or catches, fashioned to hold them firmly in a level position. Flexible wires ready to be inserted in the binding posts of the meters and short-circuiting plug devices, allowing the cutting out of any meter without opening the circuit, should also be provided. The meters should be connected in series, and the circuit, which must be of large wire, should pass through a main switch and cut-out, a rheostat to adjust the voltage, a good dead-beat wall ampere meter and a master meter used as a standard in making tests. There should be also, connected across the circuit, a reliable voltmeter, dead-beat if possible, and a bank of incandescent lamps of various candle-powers, say 16, 10 and 5, to adjust the load. The "master meter" or "standard" should be tested once a month. The following directions for testing will be found useful. If the master meter is a "current" meter, proceed as follows:

1. Adjust the current to full load of meter. 2. Count the revolutions of the armature by means of the tell-tale index at the top of the shaft or otherwise, for a number of seconds, depending on a constant furnished by the makers for each size of meter. (This constant represents the time taken by the armature for one revolution when a current of one ampere is passing). 3. The revolutions should be counted for a number of seconds, equal to several times the constants, in order to secure accuracy, and the revolutions counted during that time, multiplied by the constant of the meter, and divided by the number of seconds, should equal the amperes passing through the meter during the test. If the amount is greater, the meter is running fast, if less, the meter is too slow. 4. Repeat the test at half load and quarter load. The current should be calculated from the indications of a Siemens dynamometer. If none is available, the wall ampere meter, which should be frequently calibrated, may be used instead.

For an "energy meter" proceed as above, adjusting the voltage carefully to normal as well as the current and use a watt-meter instead of the ampere meter. A stop watch is better for this test. If no stop watch is available, two men should make the test, one counting the revolutions, the other holding an ordinary watch. The case should be on the meter during this test to avoid the disturbing influence of air currents, the rotation of the armature being observed through a small window in the top of the case. The voltage should be quite steady.

There may be a separate master meter for every kind and size of meter if desired, but that is hardly necessary. Meters can be adjusted by altering the angle between the primary and secondary coils in inductive meters, or by shifting the position of the retarding permanent magnets where these are used. When it is desired to test a number of meters, examine them and see that the armatures are turning freely and the shafts resting properly in the jewel bearings, hang them upon the testing rack, connect them in series, and put the cases on, then, 1. Close the circuit, adjust the voltage and turn on one 5 candle-power lamp and see if meters start. (Meters of ten amperes should start on this lamp, those of twenty amperes on one lamp of ten candle-power, those of forty amperes on two similar lamps, and those of eighty amperes on two lamps of sixteen candle-power. Meters that fail to start as above should be tagged for repairs). 2. All the meters on test being of the same size, adjust current to full load and watch the pointers on the last right hand dials; run the meters, including master meter, cutting them in and out of circuit as required until all the pointers are exactly over a number in the last right hand dial. 3. Open the circuit and take readings of all the meters. 4. Close the circuit, adjust current to half load, and allow the meters to run several hours, after which readings may be taken and the "consumption" compared with that recorded by the master meter.

A meter testing over three per cent. slow or fast should be given a second test to confirm the first. The advantage of a long run in series with a standard meter is, that it makes it easy to detect and measure very small percentages of error. When a meter is brought in for any reason it should be tested before it is taken out. When it becomes necessary to test a meter after it has been installed, it is better to bring it to the meter room, putting another one in its place, as no proper test can be made on the consumer's premises. Several methods have been suggested for domiciliary testing, but none are quite satisfactory, besides it pleases a customer better to change his meter when he has lost faith in it.

Meters should be of as small a capacity as may be used without inviting their total destruction. It is better to take chances of an occasional burn-out, than to install meters that will run during seventy-five per cent. of their working hours on less than half load, and thirty-three per cent. of the time on one-quarter load or less. Under these circumstances meters, as we know them, cannot be expected to do the supply company justice. It is impossible to entirely eliminate friction in meters, and they stand on the order of their going, as it were. They are also slow on light loads. The most effective remedy is to use small meters. It is true that they are also slow on high loads, but the high loads seldom come and never stay long. The importance of using small meters may be fully realized by reference to an experiment reported by Mr. Lyman C. Reed, where a load varying from one to ten incandescent lamps was passed through two meters in series, one of 7½ amperes capacity, the other of 100 amperes. The small meter registered thirty per cent. more than the large one. Mr. Duncan suggests the following rule for his meter:

For	3	to	7	lights	install a	5	light meter.
	8	"	14	"	"	10	" "
	16	"	20	"	"	15	" "
	25	"	35	"	"	25	" "
	40	"	65	"	"	50	" "
	70	"	100	"	"	75	" "

No hard and fast rule can be laid down; much depends on the class of consumers to be served. In private residences, for instance, a ten-light meter would do up to twenty lights, a twenty-light meter up to thirty-five lights, and a forty-light meter up to seventy-five lights in the majority of cases. It has been suggested to put two meters in parallel on large installations, one large and one small meter, with a mercury switch actuated by the current and intended to automatically cut out the large meter whenever the load fell below a predetermined amount. The suggestion is worthy of consideration. Great care must be exercised in carrying meters through the streets. A light express wagon with a box partly filled with straw, wood fibre, or other packing, in which the meters may be placed on their backs, is a good thing to move them in. They may be safely carried by hand, also on a bicycle, but in the latter case the rider must be careful to avoid sudden jars. Whenever a meter is taken out for installation, the reading should be taken and left on record in the meter room, in case the reading or "start" is not taken at the consumer's premises. Meters should not be installed on shaky partitions or those containing doors liable to slam, or on walls subject to vibrations. They should be in a dry place, easy of access and open to daylight or otherwise lighted, and, if possible, they should be protected from extremes of temperature. Meters should not be placed on or too near the floor, nor too high. You cannot expect your meter reader to stand on his head or to carry a step-ladder. In such cases he will attempt to get the reading at a distance and probably get it down wrong. A little missionary work among electric wiremen and contractors will lead, in time, to the practice of arranging a place for the meters in accordance with the above recommendations.

Before connecting the meter it is well to try lamps here and there about the place, leaving meter loop open, to make sure that there are no branches taken off outside of the meter. Meters should be levelled and rigidly fastened to the wall. After installing the meter, one or more lamps should be turned

on to ascertain that the meter starts readily. For this purpose meter cases should have a window through which the movements of armature or shaft can be seen. No openings should be left between the cover and the back of the meters where insects may go in. They seem to find comfortable quarters there, and spiders weave their webs around the moving parts, retarding and sometimes stopping the meter. This is more likely to happen where houses are vacated during the summer holidays. The writer has used a stick of pine wood, about four inches long, one-quarter inch wide, and one-eighth inch thick, between the cover and back casting of Schallenberger meters, at the top, with good success. It has been suggested to squirt soft putty with a syringe, so as to practically seal the cover to the back, but this is seldom necessary. It is a commendable thing, however, as it excludes dust as well as insects. The connecting wires should be pulled through the binding posts until no bare copper is accessible from outside the meter case. The cover over the binding posts should be sealed with a lead seal bearing the mark of the meter department. It should be the duty of employees installing meters to see that there are no bare places or cut-outs on the mains between the meter and the service switch and main cut out, and to see that the latter is supplied with copper-tipped fuses of the right size properly put in.

Meters should be read monthly, if practicable, as "short accounts make good friends," but the large amount of clerical work involved in this practice often makes it preferable to have only quarterly readings. However, this makes very heavy bills in winter, which is objectionable. A good plan is to divide the six summer months, May to October, inclusively, in two periods of three months each, and the six winter months in three periods of two months each. The shorter winter periods will make the difference in the bills less pronounced and facilitate the collection of accounts. This compromise is confidently recommended as one that works well and gives satisfaction to consumers. The dates of the readings should appear on the bills, as they will show the number of days covered by the amount and frequently explain apparent overcharges. Reading meters correctly is not as easy as it looks. Men should be trained in the work and not changed unnecessarily. An unreliable meter reader is dear at any price. Errors in reading are mostly due to the fact that each dial is read by itself. Experience teaches that when a pointer is near a number, it is necessary to consult the next lower dial to determine whether the first pointer is short of or past the number. That is because the pointers are sometimes blunt, improperly set, or have a little side play. A plan which has been very successful in preventing errors, is to furnish the reader with books printed with facsimiles of the dials of a meter. The reader does not read in the ordinary sense, he merely copies in his book the position of each pointer, which is represented by a pencil stroke. The reading is done in the office.

A great saving of time may be made by using numbers to designate customers. Thus the meter reader would enter a reading taken at "A. G. Richardson, 319 Waverley street west," as "958. Richardson." The number is the page of Mr. Richardson's account in the ledger, and the addition of the surname makes identification of the reading more certain. The clerk entering the readings in the meter ledger should make each day a list of all readings which appear quite wrong from his knowledge of customers and their previous record in the ledger. This list should then be sent to the meter department with instructions to re-read the meters. Many errors will be corrected in this way before the bills are sent out, and meters that stop will be detected. Consumers sometimes complain that their bills are too high, and some have been known to express the opinion that the meters ran too fast, but the writer once encountered a consumer who said his meter was too slow; that was in Ottawa. When complaints are made, it is a good practice to get an extract from the complainant's account showing the total net cost of the light for a year. This will often be a pleasant surprise to him, as he has likely figured it out in his mind by taking his highest bill and multiplying it by the number of readings in the year, forgetting the summer bills. The period complained of should be compared with the corresponding period of the preceding year, if possible, and the preceding period should be investigated to see if meter was not under-read. In any case, offer to re-read the meter. If the first reading is confirmed and the bill really seems wrong, it is better to change and test the meter. When a customer makes general statements as to the small quantity of light he has used, you should get him down to details. Figure out with him the probable use of each lamp or group of lamps separately. Hold him down to facts. When you come to add it up he will be surprised, and the meter will generally be found to be not such a liar after all.

The practice of metering the output of the central station, which is becoming quite popular, is a move in the right direction. The data obtained through the use of station meters is not otherwise available. It is sure to lead to economies in the station, and will be of material assistance in making and re-adjusting rates.

In inaugurating meter rates, it has been customary to copy the practice of the gas companies, sanctioned by long usage, of a single rate, with or without discounts off large bills. The conditions under which electric light generating plants operate are, however, very different from those of a gas plant. The gas plant is fully utilized, and works at the point of highest efficiency for as many hours as may be desired, storing the product that is not immediately required. For an electric light plant the contrary is the case. Forced to run our plant from sixteen to twenty hours per day at a small percentage of its total capacity, which must be such as to meet the large demand which will be made upon it for a few hours every day, we find that the great bulk of our expenses are incurred, not in running the plant, but in getting ready to run. The charges assumed for each consumer connected to our lines, in order to be ready to supply him, are fixed, whether the lights are to be used ten minutes or ten hours per day. The cost of supplying current after the first ten minutes is only from one-third to one-sixth of the fixed charges previously incurred. It is easy to understand, therefore, that a consumer using his lights only a short time every day, which is likely to be during the period of highest load at the central station, may not be a source of profit and may sometimes be a source of loss.

Does it not seem reasonable that this consumer should pay such a meter rate that his yearly payments shall cover the fixed expenses made on his account according to the number of units held in reserve for him and subject to his call? This rate being applied to all consumers for, say, the first hour of the use of their lamps, would fully protect the supply company from loss on account of fixed expenses, so that any additional current would only need to be charged with the variable expenses of running, and could be sold at such a low rate as would encourage the further use of current during the hours of light loads at the central station. Such a method of charging for current naturally tends to lower the peak of the station load curve somewhat, but especially to build up, if not the lowest, at least the intermediate portions of it, and thereby to increase the earning-power of the plant.

The above considerations have led managers of electrical supply enterprises to devise various methods of charging for current in harmony with the principle of differential treatment of consumers, according to their value to the supply company as a source of profit. Arthur Wright, electrical engineer of the municipality of Brighton, England, who has devised a system of meter charges known as the "Maximum Demand System," wishing to show the injustice and loss involved in the old single rate plan, cites two cases, his worst and his best customers. The first employed for his maximum requirements 177 h.p. of the generating and distributing plant, capitalized at $36,966, costing, for interest, sinking fund and depreciation only, $2,582. He used in one year the equivalent of all his lights, burning 61 hours, and paid, on the single rate plan, $823.

The other employed 1.9 h.p. of the plant, capitalized at $394, and costing $27.70 annually. He used in one year the equivalent of all his lights, burning 2,004 hours, and paid $288.

Thus the larger consumer, who paid $823, and who would under the single rate plan be entitled to the larger discount, was actually a source of loss to the supplier to the extent of $1,759; while the small consumer who paid $288 netted the supplier a profit of $260 on the capital charges, and the variable expenses were also much less in his case, as he received only 3,807 h.p. hours, while the large consumer used 10,797 h.p.

hours. These are extreme cases; yet if similar statistics were compiled from the records of electric supply companies in this country, many cases would no doubt be brought to light which would show the injustice to supply companies and long hour users of the single rate system of charging, in a manner almost as glaring as in the example just given.

The greatest difficulty in the way of these improved methods probably lies in the fact that consumers, especially the short hour consumer, will not look at these things through our own glasses. He is not concerned about the unfavorable conditions under which our own plants are operating, and seriously objects to pay a larger average rate than his neighbor, no matter how conditions may differ. It is sometimes argued by advocates of differential rates that the supply company should leave these consumers alone and seek for business rather among the smaller but longer users; but it is well known to those who have had to fight opposition that it is advantageous to have the patronage of the large business houses, and to light the more prominent buildings, mostly short hour consumers, on account of the advertising value of such installations. Among the many systems proposed, the following are the most worthy of notice: 1. The Wright maximum demand system. 2. Differential meter rates based on the installation. 3. Two-rate meters. 4. Fixed price per light to cover fixed charges, wholly or in part, and low meter rate.

The Wright system aims to charge the higher rate for the first hour's use of the maximum current used at any time during a given period without regard to the size of the installation. The maximum current is indicated by the "demand indicator," an instrument invented by Mr. Wright, which is installed in series with the main current wherever a recording meter is used. It consists of a "U"-shaped glass tube with a bulb at each end, partly filled with colored sulphuric acid and hermetically sealed. A strip of platinoid is wound around one of the bulbs. The current is made to pass through the platinoid strip, which becomes heated, and the air within the bulb expands, driving the liquid up the other leg of the "U"-shaped tube until it reaches the other bulb, when it overflows down into a branch tube, which is graduated to indicate, by the height of the liquid within it, the maximum current that has passed through the instrument; the expansion of the air being proportional to the heat developed therefore to the square of the current. When this instrument has been read it may be re-set by tilting it until the liquid runs out of the branch tube. The cost of this indicator is about ten dollars. In Brighton, England, where the system has been working very successfully for about three years, the rates charged were in 1898 fourteen cents per kilowatt hour for the first hour's daily use of the maximum current recorded on the Wright meter, and three cents per kilowatt hour for any additional consumption. It will be seen what inducements are offered to long hour users. This was found to be equivalent to an average rate of 6.64 cents per kilowatt hour. The system may be modified to suit local conditions; thus the higher rate may be applied to less or more than one hour's daily use, and again this quantity may vary according to season. The Chicago Edison Co., who use this system, charge for fifteen hours' use of the maximum demand per month in summer at one cent per lamp hour. For the six winter months the rate is applied to forty-five hours' use per month. Additional consumption is charged at half rates. The Edison Electric Illuminating Co., of Boston, make the hours' use to be charged at the one cent rate vary from month to month. The hours are ten in July to fifty in January.

Whatever may be said against the Wright system, there is no doubt that the use of it or some other differential system would enable us to better compete with gas in the case of such long hour consumers as drug stores, hotels, etc. The demand indicator will not record demands lasting less than fifteen minutes, but a consumer may require an unusual number of lights on some special occasions, and he is unwilling to have his bill increased by an amount out of reasonable proportion to the privilege required. In cases like that, experience has shown that it is necessary to read the indicator before and re-set it after this unusual demand, and to take no account in the bill of this special maximum. This proceeding in a large city would involve considerable expense and trouble and complicate the system somewhat. When the indicator has been read and re-set there is no record left of the indication except in the company's books, which may lead to disputes with consumers difficult to adjust.

A device intended to combine with an ordinary recording meter the advantages of a demand indicator has been put on the market by Edward Halsey, of Chicago. It can be applied, it is said, to any meter using magnetic drag as a retarding device. The armature shaft is divided horizontally in two parts and they are connected by a ratchet coupling. The upper part carrying the armature has a pointer rigidly attached to it, and the lower part carries the copper retarding disk, which is graduated. The pointer normally stands at zero over the copper disk. The operation is as follows: As the demand increases the speed of the shaft and the magnetic drag also increase. The lower part of the shaft lags behind the upper part by an angle dependent on the torque or the energy passing through the meter, the ratchet coupling maintains the angle between the parts when the current is afterwards reduced, and the position of the pointer over the copper disk may be read as the maximum demand. Another method of charging, probably ante-dating the Wright system, and aiming at the same results, consists in charging the higher rate on the first hour, more or less, of daily use of all the lights installed. While this method removes the necessity of the extra meter or indicator it is open to several objections. It puts a large burden of charge on the short hour consumer and discourages the installation of lights, with the probable effect that the consumer will install electric lights where the daily use of them will warrant this proceeding and employ gas or some other illuminant for the lights that are seldom used. While this may cause no direct loss to the supply company, it is not conducive to the popularity of electric lighting, which would be considered somewhat of a luxury. It is not as equitable as the Wright system, inasmuch as our fixed charges are not governed by the total installation as much as by the maximum demand, and two consumers with equal installations may show great differences as to their maximum demands on the station. The system for instance does not discriminate between a consumer using say thirty lights (all his lights), one hour and another using ten out of his thirty lights three hours. Residence lighting, which should be specially encouraged, would be discouraged by this system. The expense and difficulty of ascertaining the number and candle-power of the lights installed would be considerable. Constant checking would be required, involving frequent domiciliary visits by the inspector, and there would always be uncertainty as to data so obtained.

Still another variation of differential rates is found in the use of the two-rate meter of the General Electric Company. This meter has two sets of registering dials, and the armature is connected by a clutch to one or the other, at any predetermined time, by the agency of a clock contained in the meter and automatically wound up by the current. Thus, the left hand dials for instance will record the consumption taking place during the few hours of station peak, which will be charged at the higher rate, and the left hand dials will record the consumption at all other times, which will be entitled to the lower rate. This system does not discriminate against the short hour consumer to the same extent as the two systems previously described; he is only charged the higher rate for such use as coincides with the station peak, and only to the actual amount of such use from day to day, and in its tendency to straighten out the station's load curve it is the equal of the other systems. Those short hour consumers, whose local peak never coincides with the station peak, would, under this system, get a lower rate, which is no doubt quite just. The two rate meter does not need re-setting and preserves its record so that errors in reading may be rectified at any time. The meter costs about $25 more than the ordinary recording meter. There is a class of consumers that are undesirable under any system of meter charges. I refer to the very small consumers, who use less than $10 per year, and while an electric supply company may not refuse any business without inviting public criticism, there should be a minimum charge of $10 and upwards per year for each customer. In some cases the minimum is made large enough to cover the fixed charges, or

a large percentage of them, and a very small meter rate is charged in addition. This is a sort of compromise between the flat and meter rates, and should be a popular plan for certain classes of customers. It offers to the consumer the advantage of knowing practically the amount he will have to pay, and equalizes the winter and summer charges, and the small meter rate will prevent useless burning of lights. It is not a system suitable for general application,but it may well serve, however, as a transition from the flat to the meter rate, and might be tried with advantage by those charging flat rates exclusively.

There is so much to be said for and against the various systems which have been proposed, that supply companies still charging a single meter rate find themselves face to face with a very difficult problem With so many things to choose from, it is perhaps a case of "how happy could I be with either," or they hesitate to make a change which may cause them temporary loss of revenue The single rate certainly has the advantage of simplicity, and is thoroughly understood by consumers, but so long as it will be used, so long will it be necessary to make special contracts of all kinds, and the flat rate will continue to flourish with more or less vigor. In conclusion, it should be said that meters and meter rates is too broad a subject to be treated satisfactorily within the limits of a convention paper If the two topics had been separated, and each formed the title of a separate paper, the results would no doubt be of greater value to the members of this association.

AN EXHIBITION OF AXES AND SAWS.

A test of axes and saws is to be held in Ulverston, a small town in Tasmania, under the auspices of the United Australian Axemen's Association, November 30th.

British makers have for some time complained of the preference shown for United States saws and axes, so it has been decided, at the gathering this year of sawyers and axemen of Australia, to hold a contest, open to all British and American, and possibly Swedish and German saws and axes, and to all Australasian sawyers and axemen. The committee in charge of the trial will include Hon. Sir Edward Braddon, Prime Minister of Tasmania, and other gentlemen of standing. This should prove a valuable opportunity for opening up an export trade in Canadian products, if they are of as good quality as we believe them to be.

A CANADIAN ENGINEER ABROAD.

Lord Salisbury was the principal speaker at the forty-first annual dinner of the Railway Benevolent Institution, held at the White Hall Rooms in the Hotel Metropole, London, on May 17th. In proposing the toast of the evening, His Lordship made reference to the construction of the railway in the Soudan, and incidentally paid a very marked compliment to Lieutenant Girouard, of the Royal Engineers. Lord Salisbury spoke as follows:

"In the Foreign Office they were particularly employed in considering what influence railways had on the destiny of nations. By a tremendous effort of railway creation, they had recently conquered Egypt. No doubt the Sirdar wielded many weapons, and no weapon less surely than that of his own splendid intelligence and skill, but if we went out of that and asked what material weapons he wielded, we should say that the Sirdar won by the railway, and the railway alone—that railway also which he built at the rate of about two miles a day from Korosko almost now to Khartoum. That railway enabled him to succeed, where a far larger force, with greater support, failed. He could imagine nothing more likely to satisfy the dreams of any railway engineer than to think of what the Sirdar had done in this case. Think of building a railway at the rate of two miles per day, across a country where there are no tunnels, where there are hardly any gradings and no embankments, and where they had an unlimited command of labor, and no difficulties about money. Above all, where they had the use of the splendid skill of Lieutenant Girouard, a lieutenant of French extraction in Canada, who was now the Railway Commissioner in Egypt. His wonderful skill enabled the Sirdar to complete this railway with a rapidity and exactitude that contributed in no small degree to the splendid success which his chief accomplished."

Lieutenant Girouard is a son of Justice Girouard, of the Superior Court, Ottawa.

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

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

(Concluded from last issue).

Various methods were adopted for excavating and replacing the earth. On one sewer of 20 feet cut staging was first tried alone, and afterwards cars were added to carry the material back along a line of rails laid by the trench, and dump into the same. These cars were moved back by men pushing them.

On two sections a machine (built by the contractor) was used for lifting and backfilling. A line of trestle work was made to straddle the trench for about 200 feet, and the whole arranged to move forward on a track as required. In the upper part of the trestles two longitudinal beams were fastened close to each other to form a tramway for a small carriage to run on. As each bucket was filled in the trench, it was lifted by the cable to the carriage, and hauled back along the line by a wire rope passing round a wheel at the rear end of the trestle, and over the framework to the engine stationed about 50 feet in advance of the other end of the same. After dumping, the bucket was returned to be refilled. The buckets were made oblong, about 3 feet by 1 foot 6 inches by 2 feet. The machine worked successfully. Horse derricks (as they are called) were used on several deep sections. These consisted each of a tripod (made to stand over the trench) having a pulley at the top and a wheel at the bottom of one of the legs, through which a one or one and a quarter inch rope passed. One end of the rope was fastened to a ring with three chains—two of which had a ring at the other end and the third one a hook. In operating, the chains were fastened to the loaded wheelbarrow in the trench by slipping the rings over the handles and the hook through the wheel, and hauling the load up by a horse at the other end of the rope. This method was used on section "J," where the depth averaged 29 feet for a length of 2,900 feet, and gave fair satisfaction. One contractor operated a system of hoisting buckets by an engine with four drums, then shoving them back by hand and dumping.

On the north sections L., M., N., O., the material was (and is being) excavated and filled into water-tight steel buckets (holding about 10 cubic feet each), which were then hoisted by means of a derrick set on a car, and run back and dumped—the hoisting engine supplying also the motive power to run the truck back and forward. This machine has proved to be a very convenient one.

To give some idea of the cost of moving earth, a table has been prepared and placed at the end of the paper giving the probable cost to contractors by various methods. The cost of excavation includes all timbering work, backfilling, wear on apparatus, etc., and in case of tile sewers the labor of laying tile. It would obviously be unfair to make the figures given in the table a basis for close comparison of cost of work by various methods as so many other and unknown quantities enter into the problem, such as the difference in foremen—their ability to handle men, etc.—quantity of lumber left in, etc. Some figures are here given showing approximate cost of taking out clay on deep section by the use of horse derricks described before. First six feet was thrown out by hand (add this to the depth given for total depth of sewer).

Depth.	No. of Derricks.	Horses.	Men.	Approx. cost per cubic yd.	Materials.
17 ft 2 in.	4	2 2-3	14	58c.	Dry hard clay.
17 ft. 6 in.	3	2	10½	58c.	Dry hard clay.
19 ft. 6 in.	5	3 1-3	17½	82.7c.	Clay with water.
21 ft. 0 in.	4	2 2-3	14	86.2c.	Hard clay with water coming down sides.
23 ft. 6 in.	8	5 1-3	28	56c.	Upper half free working sand, lower half hard dry clay.
29 ft. 6 in.	4	2 2-3	14	39.2c.	Dry hard clay.

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

Water mains where intersected, were protected from sagging by timbers brought up from the arch, or occasionally by building brick piers under them. Tile sewers crossing above the work were usually supported by building two parallel brick walls to the haunches of the pipe and packing between with concrete.

To reach the sewage farm a long stretch of low lands had to be crossed. These low lands have at some former period been the bed of the river which coming through what is now the west part of London West, must have swept for about a mile straight south of the present channel, and then bending sharply to the west returned to its present position within a few hundred yards of its point of deviation. Some of the old channels are still below the river level, consequently standing full of water, and are known as the East and West Coves, and at the point where the sewer is built, there is some 500 feet of higher land separating them. The West Cove is connected with the river. This low land being from 2 to 16 feet below the grade line of the sewer, it was decided (after considerable opposition from the ratepayers) to lay an inverted syphon, and in order to make the most of the ordinary dry weather flow, the size was reduced to 20 inches in diameter, the intention being to lay an additional 24-inch pipe when required, and thus bring the total capacity eventually to that of a 30-inch pipe, which it was originally intended to lay at once. The object is of course to have as great a present velocity as possible. Cast-iron pipes were used specified to weigh at least 1,620 lbs. per 12-ft. length. They were laid in the same manner as water pipes. The descending leg of the syphon is a brick well 10 feet in diameter and 13 feet deep below grade, connecting with the pipe by a 20-inch gate valve. From this well a 16-inch pipe leads to a relief sewer running to the river—a separate connection being made also with this relief from the upper grade. These are for purposes of overflow for storm-water, and for diverting flow when necessary to examine the syphon. Over this syphon well a house will be built to cover valve gear, etc., and to allow the sediment and coarse screening to be removed easily. The ascending leg is not now being built, but it is intended to make it a 20-inch pipe. From its foot a 20-inch pipe is laid to the river, and at present the whole flow will be discharged there. The syphon crosses the East Cove by a 20-inch steel pipe 300 feet long laid on cedar cribs 6 feet by 8 feet (50 feet apart) sunk to hard bottom and filled with stone The steel pipes are fastened to these by iron straps passing over the top and bottom to ¾-inch rods in the timbers. Across the West Cove for a length of about 300 feet, oak piles were driven in pairs well braced and capped with timber cut to the shape of the sewer, while for the water-way a culvert was formed by two concrete walls made wide enough for a roadway as well. Manholes were left at intervals of about 600 feet, there being a special casting in each, closed with a cover bolted down. The length of the syphon is 3,200 feet, and the maximum head will be about 22 feet. The syphon pipe is laid on a 1-500 grade.

SAND FILTRATION OF PUBLIC WATER SUPPLIES.*

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

(Continued from last issue).

Bacteria belong to the lowest and smallest forms of life. Structurally they are composed of a single cell with a wall, possibly of cellulose, and contents consisting of apparently structureless protoplasm and a nucleus; and are thus comparable to the bone, blood, nerve cells, etc., which represent the ultimate structural composition of the animal body. They are of such extreme minuteness as to be visible only to high powers of the microscope. In their greatest dimensions they vary from 1-10 to 2 micro-millimetres (from 1-250.000 to 1-12,000 of an inch). A sphere 1-25 of an inch in diameter could contain more than 500 millions of the larger ones, and it would take a thousand of them placed in a row to reach across the diameter; so that it is little wonder that their presence was, until a few years ago, scarcely suspected. They are generally transparent, but may be stained for purposes of study by some of the aniline dyes. It was at first doubtful whether they should be classified as plants or animals; but it is now definitely decided that they are plants. Some of them have the power of motion, which appears to be by means of little hair-like appendages or cilia. They reproduce by fission—a simple process by which a single bacterium divides itself in the middle, thus producing two. Under favorable conditions this multiplication can go on with incredible rapidity. They comprise a great number of species with definite characteristics and requirements for growth, etc. All these species are included in the general term bacterium, or microbe, or germ. They may be classified in various ways depending upon their form, the nature of their environment, the products of their action, etc. According to its form a germ may belong to: 1. The micrococci, or ball shaped. 2. The bacilli, or rod shaped. 3. The spirilla, or spiral shaped.

They occur usually as separate individuals, but may also occur in pairs, tetrads, or in a row like a chain. Besides these forms they are often found under certain circumstances in irregular groups or masses, held together by a transparent glutinous material which they secrete through their cell walls. These sticky, jelly-like masses are termed zoogloea. Unlike the algae and other green plants they cannot exist upon purely inorganic matter, but require for their nourishment matter already organized in some form. Moisture is also a necessity to their proper growth; and thus according to their habitat or preferred environment they are classified as: 1. Saprophytes, living on dead animal or vegetable matter, or on water containing these in solution. 2. Parasites, subsisting on a living host, in the body of which they grow and multiply, in some cases without any injurious effect, but in others causing disease and death. It is not known whether these results are produced by their action in obtaining their food or by the products which are thus set free. These injurious members of the parasitic class are the so-called pathogenic or disease-producing bacteria; such as the well-known germs of typhoid and cholera. Some species of bacteria are able to exist either as saprophytes or parasites, and are called facultative.

Another classification depends upon their ability to live in the presence or absence of oxygen, e.g.: 1. Aerobic, requiring the presence of oxygen. 2. Anaerobic, unable to exist in the presence of this gas. Facultative anaerobics can live either with or without oxygen. There are various other ways of classifying them which are of no special interest in this connection. The most important classification, from our point of view, is that which divides them into parasites and saprophytes. The great majority of bacteria belong to the latter class, and depend for their nourishment entirely upon lifeless animal or vegetable material. Their energies are thus devoted to the task of attacking dead and decaying organic matter, tearing it apart (in the chemical sense), breaking up its complex combinations, and ultimately reducing it to unobjectionable inorganic compounds. This is accomplished in many different ways, depending upon the attendant circumstances and the species of the dominating germ. But the final result is the same. All these destructive processes in the history of organic matter, which have been previously referred to, were formerly considered to be purely chemical; but it is now known that if the bacteria are absent or in any way rendered inactive, no decomposition of any kind can take place even in air. Hence, it is evident that the role they play in nature is, for the most part, a beneficent one. They are the universal scavengers, and but for them all organic growth would in time be overwhelmed by its own waste. There are, however, also the pathogenic members of the parasitic class, which, though few in number when compared with the others, are yet possessed of the same capacity for multiplication when the conditions are favorable. But while the absence of such conditions will arrest their growth and development it does not necessarily cause their death. For instance, the temperature most suitable to the typhoid germ is that of the human body, which is its natural habitat; yet, it can exist for months in the middle of a block of ice, and then continue its normal career with undiminished energy and virulence. Hence of the different kinds of water pollution, human sewage is the most to be feared, since it is at any time liable to contain such germs; and the method which can best ensure their removal is evidently the one best suited for domestic purification.

With the adoption of bacterial purity as a standard for water purification, it is no wonder that it was anticipated that the sand filter would prove even of less hygienic value than it did from the chemical point of view. Thus in a paper read

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

before the Institute of Civil Engineers about this time the following statement occurs: "Filtration is another remedy put forward as infallible by those who have not grasped the subject. How can filtration affect substances dissolved in water? And as for the minute organisms found in putrescent bodies, they could pass a hundred or a thousand abreast through the interstitial spaces of ordinary sand as used for this purpose." Nevertheless, as experiments and tests multiplied, it soon became evident that these same clumsy contrivances were actually removing from 97 to 98 per cent. of all the germs contained in the water. Not only this, but continued study and experiment since then have resulted in such changes in the methods of building and operating these filters, that they can now be depended upon to remove from 99 to 100 per cent. of the bacteria, and although numerous other devices for filtering have been invented and tried, so far none have been shown to be equal in efficiency to the sand filter. Thus did these earlier engineers build better than they knew, and produce results whose excellence they did not even suspect. Investigation into the manner in which it was possible for a comparatively porous material like the sand bed to hold back such infinitesimal bodies as the bacteria revealed a paradoxical condition of affairs, viz., that these germs, while constituting the most dangerous element in the pollution of drinking water, were at the same time the chief agents in its purification. It was found that the purifying action was partly mechanical and partly biological, the circumstances attending the latter not being very well understood. The manner in which it takes place and the means by which it may be enhanced, will be referred to while describing the construction and operation of a modern filtration plant.

In describing the materials of the bed and the best method of disposing them, we shall begin with the sand. It is in the sand layer that the actual purification takes place; and it is observed that the efficiency and economy of the process are dependent to a considerable extent upon the size of the sand grains and the thickness of the bed. It is the smaller grains which determine the "effective size" of a sample of sand; since, by filling up the spaces between the larger ones they fix the diameter and length of the channels through which the water must pass. At Lawrence, as the result of experimenting on the rate at which water flows through various sizes of sand, the "effective size" is taken as that of the grain which has 10 per cent. by weight of the smaller sample than itself and 90 per cent. larger. This size is obtained by a process of mechanical analysis described in the report for 1892, which also gives what is termed the "uniformity co-efficient," the latter being the ratio of the size of the grain which has 60 per cent. smaller than itself to the "effective size." If we look more closely into the purifying action of the sand, in order to be able to understand just how it is affected by difference in the "effective size," "uniformity co-efficient," thickness of the bed, etc., we shall see that what takes place is as follows:

When water is first let in to the filter, it rises to a depth of 3 or 4 feet above the surface of the bed; and it is either held there for some hours, or filtration is allowed to proceed at once, the first part of the effluent being wasted. In either case, the sand grains at the surface soon become enveloped in a membranous film composed partly of the zoogloea form of the bacteria, and partly of the more or less finely divided organic matter which the water holds in suspension. This sticky jelly-like substance, extending around and between the sand grains, entangles and holds back the smallest particles in the water, even the bacteria themselves. The latter are not only prevented from moving further, but are detained under such adverse circumstances as to not only arrest their growth and multiplication, but also to cause their death. Naturally the larger suspended particles, water animalculae, fragments of plants, etc., are stopped at the very surface of the sand and a continuous mantle called by the Germans the Schmutzdecke is soon formed and covers the whole bed. Under certain circumstances, as for example when the water contains a large algae growth, this layer forms a dark greenish carpet of a texture like felt, which when dry can be peeled off in flakes. Ordinarily, however, since it contains a certain quantity of silty matter, it penetrates the sand for a depth of half an inch or so. But even when formed in this way there is often almost a distinct plane of cleavage between it and the sand below, which makes it very easy to remove with broad square-cornered shovels. This operation becomes necessary when the gradual thickening of the surface layer prevents the required quantity of water from passing.

It will thus be seen that the surface film forms by itself an exceedingly effective filtering material, but with a very delicate structure; and as such, should be carefully guarded against any influence which might cause its fracture. Several European engineers have concluded that it alone constitutes the actual filtering medium; and that the remainder of the sand bed serves merely for its support, and for steadying the flow of the water through the bed. But experiments made at the Lawrence Station do not by any means verify this view. Indeed they have shown that if great care is taken not to disturb the underlying sand, almost the whole of the surface layer may be removed without at all affecting the bacterial character of the effluent. It is also shown that a new filter does not arrive at what is called its "full bacterial efficiency" until it has been in use for a considerable time; even though in the meantime surface layers may have been formed of sufficient thickness as to completely clog the filters. By examining the sand, it has been found that this sub-surface purification only occurs when the sand grains for a considerable depth below the surface have become coated with a film of the gelatinous organic material referred to above. It has also been shown that if, during scraping, the bed is subjected to any considerable mechanical disturbances, as by spading, by which these envelopes are broken and detached, the result is a decided inferiority in the quality of the effluent. It is a well known fact, that the longer sand is in use the greater is its efficiency for filtering purposes.

All these considerations go to show that while undoubtedly most of the purification takes place in the surface layer, it is not absolutely essential. The facts stated are chiefly of importance in so far as they indicate the true principles upon which the process of filtration depends. They should by no means tend to lessen the care which ought always to be exercised to preserve the surface layer intact. The purifying power of the main body of the sand should be considered as a factor of safety, and as an additional guarantee of good results. As to the influence of the size of the sand, it may be stated generally that the "uniformity co-efficient" should be as low as possible. Also that the smaller the "effective size" the more efficient is the filtration, the less liability is there to disturbing effects, and the sooner does the sand arrive at its full bacterial efficiency. At the same time it must be operated at a lower rate, becomes clogged more easily, and thus requires more frequent scraping. The latter performance, together with the periodic renewal of the sand, will form the principal part of the expense of operation. There is thus a minimum limit beyond which it would be uneconomical as well as unnecessary to go. The best size, taking everything into consideration, will evidently depend to a considerable extent on the quality of the water and other local circumstances. The "effective size" of the sand used in the principal European filters varies, according to Allen Hazen, from .20 to .44 millimetres; and the "uniformity co-efficient" from 1.5 to about 3.7.

As to the proper depth of the sand layer, there is even now considerable difference of opinion among engineers. The great variations in the depths of the sand in the older filters, are not surprising, considering the fact that when the most of them were built nothing was known of their biological action. If we adopt the view, that it is only the surface film which filters, the determination of the best thickness becomes merely a matter of comparing the extra operating expense due to the more frequent renewals of a thin bed, with the corresponding saving in first cost. In most of the European filters the renewal does not take place till the thickness of the bed has been reduced to from 12 to 24 inches. The former is the limit imposed by the Imperial Board of Health of Germany. It would seem to be better practice to require a minimum depth of from 2 to 3 feet, in order to have at all times the benefit of the steadying effect produced by depth of bed. Besides this there is the additional advantage of having a deep permanent layer, which is never disturbed, and which, therefore, causes the filter to increase instead of decrease in efficiency as it grows older.

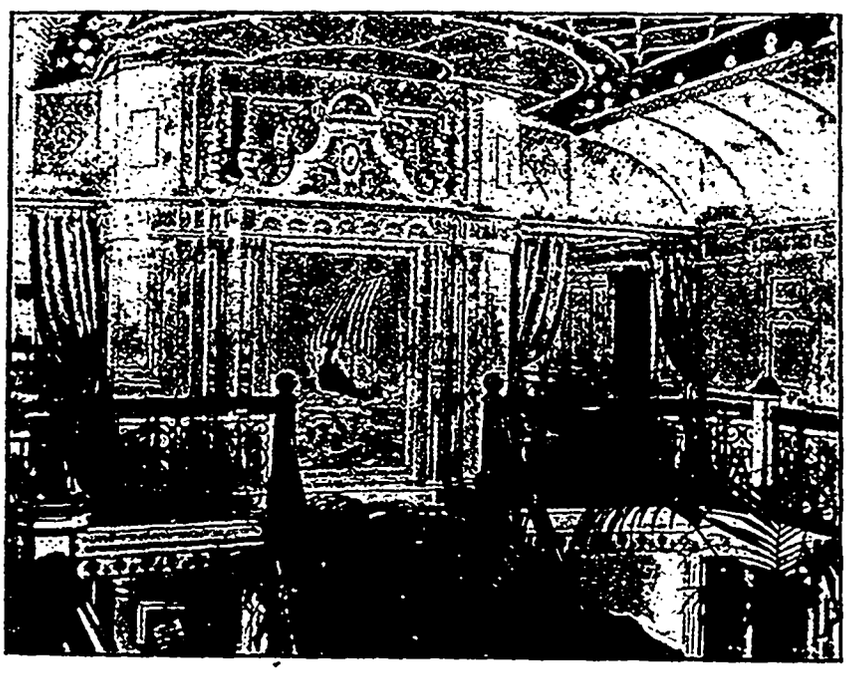
(To be continued).

The by-law to issue debentures for $120,000 for the purchase of the waterworks was defeated in Stratford, Ont.

THE R. & O. COMPANY'S ADVANCE.

The completion of the Richelieu and Ontario Navigation Company's new steamer "Toronto" marks a new era in steamship traffic on Lake Ontario. In placing on this route a boat the superior of anything heretofore seen on Lake Ontario, and the equal in equipment, if not in size, of anything floating on any of the inland waters of this continent, the company has shown its desire to meet all the demands of the modern tourist. The great lake and river route for summer travel increases in popularity with time, and with such steamers as the "Toronto," its attractions will be still greater in years to come. As some account of the "Toronto" was given at the time of her launching last year it will only be necessary to repeat her dimensions, which are: Length over all, 278 feet, length of keel, 270 feet; beam, 36 feet; beam over guards, 63 feet; depth, 8 feet draught, and 6 feet out of water. Her engines are of the inclined triple-expansion three-crank type, with cylinders 28 in., 44 in. and 74 in., and a stroke of 6 feet. They are 2,000 horsepower and are guaranteed to make a speed of 17 miles per hour, though 19 miles was made on the trial trip. There are four boilers of the return tubular type, 11 ft. diameter by 11 ft. 6 in. in length. Each boiler has a 41½ in. Morrison suspension furnace fitted with hot blast system. The electric lighting is done by two 350 light multipolar dynamos, each driven by a separate engine. The steamer has 136 state rooms, and has sleeping accommodation for 365 persons.

The features of the "Toronto" most deserving of special mention at this time are the interior fittings and decorations which have been designed and carried out by Bond & Smith, a young firm of Toronto architects, whose work has been noticed in The Canadian Engineer on previous occasions. It is safe to say that the interior work in the "Toronto," has made the reputation of this firm as architectural designers. The entrance hall of the main deck, extending the whole width of the vessel, is in the Grecian style, in red mahogany, and the striking feature of this is a number of frieze panels in old ivory, illustrative of events in Canadian history, such as "Hiawatha advocating the league of the Iroquois." "Frontenac's arrival at Kingston." "Portaging at Lachine," "Trading with the Indians at Fort Rouille (Toronto)." The treatment of these panels is highly artistic and the faces and habiliments of the Indians are much truer to nature than is usually found in such work. The furniture here is in quarter cut oak, Flemish style, with green leather. The main saloon and gallery of the upper deck are in the style of Francis I., with wall and ceiling in cream and ivory finish, the furniture being in white mahogany with crimson plush. The electric lights here are ranged in lines corresponding to the outlines of the boat, while the ceiling decorations are attractive without being heavy or elaborate. With the instinct of an artist Mr. Bond has taken advantage of the position of the bulkhead to insert a decorative panel by F. S. Challoner, R.C.A., representing a Viking ship. This panel is set in elaborately carved pilasters and pediment, which has quite an imposing effect when viewed from the foot of the gangway. A view of this piece is given herewith. The dining saloon, which is on the upper deck, is in the style of Louis XVI., with walls and ceiling in cream enamel, furniture in red mahogany with brown leather upholstering, window draperies in rich old gold and cream brocade. Over the pantry, which forms the inner wall of the dining saloon, is a series of historical friezes in ivory finish, representing different types of ancient ships. The smoking room is in Mooresque style, the woodwork and furniture being in chestnut stained green, with stencilings on the walls, and stained-glass windows of oriental design. Adjoining this on one side is the correspondence room for readers and writers, and on the other side the bar, both being finished in white mahogany in Elizabethan style. There are wash rooms, closets and barber shops all fitted up in most modern style. To the well-to-do tourist the most interesting feature of the staterooms, are four special rooms on either side amidships, known as the blue room, the pink room, the green room and the yellow room. These are finished in the style of Louis XV., and the decorations, even to the bedding appointments, are in the tints that give the name to the respective rooms. These are for bridal parties and those who can afford to pay for special luxuries. On the upper deck are ladies' lavatories and bath-rooms. It should be mentioned that the furniture, as well as the interior decorations, were designed by Bond & Smith, and fortunately for the result, these gentlemen were allowed a free hand in carrying out their ideas. The work was under the personal supervision of Mr. Bond. A pleasing feature of the boat, from the tourist's point of view, is that on the top of the hurricane deck is a spacious promenade, free from obstruction, where the passenger, in fine weather, may view the scenery from a height of 35 feet above the surface of the water.



AFT END OF MAIN SALOON, STEAMER "TORONTO."

Charles F. Gildersleeve, who has guided the affairs of the Richelieu and Ontario Navigation Co. as general manager since 1894, is a man exactly fitted both by temperament and taste for the position he was called to fill, and as this brief time has shown, it was a lucky star that presided over the company when the appointment was made. Courteous to outsiders, modest to a degree in his dealings with his fellow officers, and considerate to those beneath him, he is liked by all; but he might still have been the failure that some of his predecessors were if he had not possessed in the marked degree he does the

faculty for administration, and a wide knowledge of ships. The last named qualities may be said to have been both inherited and acquired, for his father, Henry Gildersleeve, a ship-builder from the Connecticut River, near Hartford, was the pioneer steamboat builder of Lake Ontario, and a very successful vessel owner. Mr. Gildersleeve, who settled in Kingston at the beginning of this century, took hold of the half built "Frontenac" and finished and launched her as the first steamer on Lake Ontario. He also built another steamboat, the "Charlotte," about 1817, which plied between Prescott and the Carrying Place. He also built the "Sir James Kempt," the "Prince of Wales" and the "Henry Gildersleeve," all boats prominent in the history of early navigation on Lake Ontario. Still another of his boats,

CHARLES F. GILDERSLEEVE.

the "Commodore Barrie," was run into by a schooner in the middle of the lake and was never heard of after. The elder son continued to run the boats till his death in 1864, when the subject of this sketch succeeded to the business with which he had been familiar from childhood. Though having a natural taste for ships Mr. Gildersleeve had been intended for the law and had passed his examinations, and actually practiced for some time, when the death of his brother brought him back to his favorite field. Mr. Gildersleeve's practical knowledge and good judgment began to tell on the financial aspect of the company's affairs from the first year he took hold. Without making any revolutionary demands he set to work overhauling each one of the company's 26 boats, putting in a new boiler in this one, compounding the engines of that one, lightening another by removing useless equipment, increasing the carrying capacity of still another, in each case reducing the cost of running or adding to the earning power of the boat. This work, carried out step by step, and without bluster, has in the short space of four years lessened the expenses of the company by $50,000 per year, and yet increased the volume of its business. Mr. Gildersleeve has kept up with the times by studying the developments of marine engineering, and has known how to apply the knowledge he has gained. To bring such knowledge to bear in an emergency is specially important, and the directors have seen more than once how essential it is to have its affairs directed by a man of cool, clear head when an accident occurs. For instance, when the "Magnet" ran on the Split Rock a couple of years ago, Mr. Gildersleeve was on hand on the day of the accident—which was a Wednesday—and before the end of the week she was got off with such slight damage that she was repaired and running, and only lost one trip. A similar accident at the same spot under a former regime resulted in a heavy loss in money and time. The placing on Lake Ontario of a palace steamer like the "Toronto" is the latest monument to the foresight and ability of the present general manager of the R. & O. Co.

Captain Henry Esford, master and pilot last season of the steamer "Corsican," one of the Richelieu and Ontario Navigation Company's fleet, plying between Montreal and Toronto, is a young man whose ability and carefulness have raised him to the responsible position of captain of the "Toronto." He was born on November 17th, 1855, in Barriefield, near Kingston, Ont. His father being Thos. Esford, blacksmith, of Barriefield. Captain Esford received his education in the public schools of Barriefield, and when he was 16 years old he began an apprenticeship to a cordwainer in Kingston. He abandoned it in a few months and went sailing in 1872 when he was 17 years of age. The first boat in which he sailed was the steamer "Spartan," belonging to the Richelieu and Ontario Navigation Co. For thirteen years Capt. Esford remained with the "Spartan," and had advanced to the position of mate. He left her, and in 1885 became mate on the Richelieu and Ontario Navigation Company's steamer "Magnet," running between Charlotte, N.Y., and Prescott, Ont., on the St. Lawrence river, for two years. During this period he had become particularly familiar with the channels in the St. Lawrence river and rapids, and became one of the best pilots on the river. In 1888 he took the position of pilot on the steamer "Passport," and remained with her about five years, when he was changed on to the "Spartan" as mate and pilot. He sailed the "Spartan" for one season, and then took charge of the "Corsican," in which vessel he has been ever since. During the first two years on the "Corsican" he was master and after that became both captain and master. Captain Esford is also his own pilot in the rapids of the St. Lawrence river. That he is a valued navigator is evidenced by the fact that he has been in the employ of the R. & O. Nav. Co. for 24 years. One of the most exciting episodes in the history of Captain Esford was the burning of the R. & O. steamer "Corinthian," which happened down in the St. Lawrence river in the Coteau Rapids, in 1893. There were ninety passengers on board and a large quantity of baggage when the fire broke out. Whilst a vessel is running the rapids every man of the crew on board is required to

CAPTAIN HENRY ESFORD.

handle the boat, and at that time there were four men at the tiller, four men at the wheel, and others were trimming the baggage, so that there was no person left aft when the fire broke out in the dining-room. It is supposed that the fire originated through a lamp exploding on the carving stand. The captain ordered the vessel beached; by the time this was done he had four life boats swung ready to lower into the water. Gang planks were laid from the ship to the boats, and from the boats to the shore, and all the passengers and baggage were safely landed. Rapid work was done, for in fifteen minutes after the fire was discovered the vessel was completely devoured by the flames. The captain received great praise from the company, as well as from the passengers, for his energy and presence of mind on this occasion.

Wm. A. Black, chief engineer of the new steamer "Toronto," was born at Beauharnois, Que., in 1843, and served his apprenticeship as a machinist in the St. Lawrence Engine works, owned by W. P. Bartley & Co. On fulfilling his indentures he went to work for the Canada Engine Works (E. E. Gilbert), first at shop work and afterwards as erecter. He

began his marine career as second engineer of the old "Passport," under Capt. Sinclair. From this boat he went as second engineer of the "Athenian" for a year, and in the following year was chief engineer of the propeller "Bruno" running between Montreal, Detroit and Toledo. After a couple of years with the Gilberts he returned to the "Passport," this time as chief engineer. After two years in this position he was transferred to the "Corsican," and then took to the ocean as engi-

WM. A. BLACK.

neer of one of the steamers running between New York and the West Indies. Returning to Canada he took charge of the engines in the Montreal Rolling Mills, but shop confinement did not agree with him and he came back to the R. & O. Co.'s service as engineer of the steamer "Hamilton." While the new steamer "Toronto" was being built he was appointed inspecting engineer on behalf of the R. & O. Co., and in that position rendered valuable service to his employers by foreseeing errors and providing against defects. Mr. Black's care and caution has been rewarded by his appointment as chief engineer of the company's premier boat.

Industrial Notes.

The Gurney Foundry Co., Toronto, is about to enlarge its premises on King street west.

The new pulp mill at the Cushing mills, Union Point, near St. John, N.B., is now building.

Dwelling houses to the value of $100.000 were built in the town of Fort William last year.

C. James is to build a large machine shop at the corner of King William and Mary streets, Hamilton, Ont.

The Hudson Bay Co., Winnipeg, has ordered a 100 h.p. boiler from the Robb Engineering Co., Amherst, N.S.

The municipality of Montreal West has decided to pay $60,000 for the ownership of the sewage system of the suburb.

W. W. Chown & Co., Belleville, Ont., have recently built a new tinware factory, and are now employing about sixty hands.

The Model gas engine made by the Goldie, McCulloch Co., ltd., Galt, Ont., is proving very popular; before June 1st sixty engines had been shipped.

The officers of the Berlin Rubber Mnfg. Co. are: President, Jacob Kaufman; secretary-treasurer, Albert L. Breithaupt; manager, George Schlee.

Willis Chipman, C.E., has advised for London, Ont., an intermittent filtration plant, costing $28,000 for equipment, and $200 a year for maintenance.

Geo. Wilson, Kingston, Ont., has the contract for building the addition to the Dominion Cotton Mills Co.'s mill in Kingston, Ont., to cost about $100,000.

Willis Chipman, C.E., has been engaged by the Smith's Falls, Ont., town council to prepare plans for a system of waterworks, sewerage and street improvement.

Brantford, Ont., waterworks will buy a 5,000,000 gallon pump at once.

Moulders in Kingston, Ont., have received an advance of 30 cents per day.

Hunter Bros., Kincardine, Ont., are to build a steel bridge at Florence, Ont., costing $727.

E. F. Valiquet is now master mechanic with the Beaver Portland Cement Co., Maulbank, Ont.

W. A. Kribs, Hespeler, Ont., is building the Preston, Ont., Furniture Co.'s new three-story brick factory.

The Westinghouse Air Brake Co. is building a very complete brass foundry in Hamilton, Ont.

The Goldie, McCulloch Co., Ltd., Galt, Ont., has granted a 5 per cent. raise all round to its employees.

The Lancaster, Ont., Machine and Knife Works, which was destroyed by fire some months ago, has started again.

Welland, Ont., will spend $21,000 on street improvements, $2,000 on a town hall and $11,000 on a new school building.

The Maritime Clay Works is said to have received an order for 6,000,000 bricks for the new iron company at Sydney, C.B.

The Hamilton, Ont., Car Wheel Company has increased the wages of its employees unasked. The advance is 36c. and 54c. a day.

John and W. F. Cowan, Oshawa, Ont., have offered Ontario County $5,000 cash and 45 acres of land to build a House of Refuge in Oshawa.

M. S. Foley, Montreal, will build an apartment house eight stories high at the corner of Dominion square and Metcalfe street to cost $80,000.

Architect Powell, of Stratford, is preparing plans for a new Roman Catholic Church at Comber, Ont., to cost $10,000. It will be built this fall.

Henry Sheldon of the Aylmer, Ont., Iron Works, is said to be negotiating for the purchase of the right of manufacture of a motor carriage in Canada.

Steel bridges at Fergus and Bosworth, Ont., are to be built at once. Fergus, Hunter Bros., Kincardine, $1,881; Bosworth, Hamilton Bridge Co., $1,350.

The sewage farm for St. Denis Ward, Montreal, is now in progress. Coke filters will be used to treat the sewage before it is discharged on to the land.

The laborers employed in handling material for the Hamilton, Ont., Blast Furnace Co. struck recently on account of disagreement with a sub-contractor.

Leaper Bros., Hawkesville, Ont., are sinking artesian wells for the Waterloo, Ont., water supply. Contracts will be let in a short time for a complete pumping plant.

The contract for rebuilding St. John's church, Brockville, Ont., has been awarded to Mr. J. D. Warwick at $6,200. The old walls will be used, as they are in excellent condition.

The property of the Kingston, Ont., Vehicle Works was sold recently for $6,500. The building in the first place cost the Stevenson Piano Company $39,000. The Vehicle Company secured it for $12,000, and spent that much more in improvements on it.

The Montreal Pipe Foundry Co., Ltd., has received an order from McConnell & Marrion, engineers, to supply sixty "G. A. Robertson" catch basins for the municipality of Verdun. Orders have also come in from Winnipeg and Western Ontario for this basin.

J. Wood, Sackville; A. L. Palmer, Boston; F. S. Whittaker, St. John; J. E. Whittaker, G. M. Wilson, Hampton, N.B., have been incorporated as the Ossekeag Manufacturing Co. to buy the business of the Ossekeag Stamping Company, Hampton, in the manufacture of iron, steel, tin, enamelled, japanned and galvanized ware; capital, $250,000.

W. H. Murray, W. M. MacKay, J. H. Thomson, J. Pender, J. E. Moore, C. McDonald, W. W. White, H. D. Troop, M. B. Edwards, C. Miller, A. P. Barnhill, St. John, N.B.; C. T. White and S. H. White, Sussex, N.B., have been incorporated as the St. John Iron Works, Ltd., to take over the general foundry machine, and boiler making business of Waring, White & Co.

Moosomin, N.W.T., is to build a $12,000 school house.

S. Boman is to build a tannery in St. Jacobs, Waterloo Co., Ont.

The Peterborough Lock Co. is to add some new machinery and increase its output.

The county council of Essex, Ont., has voted $14,000 towards the establishment of a house of refuge.

Mount Allison University residence buildings at Sackville, N.B., recently burned, are to be rebuilt at once.

The Guelph, Ont., Pavement Co. is laying cement sidewalks in Orangeville, Elmira and Waterford, Ont.

The waterworks by-law in Waterloo, Que., for effecting a loan of $40,000 to buy out the company, was carried June 12th.

The McEachren Heating and Ventilating Company, Galt, Ont., has received orders for heating the new P.E.I. Hospital at Charlottetown.

Cunliffe & Ablett, the proprietors of the Rossland Engineering works, have decided to add a foundry to their present machine shop plant.

A brickmaking plant has been installed at Trail, B.C., by A. C. Luff and Richard Tunswell. The plant is turning out 20,000 bricks per day.

The Bear Lake Mica Co. is asking for a site, exemption from taxation and water rates, if it establishes in Kingston, Ont., a mica refinery.

H. N. Ruttan, city engineer of Winnipeg, has been engaged by town council of Medicine Hat, N.W.T., to make estimates on a waterworks system.

By-laws are being submitted in Dunnville, Ont., to authorize the borrowing of $15,000, to pay off floating debt, build granolithic walks and construct a water filter.

The Ontario Box Co., Hamilton, has placed an order with the Smart-Eby Machine Co., Ltd., Hamilton, for a clamping machine for clamping and trimming box shooks.

The Semmens-Evel Co., Hamilton, is having its wood working machinery, which was recently damaged by fire, overhauled and repaired by the Smart-Eby Machine Co., limited.

Baxter & Galloway, Burlington, Ont., have placed an order with the Smart-Eby Machine Co., limited, Hamilton, for a 50 h p gasoline engine to be used in driving their new flour mill.

R. L. McCormack, A. E. Wheeler, E. T. Carter and J. McP. Taylor, Toronto, and E. McConnell, W. Campbell and W. E. Hoge, Toronto Junction, have been incorporated as the Acetylene Gas Machine Manufacturing Company of Toronto, limited; capital, $20,000; chief place of business, Toronto.

The ratepayers of Nelson, B.C., have voted for the spending of $30,000 on waterworks, $15,000 on sewers, and $15,000 on an electric light plant.

A combine of the car wheel makers is said to have been formed to include both Canadian and United States firms. It is the International Car Wheel Co.; capital, $15,000,000.

An application for exemption from taxes and the water rate for twenty years to the town of Longueuil, Que., has been made by W. D. & F. Hoerens, who intend to establish a chocolate factory.

G. & H. Barnett Co., Black Diamond File Works, Philadelphia, Pa., have sent out neat folders calling attention to the exhibition of United States manufacturers and their exhibit there, Sept. 14th to Nov. 30th.

A survey and map of the town of Dartmouth, N.S., will be made by A. Foster, Kingston, N.S., for $700. Other tenderers for the work were W. P. Morrison, Dartmouth, $1,100, and W. A. McDonald, Halifax, $795.

The Trent River Paper Mill Company has bought the Sills Bros.' water privileges, etc., on the Trent river, above Frankford, Ont. The new paper mill, which is three times as large as the original, will have a machine room 260 x 60 feet.

John E. Parker, manager of the Meriden Britannia factory, Hamilton, on his return from the meeting of the directors of the American Silver Plate Trust, said that they decided to continue the works in Hamilton and in Toronto, and close those in Montreal.

The Hamilton Bridge Works Co. is supplying two short iron bridges to the town of Peterborough, Ont.

J. A. Bell, C.E., of St. Thomas, Ont., is preparing plans for a steel bridge to be erected over the Catfish creek at Orwel, and for a steel bridge to replace the Luton bridge, near Mapleton, Ont.

The Botsford-Jenks Company, of Port Huron, is negotiating with the town of Meaford, Ont., for the erection of an elevator of 1,000,000 bushels capacity. The town proposes to grant a bonus of $25,000.

The Toronto Wire Fence Company has accepted Port Huron's proposition to put in its patents at $1,500 and $1,500 in cash, and citizens at Port Huron will contribute $3,000, making the capital stock $6,000.

E. D. Langille, of the Oxford Foundry and Machine Co., Amherst, N.S., has completed the smokestack for the Maritime Clay Works at Pugwash, N.S. It is 120 feet high, 5 feet 10 inches in diameter, and weighs eleven tons.

It is said there is every prospect that the N. B. Paper and Pulp Mills Company will build their mill at Tobique Narrows this season. It is expected the dam and mills will be erected this summer and the machinery put in next winter, says the Fredericton, N.B., Reporter.

The City of Hamilton has placed an order with the Smart-Eby Machine Co., Ltd., for a duplex sludge pump fitted with special water valves for the sewerage disposal works. This pump is to replace one of those at present in the sewage disposal works.

The Montreal Pipe Company, Acadia Mines, N.S., is turning out large quantities of water pipe. It has shipped during the last six weeks 368 tons. This pipe has been shipped to Liverpool, Sydney, Yarmouth, Halifax, Kentville, Westville and Sherbrooke, Que.

S. T. Waggoner, H. B. Muir, Montreal; D. Betzner, D. B. Betzner, Berlin; G. N. Weeks, G. Rowntree, R. J. Young, D. L. Chapman, J. E. Boomer, R. Skelly and C. H. Zeigler, London, Ont., have been incorporated as the Waggoner Ladder Company, Ltd.; capital, $20,000; to make ladders and other wooden articles.

The Detroit Lubricator Co., Detroit, Mich., has just got out a new line of glass body oilers and glass body oil pumps. The oilers, while simple in design, are equipped with all the latest improvements, including the set feed and stop feed features, and they are well and strongly made, with cast tops and bottoms. There has been also issued some printed matter descriptive of same.

Mullin & Muir, decorators, Toronto, are promoting the establishment of a wall paper factory in Orillia, Ont. The proposed company is to be capitalized at $100,000, of which $40,000 will be raised by the promoters, and $20,000 subscribed by local capitalists. The company would undertake to employ 65 hands, pay out $40,000 a year in wages, and put up two buildings, one 300 x 65 feet, and another 100 x 50 feet.

J. L. Archambault, Q.C., city attorney of Montreal, has given his opinion concerning the interpretation to be given to the word "machinery," which is to be taxed, as well as the factories themselves, under the terms of the new charter. The learned counsel holds that according to the terms of the Civil Code the word "machinery" includes all the appurtenances and fixtures connected with the work carried on.

In the case of the General Engineering Co. v. Dominion Cotton Mills and American Stoker Co., the defendants have obtained an order nisi for a new trial of the case from Justice Burbridge, on the ground that they have been put in possession of evidence since the trial to show that the plaintiffs' Canadian patent expired at the same time as an English patent for the same expired in 1897. The order is returnable on July 8th.

A. O. Norton, manufacturer of lifting jacks at Coaticook, Que., is working his plant to its fullest capacity and is still considerably behind in filling orders. The May business was double that of the corresponding month of last year owing to the large increase in both home and foreign orders, several large shipments having recently been made to Australia, South Africa and India. Additional machinery has been installed and the plant will likely be still further enlarged in the near future.

The Anglo-American Iron Company, of the State of Ohio, is authorized by Ontario license recently granted to purchase and own real estate for mining purposes, and to mine for ores, minerals and other substances; to buy and sell ores, minerals and other substances, and to manufacture the same into all forms

Hamilton, Ont, is to have another big industry, it is said, the Hoepfner Refining Company. The capital stock of the company is fixed at $600,000, and it is intended to mine and refine zinc, lead, silver, nickel and copper ores. The company has a process which is thought to be the best yet invented, which is now being patented. Application has been made for incorporation. The applicants are: C. Hoepfner, Ph.D., Frankfort-on-the-Main; A. T. Wood, M.P., Hamilton; David Maclaren, Ottawa; N. Dyment, Barrie; Hon. J. M. Gibson, John Moodie and John Patterson, Hamilton; H. Necarsulmer and A. F. Fuerst, New York.

A new industry, the Expanded Metal and Fire-Proofing Company, limited, is building a two-story brick factory on Pearl street, Toronto. The first board of directors of the company, are: T. W. Horn, Toronto, president (Mr. Horn being the well-known president of the Luxfer Prism Co); Charles W. Adams, late Western Passenger Agent of the Pennsylvania Railway, and now president of Edward Head-Light Co; W. W. Ramsay, president of the Chicago Expanded Metal and Fire-Proofing Co., and F. W. Barrett, Toronto, who is secretary-treasurer of the company. Charles S. Spencer of Chicago will be the company's chief engineer.

The litigation between the Hancock Inspirator Co., Boston, U.S., and the Penberthy Injector Co., Detroit, has been terminated by the Penberthy Co. purchasing of the Hancock Inspirator Co., the Loftus "ring valve" Injector patent, No. 300,092, upon which the litigation was based. The Hancock Co. reserved a license to themselves to manufacture injectors under this patent not intended for the farm engine trade. The American Injector Co. has for several years had a license under this patent, but desiring an interest in the patent and the dismissal of a suit against it by the Penberthy Injector Co. on the Borland patent, it has purchased a one-third interest. It and the Penberthy Injector Co. are now the sole owners of the Loftus patent above referred to.

Electric Flashes.

The Cataract Power Co. now controls the Hamilton Street Railway as well as the Radial Railway and the city lighting.

Dundalk, Ont., carried the by-law, authorizing its council to install a civic electric-lighting plant, by a majority of almost 2 to 1.

The engine for running the electric plant for the new Toronto city hall has been ordered from the Robb Engineering Co., Amherst, N.S.

The Robb Engineering Company, Amherst, N.S., is building two 350 h.p. engines for the Sao Paulo Railway, Light & Power Co., Brazil.

Hamilton, Ont., was in complete darkness for a short time one night last month when a fuse blew out in the Cataract Power Co.'s power house at DeCew Falls.

An agreement has been reached between the city council and the Grand River Electric and Power Co., Paris, Ont., by which the latter will be granted a franchise to enter the city of Brantford.

The Keewatin Lumber Co.'s plant is to be equipped by the Citizens' Telephone & Electric Company, Rat Portage. About 125 lights will be installed and run by a current from Rat Portage, Ont.

The Chambers Electric Co., Truro, N.S., is taking out two of its return tubular boilers, replacing them with a 150 h.p. "Mumford Improved" boiler, manufactured by the Robb Engineering Co., Amherst, N.S.

On the 24th June current was turned on at the Chambly power house and transmitted to Montreal experimentally. All the connections are being tested preparatory to the formal opening which will take place soon.

The Toronto Suburban Street Railway is asking a considerable enlargement of powers from York Township. This is understood to be part of a scheme which includes a number of electric lines radiating from Toronto.

A working model of a canal boat propelled by electricity was on exhibition in Montreal recently. It is the invention of H. M. Welch, Cowansville, Que. It is claimed for the boat that it will do away with the necessity for locks, as it will ascend rapid currents.

The roadmasters of the Toronto Railway Company recently banqueted Superintendent Gunn. Roadmaster Wallace, president of the Roadmasters' Association, was in the chair. General Manager Keating was present and expressed hearty approval of the association.

The Metropolitan Railway extension to Bond's Lake was opened June 15th by H. S. Howland, D. R. Wilkie, Mr. and Mrs. William Ramsay, Scotland; Miss Howland, C. D. Warren (president of the road), and J. W. Moyes, manager. A feature of the trip was the operating of the first car by Miss Howland.

Geo. W. Cain, a lineman in the employ of the City of Brantford, has entered action against the Brantford Street Railway Co. for $5,000. Cain was fixing a telephone wire when his hand touched a live electric wire, the results of which kept him in the hospital for a month. It is claimed the wire was not properly insulated.

Jack & Robertson, 7 St. Helen street, Montreal, have been appointed Canadian sales agents for the Sprague Electric Co., of New York, manufacturers of the celebrated Sprague Electric elevators and various "Lundell" brand electrical apparatus. The Sprague Co. is fortunate in securing so popular a firm to represent them in this market.

The Galt Gas Light Co. is dismantling the old Dickson Mill preparatory to making a first-class electric light and power station. A stone boiler shop, 40 x 40, will be built on the south side of the mill, for a steam auxiliary plant, and brick chimney 100 feet high. Three water wheels, two new, will be placed in the building and a lot of crib work will be done at the eastern end of the dam.

Engineers under V. M. Roberts, C.E., were recently engaged upon a railway survey between Preston and Berlin, Ont. They were said to be not connected with the proposed Hamilton scheme, but making the survey with a view of extending the Galt and Preston road to Berlin. Another party of engineers under T. E. Hillman, C.E., is making a survey for the proposed Hamilton-Berlin line.

A. F. Bury Austin, 411 Board of Trade Building, Montreal, wholesale lumber and timber for railway and building works, has secured contracts to supply material for the construction of the Shawenegan Falls Water & Power Co.'s works at Shawenegan Falls, Que., and to supply the material for the construction of bridges, etc., for the Great Northern Railway now building from Hawkesbury to Quebec.

Nelson Graburn, assistant superintendent of the Montreal Street Railway, has resigned his position with that company, and will shortly go to Glasgow, Scotland, where he will become superintendent of the Glasgow Corporation tramways. Mr. Graburn had charge of the electrical equipment for the Montreal company. He has been in the employ of the road for a number of years, in fact, since the change was made from horse cars to electric motors.

At the annual meeting of the Ottawa Electric Light Company it was shown by the annual report of the directors that the revenue from all sources for the year ending April 30, 1899, was $161,615. The expenses of operation and maintenance, with interest on the bonds, etc., amounted to $113,268, leaving a net surplus of $48,346. From this surplus a dividend of 6 per cent., or $44,653, for the year 1898-99, was paid on the capital stock of $765,800, leaving a balance to go to credit of profit and loss of $3,692. During the year, $57,878 was expended on new plant. The total plant is now valued in the company's statement at $1,209,438. As compared with the previous year, 1897-98, the revenue was $2,031 greater, despite the fact that the price of electric light was lowered 20 per cent. during the year. There are now in use in the city 77,255 incandescent lights, 621 arc lights, 23 heaters, and 103 motors.

Woodstock, Ont., has voted $7,000 to equip a fire hall and fire alarm system.

The capital stock of the Callender Telephone Exchange Co., Ltd., has been increased from $100,000 to $450,000.

The question of an electric railway from Pembroke, Ont., to Beachburg, Forester's Falls and Westmeath is being agitated.

Baddeck, C B., is talking electric lights. It is more than probable that within a few months an electrical plant will be installed there.

Eager & Sanderson, Winchester, Ont., are installing a 500 light dynamo. The entire plant was furnished by the Royal Electric Co., Montreal.

The ratepayers of Niagara Falls, Ont., are willing to buy the plant of the local light and power company for a sum in the neighborhood of $71,000.

Grafton & Co., Dundas, Ont., are operating their tailor shops by S.K.C. two-phase motors, current being supplied by the Dundas Electric Co.'s two-phase plant.

Nelson is to have a street railway. The Colorado Fuel & Iron Company, of Bessemer, Col., was the successful bidder for the contract to supply about two miles of rails.

The share of the profits of the Toronto Street Railway Co. paid to the city for May was $8,425, being an increase of over $1,000. The railway's receipts for the month were $105,313.

The Royal Electrical Company has made application to the Barrie, Ont., council for a franchise which will entitle it to the control of an electric road between that town and the Allandale suburbs, a mile distant, and also give it privileges to extend the line to other points tributary to Barrie.

The British Columbia Electric Railway Company, Ltd., has restored the wages of the trackmen in its employ to $2 a day. This was the old rate, but, owing to depressed business conditions, it was found necessary to reduce the wages to $1.75 a day for a time.

The Winnipeg municipal arc lighting plant which was to be running July 1st will not be in operation for some weeks. The city is not making any preparations to compete with the existing company in incandescent lighting, and will probably not do so for a period, though the municipal buildings will be lighted from the city plant.

A 75 k.w. S.K.C. dynamo was put in operation at Grand Valley, Ont., a few days ago, and is now supplying from one phase of the machine, the town of Grand Valley with 500 incandescent house lights and some 50 c.p. street lamps. From the other phase of the same machine, which is wound for 5,000 volt current, they are supplying the town of Arthur, 12 miles away, with about 600 incandescent house lights and five enclosed arc lamps, as well as fifteen 32 c.p. incandescent street lamps. This plant is one of the most unique and complete in Canada.

Geo. Wilson & Co. of St. Catharines, who operate a large planing mill and sash and door factory, where they have plenty of refuse for steam purposes, have found it cheaper and more satisfactory to operate their mill by electricity, and have entered into an agreement with the St. Catharines Electric Light & Power Co. to furnish them with from 50 to 75 h.p. They have also placed their order with the Royal Electric Co. for a 50 k.w. S.K.C. synchronous motor. There are also a number of other firms which contemplate making changes from steam to electricity.

The Electric Light Co., which recently secured a contract for lighting the town of Merritton, Ont., and which has about 400 incandescent lamps installed in houses and 20 enclosed arc lamps on the streets, began operations with its own water power and apparatus. It has, however, made an arrangement now by which the St. Catharines Electric Light & Power Co. are to furnish them current from their station, which is about four miles distant. The plant of the St. Catharines Electric Light & Power Co., is being considerably changed and enlarged. One side of the new 200 k.w. S.K.C. generator will supply the town of Merritton and that district lying south of their power house, and the other phase that portion of the city of St. Catharines north of the power house. During the hours of daylight this poly-phase machine will be used for supplying power to the different industries in and about St. Catharines.

Price Bros., Amqui Mills, Que., have their entire saw mills, docks and yards lighted by electricity. The plant, which was furnished by the Royal Electric Co., started up recently.

P. Young, formerly of Almonte, Ont., who has been filling a position in the pulp mills at Sault Ste. Marie, Ont., has been appointed electrician and mechanical engineer of the Canadian Sault Ste. Marie canal.

The calcium carbide works to be built by the J. R. Booth Lumber Co. will use 250 tons of sawdust per day to produce the necessary carbon. A building 150 x 104 feet and four stories high is to be erected.

The manufacturing warerooms of Geo. Bean, Dundas, Ont., have been changed from the old motive power to electricity, the Dundas Electric Co., furnishing the current, and the Royal Electric Co. a two-phase S.K.C. motor to drive the establishment.

Taylor & Co. of Dundas, Ont., have placed an S.K.C. two-phase motor in their work shop and will hereafter operate by electric current furnished by the Dundas Electric Co. Dundas will soon follow the lead of Hamilton and become, with all its factories, a smokeless city.

A. C. Miller & Co. of the "Alexandria" have placed their order with the Royal Electric Co. for a complete electric lighting plant for this new steamer. The work of installation is going on now, and on completion will be one of the best electrically equipped vessels on the lake.

Theron R. Gue, Halifax, N.S.; A. E. Porter, Brooklyn, N.Y.; H. J. Smith, Compton Lake, N.J.; B. F. Pearson, Halifax, N.S.; W. H. Covert, Halifax, N.S., have been incorporated as the Dominion Electrical Works, Ltd., to manufacture and deal in electrical supplies of all kinds.

The new steamer "Argyle," plying between Kingston and Ontario lake ports, is one of the palace steamers of Lake Ontario, its fittings being of the finest. It is lighted throughout by electricity, and also has a search light. The entire electrical plant was installed by the Royal Electric Co., Montreal.

George C. Hinton & Co., Victoria and Vancouver, B.C., have received a contract for an electric plant, which will cost $60,000, for the west extension of the Wellington coal mines. There will be a large electric generator, electric hoists and electric locomotives. It will be a complete electric coal mining plant.

The Canadian Electric Light Company, which proposes to utilize the Chaudiere Falls to supply light and power to Levis, Que., has now its capital of $200,000 subscribed. John Breakey has been elected president and the directors have under consideration for the development of their water power plans from J. E. McCarthy, C.E., and T. Pringle & Son, Montreal.

The sale of the Chats water power on the Ottawa river, which was to take place on June 9th at the office of the Commissioner of Crown Lands, at Quebec, was again postponed, no date being fixed. The upset price was $20,000, but no offers for sale en bloc were received, but only for certain portions of the chutes, and these offers are now under the consideration of the Commissioner.

The law governing the building of lines of telegraph or telephone is to be added to by the Dominion Government, providing that where any company has power by Act of Parliament to construct lines of telegraph and telephone or for the conveyance of power or light such company may, with the consent of the municipal council or other authority having jurisdiction over the railway, square or other place and as often as the company thinks proper may break up or open such highway or public place subject to restrictions which are duly imposed. Travel is not to be obstructed. The Act will regulate the height of wires, and poles shall be straight, and in cities painted, if so required by the municipal authorities. Wires may be cut in cases of fires. The company shall not needlessly destroy shade trees. The municipality shall have supervision over these works, and the surface of the street shall be restored to its former state. In case Parliament shall order at any future time wires to be placed underground, companies now entitled by their charters to carry them on poles shall not collect any damages. If for the purpose of removing buildings or in the exercise of the public right of travel it is necessary that poles or wires be removed temporarily they shall be so removed at the company's own expense.

The Montreal Belt Line Railway have secured the steamer "Mansfield" as a ferry between Bout de l'Ile and Charlemagne, and Repentigny, on the opposite side of the river, making the trip in less than ten minutes. The boat in question will connect with every car that arrives at and departs from Bout de l'Ile, and will also carry freight. The company is also running an hotel.

Hamilton, Ont., has accepted the offer of the Cataract Power Company to light the city for a term of ten years at the expiration of the present contract for $85 a lamp per year up to 425 lamps; from that number to 500, $82.50 a lamp. It was estimated that at those rates a saving of $2,500 a year would be effected by the city. The present contract rate is $91 a lamp per year; if at the end of five years the contract price is not satisfactory, the contract could be terminated by giving a year's notice.

John Starr, Son & Co., Halifax, N.S., have recently closed a contract for all the electrical apparatus for the street railway power and lighting plant, which is to be established in St John's, Newfoundland. The generating station will have a capacity of 1,500 h.p., which will be transmitted eight miles to St. John's, and there distributed from a sub-station. Step-up and step-down transformers will be used, the current being transmitted at 15,000 volts. The 500 volt direct current for the street railway will be derived from rotary converters. The apparatus throughout will be of Westinghouse make, for which this firm is agent in the Maritime Provinces and Newfoundland.

The item for $11,000 for lighting the public buildings at Ottawa caused some discussion in the House recently. Mr. Fielding explained that the lights cost $2.25 per annum per light of 16 candle power. The Government, in addition, paid the whole cost of putting in the electric light fixtures, and the total number of lights is nearly 6,000. Mr. Taylor, Gananoque, Ont., said that in his house, he had 22 lights of 16 candle-power, for which he paid $30 a year. Mr. Sproule said that in Durham, Ont., lights cost one dollar each a year. Mr. Foster said that in Ottawa private householders were getting light much cheaper than the Government. The discussion brought out the further fact that it cost $3.50 per light to put them into the building. The members were plainly of opinion that these prices were excessive.

Notice to begin work in ten days was given the Central Construction Co., Buffalo, by the town of Orillia, Ont., June 17th. The company was unable to furnish a bond of $5,000 as a guarantee of the efficiency of the plant for a longer period than the manufacturers were willing to insure the machinery against any inherent defect and the contract has been declared forfeited. The Westinghouse Co. which was to supply the electrical plant at $35,000 will, it is said, probably proceed with the work. If not tenders will again be called for. The leading Canadian companies will tender, and the New York Engineering Co., New York, is said to also be in the field. Some concessions on the original specifications had been made to the Central Construction Co., notably the substitution of aluminum for copper wire.

The Montreal Street Railway Company has generously decided to set apart $25,000 yearly for the benefit of its employees, as follows: 1. On and after the 16th inst., all permanent employees in the operating department and workshops will be insured in an accident insurance company of good standing, and the premium will be paid by the Montreal Street Railway Company. This insurance will amount to $1,000 in the event of death from accident, either on or off duty, one-half this amount for total disablement, and $5 per week indemnity for time lost through injuries or diseases specified in the policy, full details of which will be given when the final arrangements are made with the insurance company. 2. Motormen and conductors who have been regularly in the company's service for two years and over will have their wages increased to 15 cents per hour. 3. In addition to the above advantages, motormen and conductors who have been regularly in the company's service for five years and over will receive free uniforms.

The Lachine Rapids Hydraulic and Land Company is said to contemplate a number of important improvements this summer. To avoid frazil ice an additional wing dam, one thousand feet long, will be constructed. This will begin where the present wing dam leaves off, and will extend up a thousand feet at an angle to the present structure. The new dam will make the intake one thousand feet wide and thirty feet deep, whereas the present intake is five hundred feet wide and twelve feet deep. It is desired that in order to avoid the frazil ice, the current should be directed toward the centre of the river, and thus leave the water quiet at the intake of the wing dam in order that it will freeze over. The company will also build about 1,000 feet of cribwork, and out of the tail race they expect to excavate about 20,000 or 25,000 cubic yards of reef, so that there will be nothing upon which the frazil can hang. In order to provide against all contingencies the company is going to install a steam plant, in a fire-proof building, on Chenneville street, which will supply the Montreal users with light, in case of anything occurring at the works. To provide in case of accident, for the wants of other customers, a steam plant will be put in at Cote St. Paul, also in a fire-proof structure, to take care of the street lighting there, as well as in Westmount, St. Henri and Montreal West. It is expected that the whole of this work will be finished by December 1.

Railway Matters.

Arnprior, Ont., is to have a new C.P.R. station.

The Central Ontario Railway Company is advertising for tenders for the extension of its line to Bancroft.

Over 500 men are employed on the construction of the coast railway between East Pubnico and Barrington, N.S.

T. McAvity & Sons, of St. John, N.B., are manufacturing for the C. A. Railway and O., A. & P. S. Railway 5,000 bronze car bushes, amounting to $15,000.

Work was commenced June 15th on the Inverness, C.B., railway. Thirty miles of the road, according to the contract, must be completed by December 31st, 1899.

The new C.P.R. train "The Imperial Limited," began running on June 18th. It covers the distance from Montreal to Vancouver in 100 hours. It runs every day.

The old St. Lawrence & Ottawa Railway bridge, now owned by the C.P.R. across the Rideau, near New Edinburgh, will be replaced shortly by a new steel truss bridge.

The families of McDonald and Fraser, the two Nova Scotians who died from neglect while laborers on the Crow's Nest Pass, have been given $1,500 each by the C.P.R.

The East End Incline Railway, Hamilton, Ont., and about 40 acres of park land adjoining it on the mountain top will be sold by auction, July 14th, to satisfy creditors, who hold mortgages. The principal creditors are Toronto men.

The work of converting the railway from Robson to Rossland, B.C., recently acquired by the Canadian Pacific, from a narrow to standard gauge, was completed last month. Rossland, B.C., is now only four days' travel from Montreal.

The Montreal and Southern Counties Railway Company have had surveyors employed at work for some time on the south side of the river laying out routes. They are now about to begin work on the first section of their system to connect, for the present, with the Grand Trunk Railway at St. Lambert.

The Ottawa & Gatineau Valley Railway has just concluded negotiations for the lease of 9 of the largest lakes in the Upper Gatineau. These lakes which are well known fishing grounds will be used for the benefit of the company's patrons. Club houses will be erected and boats, fishing tackle and all requisites will be kept on hand for the use of sportsmen.

A comparative statement of the railways of the world shows that Canada has, with one exception, a greater mileage than any other country in the world, on the basis of population. We even surpass the United States, which has 26¼ miles of railroad to each 10,000 inhabitants, against Canada's 32.17 miles for the same number of inhabitants. Australia is practically on a par with Canada, its percentage being 32.23 miles. The computation is made in a late edition of a prominent German publication devoted to railway affairs, and known as The Archiv fur Eisenbahnwesen.

Evidence to the fact that the construction of the Niagara Central railway to Port Dalhousie at once seems to be forthcoming is the statement that 8,000 ties for the work have been shipped, and are now on the M.C.R. tracks.

The Portage du Fort and Bristol Railway bill was passed at Ottawa with some amendments. The company will only be incorporated from Quyon westward to Pembroke, and to reach Hull and Ottawa will obtain running rights over the Pontiac and Pacific Junction Railway from Quyon down to Hull. The P. and P. J. Railway Company wanted the junction of the two railways made at Shawville, while the Portage du Fort Company wanted the junction at Quyon. The P. and P. J. Company said that if Quyon was adopted their business would be seriously jeopardized, because the section of the line between Shawville and Quyon was one of the best paying. The Portage du Fort Company contended that the engineering difficulties made Shawville as a junction point almost an impossibility. Quyon was decided upon.

Mining Matters.

The Waterloo mine, Camp McKinney, B.C., is to have a stamp mill at once.

T. B. Caldwell, Lanark, has fifteen men at work on his Calabogie, Ont., iron mine.

A 12-drill compressor is to be installed at once on the Cariboo mine, Camp McKinney.

Natural gas has been discovered in quantity at various points near Newmarket, Ont.

The gold output from the Yukon mines for the past season is estimated to be about $20,000,000.

Leopold Meyer, Ottawa, acting for United States and Canadian capitalists, has bought the gold mine owned by Dale & Co., Madoc, in Hastings county. The purchase price is said to be $225,000.

E. A. Teskey, St. Thomas; L. Teskey, M.D., Toronto; C. E. J. Smith, J. A. Thomas, London and L. E. Smith, Bothwell, Ont., have been incorporated as the Traders' Oil and Gas Developing Company: capital, $20,000.

The Jenckes Machine Co., Sherbrooke, Que., recently sold to the Rosie Marie Company, which is operating properties on Alberni inlet, on the west coast of Vancouver Island, a compresser, two drills, a crusher, rolls, boiler and engine.

T. R. Deacon, M.E., O.L.S., Rat Portage, Ont., late manager of the Ontario Gold concessions, has been appointed resident Canadian director of the Mikado Gold Mining Co., Ltd., and will hereafter represent the company in that capacity in Canada. The Mikado is one of the best known gold producing mines in Canada.

H. J. Beemer has disposed of the Zenith mine at Rossport, Ont., to the Grand Calumet Mining Company, for $254,000. Under the new management, the Zenith will be worked on a larger scale, and an extensive plant will be put in. At present there are 18 men working in the mine, and 180 tons of ore, running from 43 to 55 per cent. pure zinc, are being taken out weekly.

The Katherine Lead and Zinc Mine near Millbridge, Ont., contains ore rich in lead, zinc, and 20 ounces of silver to the ton. The ore is being sent to Europe for treatment. The officers of the company are: Charles L. Meyer, Ottawa, general manager: F. I. Daniels, superintendent; Robert Phillips, Henry Smith and Henry Lloyd, foremen; Fred Daniels, machinist.

The Standard Oil Company, which began work last autumn with a hundred men on Michipicoten Island in Lake Superior, in the reopening of old copper mines, has given orders to stop work at once, the showing of copper secured by the expenditure of a large sum of money being discouraging. Those who know the Standard Co.'s methods will now do some careful prospecting in the neighborhood, as if there were no copper in the mine, the statement to that effect would hardly be published.

Large quantities of gold are now being turned out by the Canadian Gold Fields Company at Deloro, and the Cordova Exportation Company at Belmont, but as these companies do not wish to interest the public they refuse to publish any figures on their output.

There are reports of a wonderfully rich strike on the hills at the back of Dahl river, in the Koyokuk district. Nuggets, it is said, some two and more inches have been found, and a rush is on to the scene of the finds, the maddest, it is said, in the history of the Yukon.

Walter E. Bagnell, chairman of the Bagnell Oil Company, and managing director of the Canada Petroleum Company, which controls the Gaspe oil fields, recently returned from the scene of operations in Gaspe peninsula, and says that if the proper facilities are afforded, the company is prepared within six months to land a cargo of petroleum products in England, and to place a high class of illuminating oil on the Canadian market.

The well known Barker mine in the Lower Manitou, HW339 and 443, Ont., has been sold for the sum of $250,000, Messrs. Donald Keith and W. F. Hugo of Duluth being the purchasers, associated with whom are other prominent Duluth and Toronto capitalists. This property was acquired by the Barkers in the fall of last year from T. Woodworth and Isaac Sanderson, and with all possible speed a Tremaine mill was installed as a testing mill to show up the value of the property, with the present satisfactory results.

The details of the extension of the department of mining and metallurgy at McGill University, made possible through the continued generosity of Sir William McDonald, have now been decided upon. Instead of one assistant, as in the past, Prof. Porter will hereafter have under him a lecturer on metallurgy and assaying, a demonstrator or assistant, and a sufficient force of mechanics to attend to the machinery of the laboratories. Mr. J. W. Bell, Dr. Porter's demonstrator for two years, has been promoted to the post of lecturer on metallurgy. A fellowship, to be known as the "Dawson" fellowship, in recognition of the late Principal's services to the mineral industries, has been instituted for teaching research in mining and metallurgy. It is hoped that the demonstratorship and fellowship will be filled from the ranks of the graduating class.

The coal mining industry of the Northwest Territories is assuming considerable proportions, and when fully developed will, no doubt, constitute one of the most important resources of the country. At the present time the only large collieries are those at Anthracite, some four miles east of Banff, on the Canadian Pacific Railway; at Canmore, about fifteen miles southeast of Banff, also on the main line of railway; at Roche Perue, on the Sault line of railway, in Eastern Assiniboia, about four miles from the international boundary; and at Lethbridge, in Southern Alberta, some fifty miles from the boundary, and about the same distance from the foot of the Rocky mountains. In addition to these, there are a number of small mines, many of which are situated in the vicinity of Edmonton, on the North Saskatchewan. It is a rather remarkable fact that of the 338,661 tons of coal mined during last year over two-thirds was exported or consumed by the various railways. It is estimated that not more than from 75,000 to 100,000 tons is used in the Territories for domestic purposes.

Further details are to hand regarding the successful trial of Crow's Nest coal made by the British Admiralty. Rear Admiral Palliser, in command of the Pacific Squadron, reported that he found the Crow's Nest coal superior in every respect to the Pacific Coast or North of England coal, having less smoke, less ash, more durability and greater evaporating power. The only coal he thinks compares with it is the best Welsh article, and he declares that it is equal to this in most respects. This is a most important matter, and the successful test of the Crow's Nest coal at Vancouver probably means a big annual contract with the British Admiralty Office. At present all the coal used by the Pacific Squadron (40,000 tons per year) is brought 20,000 miles by sea, but now it can be supplied from Fernie, B.C., by only 500 miles' transportation. It is also said that the general manager of the Crow's Nest Coal Company is negotiating with the United States naval authorities with a view to supplying the American Pacific Squadron with this fuel.

Marine News.

A new company, known as the Societe de Navigation Franco-Canadienne, will in July establish a line of steamers from Montreal to Bordeaux.

The Marine Hospital, St. John, N.B., has been handed over to the town by the Government for use as a home for incurable cases. The late W. W. Turnbull of St. John, on his death-bed gave $100.000 to endow such an institution.

James Dunsmuir has withdrawn his offer to provide Victoria with a fast rail and ferry connection with Vancouver. The people of Victoria did not approve of the conditions, as there seemed to be some prospect of Dunsmuir making a profit on his investment of $1,000,000.

The series of yacht races at Pointe Claire, Que., for a special cup presented by James Ross, between the "Dominion" of the Royal St. Lawrence club, which won the Seawanaka cup last year, and the "Yankee" of the White Bear club of St. Paul, Minn., were a complete triumph for the Canadian builder.

A land slide took place during the night of June 1st on section eight of the Soulanges canal. A block of land 300 feet in length and 50 feet in width slipped from the bank right across the canal at the spot where the slide of two years ago occurred, when the pier was carried in. The place had just been lined with stones and everything went in.

The officers and crew of the Canadian steamer "Gaspesia," whose owners were recently condemned to pay $12,500 salvage to the steamer "Kite," for towing the "Gaspesia" out of the ice floes in the Gulf of St. Lawrence, have brought suit for four months' wages, aggregating nearly $12,000, as they number 80 all told.

The Richelieu & Ontario Navigation Company has purchased for $80,000 the "Virginia," owned by the Baltimore Packet Company, of Baltimore. The boat is described as a model of paddle-wheel steamers, being a sister ship of the company's steamer "Carolina." The "Virginia" is a larger steamer, and is fitted throughout with electric lighting, bells and first-class accessories for heating and ventilation, and has a capacity of nearly 350 passengers. She has an extra forward deck. It is said she cost $225,000 originally. The "Virginia" will replace the "Carolina" on the Saguenay route.

A pamphlet and maps describing the St. Clair and Erie Ship Canal has been issued. This project involves the building of a canal across the narrow neck of land separating Lakes St. Clair and Erie. The distance is 13 miles. The construction of a canal of this length would save 79 miles of dangerous lake and river navigation. The canal would undoubtedly be of great advantage to United States shipping, more so than to Canadian. The shipping passing Detroit amounts to 32,000,000 tons per annum. It is estimated that at least two-thirds of this amount would use the canal. The charges on this tonnage, at 2½c. a ton, would produce a revenue of $550,000 a year, quite enough to finance the enterprise. In addition to this, it is claimed there would be a saving of $1,014,200 a year to the vessel owners by reason of the shorter and safer route via the canal. An extraordinary feature about the project is that the promoters do not ask for a subsidy of any kind.

Another new steamer for the regular direct service between Manchester and Canada was launched successfully at the yard of Palmer's Shipbuilding & Iron Company (Limited), Jarrow-on-Tyne, says the Manchester Guardian lately. She is named the "Manchester Port," and has been built to the order of the Manchester Liners (Limited), under the direction of A. H. Walker and J. F. Kitching, superintendents for Sir Christopher Furness, and Mr. James Robertson of Manchester, marine superintendent for the owners. The "Manchester Port" is a finely-modelled steel screw steamer of about 14,500 tons displacement and nearly 9,000 deadweight capacity. Her principal dimensions are: Length, 467 feet over all, and 452 feet between perpendiculars; beam, 52 feet; moulded depth, 39 feet. She is therefore slightly larger than the "Manchester City" and the "Somoa," which are respectively 447 and 445 feet long between perpendiculars, with an extreme breadth of 52 feet, and are the largest vessels which have yet navigated the Ship Canal.

Personal.

C. H. Wallace, assistant city engineer, Hamilton, Ont., has resigned and returned to his former home in Great Britain.

T. H. Trethewey has been engaged as consulting engineer by the Dominion Consolidated Mines Company, and his son, W. J. Trethewey, has been secured as permanent superintendent.

A. A. Brewer has resigned his position as assistant engineer on the Farran's Point canal staff, and has gone to Boston, Mass., where he has secured a good position with the Boston Bridge Company.

J. M. Macoun, of the Dominion Geological Survey, has been appointed forestry inspector for Canada, and has been commissioned to arrange for exhibits of Canadian woods to be sent to the Paris Exhibition.

Notice is given in the Quebec Official Gazette that P. E. Mercier, O. H. Cote, H. Lefebvre and A. Terreault, students of the Montreal Polytechnic School, have obtained the diploma of civil engineer

R. G. Reid, the well-known contractor, whose name has been prominently before the public latterly, in connection with the industrial development of Newfoundland, has returned from a trip to Africa, undertaken for the benefit of his health, which has been much improved.

W. Heald shot himself accidentally while cleaning a revolver in a hotel in Winnipeg, June 21st. He was very well known as a contractor on the C.P.R. and O.A. & P.S. Railway, and was most popular with his workmen and fellow contractors. In private life he was universally esteemed.

Donald Gibson, electrician of the Toronto fire department, who died recently at the age of 74, was born in Glasgow, Scotland. He was apprenticed to a gas firm and came to Toronto in 1854, at the request of the Consumers' Gas Company. He became their foreman till 1871, when he was appointed electrician of the City Fire Department. His sons are: Allen, living at Davenport, Iowa; Henry, employed at the Consumers' Gas Company; William, with the Toronto Electric Light Company, and Arthur, at the Experimental Farm in Ottawa.

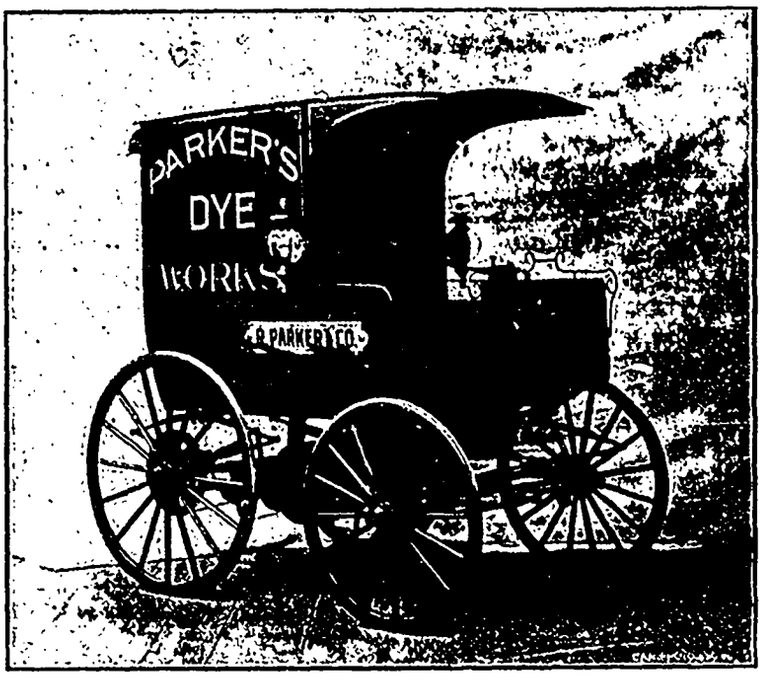
Thos. W. Dyas, advertising manager of The Toronto Mail & Empire, died recently in Toronto. He was born in County Cavan, Ireland, and crossed the Atlantic with his parents in 1850, settling in New Orleans. Nine years afterwards the family removed to London, Ont., where he received his education, and afterwards studied civil engineering and land surveying with William Robinson, at that time city engineer, and he was afterwards out with surveying parties in the Lake Superior district and elsewhere. In 1877 he became a member of The Mail staff.

F. H. Lynch-Staunton died recently at his home in Hamilton, Ont., after a long illness. He was born on August 15, 1828, in the County of Galway, Ireland, being the second son of George S. Lynch-Staunton, D.L. He was educated at St. Mary's College, Oscott, England. The deceased came to Canada in 1854. He practised his profession, civil engineer and provincial land surveyor, in Bruce county for ten years. He lived in West Flamboro' from 1865 to 1876, where he had a large farm, and came to Hamilton in 1876. The deceased was engineer-in-charge of the building of the old high-level bridge and the Hamilton and Dundas Railway.

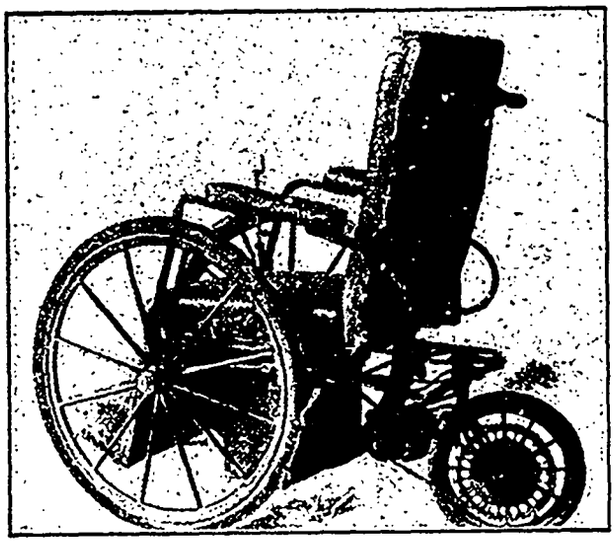
ELECTRIC DELIVERY WAGON.

This delivery wagon is equipped with an eight horse power motor, weighing about 120 pounds, and a battery of 36 cells, the total weight of which is 460 pounds. The total weight of the entire vehicle ready for running is 1,620 pounds. The wagon alone without equipment weighing 1,000 pounds. The battery is only about one-third the weight of any other battery, while the motor is of much greater efficiency than any other of similar size and weight. The battery and motor are both made under the Still patents. With this electrical equipment the Parker wagon can ascend a grade up to 40 per cent. while the best elec-

trical delivery wagon in the market, of American make, advertises nothing higher than an 8 per cent. grade. As a matter of fact the Parker wagon will carry a load of 650 pounds up a 20 per cent. grade. An interesting illustration of its power to ascend grades was given at the factory the other day, when an expert bicyclist failed to ascend the grade up the factory platform without a running start, this grade being about 20 per cent., but the electric wagon, carrying a passenger besides the driver, ascended this grade at 5 miles per hour, with a start of only 3 feet from the foot of the grade. The range of the battery without recharging is 30 miles, and the speed is regulated from 3 to 14 miles per hour. The control is simple and effective, the controller when reversed acting as a very effective brake upon the motor shaft. While the efficiency of the electrical equipment of the Parker wagon is greater than that of any other in the market, the price of the wagon completely equipped ($1,000 f.o.b. Toronto), is considerably less than that of the American vehicles. The electrical appliances are the invention of W. J. Still, a young Toronto electrician. The Still Motor Company has just been organized with a capital of $75,000, to take over the business of the Canadian Motor Syndicate and manufacture electric vehicles of all kinds on a large scale. Already the factory is crowded with orders for months ahead. The factory premises are at 710-724 Yonge street, Toronto, having a frontage of 125 feet on Yonge street, and running through to St. Nicholas street.



ELECTRIC DELIVERY WAGON.



ELECTRIC INVALID'S CHAIR.

This chair is owned by a young man who has the use of only one hand. It was equipped by the Still Motor Company with three battery cells (under the seat), weighing 33 lbs. The motor (¼ h.p.) is attached to the hind wheel. The controller starts, steers, speeds, reverses and controls the chair, which is unique in being the smallest motor carriage in the world, being only two feet wide. Speed 4½ miles per hour.

THE IMPROVED SAMSON BATTERY.

It is twelve years since the "Samson" battery was introduced, and its increasing sale year after year ever since, attests its popularity. It has become the standard open-circuit battery of America, its makers claim. Hundreds of testimonials have been received attesting to its superiority for all classes of electrical work. They have lately made a change in the style of the battery, which cannot fail to add to its hitherto increasing popularity. This new style will be known as the Improved "Samson" Battery. The improvement consists mainly in joining the carbon, zinc and cover in such a way that it is impossible for a short circuit to occur inside of the jar. The cover is made of a hard, dense material, into which is locked the carbon The cylinder zinc is firmly held to the cover by a nut, and the result is, mechanically speaking, a one-piece battery, which can be handled as such, thus dispensing with the rubber rings, etc., previously used. The carbon is held half an inch away from the bottom of jar, and the zinc is a trifle shorter than the carbon. This is to save possible bridging of salts. The battery is shipped, set up, and to use same it is only necessary to remove the packing. The shape of the jar has also been altered, so that the whole appearance of the battery is very much improved. The "Samson" carbon is manufactured in France and is composed of two parts, a fluted lower portion and a flat top carrying the binding post, which are baked into one piece in the kiln. This process is peculiar to this carbon, and is a necessary one to obtain the best results. The crude carbon is remarkably pure, and great care is used to free it from all injurious elements, such as iron and other foreign substances, which would be liable to produce local action. The carbon mixture is subjected to a special patented process, which renders this portion after baking, more porous than any other battery carbon ever produced. The lower portion is a thin-walled, fluted, hollow cylinder, made from special materials and by a special process, resulting in a quality of battery carbon which, as is the case with some natural products, cannot be obtained in this country. While the crude carbon is remarkably pure, great care is taken to free it from all injurious elements, such as iron and other foreign substances, which would be liable to produce local action. The carbon mixture is subjected to a special patente-

process, which renders this portion after baking more porous than any other carbon ever produced. The top portion is composed of an entirely different kind of carbon from that used in the lower portion, which, after being subjected to enormous pressure, is treated when the carbon is complete in a way which renders it impervious to the creeping tendency of the solution and action of the ammonia gas. The upper and lower portions after being formed, are properly baked in the kiln, after which the top of the carbon is heated red hot and plunged in hot paraffine, so that it enters into the minutest pore instead of simply collecting on the outside, as is the case with many battery carbons. The carbon made in this way has a hard dense top and a very porous lower portion. As the makers claim, no other carbon is made in this manner, and it is impossible to obtain the greatest advantages when a carbon is moulded in one piece. A one-piece carbon must necessarily have a hard top to resist the internal creeping, and in consequence has a hard lower portion which is not made porous, as some carbon manufacturers seek to make the trade believe by simply granulating the surface. Open pores which can be plainly seen in the Samson are not produced by such a method. A combination of manganese and pea carbon is placed inside the fluted portion and held in position by a specially prepared plug which will not fall out. It is this depolarizer and its close proximity to the exceptionally porous carbon which imparts to the battery its remarkable recuperative qualities. The result of this thorough and necessarily expensive mode of manufacture is the production of a battery carbon it is said, which has a larger surface, longer life and greater recuperative power than any other carbon element ever manufactured, and we guarantee the completed battery will stand more hard usage and continue its service more satisfactorily than any other open-circuit battery. An improvement has also been made in the carbon binding post connections, which is bolted on across the top of the carbon, and is held in place by a safety check nut. This change removes all possibility of the connection being affected by corrosion due to creeping of the salts. In addition to the cylinder zinc as heretofore supplied with the "Samson" battery there is supplied a special rod zinc heavily amalgamated. The rod zinc is also supported by the cover and held away from the bottom of the jar, and is provided with a rubber bushing to prevent any possibility of short circuit. The "Samson" battery, fitted with this special rod zinc, is adapted for service when the large current delivered by the cylinder zinc is not required, but the best possible recuperative ability is necessary. The improved "Samson" battery is made in one size only, 4½ inches square and 8 inches high over all; it has a voltage of from 1.40 to 1.47 and an amperage on short circuit of from 12 to 16 amperes with the cylinder zinc, and about 5 amperes with the rod zinc, with the lowest internal resistance of any other open-circuit battery in existence.

Notwithstanding the improvements made in the "Samson" John Starr, Son & Co., Halifax, N.S., have, owing to increased facilities for turning them out, been able to reduce the price of same. John Forman, Montreal, has been appointed agent for Ontario and Quebec.

THE IRON BOUNTIES.

The Minister of Finance has introduced into the House of Commons the following resolution with regard to steel and iron:—That it is expedient to provide that the bounties on steel ingots, puddled iron bars and pig-iron, made in Canada, authorized by Chapter 8 of the Act of 1897, shall, on the termination of the period herein mentioned, be gradually reduced, during a limited term, until they are extinguished, and that the bounties to be paid for the additional term shall be as follows: From April 22, 1902, to June 30, 1903, both inclusive, the bounties shall be 90 per cent. of the amount fixed by the said Act, From July 1, 1903, to June 30, 1904, both inclusive, the bounties shall be 75 per cent. of the amount fixed by the said Act. From July 1, 1904, to June 30, 1905, both inclusive, the bounties shall be 55 per cent. of the amount fixed by the said Act. From July 1, 1905, to June 30, 1906, both inclusive, the bounties shall be 35 per cent. of the amount fixed by the said Act From July 1, 1906, to June 30, 1907, both inclusive, the bounties shall be 20 per cent. of the amount fixed by the said Act. Provided, however, that if any steel ingots be made from puddled iron bars manufactured in Canada, no bounty shall be paid on such steel ingots. The said bounties shall cease and determine on June 30, 1907.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

CARD OF THANKS.

I desire to thank the members of the Ontario Association of Stationary Engineers for the honor they conferred on me at their annual meeting held at Hamilton on the 29th of May, in electing me a member of the Board of Examiners, Yours fraternally, W. F. CHAPMAN.

Brockville, June 24th, 1899.

FIRES OF THE MONTH.

June 1st. A. Dickie's sawmills, Lower Stewiack, N.S.; loss, $25,000; to be rebuilt at once.——June 3rd. The Poaps' sawmill, owned by H. P. Alguire; Osnabruck Centre, Ont.; loss, $3,000.——July 3rd. A. McNair's sawmill, Hastings, B.C.; loss, $20,000.——June 10th. E. Laliberte's steam yacht, St. John, N.B.; loss, $1,000.——June 11th. The leach houses of the Lang Tanning Co., Berlin, Ont.; loss, about $3,000.——June 11th. Trenholm & Armitage's woolen mill, Coaticook, Que.; loss, $8,000.——June 11th. The Residence, Mount Allison University, Sackville, N.B.; loss, $60,000, insured; to be rebuilt at once.——June 16th. Dun Bros., shingle mill, Beckwith, Ont.; destroyed.——June 18th. A Riddell's saw and shingle mill, Hopeville, Que.; destroyed. ——June 20th. James M. Squire's grain elevator, Wellington, Ont.; destroyed; partially insured.——June 20th. Toronto, Ont, Glass Co.; carpenter shop destroyed; other buildings damaged; loss, $10,000; fully insured.——June 20th. Kingston, Ont., Montreal Transportation Co.'s, tug "Bronson;" burned. ——June 26th. Iroquois, Ont., water-works buildings destroyed; loss, $6,000.——June 28th. Lethbridge, N.W.T., fan-house and casing, No. 2 shaft; destroyed.——June 29th. Toronto Industrial Exhibition buildings, Machinery Hall, destroyed; loss, $17,000.——July 2nd. Laurentide Pulp & Paper Co., Grandmere, Que.; damages about $35,000.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades in May, 1898-99 and the five months ending May, 1898 and 1899:—

	Month of May,		Five Months to May,	
	1898.	1899.	1898.	1899.
Hardware	£1,051	£1,295	£8,896	£7,595
Cutlery	1,654	5,332	14,700	20,970
Pig iron	550	1,447	5,774	3,431
Bar, etc.	792	1,152	4,143	3,524
Railroad	—	12,358	6 972	12,507
Hoops, sheets, etc.	6,053	16,013	11,260	22,658
Galvanized sheets	6,888	13,805	20,648	19,316
Tin plates	21,122	21.379	60.333	54,376
Cast, wrought, etc., iron	2,811	6,199	11,383	12,256
Old (for re-manufacture)	606	437	1,504	573
Steel	4,721	11,647	24,129	23,626
Lead	3.703	6,883	7,805	14,643
Tin, unwrought	2,967	1,663	8,108	7,267
Alkali	5,169	6,591	16,634	13,237
Cement	2,650	4,684	8,093	9,018

SUPPLEMENTARY ESTIMATES OF THE DOMINION.

Intercolonial Railway.—To provide new machinery at Moncton and Riviere du Loup shops, etc.	$ 35,460 00
Enlargement of Farran's Point Canal	22,000 00
Deepening, etc., North Channel, St. Lawrence	212,000 00
Deepening, etc., River St. Pierre, Lachine Canal	8,500 00
To purchase double metallic telephone line, Chambly Canal	700 00
River St. Lawrence ship channel	60,000 00
Halifax Quarantine Station, Lawlor's Island	17,000 00
New dredging plant	15,000 00
Towards the construction of Upper Traverse permanent lighthouse, to replace lightship	20,000 00

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Toronto No. 1, Canadian Association of Stationary Engineers, held its annual meeting June 21st in the hall at 61 Victoria street, when the following officers were elected: President, H. E. Terry; vice-president, J. Huggett; recording secretary, W. J. Webb; financial secretary, A. E. Bourne; treasurer, S. Thompson; conductor, James Bannan; doorkeeper, W. Butler; trustees, W. Lewis; A. E. Edkins, W. J. Webb; delegates to convention, A. E. Edkins, C. Moseley, I. W. Marr, W. J. Webb, J. G. Bain.

Hamilton branch, Stationary Engineers' Association has elected the following officers for the ensuing year: President, T. Chubb; vice-president, A. Scusthrope; recording secretary, Jos. Ironsides; financial secretary, J. Carroll; conductor, W. Collins; doorkeeper, C. Carter; treasurer, W. Cornish; trustees, R. C. Pettigrew, George Mackie and W. Stevens; representatives to Executive Association, George Mackie and Joseph Ironsides.

The Association of Stationary Engineers, No. 9, Berlin, has received a grant of $50 from the municipality towards issuing a souvenir programme for their annual convention to be held in Berlin on August 15th, 16th, and 17th next.

At a meeting of the Canadian Association of Stationary Engineers, Montreal, last month, the following officers were elected for the ensuing year: President, W. Ware; first vice-president, H. L. Thompson; second vice-president, J. O'Rourke; recording secretary, J. Carr; corresponding secretary, H. Smythe; financial secretary, H. Nuttall; treasurer, T. Ryan; conductor, W. Wady; doorkeeper, J. Hartenstein; trustees, H. Smythe, J. J. Yorke and J. Murphy. This branch has withdrawn from the Executive, the matter having come up for discussion twice recently. The first vote gave a majority for remaining in the general association, but in the last vote it was decided by a majority of about two to one to withdraw and continue as an independent association. The principal reason urged for the step appeared to be that the cost of sending delegates to the convention was too great for the advantages derived from it.

THE NATIONAL ASSOCIATION, MASTER PLUMBERS AND STEAM FITTERS OF CANADA.

The Master Plumbers' Convention opened in Ottawa, June 30th, with 30 delegates in attendance. President Wm. Smith of London, Ont., was in the chair, and the session was devoted to the reception of reports and the appointment of standing committees. The reports of William Mansell of Toronto, the secretary, showed that the organization is in a prosperous condition and that trade in Canada has had its share of the present good times. The finances of the association are likewise in good condition. The annual banquet of the association was held the first night. The following officers were elected: President, W. H. Harris, Montreal; vice-president, W. Mansell, Toronto; treasurer, W. Meredith, Toronto, re-elected; secretary, P C. Ogilvie, Montreal; Executive Committee, Jos. Wright, British Columbia; John Watson, Manitoba; H. A. Knox, Ottawa, Ont.; J. Wilson, Montreal, Que ; Frank Powers, Lunenburg, N.S., Maritime Provinces. Next year's convention will be held in Montreal.

THE CANADIAN ELECTRICAL ASSOCIATION.

The ninth annual convention of the above association was held at the New Royal Hotel, Hamilton, on the 28th, 29th and 30th June, the president, W. H. Browne, of Montreal, in the chair.

Among those who registered attendance were the following: A. A. Dion, C. Thomson, John Murphy, D. R. Street, W. W. Grant, W. Ahearn jr., and O. Higman, of Ottawa; W. H. Browne, Alex. Barrie, W. J. Plews, J. Carroll, P. G. Gossler, F. H. Leonard, jr., C. H. Wright, Geo. H. Olney, N. W. McLaren, N. C. Ross, R. E. T. Pringle, Frederic Thomson, P. H. Hart, H. G. McLaren, C. A. Woolsey, E. A. Wallberg and William T. Bonner, of Montreal; A. M. Wickens, A. F. Macallum, Wm. McCaffrey, Joseph Rogers, John Milne, O D. MacArthur, E. D. McCormack, W. H. Warrington, G. F. Haworth, A. C. McDonald, A. Esling, T. R. Rosebrugh, J. W. Campbell, J. J. Ashworth, A. P. Horner, C. H. Mortimer, E. B. Biggar, A. E. Payne, J. A. Kammerer, J. J. Wright and A. B. Smith, of Toronto; Geo. Black, W. A. Turbayne, E. Irving, W. G. Angus, F. W. Martin, J. B. Griffith, H. R. Leyden, H. W. Woodman, J. A. Nelles and Gordon J. Henderson, of Hamilton; Mark B. Thomas, of Dundas; C. H. Waterous and J. F. H. Wyse, of Brantford; E. E. Cary, G. A. Powell, D. H. Henderson and J. Sangster, of St. Catharines; Geo. C. Hinton, Vancouver, B.C.; H. O. Fisk, Peterboro; John Yule, Guelph; S. E. Fletcher, St. John's, Que.; J. W. Purcell, Walkerville; A. A. Wright and W. A. Mackay, Renfrew; Andrew Sangster, Sherbrooke; L. A. Somers, Halifax, N.S.; James Waddell, Charlottetown, P.E.I.; John Philip, Grand Valley; B. F. Reesor and — Sadler, Lindsay; Stephen Noxon and John E. Gayfer, Ingersoll; Geo. W. Shand and W. Williams, Sarnia; J. E. Bilger and W. A. Green, Berlin; James Anderson, Windsor; P. H. Hover, New York.

Before proceeding with the order of the day the president called upon Mayor Teetzel to open the meeting.

The mayor, who was received with cheers, said a more hearty welcome could not be given to any body of men than to the electricians. Hamilton was especially interested in electricity. It was in this city that this association held its first convention in 1892, and comparing the present association with that which gathered here in the days of its infancy, he must congratulate them on the advance made. To the members attending the present convention he would point out the fact that no city on this continent, east of the Mississippi, had so much electrical power transmitted so great a distance, as Hamilton, which has now fairly earned its new title of the "Electrical City." This result was largely due to the enterprise and courage of its own citizens. He would mention two other facts of historic interest; one was that Hamilton was the first city in Canada whose streets were lighted by arc lamps, arc lighting having been introduced in 1884; and it was the first Canadian city to have a system of electric street railway. In the great revolution which electricity was making in the industrial arts Canada had taken no mean part, for Bell of telephone fame was a Canadian by birth; Edison had received his early education in Canada, and had we not our Wrights, our Thompsons, our Leydens and our Brownes?

Mr. Yule on behalf of the association returned thanks to the mayor for his warm welcome.

The business of the convention then began with the presidential address. President Browne, after referring to the papers that had been provided on various subjects, said:

"You will be particularly gratified by the report of the Committee on Legislation, through whose efforts was achieved the passage at the last session by the Ontario Parliament of an eminently just enactment having to do with relations between municipalities and electric companies. The report of that committee will show that both municipalities and existing electric lighting interests are protected from unwise and hasty investment on the one hand, and from constantly impending danger of threatened annihilation of existing investments on the other hand.

"The ninth convention of this association is very appropriately held in the city where its first convention took place. Nowhere could the progress of electrical development be more emphatically demonstrated nor the contrast with conditions existing only seven years ago, be so sharply defined than in this city of Hamilton. For here is tangible evidence in active daily operation of the furthermost advancement of the electrical art of to-day, in the distribution of the potential energy of Lake Erie throughout the city, dispelling its darkness and operating the machinery of its manufacturers. At the first convention of this association, held in this city only seven years ago, the probability of such a practical, commercially successful demonstration was considered to be in the far and remote future, as appears from the record of that convention. The transmission of energy a distance of thirty odd miles, as is the case here in Hamilton, was looked at doubtfully both from a physical and commercial standpoint. To-day no doubt exists as to the physical capability of transmitting and manipulating electric currents of high potentials, long distances, for the varied uses of light, power, heating, chemistry and metallurgy. The ques-

tion no longer is, 'Can we apply the electric current to this and to that purpose?' but 'What new fields of enterprise can it enter and develop?' This transformation in Hamilton took place shortly after the conclusion of the convention last year in Montreal. Since that time also there has been put into operation, a plant at Rossland, British Columbia, transmitting about the same amount of power the same distance as here. Many of you last year visited the works at Chambly, then under construction for the transmission of current to Montreal, and it is my pleasure to announce that the electric current has been transmitted from the power house on the Richelieu River, and the waters of Lake Champlain, transformed into electric energy, flow throughout the city of Montreal. Such enterprises are so much the accepted fact and indicate successful physical accomplishment so thoroughly, that many other similar enterprises, covering even greater distances, are being seriously considered by conservative capitalists, keen to perceive the great commercial advantages that will accrue from the developments made in this field of electric science.

"Arising from the increased uses of water powers for the generation of electric energy and the successful application of such energy to commercial motive power uses, a condition is beginning to assume shape with every indication of increasing, which may modify existing manufacturing conditions, and perhaps change habits and methods of living. I refer to the limitation of the use of electric current for manufacturers' motive power to the hours of daylight, or perhaps more properly speaking, to the time outside of those hours when the need of illumination makes greatest demand upon the electric plant. A considerable objection to undertaking to seek motive power business, has been the necessity of increased capital for plant in excess of lighting requirements, to take care of the load which would exist during the hours when the motive power load and the lighting load would be called for simultaneously. The idea has been maintained and acted upon that it is profitable for many, if not all manufacturers, to discontinue work as soon as the dark hours begin, for the reason that the cost of manufacturing is increased during such dark hours by the necessity of expense for illumination, and by the diminished productive capability of the operatives. Besides avoiding these increased expenses, manufacturers can obtain the use of electric current for power, at a considerable reduction in price outside of the hours in which the greatest demand necessarily occurs for lighting. The cost of motive power to the manufacturer can be thus made much cheaper than he could otherwise produce it.

"This additional source of revenue, or increased return upon capital investment for plant and lines, will also enable the generator and distributor of electric current to sell such current for lighting profitably, at a less rate than when no revenue is derived from the plant in the day time. Less price for lighting will assist materially in the increased use of electric current for illuminating purposes. Since this idea was first suggested it has grown considerably, and its application is being gradually extended, and it does not seem too much to say that in a few years the hours of manufacturing will be restricted to the hours of daylight, with all the advantages that will result therefrom. While this condition is of most value to the water power generation of electric current, it is of great value also to steam generating plant, by reason of the increased return upon invested capital which it will provide. The suggestion is well worth thoughtful consideration and furtherance.

"In another direction also, the assembling of our convention in this city demonstrates the progress that has been made since the commencement of the career of the association. At the first convention there were present 57 active and 24 associate members. The total membership of the association, by the report of the secretary-treasurer, at the present time is about 250. This increase, continuous and progressive from the first convention, indicates not only lively and hearty appreciation of the advantages to be derived from association for mutual intercourse and improvement of knowledge from interchange of ideas, but also denotes continuous growth of the electric interests and the progressive development of new enterprises.

"Surveying the entire field of electrical industry in Canada to-day, it may be fairly said that if all are not in thoroughly sound and healthy condition, the greater number of them are prosperous and improving. In the days of the first convention, this could not be so well said, for as many of you remember, conditions were precarious and probability of success uncertain. Here again I may allude to the result recently accomplished by our Committee on Legislation, which will greatly tend to advance such prosperity. Already it has had the effect of strengthening and fortifying existing enterprises, encouraging owners to endeavor to extend and increase their business, to enlarge and better their plants, because now they feel assurance that their investments are protected, and that they cannot be deprived of them ruthlessly and recklessly. This is as it should be, not only from the point of view of the private owners of such enterprises, but from that of the general public and municipal interests."

After urging members to solicit new members to join the association he went on to say: "The value of concerted action for mutual information and advantage may be illustrated by the following: Many persons interested in electric lighting were solicitous as to the possible invasion of their business by acetylene. For the purpose of assembling authentic information as to the progress, present status and use of acetylene for domestic and commercial illumination, a circular was sent to cities, towns and villages throughout Canada, having electric plants, requesting exact statements as to the conditions existing in those localities concerning its use and its interference with electric lighting. Replies were received from 103 localities. The results have been tabulated, and with some extracts from newspapers, will be presented in the proceedings of the convention, so that every member will have accessible the fullest and latest information on that subject in convenient form. Here it seems sufficient to say that no serious menace for the present, at least, need be anticipated therefrom to the electric lighting industry, although undoubtedly useful and profitable fields will be found for the desirable and proper use of acetylene." In conclusion Mr. Browne thanked the officers and members of the committees for their hearty co-operation, and resumed his seat amid applause.

The secretary-treasurer, C. H. Mortimer, then read his report, which, after referring to the important work done by the Committee on Legislation in dealing with amendments to the Municipal Act—a work which had already justified the existence of the association—recommended further action towards safeguarding the rights which have been secured to electric lighting companies by the Conmee Bill. The Executive Committee held three meetings during the year. At the first of these, held on September 9th, accounts in connection with last convention amounting to $240 were passed; the additional sum of $50 was granted to assist the Entertainment Committee to discharge its obligations. On March 23rd, the committee met to consider arrangements for this convention, and other business; a committee was appointed to make the necessary local arrangements, consisting of George Black, H. R. Leyden, Gordon J. Henderson, E. E. Cary, Wilfrid Phillips, A. B. Smith, together with the following gentlemen as honorary members: Clyde Green, J. A. Nelles, Mark B. Thomas, J. B. Griffith, with power to add to their number. A committee to arrange for convention papers was appointed as follows: The President, E. E. Cary, A. A. Dion, J. J. Wright, John Carroll and the secretary.

On the 20th of May, the committee met to receive reports of the various sub-committees, and to complete arrangements for the convention. Accounts for convention buttons and printing, $23.05, were passed.

The number of new members elected since last report is as follows: Active, 20; associate, 2; total, 22. During the same period there have been removed from the roll 14 active, and 1 associate, leaving the present membership 241, or a gain of 7 over last report. (New members added since the report was made up bring the total membership to about 250).

Several members in arrears for fees have objected to make payment, on the ground that they joined the association for one year only. It should be clearly understood that when a person joins the association, he is to be regarded as being a member until his formal resignation is placed with the secretary. I would respectfully suggest that the form of application for membership be altered so as to conform to this view.

The receipts and disbursements have been as follows:

FINANCIAL REPORT FROM MAY 31ST, 1898, TO 31ST MAY, 1899.

Cash in bank, June 1st, 1898	$281 18
Cash on hand, June 1st, 1898	19 46
151 active members' fees at $3	453 00
1 active member's fee at $3, paid $2	2 00
22 associate members' fees at $2	44 00
	$799 64

DISBURSEMENTS.

Expenses of convention		$435 14
Grant to local committee	$200 00	
F. J. Jenking, stenographer	40 00	
Martel-Stewart (show cards)	5 00	
Convention buttons for 1898	64 64	
"Electrical News" printing account	101 50	
Cuts for convention paper, and duty on cuts	20 49	
Express on parcels	2 08	
Telegrams	1 43	
Grant to secretary		$125 00
Postage		46 18
Express charges		26
Letter file		40
Telegrams		1 00
Exchange on cheques		3 60
Stationery and printing		19 95
Buttons and badges for 1899		12 50
Balance in bank		137 76
Balance on hand		17 85
Total		$799 64

The report was adopted, the financial statement having been duly audited.

RECEIPTS.

Cash in bank, June 1st, 1899	$137 76
Cash on hand, June 1st, 1899	17 85
52 active members' fees at $3	156 00
5 associate members' fees at $2	10 00
Total	$321 61

DISBURSEMENTS.

Postage	$ 12 30
Exchange on cheques	1 65
Stationery	55
Cash in bank, June 27th, 1899	296 76
Cash on hand, June 27th, 1899	10 35
Total	$321 61

The Committee on Legislation reported through the chairman, John Yule, that they had made a strong and successful effort to show the legislature of Ontario the righteousness of the contentions of the electric lighting companies, and to show the injustice of the provincial law as it then stood. The result is that the provisions of the Act relating to the transfer of waterworks from private corporations to municipalities are made to apply to electrical companies on equitable terms. High praise was given to James Conmee, member for West Algoma, for the patience and tact with which he handled the question, and the force with which he had stated the case to members, as well as for the fairness he had shown to those who raised objections to the bill in the public interests. The new bill, therefore, gave every security to the public and to municipalities, while safeguarding the rights and investments of the companies. The names of Donald Guthrie, Q.C., Guelph; W. D. McPherson and Edward Bayley, of Toronto; Mr. Gould, of Hamilton, and Mr. Pepler, Q.C., of Barrie, were also mentioned in connection with the bill. About fifty companies contributed to the fund for the defence of the electrical interests, a statement of which was appended, the names of the Royal Electric Co. and the Packard Electric Co. being mentioned for their generous and unsolicited donations to the fund. The committee called special attention to two clauses in the new Act. One of these clauses provided that companies in cases of disagreement with the municipalities may have the contract price for street lighting fixed by arbitration, thus removing the complaint that lighting companies could make a municipality pay an unreasonable price where there was no competition. The other clause was that fixing the price of residential lighting by arbitration also. While there seemed to be every probability that the principle of the Conmee bill would be maintained it was desirable that a fund should be created by annual contributions from the electric light and power companies and allied interests for the purpose of watching future legislation affecting their business. The committee had paid for legal services $1,854.87, and for printing, etc., $171.90, and had a balance in hand of $75.67. The subscriptions to the fund amounted to $1,955, which with the balance in hand from the previous year made a total of $2,102.44, disposed of as above specified.

Mr. Dion, in moving the adoption of the report, said this committee had done an enormous amount of work, and their zeal was beyond all praise.

P. G. Gossler presented the report of the committee appointed to confer with the underwriters of the province of Quebec as to the regulations governing electrical installations. The question of building regulations and inspection of wiring was discussed with the secretary of the Board of Underwriters and a special committee of the same, but no understanding could be arrived at. The underwriters held that the cost of the system of inspection would be too great for them to undertake. They had provided rules for electrical installations, and they considered that the electric companies should in their own interests see that these rules are carried out. The committee, however, recommended that the work be continued in the hope of bringing about a more efficient system of inspection. After discussion it was decided that the committee be maintained, the following being members: P. G. Gossler (chairman), Montreal; A. A. Dion, Ottawa, Ald. Geo. W. Sadler, Montreal, and Andrew Sangster, Sherbrooke, Que. In connection with this report a letter was read from Ald. Sadler, explaining that until the amendments to the city charter had been adopted it was considered advisable to defer the proposed building regulations, of which the electrical regulations would form a part.

Mr. Dion wished to place on record the sense of loss sustained by the association in the death of F. H. Badger of Quebec.

J. A. Kammerer, chairman of the Statistical Committee, reported that the committee had during the year gathered a quantity of information on the electrical industries of Canada, but as the data could not be completed in any department it was desirable to continue the committee for another year under the same personnel. The report was adopted.

J. J. Wright, chairman of the Committee on Meter Inspection, reported that there were no special developments during the year calling for a formal report.

Mr. Dion said it was desirable to take up the question of the Government regulations on meters, which might be amended so as to allow of the breaking of the seals of meters under certain restrictions. The cost of meter inspection is quite an item with some companies, and the privilege of adjusting meters on the premises where the difficulty was of a simple nature would save much expense.

The president appointed the following as a committee to nominate officers for the ensuing year: Messrs Cary, Carroll, Wright (Toronto), Yule and Wyse.

Mr. Dion then read his paper on "Meters and Meter Rates," which will be found on another page.

Mr. Gossler, in opening the discussion on the paper, said that in testing meters in series they were apt to run slow owing to induced current, and great care was necessary with meters having jeweled bearings. There was a great difference in the behavior of meters. Some would start on two-tenths of one per cent. of the load, but the proper registration of a meter under half a load entirely depends upon jeweled bearings.

Mr. Fisk said his experience was that the Thompson recording watt meter ran slow on a light load. This was due to friction of the parts, but he found that if an auxiliary coil was put on this friction would be overcome.

In reply to Mr. Wright (Renfrew), Mr. Gossler said the meter records were kept by a sort of card catalogue, each of which gave the history of a meter for a year.

Mr. Dion said that in Ottawa the station meter was used to check off the records of all the other meters. The total readings of the customers' meters were compared with the record of the station meter, and the difference between the two showed the waste and the amount out on flat rates.

Mr. Wright (Renfrew), said the meter records of his company were kept in a book, two pages being devoted to a customer, and showing the record of each customer and meter.

Mr. Browne said that by the card system adopted by his company, each reading of the customer was shown for the year, and any change of meter was noted on this card. The accounts were first sent out quarterly, following the rule in vogue with the gas company, but they changed to monthly accounts, and after a time the customer got into the way of paying monthly. The change was satisfactory alike to the customer and the company, as the monthly bill was not only easier to pay, but the months of heavy and light consumption could be readily compared with the same months of previous years, whereas if the bill ran for three months it was not so easy to convince the customer that the size of the bill was in proportion to his actual consumption.

Mr. Dion, replying to Mr. Gossler, said it did not matter about the induction load, provided the master meter used in the test was affected the same as the other meters.

Mr. Gossler said his company found that to adjust the meter to three-quarters of a load was more equitable to all concerned.

Mr. Dion said he tested to half a load also.

The debate was then adjourned to allow the members to take a trip over the Hamilton Radial Railway to Burlington Beach, visiting en route the power house of the company, and the power house of the Hamilton Street Railway. An excursion on the lake which had been planned for the evening was given up owing to the gale that blew during the afternoon and evening.

On reassembling Thursday morning the president brought up the subject of the Legislation Committee's proposition to create a fund for keeping in touch with future legislative movements.

Mr. Yule suggested that the companies should be asked to contribute annual subscriptions, ranging from $10 each down to $1 or $2, and that a solicitor be retained to watch matters.

The president wished it to be thoroughly understood that the companies were only fighting against unjust legislation, and were not necessarily opposed to any law that might be introduced.

Mr. Wright (Toronto), moved, seconded by Mr. Wyse, that the plan of annual subscriptions be carried out, leaving the details of the plan to the committee.—Carried.

Upon the report of the nominating committee the following were elected to compose the standing committees of the year:

Committee on Statistics: J. A. Kammerer (chairman), A. A. Wright, Renfrew, and J. F. H. Wyse.

Committee on Meters.—A. A. Dion (chairman), E. E. Cary and J. J. Wright (Toronto).

Committee on Legislation.—J. J. Wright (chairman), B. F. Reesor, C. B. Hunt, John Yule, H. R. Leyden, A. A. Dion, W. H. Comstock and A. L. Breithaupt.

In a short discussion on the subject of fire underwriters' rates governing electrical installations in buildings Mr. Gossler said the only places in Canada where the fire underwriters' rates were enforced by the local authorities were Winnipeg and Brandon.

Mr. Woolsey gave the general practice in the United States, where in most cities there was a double inspection of wiring and other electrical installation. First, the city had its inspector, who passed upon the work, and then the insurance companies sent their inspector to see that all was right. If either inspector condemned any part of the work it had to be altered.

The president said the difficulty here was that there was no centralized authority to whom one could look to see that the rules framed by the fire underwriters were carried out. It would be immaterial whether the inspector was appointed by a city or by the insurance companies. He suggested that the name of Andrew Sangster be added to the committee on this subject.

This suggestion was adopted, the committee being composed of Messrs. Gossler, Dion, Sadler and Sangster.

On the proposition of Mr. Dion it was unanimously decided that Ottawa should be the next place of meeting.

On motion of Mr. Leyden, seconded by Mr. Yule, it was decided to present to James Conmee, M.P.P., a suitable testimonial in recognition of his services in behalf of the fair and equitable legislation that had been obtained in Ontario for the protection of electric light companies.

On motion of Mr. Smith the usual grant was given to the secretary.

The discussion on meters was then resumed by Mr. Wright, of Montreal, who considered that an ammeter was as good as a dynamometer for all practical purposes. Large meters working on a small load often gave a loss, and it often happened that after midnight a meter would stop altogether. Sometimes a difference of 20 to 30 per cent. would be recorded in a house meter working at different hours under the same number of lights.

Mr. Leyden thought it was better to inspect meters on the premises for the satisfaction of the customers.

Mr. Fisk said the companies paid the Government to keep the public informed on the subject of meters, and if they tried to humor every customer they would keep themselves in hot water all the time.

Mr. Woolsey said the rule in the United States was that where there was a doubt about the correctness of a meter the customer might demand a test. If on calling in the inspector the meter was found correct the customer paid the inspector's fee of $1, but if it was not correct the lighting company paid the $1.

Mr. Dion said that in Ottawa the Government Inspector refused to inspect meters on the premises, so that such a plan was out of the question.

Mr. Gossler said that out of 3,000 customers of his company (the Royal Electric Co.), they had not thirty complaints in a whole year, although they used several different makes of meters.

Mr. Brown added that their practice was to explain the mechanism and the working of the meter, as clearly as possible, and the customer was more easily satisfied when taken into the company's confidence. On the subject of meter rates, he explained that the Royal Electric Co. had three rates: 1st, a single rate; 2nd, a rate fixed by a measurement of the first hour per lamp per day, and for all in excess of this a low rate representing the cost of production of current beyond the first hour. They took the number of lamps in a place and multiplied by 30 days, from which result, by deducting the sum of the first hour's consumption, the excess could be shown. The maximum transformer capacity of each customer is determined. The third method is to charge a fixed sum per year, representing the cost of the energy required to keep in readiness to serve the customer, plus a return on the plant invested in the customer's installation. This rate was usually for large establishments. Accounts were payable monthly, and no contract made for less than a year, while about 2,000 of their customers were under a five years' contract. Recounts of lamps in customers' premises were made from time to time.

Mr. Wright (Toronto), said his company separated commercial lighting from residential lighting, allowing a discount of 40 per cent. off the former, and 60 per cent. off the latter rates. An allowance is made to large consumers. Meters are used in all cases.

Mr. Henderson said that in Hamilton, since the first of May this year, special inducements had been given to merchants for window lighting in the evenings, and they found the plan generally appreciated by the merchants and public, as it gave the city a very attractive appearance.

A hearty vote of thanks was given to Mr. Dion for his valuable paper.

Mr. Hart's paper on "Central Station Accounting," was then read. This paper will appear in next issue.

In the afternoon the Nominating Committee submitted the names of candidates for the Executive, to be voted on the following day.

During the discussion of Mr. Hart's paper, it was decided to recommend to all central stations a uniform system of keeping accounts, and a committee, composed of Mr. Hart and Mr. Wright, of Renfrew, was appointed to draw up a plan.

The president announced that the following question had been put in the "Question Box:" "What is the watt gain in transmission in the line of the Cataract Power Co., and how do you explain it? Is it possible that the line is crossed with the Radial Railway?" (laughter).

Mr. Leyden, in reply, said there was no gain at all. We have a rise of potential of about 10 per cent. at no load varying from 15 to 18 amperes per phase of 2,000 volts, but as the load comes on, the effect disappears gradually in proportion to the load. But it can be made to disappear altogether by putting on an inductive load; or over exciting the synchronous motors, making a leading current. This phenomenon was first discovered at Ferranti's plant at Deptford, near London, and is known as the Ferranti law. There is no gain in power; only an apparent gain in the pressure.

Another question in the box was, "Where is the proper place to begin charging a customer for wiring, at the property line or inside the building?"

Mr. Dion thought the company's responsibility should cease at the secondary terminals of the transformer.

Mr. Wright (Toronto), said the company should charge for wire only up to the point where the wire touches the building; and technically speaking the meter and cut-outs should be considered the property of the customer, otherwise the company might be held responsible for a fire or accident inside the building.

Mr. Leyden remarked that all fixtures were subject to seizure.

Mr. Browne said his company had a clause in its charter specially exempting from the ordinary law of seizure all their wires and other property, so that when a seizure was threatened, the landlord was notified of this exemption.

Mr. Gossler thought that all secondary wiring only should be the property of the customer.

Mr. Dion agreed that the company should own all the primary installation. He would like to sell the meters to the customers, but conditions were such that this could not be done in Ottawa.

Mr. Woolsey said that in the United States all property placed with screws belonged to the company.

Another question was "Should rent be charged for meters?"

Mr. Wright (Toronto), said all watt meters and direct reading-meters were charged for by his company. This had to be done to cover the cost of Government inspection.

Mr. Anderson said that in Windsor a charge was made for meters in all cases where the customer's account was under $5 per month, but not when it was in excess of that amount.

Mr. Leyden thought each department should pay for itself, and a charge of $3 a year was reasonable. He figured that 20 per cent. of the value of the meter was a fair annual rental.

Mr. Wright (Renfrew), said his company charged 25 cents a month for meters and this was a fair rate, when the company had to pay Government inspection, repairs, etc.

The subject of day and night loads on central stations was then discussed. This will be referred to in next issue, as will also Mr. Plews' paper on the "Protection of Low Tension Wiring Againt Dangerous High Potential Currents."

The next paper was that on "Transformer Economy," by F. H. Leonard, which will be found on another page.

On Thursday evening the annual dinner was held, the president in the chair. After the toast of "the Queen" "Our Association" was responded to by J. J. Wright, of Toronto; "Our Guests," by Col. Shepard, U.S. Consul; "Hamilton, the Electric City," by Mayor Teetzel; "Our Rights and Wrongs," by S. Noxon, and the "Press," by A. F. Pirie.

On resuming business Friday morning, the president announced a telegram from George Johnson, Dominion Statistician, stating that the number of passengers carried by the electric railways of Canada last year had reached the 100,000,000 mark. The announcement was greeted with cheers.

The election of officers was then proceeded with, the result being as follows:

President, A. A. Dion, Ottawa; 1st vice-president, E. E. Cary, St. Catharines; 2nd vice-president, P. G. Gossler, Montreal; secretary-treasurer, C. H. Mortimer, Toronto; Executive Council, J. J. Wright, Toronto; A. B. Smith, Toronto; Ormand Higman, Ottawa; John Carroll, Montreal; George Black, Hamilton; D. R. Street, Ottawa; Andrew Sangster, Sherbrooke; J. F. H. Wyse, Brantford; B. F. Reesor, Lindsay, and W. H. Browne, Montreal.

A. A. DION.

A biographical sketch of A. A. Dion, the recently elected president of the Canadian Electrical Association, appeared in the issue of The Canadian Engineer for July, 1898.

P. G. GOSSLER.

P. G. Gossler, the newly elected second vice-president of the Canadian Electrical Association, was born in the State of Pennsylvania, 28 years ago, and was educated at the High School and Pennsylvania State College, Philadelphia. He took a course of mechanical engineering, in which he graduated in 1890. After a year in the draughting room of the Chester Foundry and Machine Co. and the Edison General Electric Co., he went to the United Elec. Light & Power Co., N.Y., as assistant to the chief electrical engineer. He remained there till 1895, when he came to Montreal and entered the service of the Royal Electric Co. as engineer and superintendent of the light and power department. Mr. Gossler is a young electrician of high promise, and in the discussions at the recent convention his observations were distinguished by their pertinence and lucidity.

During the election a lively debate took place on the question whether members representing electrical supply concerns should be eligible for election to the higher offices of the association. Mr. Black's name had been presented by the Nominating Committee as first vice-president, but on the demand of Mr. Carroll that there should be some "young blood" in the Executive, Mr. Black promptly withdrew his name. Had he stood he would undoubtedly have been elected, but upon his withdrawal the name of Stephen Noxon, representing the Central Station interest, was put up against E. E. Cary, the candidate of the "supply men." Mr. Kammerer, supported by Mr. Woolsey and others, maintained that by an

unwritten law it was understood that the offices of president and vice-president should be filled by men representing either central station interests or telephone and telegraph interests, and that where the rule had been departed from, in the case of the older associations in the United States, it had lowered the status and influence of the organization. Messrs. Bonner and Carroll thought, however, that the lighting men were as much dependent on the supply men as the supply men were upon them. Messrs. Dion and Anderson regretted that the discussion had taken this turn, and deprecated any jealousy between the two interests. On being put to vote Mr. Cary was declared elected by 29 to 26. Several members, representing central stations, were absent from this session.

The following resolution was moved by O. Higman, seconded by James Anderson: Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy the illuminating power of the arc lamp, and the great necessity for a more precise definition and statement of the obligation of the producer of electricity for illuminating purposes to the consumer thereof, be it resolved, "That in the opinion of this association, what is ordinarily known as a 2,000 candle-power arc lamp is one requiring on the average 450 watts for its maintenance, the measurements being made at the lamp terminals, where no sensible resistance is included with the arc. In case such resistance is used it must be excluded in the measurement."

The mover said there was a good deal of misunderstanding in the matter, and he was frequently called in to decide disputes in regard to lighting contracts, which might not occur if there was a clearer definition of the power of arc lamps.

Mr. Gossler suggested that in view of the practice of reducing the candle-power of lamps and increasing the number of lamps, it might be well to put the definition so that it would be of more general application.

Mr. Thomson (Montreal), also pointed out that 450 watts of straight current would give more candle-power than the same number in alternating current, and there was also a difference between open and enclosed arc lamps.

The president understood the resolution to mean, not that the association should make an arbitrary standard, but that the term candle-power should be abolished, and that contracts should be on the basis of the energy supplied.

Mr. Gossler pointed out another difficulty. An energy of 450 watts might be supplied to a lamp, but in some lamps 300 watts of this energy might be consumed in the mechanism of the lamp, and only 150 appear in light.

Mr. Higman said that the average lamp known as 2,000 c.p. really gave only about 750 c.p., so that when the term was used, the contracting company undertake to give what they really cannot give, and the words candle-power should therefore be dropped.

After further discussion Messrs. Higman, Gossler, Thomson (Montreal), Yule and Wyse were appointed a committee for the purpose of taking up the question raised by the resolution, and rating the power of arc lamps on the basis of energy.

On motion of Mr. Yule, votes of thanks were passed to the City Council, and the various companies, who had contributed to make the convention a success.

Mr. Turbayne's paper on "Enclosed Arc Lamps," was then read. It will be dealt with in another issue. Mr. Cary's paper, which is also crowded out, was taken as read.

After short addresses by the retiring president, and incoming president, the convention closed with a vote of thanks to president Browne for his unselfish devotion to the interests of the association during the past year.

CONVENTION NOTES.

The trip out to Grimsby over the Hamilton, Grimsby, and Beamsville Electric Railway was one of the pleasantest features of the convention, and manager Nelles' care of and attention to his guests was highly spoken of.

The most instructive of the social features was the trip to the great power-house of the Cataract Power Co., at Decew's Falls, about four miles from St. Catharines. The members were given complimentary tickets by G.T.R. to St. Catharines, where several vans awaited them, and the trip afforded some glimpses of the rural surroundings of the Garden City. The view from the top of the bluff at the intake was greatly admired. The Cataract Power Co. started last November with the transmission of 500 horse-power, which has been increased till now they are sending about 1,400 horse-power into Hamilton. This will be increased shortly by several large contracts, bringing the total up to 2,400 or 2,800 h.p.. The power-house, as it stands, has equipment for 7,500 h.p., but if the capacity of the company's canal were fully taken up, it could transmit 15,000 h.p.

Hamilton presented quite a gay appearance during the convention. The Gore in King street, so rich in its floral display, was illuminated at night with festoons of colored incandescent lights, while the City Hall had across its front in large electric light letters the words "Welcome to Hamilton," and the headquarters of the convention were illuminated with the monogram of the association inside a maple leaf.

TRANSFORMER ECONOMY.*

F. H. LEONARD, JR., MONTREAL.

The practical use of A. C. transformers covers a period of little more than a decade, and yet in so short a period has been developed into the most perfect piece of apparatus known to the art of electrical engineering. Transformers having a full load efficiency of 98 per cent. in the large sizes are not unusual, and in the very large sizes even this high figure is exceeded, and with the best designs the no load losses are less than one-half the full load loss, permitting an exceedingly high efficiency to be maintained over the entire working range. While the commercial application of transformers is so recent, the principle was demonstrated more than 67 years ago by Farady, whose investigations gave to the electrical engineer the principles on which are based the science of dynamo electricity. Farady, in 1832, made a crude transformer, which is identical in general principle and construction with the commercial article of to-day. There are many types and modifications of details, but the commercial transformer of to-day may be simmered down to two general types, known as the shell type and the core type; the once much-talked-of hedgehog transformer, so stoutly championed by Swinburne, having dropped out of the race entirely. There are still strong adherents to both of the first-mentioned types. The adherents to the core type of transformer will tell you that the coils are more easily wound and the core itself more easily insulated, that the copper coils being on the outside radiate the heat due to internal losses more quickly. Notwithstanding these seeming advantages to the casual observer, the Johnson & Phillips Co., Ltd., of London, England, who first manufactured this type of transformer from the designs of Gilbert Kapp, after extensive experience with them, abandoned their manufacture and became adherents to the shell type.

For an equal investment in material and labor it has been demonstrated that with proper design a better transformer can be built of the shell type than of the core type. The double magnetic circuit of the shell type gives a shorter average path for the lines of force, which combined with a smaller number of breaks or interruptions in the magnetic circuit call for a less number of ampere turns or magnetizing force, and result in giving the shell type the advantage of a better power factor at light load. With proper machinery the coil for the shell type transformer can be wound and carefully insulated with but little more trouble than the core type, and the waste in copper in turning the ends of the coil will be no greater than is necessary in the cylindrical coil used with the core type, which touches only at the four corners of the core, which for commercial reasons is made of a rectangular cross section, leaving considerable space inside the coil not filled with iron. There are many points of view from which comparisons can be made, too numerous for the limits of such a superficial treatise as this, which, generally speaking, favor the use of the shell type, which we believe will be the standard as improvements are made, and the results of careful tests are more thoroughly understood.

The sub-division of coils in a transformer is one of the most important features, both as regards the safety of its

*Paper read before the Canadian Electrical Association.

insulation, owing to the corresponding reduction of potentials between adjacent points, and also as regards regulation. With proper sandwiching and sub division of coils in both primary and secondary, the drop due to magnetic leakage may be reduced to a negligible quantity, so the drop in voltage, as the transformer loads up, may be practically confined to what is due to the ohmic resistance in the copper. This is essential, as the regulation of transformer plays a most important part in the quality of service to customers. Good regulation means from two per cent. in the small sizes to one per cent. or less in the larger sizes. No one has yet discovered a satisfactory method of compounding transformers so as to maintain the voltage as high at full load as at light load, and as line drop in the primaries, as well as in the secondary and inside wiring, tend to aggravate and magnify this condition, the importance of guarding against everything tending to drop the voltage will be appreciated, particularly when it is more clearly understood that a variation of one per cent. in voltage will make a difference of about five per cent. in the candle power of lamps.

Too much importance cannot be attached to hysteresis or the core loss of transformers, which calls upon the generators for a continuous supply of energy to overcome this loss as long as the transformer is in circuit regardless of the conditions of load, being the same when no current is drawn from the secondary as when full loaded, and if the power factor of transformers is low, the apparent flow of current on this score is greater at no load than at full load. Good transformers should, in the small sizes, not require more than two per cent. of the full load energy to cover this loss, and large transformers less than one per cent. While the copper loss of a transformer remains constant for any fixed load, throughout its life, the core loss—if proper precautions are not taken in the selection of iron and provisions made in the design to maintain it at a low temperature—may increase considerably, often doubling this source of loss in a very short period, and accordingly reducing the all-day efficiency, and this increased loss has to be supplied from the central station, for which it receives no income.

From the foregoing hints it will be seen that well designed, modern transformers, should give a full load efficiency depending upon their size, or from 95 to 98 per cent. or better, which, with good design and proper selection of materials, will maintain this efficiency unimpared. It is only recently, however, that such transformer could be obtained, and the matter of ageing of the core plates has but recently received attention. It is not more than three years ago that one of the largest electrical manufacturing companies in the United States sold, to a large central station, under guarantee of certain efficiencies for the various sizes of transformers, covered by the contract, and were obliged to take back every transformer before they had been in service four months, on account of the rapid increase in the core loss, which, in many cases, in the short space of time mentioned, had doubled the losses shown in the original factory tests. The iron was taken off the coils and a different quality of iron substituted, which, though not giving quite such good initial results, was able to maintain its efficiency unimpaired, exhibiting no apparent ageing after repeated tests extending over a period of eight or nine months.

By careful experiments with various samples of iron of known chemical composition, we have been able to determine which is the best for use in transformer cores, and samples of every lot of iron are submitted for test for hysteresis loss and for chemical composition. Without such precaution, no assurance of results of transformers in service can be secured. Even with the best of iron ageing will take place to a slight extent, unless precaution is taken to operate the iron at low inductions, and provide sufficient radiating surface to prevent the transformer becoming too much heated—it having been observed that iron will age much more rapidly when subjected to high temperatures. As the energy losses in transformers exhibit themselves in heat, precaution should be taken to get efficient transformers, which operate at a low temperature, obviating the tendency to char the insulation, at the same time saving the dynamo capacity necessary to overcome these losses, and avoiding the ageing of the iron and subsequent augmentation of losses.

Oil may be used in small transformers, and where the losses are large the oil helps materially in radiating the heat. The life of a low efficiency transformer may be considerably increased by filling the case with oil, but this is unnecessary in small transformers of good design. In large transformers of 100 K.W. or more, it becomes necessary to use some method of dissipating the heat, as the proportion of radiating surface rapidly decreases as the transformer increases in size, and oil or an air blast becomes necessary even in transformers of over 98 per cent. efficiency. We have designed and built 60 cycle transformers of 60 K.W. capacity, having a full load efficiency of 98 per cent., which, with only the natural air circulation, have shown a rise of temperature, after 10 hours' continuous run at full load, of less then 50 C. This same transformer operated at 125 cycles will run at a higher efficiency with a smaller rise of temperature. Such transformers are rather expensive, however, and where slightly lower efficiency will suffice, an oil transformer can be used at a much lower cost of construction, which will give no greater rise of temperature.

Lightning discharges are less dreaded now by central station managers than they used to be. Formerly every thunder storm brought with it wreck to some of the transformers on the line, this has, however, come to be the exception rather than the rule, owing to the substitution of modern transformers, in which the better insulation, together with the greater choking effect, which follows, with higher efficiency and reduced core loss, result in forcing the oscillatory high frequency lighting discharges to take some easier path to equilibrium of potentials. Notwithstanding this do not neglect to install lightning arresters, for though the improved transformers offer a more difficult path, yet if there are no lightning arresters, through which these potentials can discharge, the best transformers are liable to be punctured. The suggestion has been made to ground the secondaries or the case of the transformers. Either method makes it safer for the consumer, but both result in greater strain on the insulation of the transformer.

We have had frequent enquiries as to whether the 60 cycle transformers will work on 125 or 133 cycles. A transformer, suitable for 60 cycles or 7,200 alternations, will work better on 125 cycles or 15,000 alternations than on the 60 cycles, as the core loss is reduced through the regulation due to increased megnetic leakage, is not quite so good. It is quite the opposite when a 125 cycle transformer is used on the 60 cycle circuit, as in this case the core loss is increased about 30 per cent., and the efficiency correspondingly decreased. If the transformer is not a very superior one at 125 cycles, it is quite likely to overheat, due to the increased core loss at 60 cycles, gradually charring the insulation until it finally breaks down, in the meantime probably showing an increasing core loss, followed by further development of heat, and bringing about the end at an earlier day. As the difference between two lots of iron from the same manufacturers may make a difference of ten or twenty per cent. in the core losses of transformers, otherwise identical, it is of the utmost importance for manufacturers to make careful tests of each shipment of iron, as it is received, and when this is not done the central station has no protection unless they possess the instruments to make proper tests on the transformers themselves as they are received.

For their own protection, we would urge central station men to equip themselves with standard watt meter, dynamometer and volt meter, with which it is a simple matter to determine whether they are getting what they pay for or not. The tests are quite simple, and any central station can equip for making them at very small expense, amounting to but little outside of the cost of the necessary instruments, which are almost a necessity for any central station in checking up switch board instruments, recording meters, etc.

(To be continued).