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MISSING

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The Canadian Engineer.

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THE METRIC SYSTEM.

In last issue we printed a letter by F. A. Halsey, of New York, on the subject of the metric system. As believers in the metric system, we are always glad to offer fair play and ample space to those who, like Mr. Halsey, are wedded indissolubly to the time-honored but medley-burdened mediæval system of English weights and measures. Such articles do much good by drawing attention to the subject, and the more fully the subject is ventilated the more rapid becomes the advance of the superior, simpler and more scientific metric system. Beginning with a single nation, France, the metric system has spread from one country to another until, with the exception of the English-speaking countries, only uncivilized nations have failed to adopt it.

The burden of Mr. Halsey's letter appears to be that the English system is better than the metric system, that the metric system is not really used in European countries, but only pretended, and that a metric country can only construct machines to metric sizes.

Now, as regards the advantages of the metric system, they are sufficiently evident from the fact that all weights and measures are reduced to one unit—the metre, for all volumes are in terms of the cubic metre, and all weights are in terms of a cubic metre of water, or a sub-decimal thereof. Consequently the metre, litre and gramme form an ideally simple trio of rationally connected units to which all sizes are referred, be it the micron or millionth of a metre for microscopic work, the millimetre or centimetre for tools, or the kilometre for road lengths. With three units as the stock-in-trade and a few names for decimal multiples and submultiples the system is harmonious, definite and complete. Against this we have a burdensome, indefinite and incoherent mass of English tables that few persons remember. We have over sixty different units of length, area, volume and weight, these units being connected by farcical and fanciful weird ratios, such as 5,280 feet in a mile and 43,560 square feet in an acre. In the centuries that are to come we cannot expect our descendants to believe that we at this age were even semi-civilized when they look back upon our present system of weights and measures.

The only valid objection to the metric system is that, being a decimal system, it does not lend itself to repeated division by halving. But that is an objection to our arithmetic, and not to the metric system. A duodecimal arithmetic would have distinct advantages over a decimal arithmetic; but it is quite hopeless and impracticable to change the world's arithmetic; while a very large part of the world has already changed its weights and measures for the metric system, and it is clearly only a matter of time when all civilized nations will employ that system exclusively. No one complains that a dollar can only be divided by two twice before the even halving ceases (at twenty-five cents); whereas a pound sterling can be divided into successive halves four times before coming to a similar barrier at fifteen pence. The decimal coinage is, we all know, far superior to the old English system in spite of the limited capability of splitting in halves.

Moreover, in our English medley we constantly tend to the use of decimal subdivisions. Workmen in machine shops employ inches and mils, and commonly work to the nearest mil or decimal subdivision (1-1,000) of an inch, and do not go on splitting hairs and dividing by two. It is more rare to employ thirty-secondths than hundredths or thousandths. Similarly surveyors use feet and hundredths, not feet and inches. Hydraulic men use thousands or millions of cubic feet, or gallons, and not barrels or tons. Everywhere men struggle to throw off the duo-decimal yoke. Our money has already thrown off the fetters. Our weights and measures will do so sooner or later.

But the proof of the value of the metric system lies in the practical experience with it. All Europe uses it except England. No country regrets having made the change. The same outcry was made in each country by the conservatives before the change was made. In

Germany, for instance, the people who were too old to learn anything new, and the conservatives who saw no good in anything that did not originate in Germany, clamored against the introduction of the metric system. The literature of that day is full of pathetic pleas. We cannot change. The change is bad. We will not change. The change cannot be made. Nevertheless the change was made with very little trouble, and now no reasonable Germans ever use an old German unit except in sport.

Mr. Halsey would have us believe that Europe is in a state of seething insurrection against a compulsory adoption of the metric system. The writer has lived for a number of years in various countries of Europe, and has never seen or heard of any units used or suggested, outside of England, except metric units.

The American Chamber of Commerce in Paris recently asked the Society of Civil Engineers of France whether the old French units such as arpent, once, aune and boisseau, were still used. The society replied that they are not so used, and cited their use in phrases which are mere meaningless old sayings as vestiges of past use.

In America to-day the "shilling" is still occasionally spoken of. In Philadelphia there are still a few rents that are paid in Spanish dollars. Possibly the cloth-yard, the ell, the league and the cubit may be yet in existence. These were all in national use at one time. Does anyone hesitate on this account to say that America has a decimal coinage and no longer uses the cubit or the league.

The argument that if we were to adopt the metric system at a given date thereafter our inch machines would be useless is another fallacy that history has overthrown. It was used in all the European countries before they changed to the metric system. The German manufacturers declared that as soon as the metric system was adopted their tools would be rendered useless, because they were constructed to give German inches. There was no such trouble. The same tools were used after the system for years, making sizes that were not even metric sizes, employing odd decimals. But every machine uses decimal sizes when working to its ultimate degree of accuracy. There is no such thing, in practice, as an inch pipe. It is always a small decimal over or below an inch. So that whether the decimals are of an inch, or of a centimetre, is of little consequence. In the course of years it would, however, probably be convenient to build machines that turned out approximate even metric sizes.

The attitude of Canadian business men towards the metric system is shown in the resolutions adopted by the fifth Congress of the British Empire, held in August last at Montreal. At this congress there were business men, not scientists, representatives from Chambers of Commerce of the various British colonies, and a very strong resolution was passed by the Congress in favor of a general adoption of the metric system in the Empire by a large majority. The Canadian Manufacturers' Association, composed of manufacturers representing every industry in Canada, has declared more than once in favor of it, as has the Retail Merchants' Association.

The progressive colony of New Zealand has within the last few months passed a Weights and Measures Act, which contains a clause rendering it lawful for the Governor at any time by proclamation to declare that from and after the date named in the proclamation, being not sooner than the first day of January, 1906, "the metric system shall be the only system of weights and measures recognized for use in New Zealand; and thereafter it shall not be lawful to use any weights and measures other than those."

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INDEPENDENT TELEPHONY IN CANADA.

The year 1904 promises an active development of telephone competition in Canada. Several of the larger cities of Ontario will have before them at an early date applications for franchises to compete with the Bell Telephone Co. Judging from the widespread dissatisfaction prevailing against the rates and service of the existing monopoly, the advent of competition will be welcomed by the majority of telephone users, and also by very many who are debarred by the prevailing rates from participating in the benefit of telephone facilities. Doubtless, a great effort will be made by the existing companies to persuade city councillors that the telephone is a natural monopoly, and that competition elsewhere has not been satisfactory to the general public. Articles have been published in the Canadian Engineer, from time to time, which furnish conclusive proof of the success of independent telephone competition in the United States and Europe, and if further evidence were needed to demonstrate this fact volumes might be written containing records of successful independent exchanges. It is well, however, that at this stage those responsible for the granting of franchises should proceed cautiously and ascertain what are the conditions which have produced the successful results recorded. A careful study of these conditions will show that to enable the people to have telephone service at permanently low rates, there must be local control and no overcapitalization. In other words, the competing exchanges, if not municipal, or co-operative, should be controlled by local capital in which there is no watered stock or bonded indebtedness. If franchises are granted to syndicates representing outside capital, who are in reality only promoters, whose object is either to bond the plant, or float operating companies, retaining for themselves a large amount of watered stock, upon which subscribers have by their rentals to pay dividends, the result in the end will be failure, and the tightening still further of the grasp of the monopoly. A company has recently obtained a Dominion charter, and with a capital of only $1,000,000 they propose to build exchanges and construct long distance lines throughout Canada in competition with the "Bell" Company. It is obvious that this amount is totally inadequate to carry out the objects for which the charter was obtained, and it is further stated that the company propose to accomplish their purpose by a number of local companies bearing different names, and which we assume will be subsidiary to the existing corporation. This means that the present company will have a large interest in each subsidiary company, may, in fact, control them.

While favoring the advent of independent telephony in Canada, we confess that we should like to know something more regarding this company's future policy, before any operating franchises are given away. We believe that competition should come from the people, as it has done in the United States, with few exceptions, and therefore if local companies are established, it should be possible to accomplish this without the necessity of their being promoted and controlled by any corporation having its management in one Canadian city or the United States. One of the chief reasons for the unpopularity of the "Bell" Company is that its system of centralized management keeps it out of touch with the local needs and sympathies of the subscribers to its exchanges in all parts of Canada, and we do not wish to see this policy duplicated in independent telephony. We have also noticed that the financial success of the independent telephone movement in the United States has, in recent years, resulted in the consolidation of a number of companies, and the present indications are that the most

prosperous exchanges will in the near future fall under the control of a large trust, stocks will be watered, rates increased and the probabilities are that unless this movement is checked, a deal may be made with the "Bell" monopoly, whereby they will again control the telephone business of the United States. To illustrate our meaning we would refer to the Federal Telephone Company, of Cleveland, with a capital of $10,000,000, which was incorporated for the purpose of purchasing the securities and controlling the operating policy of a number of the largest independent telephone companies in Ohio and Michigan. It controls seventeen companies, and the following table will show that they are very much overcapitalized:

Overcapitalized Independent Telephone Companies, Whose Operations are Controlled by the Federal Telephone Company of Cleveland.

Name of Company.	Miles of Toll Lines.	No. of Subs.	Capital.	Bonded Indebtedness.	Average per Subscriber.
Cuyahoga Telephone Co.	90	9,710	$3,000,000	$2,233,000	$539
Columbian Telephone Co.	301	2,355	300,000	200,000	212
Findlay Home Telephone Co.	....	972	150,000	80,000	235
Citizens' Telephone and Mess. Co.	....	736	50,000	44,000	127
Lancaster Telephone Co.	95	732	100,000	50,000	249
Lima Telephone and Telegraph Co.	....	870	150,000	70,000	253
Mansfield Telephone Co.	88	1,575	300,000	200,000	317
Massilon Telephone Co.	48	902	75,000	75,000	166
United States Telephone Co.	8,647	200	2,000,000	1,865,000	447*
Youngstown Telephone Co.	....	1,747	200,000	200,000	229
Janesville Telephone Co.	55	1,251	250,000	150,000	320
Columbus Telephone Co.	....	6,277	705,000	650,000	216
Akron Telephone Co.	32	3,011	300,000	300,000	199

*This a long distance company and the figures in the last column give the average per mile of toll line.

In contrast with the Cuyahoga Telephone Co. (which is the largest of the Federal companies), with ninety miles of toll lines, and 9,710 subscribers, having a capitalization and bonded indebtedness averaging $539 per subscriber, the Citizens' Telephone Company, of Grand Rapids, Mich., with 2,000 miles of toll lines and 10,448 subscribers, has no bonded indebtedness and a capitalization averaging $96 per subscriber. The experience of competition in the United States points to the necessity of adopting such legislation in Canada as will prevent the amalgamation of groups of local companies with the inevitable watering of stock, and raising of rates which always follows in the train of such consolidations.

We might also point out that the People's Telephone Company, in Detroit, Mich., was an undoubted success until it was persuaded, on the plea of strengthening independent telephony, to amalgamate with the Erie Telephone Co., a corporation professing independent principles, but which afterwards sold out to the "American Bell" from which time Detroit has always been held up as an example of the impracticability of telephone competition. Had the "People's" retained control of their system, Detroit, to-day, would have a service surpassing any independent system in the United States. This is a striking illustration of the undesirability of permitting franchises to get into the hands of companies, whose whole primary object is to run the business for all that it may be worth, the interests of the people being a secondary consideration.

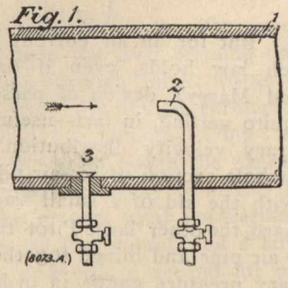
The advent of improved methods involving cheaper construction and maintenance, renders it possible to supply the people with telephones at almost one-half the existing rates, and at the same time to earn good dividends on the capital outlay, but the one means of obtaining and maintaining these low rates is by granting franchises only to local companies, independent of outside control, who shall satisfy the people that their capital is free from "water" in any form, and that the people will get what they have a right to expect, viz., service at rates which include a fair profit on the actual cost of building and operating the system. Failing this, the only available remedy for the existing high rates is municipal ownership.

TESTING ELECTRIC GENERATORS BY AIR CALORIMETRY.

An ingenious and entirely novel way of testing alternating-current dynamos was recently brought before the Institution of Electrical Engineers, London, England, by Richard Threlfall, M.A., F.R.S., of Birmingham. There is considerable uncertainty about large alternating-generator tests, and frequently, as in the case which confronted Mr. Threlfall two years ago, neither brake-power tests can be applied, because the fields of alternators are built upon the flywheels, nor, owing to structural difficulties, can one machine be run as generator and the other as motor. It occurred to him, hence, to enclose the alternators in a non-conducting casing, and to pump air through the system at a measured rate. If M kilogrammes of air of specific heat o be passed through the system per second, and the temperatures of the air on entering and leaving be t and zero degrees Centigrade, and if no heat be lost or gained by the alternator, then M o (zero—t) = H will represent the rate at which power is being wasted in kilogramme-calories. If, further, P represent the rate of external working of the engine, P^1 the power delivered by the generator in kilowatts, then the efficiency of the generator is $E = P^1/P = P^1 (P^1 + H)$. Assuming that the dynamo does not radiate like a wireless telegraph transmitter, E and H can be determined, provided we can measure the bulk of air; and this method should share with the Hopkinson method the advantage we determine in H the actual loss in the generator from all sources, and that—supposing a loss of 10 per cent., or an efficiency of 90 per cent.—any error made in the determination of H would enter by one-ninth of its amount only into the efficiency E.

The measurement of the current of air is the hard problem which Mr. Threlfall had to solve, and he finds that H can be determined in practical trials within 2 or 3 per cent. It is done with the aid of Pitot tubes, simple tubes bent over at the end, which have long been used to explore the velocity of flowing liquids. When air streams against the open end of the Pitot tube (2 in Fig. 1), which is closed

Fig. 1.

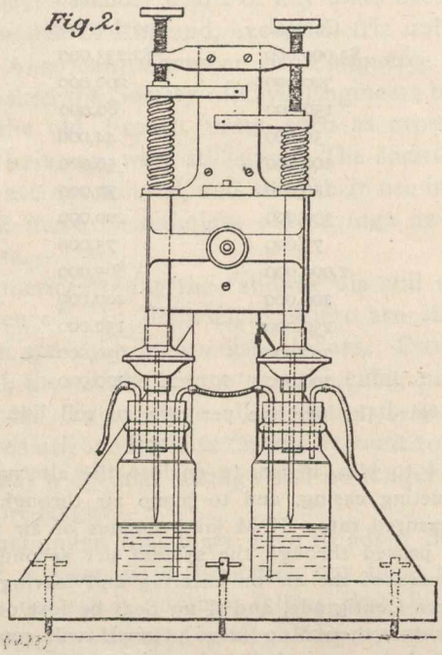


otherwise, a certain pressure, known as velocity pressure, is set up in the Pitot tube, because some of the momentum of the impining air is destroyed by the quiescent air in the tube. It has been shown by Lord Rayleigh and confirmed

experimentally in these researches by Mr. Threlfall, that this lost momentum amounts to almost exactly half of the total, and that the velocity pressure is nearly equal to $\frac{p V^2}{2}$ dynes per square centimetre, where p is the density of the air in grammes per cubic centimetre, and V its velocity in centimetres per second. A side gauge has to be provided to mark the static pressure of the external air. This may be a flanged tube (3 in Fig. 1), according to Heenan and Gilbert; or a hole may simply be drilled into the wall and a pipe screwed into it; but then care must be taken to avoid the very variable suction effect.

From the Pitot tube and the side gauge rubber tubes extend to the two bottles communicating with one another (Fig 2) by a siphon, in which readings of the pressure differences are taken with the aid of needle points. The needles are set just to touch the colored water in the bottle; the level difference is, in the instrument illustrated, which Mr. Threlfall has himself made and used daily for two years, measured by callipering jaws to within 0.01 millimetre; in a new form, made by the Scientific Instrument Company ,of Cambridge, a micrometer screw effects the reading within one second. A multiplying pressure gauge, in which the motion of a float operates a finger moving round a dial, which indicates square roots of the pressure differences (as the velocity $V = \sqrt{2p/p}$), serves as an auxiliary instrument. From Rateau's experiments we know that we want the means of the square roots of the pressure differences. If the velocity were the same at the various points of a vertical section through which a fluid is streaming, Mr. Threlfall's task would have been easy. For water we may, according to Darcy, take as average velocity that at the circumference of a circle of radius r, when R is the radius of the pipe, defined by the equation $r = \left(\frac{4}{7}\right)^{\frac{3}{2}} R = 0.689\ R$, or approximately 2-3 R. But for an air current produced by a ventilator, no such law holds, even if baffles are used. Mr. Threlfall found Marey's device of passing the air through muslin—mosquito netting, in fact—useful to secure a uniform though arbitrary velocity distribution. He had, however, to explore a whole section of his air pipe, 21 in. in diameter, thoroughly with the aid of a small size Pitot tube made of tin or millboard, the other large Pitot tube being kept in the centre of the air pipe and joined together with its side gauge to the auxiliary pressure gauge in order to make sure that the fan speed keeps fairly regularly during this exploration.

Fig. 2.



All this sounds f[illegible] complicated. Mr. Threlfall was, however, able [illegible] himself, by experiments, tabulated in his p[illegible] pressure distribution over the vertical section of his pipe remained practically constant with considerable changes in the velocity of the air current, which was varied between 325 feet and 3,640 feet per minute. When, however, the positions of the fan and pipe are altered, a new calibration has to be made. The calculation of the results of an experiment, fully given in the communication, is not difficult. For carrying out the actual tests, the 300-kilowatt alternator of 40 periods, which runs for about one-third of its diameter in a pit of concrete, was encased in wood, and the pit, which exposed a good deal of concrete, boarded round, and 3-4-in. of felt fastened over the boards. The whole casing was papered and covered with tinfoil. The fan was run at such a speed that the mean temperature within the casing remained as high as that of the engine-room. This was easily attained, and there was little danger, therefore, of direct heat leakage; connection and radiational losses were proved to be very small. Kew standard mercury thermometers were placed in the inlet and outlet, and at various points. Before the final tests were entered upon, attempts were made to measure the external currents by sending them through iron strips, 3-4-in. wide, 1-25-in. thick, wound in zig-zag in a water tank. This water calorimeter was not wanted afterwards, but experiments were conducted with 130 ft. of this iron strip to ascertain the heat effect produced in the enclosure when a current of known strength was sent through this iron resistance.

Electrical measurements were also made with the aid of a Kelvin kilowatt balance, a Duddell oscillograph, and, further, a new hot-wire voltmeter, designed and constructed by Mr. Threlfall himself, and found reliable and very sensitive during three years of continuous use with currents of 2,000 amperes maximum and 40 periods. The instrument responds to currents of 0.01 volt, and is reliable within 1 per cent. The wire is the finest silver (lace) wire obtainable. A length of about 6 centimetres is fixed between a support and the multiplying device working the micrometer screw. The wire is kept stretched by a spiral of the same wire attached to a hook, resting on the middle of the wire. As the change in length effected by the current heat is measured, the stretching must always be uniform. To ensure this, a second wire is fixed over the first and a little mirror attached to it, which mirror is tilted by the stretched calorimeter wire, whose two arms form an angle of 179 deg. The light of a small glow-lamp is reflected by this mirror, and this image is watched through a window in the front of the double aluminium case covering the instrument.—Engineering.

NEW COMPANIES.

The Toronto Coral and Mycenian Marble Co.; $100,000. J. W. Moyes and others.

The Credit Forks Vitrified Stoneware Sewer Pipe Co., Toronto; $200,000. Robert Carroll and others.

The Damascus Gold Mining Co., Bridgeburg, Ont.; $250,000. J. S. Lovell, of Toronto, and others.

The Redpath Motor Vehicle Co., of Berlin, Ont.; $50,000. A. H. Reid, of Toronto, and others.

The Ontario Pipe Line Co., St. Catharines, Ont.; $40,000. J. M. Walker and others.

The Pacific Coal and Oil Co., Toronto; $17,500,000. J. S. Lovell and others.

Les Transports Canadiens, Limited, Toronto; $1,000,000. E. L. Sawyer and others.

The American Asbestos Co., Montreal; $1,000,000. H. M. Whitney, of Boston, Mass., and others.

The Imperial Construction Co., Toronto; $199,000. C. A. Masten and others.

The Duplesis Independent Shoe Machinery Co., St. Hyacinthe, Que.; $2,000,000. P. A. Lebadie and others.

The Ripley Acetylene Gas Co., Ripley, Ont.; $2,000. S. T. Jackson and others.

The Canada Handle Co., Hull, Que.; $40,000. Chilion Jones, of Brockville, Ont., and others.

The Montreal and South Shore Auto-Car Co., Montreal; $30,000. W. B. Powell and others.

The Erie and Ontario Development Co., Welland, Ont.; $96,000. E. A. C. Pew, of Toronto, and others.

Canadian Contractors, Limited, Montreal; $3,000,000. E. L. Sawyer, of Toronto, and others.

The Ontario Traction Co., Walkerville, Ont.; $40,000. C. M. Walker and others.

The Grimsthorpe Mining Co., Toronto; $150,000. G. G. S. Lindsey and others.

The Valley Seating Co., of Dundas, Ont., $75,000. J. D. Pennington and others.

The Wilcox Manufacturing Co., of Ontario, Limited, London, Ont.; $40,000. C. E. Santo, of London, Ont., and others.

The Continuous Rail Joint Co., Montreal; $49,000. W. W. Near, of Guelph, Ont., and others.

The Steamship Senlac Co., Rothesay, N.B.; $80,000. Robert Thompson, of St. John, N.B., and others.

The King Edward Oil Co., Limited, St. John, N.B.; $40,000. W. T. Clark, of St. John, N.B., and others.

Maritime Engineering Co., Limited, Moncton, N.B.; $30,000. J. P. Weir, of Moncton, N.B., and others.

The Imperial Coal and Coke Co., Montreal; $4,500,000. F. Thompson and others.

The Toronto Iron and Steel Co.; $40,000. R. E. Mills, of Guelph, Ont., and others.

The Roche-Persee Mining Co., Winnipeg, Man.; $100,000. H. Sutherland and others.

The A. R. Williams Machinery Co., of Winnipeg, Man.; $60,000. A. R. Williams, of Toronto, and others.

The Threshers' Supply Co., Winnipeg, Man.; $90,000. J. R. Morris and others.

The Idaho-Alamo Consolidated Mines, Limited, Alamo, B.C.; $650,000.

The Princess Royal Gold Mines, Limited, Rothesay, B.C.; $1,250,000.

The Perry Creek Gold Mining Co., Perry Creek, B.C.; $500,000.

The Great Northern Mines, Limited, Trout Lake, B.C.; $1,500,000.

The Britannia Power Co., Victoria, B.C.; $250,000.

The Pacific Pile Preserving Co., Victoria, B.C.; $20,000.

The Light Traffic Co., Victoria, B.C.; $150,000.

The "Stanley Dollar" (Steamship) Co., Victoria, B.C.; $50,000.

MR. HALSEY ON THE METRIC SYSTEM.

Editor, Canadian Engineer:

Sir,—Does the writer of the letter in your last issue on the metric system wish us to believe that because some people in Europe still speak of the old weights and measures, therefore the metric system is not in use. On such an assumption Mr. Halsey might publish a violent declaration that dollars and cents have not been introduced here because he can assert truly that the Constitution of the Commonwealth of Massachusetts, as published in the latest revision of our laws, contains the following provision:

"In all cases where sums of money are mentioned in this Constitution, the value thereof shall be computed in silver at six shillings and eight pence per ounce," etc.

A few years ago a newsboy on a railroad train who had difficulty in making a few cents change with one of my fellow passengers came to me, asking if I had any "pennies." I am willing that Mr. Halsey should argue from one end of the United States to the other that this proves that the United States has been unable to abandon pounds, shillings and pence, and has not been able to introduce a decimal monetary system. A number of years ago I was informed that the price of a dinner was "two and threepence." Mr. Halsey is welcome to make the most of this. ENGINEER.

Boston, Mass., 15th Dec., 1903.

W. Moore & Sons, Meaford, Ont., are developing a 600 horse-power water power. The dam will be 710 feet long, and the race 1,600 feet. The work will be completed next summer, when power will be sold to other factories desiring to utilize electric energy.

PUMPING BY ELECTRICITY.*

BY F. H. PITCHER, C.E., CHIEF ENGINEER, MONTREAL WATER AND POWER CO.

Our large cities in the East, like Montreal, Toronto, Hamilton, Ottawa, Quebec, etc., are more favorably situated, perhaps, for obtaining cheap electric power than corresponding cities in the New England States and others along the Atlantic seaboard. This is on account of their proximity to large water powers, capable of commercial development. None of these cities is, everything considered, in a better position in this respect than Montreal. Its population, manufacturing and kindred industries offer a ready market for a large amount of power, while its proximity to the developed and undeveloped powers on the Richelieu, St. Lawrence, Ottawa, and Shawinigan rivers makes it possible to supply the demand on a commercial basis.

The following are the principal developed water powers delivering under normal conditions of operation power to Montreal, approximately, as follows:

At Chambly, Que., 21 miles from city ..... 20,000-h.p.
At Lachine Rapids, Que., five miles from city .... 14,000-h.p.
At Shawinigan Falls, Que., 80 miles from city .... 6,000-h.p.

The latter is a 30,000-h.p. development. The remainder of the power is being absorbed now by the industries at Shawinigan Falls, or will, in all probability, shortly be taken up by this city as well as by other towns and cities along the line. All of these powers are capable of expansion, and are even now being extended, so that there is little doubt that twice the present amount of electric power from water powers will be available in Montreal in the near future. The principal undeveloped powers near the city are:

Back River, six miles from city ..... 50,000-h.p.
Soulanges Canal, thirty miles from city .. 25,000-h.p.

Another important available water power of 50,000-h.p. has been developed at Massena, N.Y., approximately sixty-five miles away.

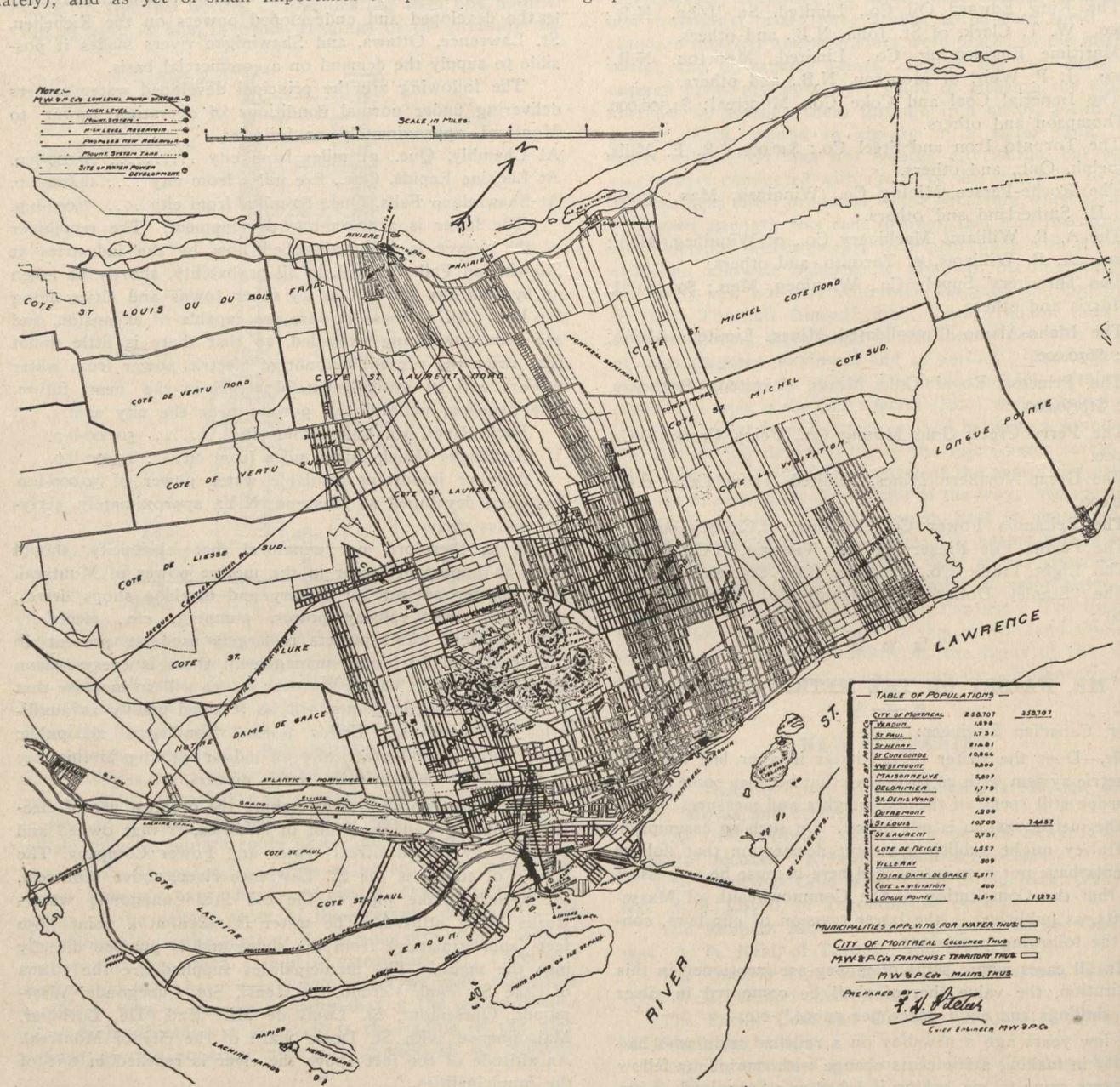
It is, therefore, not unnatural that electricity should form an important factor in the motive power of Montreal. As a matter of fact, for factory and machine shops drives, elevators, street railway power, pumping, etc., electricity from adjacent water powers is largely used at present in Montreal, and by proper management there is every reason to believe that its use in the near future will so increase that present local steam plants will be retained mainly as auxiliaries and reserves. Under normal conditions all public street lighting and practically all indoor lighting in this city is at present furnished by water powers.

The water-works system making the greatest use of electric pumps in Canada, if not in America, is that owned and operated by the Montreal Water and Power Company. The source of supply is the St. Lawrence river, above Montreal, the 36-inch intake pipe of the old Ste. Cunegonde waterworks being utilized. The water is taken at a point 1,650 feet (approximately) from the shore and is pumped directly into the mains. The municipalities supplied are the towns of Cote St. Paul, Verdun, St. Henri, Ste. Cunegonde, Westmount, Outremont, St. Louis de Mile End, De Lorimier, Maisonneuve, with St. Denis' ward of the city of Montreal. An altitude of 600 feet above the river is reached in one of the municipalities.

From the nature of things three lifts were found necessary, one of 200 feet from the river forming the main supply. This supply is pumped through force mains approximately 6,500 feet long, and then distributed through the gridirons of the towns in front of the mountain lying "below the hill." and at only a slight elevation above the average river level. The population receiving its supply from this lift is approximately one-half of the present total population supplied. In order to supply most of Westmount, and a large part of the territory behind the mountain, a second lift of 270 feet was established. The pumps at the 200-foot level take their water from a catch-basin of relatively small capacity, which receives the surplus water of the low-level system. These again pump directly nto a reservoir of 8,000,000 Imperial gallons' capacity (approximately), at an elevation of 470 ft.,

and also into the mains, there being no separate system of rising mains. This lift supplies practically all the other territory both in front of and around the mountain. The pressure for the low territory, like Maisonneuve, etc., is controlled by regulators. This is, of course, not the most economic final plan, but at present the amount of water let down through the regulators is not over 25 per cent. of the whole supply. A plan to establish a low-level reservoir connected with the back territory by a low-level gravity main around the western spur of the mountain, is now under consideration.

Besides the two lifts mentioned, there is a third, established in 1898 for the supply of a few houses on top of the Westmount Mountain. This is a lift of 180 feet (approximately), and as yet of small importance in point of size.



City of Montreal—Pumping by Electricity.

To-day over 80,000 people are being supplied in this way. Seven and one-half million gallons are consumed daily, and the pumping at all three stations is done by electric pumps. The low-level station is at the river in St. Gabriel Ward of the city proper, and is called St. Gabriel Station. The intermediate station is on Clarke Ave., Westmount, at an elevation of 200 feet, and is called Clarke Ave. Station. The remaining station is at the reservoir and is called the Mountain System Station.

The pumps at the low-level station, in 1898, were two in number—one an old type crank and fly-wheel quadruple Holly of about 750,000 Imperial gallons' capacity, and the other a duplex direct Snow steam pump of about 3,000,000 Imperial gallons' capacity. At Clarke Avenue there were two direct duplex steam pumps; one of 2,000,000 and one of 1,000,000 Imperial gallons daily capacity. The larger pumps were added to each station as the consumption in the front grew and before the back territory was connected to this source.

(To be continued.)

* * *

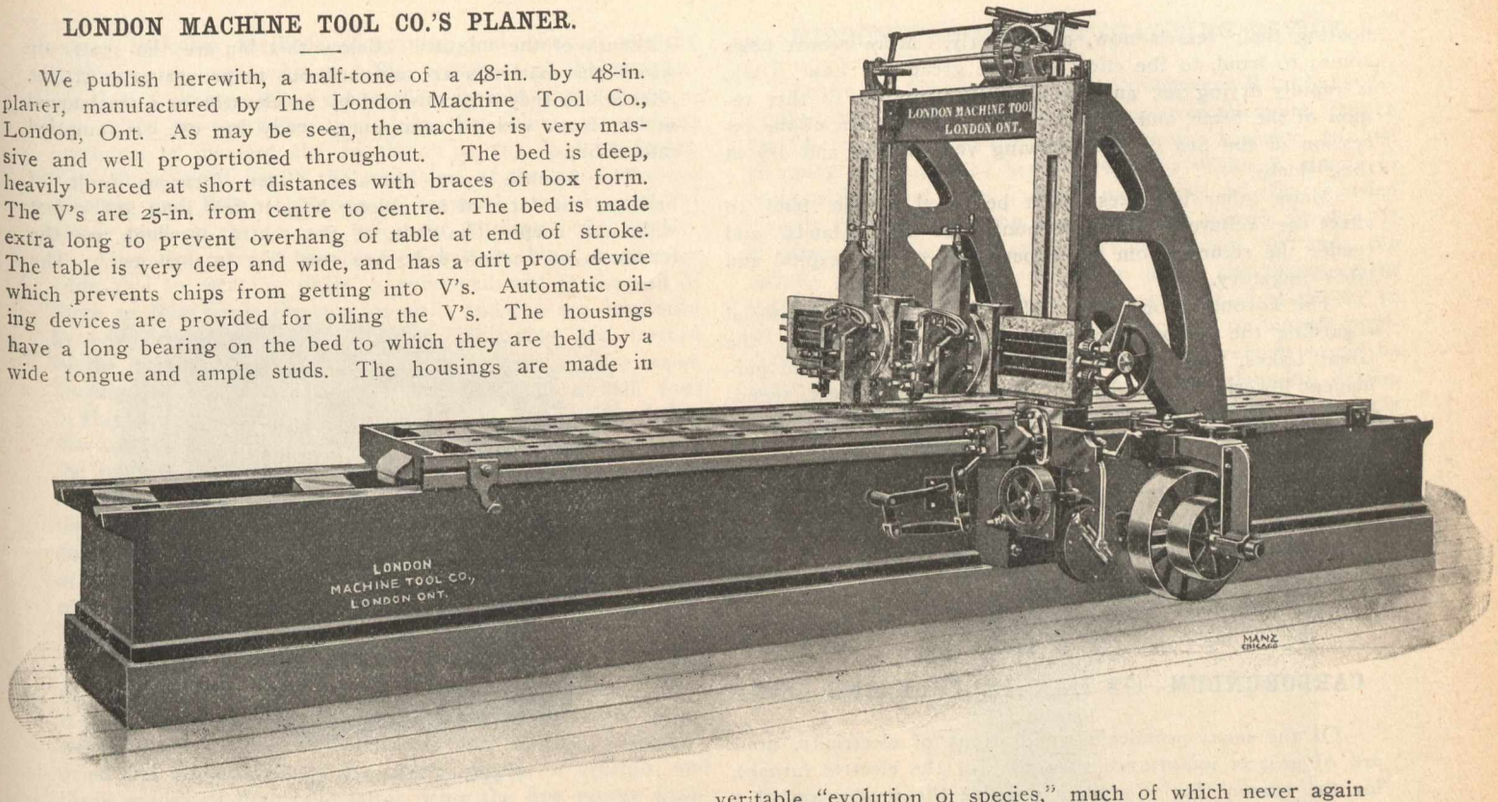
The London Daily Mail has conducted experiments with a recording telephone, or electrograph, the invention of E. G. Craven, an English engineer, once an assistant of Edison. It is a combined telephone and phonograph. Messages spoken into the transmitter in London were received by the phonograph at Wickenham, twelve miles distant, without audible sound, on a vibrating diaphram. When the phonograph was disconnected from the telephone and reversed, the messages were reproduced audibly and distinctly. The inventor claims that his invention will be the greatest convenience to business since the telephone, as it makes a permanent record of conversation.

* * *

The Toronto Railway state that their new storage battery plant will be in use in three months. It will supply power to run the additional service, morning and evening, necessary to convey the people to and from business. The power will be stored during the day when traffic is light. The plant will have a capacity of 3,500 to 4,000 horse-power. At present 8,000 horse-power per hour is required to operate the service.

LONDON MACHINE TOOL CO.'S PLANER.

We publish herewith, a half-tone of a 48-in. by 48-in. planer, manufactured by The London Machine Tool Co., London, Ont. As may be seen, the machine is very massive and well proportioned throughout. The bed is deep, heavily braced at short distances with braces of box form. The V's are 25-in. from centre to centre. The bed is made extra long to prevent overhang of table at end of stroke. The table is very deep and wide, and has a dirt proof device which prevents chips from getting into V's. Automatic oiling devices are provided for oiling the V's. The housings have a long bearing on the bed to which they are held by a wide tongue and ample studs. The housings are made in heavy box form and are of a style best calculated to resist the strains of cutting. The bar is raised and lowered by power, the lever for which is easily reached by operator. The heads have power and hand feeds in every direction, the swivels are graduated to degrees. The shoes have long bearings on bar and are accurately scraped thereto. The driving mechanism is simple but powerful. Loose pulleys are all bronze bushed. The driving pulleys can be arranged for either parallel or right angled drive. Feeds are driven by either friction or positive gear, as desired. This machine can be arranged for motor drive and also can be arranged for the use of high speed cutting steels. The weight of this planer with 14-foot bed is 32,000 lbs.



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THE WATER OF THE GLOBE.

Sir,—Moses, in his account of the genesis of the earth, tells us that God said: "Let the waters be gathered together; and let the dry land appear, and it was so done." But that King of all true scientists was far too wise and knowing to assert that all the external surface matter of the earth should, or did, become dry land within, or during the epoch of time designated as "evening and morning, one day." Much rather does he teach us that a "day," in relation to the generation of "the earth and the furniture thereof," differs widely from a day as accounted in the life of man. A brief record of the relative order in which certain evolutionary effects became manifested. An epoch of events, rather than of time, measurable by man, which he foretold shall continue in operation so long as water exists in conjunction with the earth, in an ever-increasing ratio of velocity. And the dry land everywhere bears testimony to the absolute truth of the Mosaic science. Wherever eye has seen, and foot has trod, hill and valley alike proclaim their subjection unto water in the more or less distant past. What has become of all that immense volume of water which has left the testimony of its influence on the rounded boulders and pebbles of all lands? Has it merely changed its location? If so, to where? Or, has it not rather been changed in substance? And is not the water still remaining in conjunction with the earth ever in process of being changed from its natural form and properties to the extent of many billions of tons annually, adding that amount to the dry land, through the ordinary operations of Nature, whereby vegetable and animal forms, perpetually absorbing the watery elements, evolve therefrom their own substance, a veritable "evolution of species," much of which never again reverts to its original state and condition as water?

Inasmuch as this process of evolution has been in continuous operation, possibly during millions of years, so also it may possibly continue for millions more, but at an ever-increasing rate of progress, until water is no more. Then! What of the earth, the inhabitants and "furniture thereof?" It is not my purpose to multiply words in attempting to forecast such remote future; but prefer to leave that to the professional writer of books, and confine myself to the purpose of this article, in directing public attention to the cause tending to produce certain effects, in order to enable them to intelligently conserve the best interests of the entire community, when, and wherever menaced by ill-advised and unwise projects of the avaricious, ofttimes under the specious but delusive plea of "developing the country" by enlarging, for example, existing waterways, and creating others, from these "Upper Lake" regions to the ocean, whereby their waters would be depleted at a proportionately greater rate, entirely ignoring the constant complaints—even their own—of navigators of the present existing natural channels of ever-decreasing available depth of water, not understanding or giving thought to the cause. As we have, so far, endeavored to show, the evaporative area of the water is rapidly becoming more circumscribed, so also are the retentive areas and powers of the forests and lands, whilst at the same time, congested areas of populations are multiplying between the oceans, the chief gathering-places of the rain clouds, and the drainage area of inland lakes and fresh-water storages, thus curtailing the replenishing of their waters by the amount of moisture abstracted from the water-bearing clouds coming in contact with the warm, dry air of the industrial centres. Under such circumstances, therefore, to increase the volume of outflow from these lakes, as well as others in various lands, without ensuring a commensurate increase of the supply, cannot be too strongly reprehended. Whilst, superficially, this article may seem to be more adapted for publication in the columns of a paper devoted to the exposition of abstract science and philosophy, or to one on civil engineering, rather than to one devoted to mechanical engineering it is not so in fact, inasmuch as science, civil and mechanical engineering are so intimately intercorrelated as to be inseparable. A few months ago it was reported that the great Vulcan Shipbuilding and Engineering Company had purchased an extensive tract of land on the river Elbe, to which it was about to remove its extensive works from Stettin, on the Oder, owing to the great and continuous decrease of water in the Oder, and even in the Baltic Sea, which preclude the company from

floating their vessels now, as formerly. More recent news comes to hand, to the effect that the great Salt Lake, Utah, is rapidly drying up, and causing great anxiety to that region of the State, and still more recently we learn of the recession of the Sea of Azof, leaving vessels high and dry at their docks.

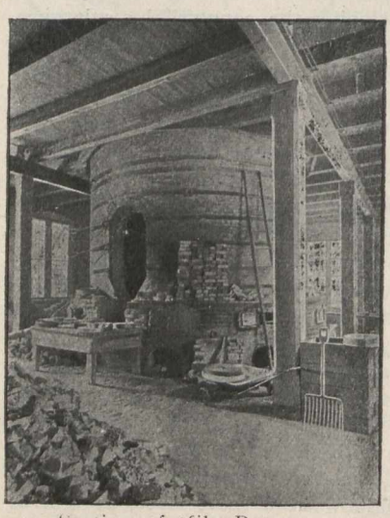
Many other instances might be cited, which tend to affect the welfare of the community in many lands, and render the returns from the expenditure of vast capital and labor nugatory.

The Toronto Globe of the 9th Dec. contained an editorial regarding the periodic lowering of the water level of the Great Lakes, "thus practically showing a continual and permanent lowering of the level." During the past year, spending some time at Collingwood, on the Georgian Bay, I was assured by an old resident that the water level there had fallen over seven feet during the past thirty-six years, say on an average of 2½ inches per year. It should then be fairly calculable how long it will take to deplete the Great Lakes below the level requisite to float a 14-ft. draft boat in the connecting channels, canals, etc.

Hamilton, Ont. J. W. PAYLER.

CARBORUNDUM—ITS MANUFACTURE AND USES.

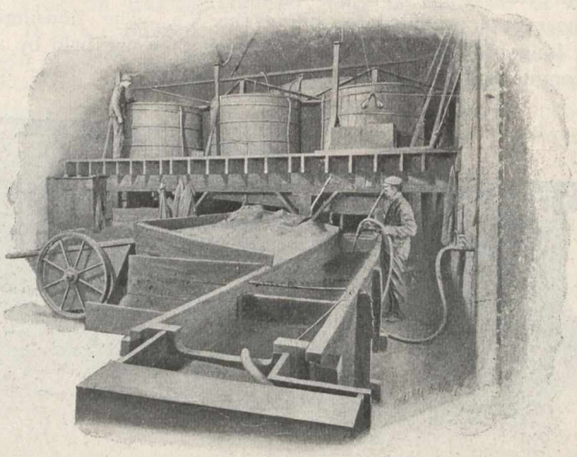
Of the many wonderful applications of electricity, none are of greater importance than that of the electric furnace, for the reason that it renders possible the production of a heat far greater than can be obtained by any other means. Under the heat of the electric furnace, steel, nickel and platinum burn like beeswax, and the best firebrick known to furnace makers is consumed like lumps of resin. It works, in short, the most incredible chemical transformations, one of the most marvellous of which is the conversion of sand and coke into a compound nearly as hard as the diamond, and even more indestructible, being less inflammable, and wholly indissoluble in the strongest acids. This compound, which is the invention of E. G. Acheson, is known as carborundum, and is manufactured at the works of the Carborundum Company, Niagara Falls, N.Y., and Ontario, Canada.



Section of Kiln Room.

The crude materials for the manufacture of carborundum are sand, coke, sawdust, and salt. These are ready for immediate use, with the exception of the coke, which must be reduced to kernels of a certain size to be used as "core" and ground to a fine powder to be used in making the charge for the furnaces. The coke is first passed through a grinder, which breaks it up into small pieces, and is then conveyed to the upper part of the building, where it is passed successively through two cylindrical screens. The first of these removes all particles of coke which are too small to form the core, while the second allows kernels of the requisite size to pass through the meshes and fall into the core bin, conveniently situated, as regards the other constituents of the mixture. Below this bin are the scales on which the materials are weighed out in proper proportions, after which they are conveyed by an elevator to a mechanical mixer, from which the mixture, ready for use, is emptied into a bin.

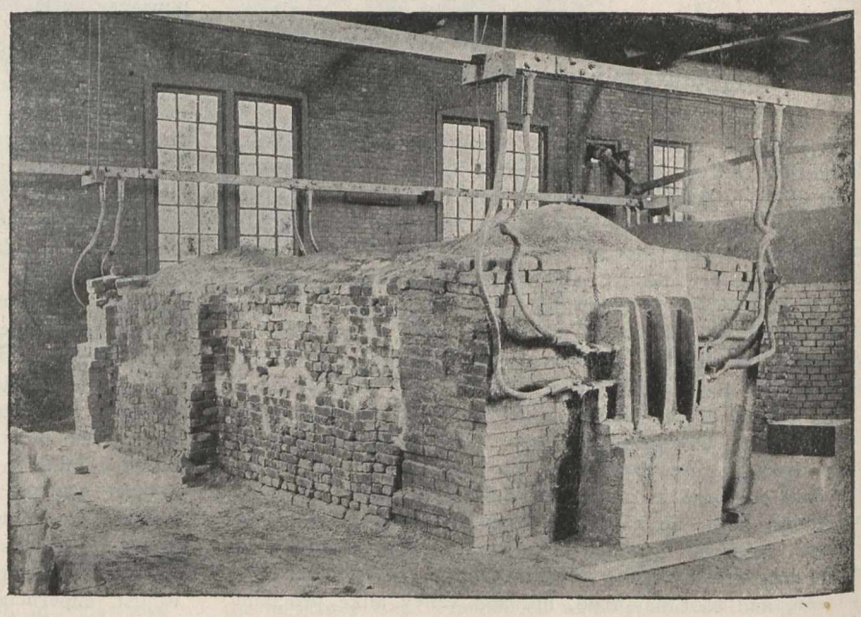
The furnace room contains fifteen furnaces built of brick in the form of an oblong box, 16 feet long and 5 feet wide and deep. The ends, at the centre of which are the terminals of carbon rods, are two feet in thickness. The



Washing Carborundum Powder.

side walls of the furnaces are built four feet high, then the mixture is thrown in to a height of just over two feet, after which a semi-circular trench is formed, the bottom being a little above the level of the lowest row of carbons. The core is then put into the trench, and the top is rounded off by hand, thus making a solid cylinder 21-in. in diameter and 14 feet long, composed of small pieces of coke, extending from either end of the furnace. The walls are now built up to five feet, the mixture thrown in and heaped up to a height of about eight feet.

All that is now required is the electric current, which is supplied from the Niagara Falls Power Co., the 2,200 volt current being transformed to 185 volts. In combination with



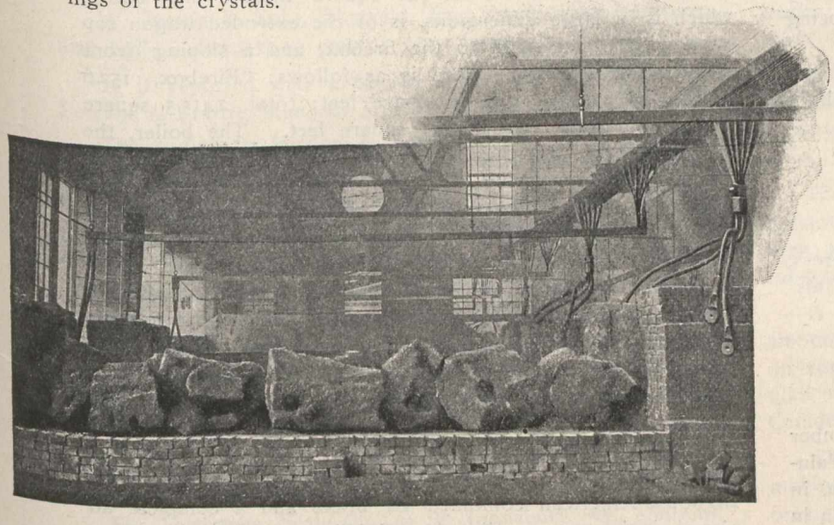
Carborundum Furnace Burning.

the transformer is a regulator, by means of which the voltage can be varied from 100 up to 250. The mains from the transformer to the furnace room are two copper conductors having a sectional area of eight square inches each. Heavy cables from these mains are bolted to the plates of the furnace. The circuit is completed by means of a water rheostat consisting of a circular iron vessel, containing salt water, into which can be lowered a large iron plate. To close the circuit the plate is lowered into the water until it rests on the bottom of the vessel. To break the circuit the plate is lifted out of the water. This device avoids the danger in-

volved by other methods of opening and closing circuits carrying such large currents. The resistance of the core being always greater when the carbon is cold, the voltage is first raised to overcome this. As the volume of current continues to increase, the regulation is run back, reducing the voltage, until finally the resistance of the core becomes constant and little regulation is required, the amount of power used on the furnace being 746 kilowatts or 1,000-h.p.

After the current has been on half an hour, a peculiar odor, due to escaping gases, is perceived, and at the end of three or four hours the furnace walls and top are enveloped by a lambent blue flame of carbon monoxide gas, formed by the combination of the coke with oxygen of the sand. During the run of a single furnace, five and a half tons of this gas are given off. At the end of four or five hours the furnace top gradually subsides, and fissures form along the surface out of which pour the yellow vapors of sodium. At the end of thirty-six hours, the current is cut off and the furnace is allowed to cool. Then the side walls are taken down, the unchanged mixture raked off, and the outer crust of amorphous carborundum removed. The inner crust is then removed and the crystalline carborundum, of which a single furnace yields about 7,000 lbs., is exposed.

After the carborundum has been removed, it is taken to a crusher, which breaks the mass of crystals apart. Then it is taken to tanks and treated for several days in diluted sulphuric acid to remove impurities, after which it is washed, dried and graded. There are twenty grades of crystals, and three grades of flour, the latter being the fine power washings of the crystals.

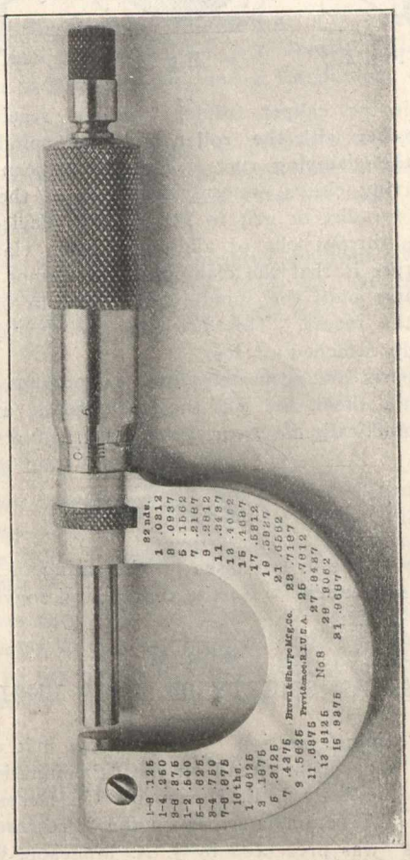


Carborundum Furnace after Burning.

Carborundum is infusible, and is also insoluble in water or acid. Its hardness approaches that of the diamond, it being almost impossible with a microscope to distinguish lines scratched on plate glass by carborundum from those of the latter. Its specific gravity is 3.123, or about 20 per cent. less than that of emery. The most interesting application of carborundum as an abrasive is in the form of wheels into which it is made in diameters varying from 1 to 36 inches, and in thickness from ¼ to 4 inches, besides wheels for special purposes such as dental, cylinders, cup wheels, roll-grinding wheels, saw-gummers, moulding wheels, etc. It is also made into knife sharpeners, hones, scythe, axe and sharpening stones, cloth, paper, etc. As compared with emery, it is claimed that it will do more work, better and faster. Watchmakers use it in place of diamond. One firm found that while emery wheels would grind about 65 rolls before becoming useless, carborundum wheels would grind 220. In regard to the tendency of these wheels to burst, it is claimed that they are safer than any other class of abrasive wheels. As confirming this statement, it is on record that at a scientific test of over sixty grinding wheels, all of which were 20 inches in diameter, conducted at the Technical High School, Dresden, an ordinary carborundum wheel attained a speed of 4,340 revolutions per minute before bursting, which was the best record made by any of the sixty wheels tested. As the proper operating speed of this size wheel, is 955 R.P.M., the factor of safety is shown to be very great.

MICROMETER CALIPER CLAMPING DEVICE.

Brown & Sharpe Mfg. Co., Providence, R.I., have recently placed upon the market an Improved Clamping Device for Micrometer Calipers, which is much superior to the clamping nut furnished heretofore. The device is simple in construction, and only a slight movement of the knurled ring is required to clamp the measuring spindle firmly. It is often desirable after taking a measurement to lock the spindle securely in the position in which the measurement was taken for reference when a large number of pieces are to be measured. Should the spindle be rotated or moved longitudinally, the accuracy of the original measurement would be destroyed, but in the construction of this clamping device, the possibility of disturbing the adjustment is entirely avoided. Another excellent feature of this device is that the tension on the spindle can be adjusted without disturbing the adjustment of the threaded portion of the screw and



nut. This is a valuable feature when measuring a number of pieces for comparison as sufficient tension can be put on the spindle to prevent its turning when the work is passed between the measuring points, and at the same time the spindle can be left sufficiently free to allow of slight adjust-

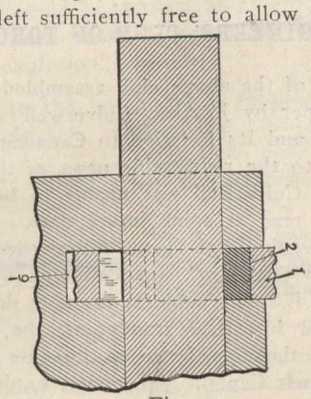


Fig. 1.

ments. When the clamping ring has been set to exert a certain tension, the rotation of the spindle cannot alter the setting of the tension for the reason that the clamping ring is held stationary and forms part of the bearing for the spindle. Referring to the cuts, figures 1, 2, 3, and 4, the operation of the mechanism is as follows: The split clamp ring 2, figure 2, fits the measuring spindle with a sliding fit when open, thus measuring a longer bearing for the spindle than

2, which fits into a recess in the slot 9, figure 2. The roller purpose. This ring is held from rotating by the lug 4, figure 2, which fits into a recess in the slot 9, figure 1. The roller 3, figure 2, which moves upon the inclined surface cut in the periphery of the ring, is actuated by the ring 1, figure 3. The clamping ring with the roller at lowest point fits into ring 1 with a sliding fit, and as the clamping ring is held from rotating, the movement of the actuating ring to the right forces the roller up the inclined surface 5, figure 2, and closes the ring concentrically around the measuring spindle.

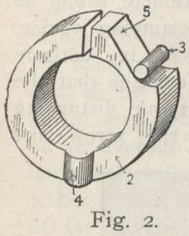


Fig. 2.

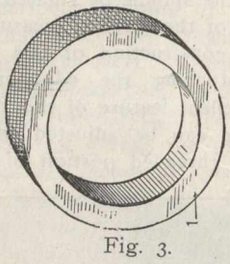


Fig. 3.

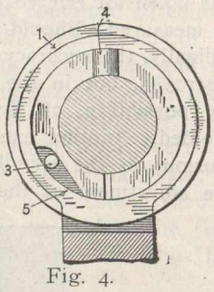


Fig. 4.

The slot in the caliper frame, figure 1, receives the hob rings together with the roller, and the spindle is passed through the clamping ring. It will be seen that as the clamping ring closes concentrically and as there is no opportunity for dirt or grit to get into the device, the spindle cannot be thrown out of alignment when clamping. Another feature is that the clamping ring cannot be taken out of the frame until the spindle has been run out sufficiently to clear the recess. This prevents the device from being accidentally detached or lost.

The parts are accurately fitted to prevent dirt or grit getting into them, and as the movements are so slight there is practically no wear.

CORRECTION.

In the article in last issue on the rating of Watt Meters, by Charles Brandeis, C.E., the sign ϕ was converted by mistake into an X.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The "Mining" section of this society met on December 3rd, when a paper was read on the "Examination and Valuation of Mines," by J. E. Hardman. On December 10th, in the "General" section, a paper on the "Pressure of Grain in Deep Bins" was presented by J. A. Jamieson, which will be continued on January 28th, a discussion following. On the same evening a paper on "The Construction of the Shubenacadie River Bridge" will be read by J. J. Taylor.

THE ENGINEERS' CLUB OF TORONTO.

The members of the above club assembled on December 9th to hear a paper by J. Alex. Culverwell on "The Enlarged Erie Canal and Its Relation to Canadian Waterways." Owing, however, to the regrettable news of the fatal illness of his father, Mr. Culverwell was unable to be present, and the paper will be read at some future date. On December 17th, a pleasant evening was spent, when a lecture on "The Alaskan Boundary Question" was delivered by W. T. Jennings, M. Inst., C.E. The subject was ably dealt with from a geographical and historical standpoint, the lecturer tracing the history of the country from the date when Captain Cook, and afterwards Captain Vancouver, explored those regions, down to the present time. Many interesting facts were quoted regarding the natives of the country and surrounding islands, their mineral and forest wealth, etc. The contentions of Canada and the United States regarding the boundary line were discussed, and evidence presented in refutation of the assertion that at the recent tribunal, Canada was not well prepared with maps. The lecturer was followed by Judge Hodgins, who, in a lucid and convincing manner, presented the legal aspect of the subject, viewed from a Canadian standpoint. A hearty vote of thanks was accorded to both gentlemen, at the close. Mr. Jennings brought with him a very comprehensive collection of maps to illustrate his lecture, and also an interesting relic in the shape of a sextant, formerly in the possession of Captain Vancouver, which was the object of much attention on the part of the members. The club has recently issued a pamphlet entitled, "Bulletin No. 1," containing an interesting record of its proceedings from the date of its inception to the present time. The number and subject matter of the papers presented during this period afford ample evidence of the usefulness of this club as an educational, as well as a social institution.

LOCOMOTIVES FOR THE C.P.R.

The Canadian Pacific Railway Company, some weeks ago, ordered twenty powerful compound locomotives from the Saxon Engine Works, of Chemnitz (Sachsische Maschinenfabrik, vorm. R. Hartmann). These engines—a number of which have been delivered at Montreal—are the first locomotives ever built in Germany for a North American railway. The engines bear the Canadian Pacific Railway Company's numbers 961—980, have six-coupled wheels, each 5 ft. 3 in. in diameter, whilst the four wheels of the leading bogie have a diameter of 2 ft. 6 in., and the tender wheels are 2 ft. 10 in. in diameter. The cylinders are 22 in. by 26 in., and the steam pressure 210 lb. per square inch. The boiler, which is of large dimensions, is of the extended wagon top type, with radial stays to the firebox, and a sloping front sheet. The heating surface is as follows: "Firebox, 152.6 square feet; tubes, 2,262.9 square feet; total, 2,415.5 square feet. The grate area is 33.1 square feet. The boiler, the inside firebox, and the tank plates are well constructed of the best mild steel, the tubes are of weldless Swedish charcoal mild steel, whilst cast and nickel steel, supplied by Fried. Krupp, are largely employed in the constructional details. The tender is of the standard hopper tank type of the Canadian Pacific Railway, and has a capacity of 5,000 Imperial gallons and ten tons of coal. The electric lighting dynamo, placed just in front of the cab and driven by a steam turbine engine, supplies current for an installation of incandescent lamps, placed along the running boards over the motion, and in the cab, in addition to a powerful "Edward's" headlight. The engines, which are finely finished and are of a graceful design, are fitted with the Westinghouse-American combined air brake and a complete air signal equipment, as also the "Gold" system of steam-heating. The locomotives have been erected strictly to Canadian practice, and from the designs of E. A. Williams, the superintendent of motive power, and A. W. Horsey, the chief draughtsman of the Canadian Pacific Railway.

The Canadian Pacific Railway Company, at the same time that they placed the contracts for the 20 locomotives with the Saxon Engine Works, also gave an order to the North British Locomotive Company, of Glasgow, for a number of locomotives of precisely similar design and dimensions. The first two of the British built engines have recently been delivered, being numbered 981 and 982, and whilst the working of both the German and British engines will form a very interesting locomotive test, the introduction of the British engines into Canadian practice will also afford an opportunity of seeing whether the admitted superiority of British over American built engines is due to either design or workmanship. It has hitherto been a very rare occurrence for orders to be placed even in Great Britain for locomotives of purely American design, as are those which have recently been delivered by the North British Locomotive Company and the Saxon Engine Works to the Canadian Pacific Railway Company.—The Iron and Coal Trades Review.

Stevens & Co., Galt, Ont., makers of special tools, have extended their works by the addition of a brick building and have added a pattern-making department.

INDUSTRIAL NOTES.

A shoe factory is in contemplation at Sydney, C.B.

The Belleville Rolling Mills will be running in January.

A cement plant has been erected at Saskatoon, N.W.T.

A freight car building plant is to be erected at Digby, N.S.

R. B. McComiskey will establish a celluloid factory at Granby, Que.

The Horwood Lumber Company, Newfoundland, will erect a steam cooperage.

A foundry to make mining and cement making machinery is to be established at Galt, Ont.

The Foundry Specialty Company propose to build a factory near Ashbridge's Bay, Toronto.

The Barrie, Ont., Carriage Co. are building a factory. The foundations will be cement.

The contract for the new waterworks system, at Regina, has been awarded to Dobson, Jackson & Fry.

W. S. Dwinnell, of Minneapolis, will erect a sawmill, costing $100,000, at Edmonton, N.W.T.

The Eugene Phillips Electrical Works will construct works at St. Louis, Que., to be completed January 1st, 1905.

The Canadian Corundum Wheel Works, Hamilton, Ont., will occupy their new factory in January.

A new waterworks pumping plant has been installed at the Royal Military College, Kingston, Ont.

W. Jessop & Sons, Sheffield, Eng., steel manufacturers, may build a factory, to employ 2,000 hands, in Toronto.

It is reported that a $25,000 hotel will be erected at Portage la Prairie, Man., by McLennan & Rae, of Minnedosa.

The engine in McKee & Sons planing mill, Toronto, was wrecked by the burning of the driving belt on Dec. 8th.

The American Seeding Machine Co. will not start in Brantford, Ont., owing, it is said, to depression in the U.S.

The foundry and machine shops of F. E. Came, Montreal, were destroyed by fire on December 10th. Damage, $25,000.

The Rudd Harness Co. are removing from Toronto Junction to Parkdale, Toronto, where they are building a large factory.

The Waterous Engine Company, Brantford, Ont., have installed two large boilers, in their new power house, which is nearing completion.

The Fairbanks Scale Co., of St. Johnsbury, Vt., contemplate the erection of a plant in the St. Francis district, Que. 600 hands will be employed.

G. H. Gooderham will establish an automobile plant, occupying three flats of a five-story building, to be erected on Temperance street, Toronto.

A large planing mill and furniture factory will be erected at North Bay, Ont. Dr. Warren, Toronto, is one of those interested.

A by-law will be introduced in Galt, Ont., to assist the proposed industry of the Galt Bridge and Structural Steel company.

The Dominion Exhibition Board has handed the city of Toronto $31,029 surplus from the 1903 Exhibition, in addition to buildings, valued at $26,113.

Warden, King & Son, will erect plant and machinery, value $300,000, at Maisonneuve, Que., fronting the Chateauguay and Northern Railway line.

The galvanizing plant of the Page-Hersey Iron and Tube Co., Guelph, is in operation. It is said to be the most complete of its kind in Ontario.

J. J. Daley, of Chicago, proposes to build a 1,150,000 bushel elevator, at Collingwood, Ont. A by-law, granting $25,000 bonus, is to be submitted.

Walkerville, Ont., is making an effort to secure one of the new steel plants of the Dominion Steel Company. Another is to be built at Leamington, Ont.

Thomas Gardner, Newmarket, Ont., is installing a five horse-power steam engine in his iron foundry.

The Farmers' Co-operative Harvesting Machine Company get a bonus of $20,000, and will erect a factory at Whitby, Ont.

F. A. Carpenter & Co., wholesale dealers in steamfitters' supplies, etc., Hamilton, Ont., offer their creditors fifty cents on the dollar.

Charles Brandeis, consulting electrical engineer, is in England consulting with a firm which proposes establishing works in Montreal.

A new industry is being opened on the north shore of the Gulf of St. Lawrence for the manufacture of fish oil, glue and fertilizers.

Boiler tubes, manometers, steel axles and principal parts used in constructing machinery are to be admitted into Peru, South America, free of duty, after April 12th next.

The National Light, Heat and Power Co., Farnham, Que., expect to turn out compressed peat shortly. The output will be 45 to 50 tons per day, and if satisfactory will be increased.

T. C. Meyers, of Johnstown, Pa., proposes to erect in Newfoundland a plant, value $500,000, to produce charcoal and gunpowder; with a pulp accessory to turn out kegs for exporting its product.

Niagara Falls, Ont., has declined to entertain the proposal of the Cullen-Johnson Brass Mfg. Co., to establish works there. They asked a $20,000 loan, with free power, water, light and taxes.

South Sharon, Pa., is to be made the greatest tin plate producing centre in the world. The American Tin Plate Company are erecting the plant to consist of seventy pot mills, employing 6,000 hands.

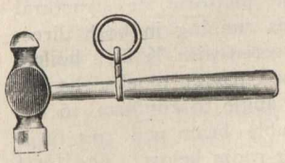
The Sunbeam Incandescent Lamp Co. of Canada, McKinnon Building, Toronto, are issuing a watch charm and stick pin in the form of miniature incandescent lamp. The company's factory is at St. Catharines, Ont.

A book, entitled "Worth Knowing," containing an amount of valuable matter for engineers will be sent free on application to the Union Petroleum Co., Toronto, Canadian representatives of the Keystone Chemical Co., of Camden, N.J.

The Electro-Manganese Co., Shawinigan Falls, has started making ferro-manganese, by the electric reduction of bog ores from the Lower Provinces. The plant uses 1,200 horsepower from the Shawinigan Water and Power Company, and this will be increased, if the works prosper, to 5,000 this year.

The jury, in connection with the fatal explosion at the United Factories, Limited, Newmarket, Ont., exonerated the management and employees from all blame. No cause for the disaster could be arrived at. The new boiler and the engine have been installed, very little time being lost on account of the explosion.

In addition to the watch charm recently advertised, the Mechanics' Supply Co., Quebec, are introducing an attractive little novelty in the shape of a machinist's hammer, which they will be pleased to forward, post paid, to any one on receipt of Canadian or United States stamps value thirty cents.



The Dodge Manufacturing Company, of Toronto, Limited, has completed its immense undertaking of furnishing special machinery and castings for the Harbor Commissioners' million bushel elevator, at Montreal. Some 250 tons of machinery and castings from the company's plant at Toronto Junction have been supplied, and the work has been approved of by the contractors, Government inspectors and engineers. The huge steel marine leg, which has been successfully hung in the tower, is said to be the largest in Canada.

Mica Boiler Covering Co., Limited, 86-92 Anne St., Montreal, have been appointed agents for James McCrea & Co., Chicago, and carry a complete stock up to 12 inches of the Climax Steam Joint Clamps, manufactured by that company. They are in a position to fill all orders immediately on receipt.

For the better distribution of its products, the Dodge Manufacturing Company, of Toronto, Limited, manufacturers of the celebrated Dodge pulleys, and many other lines now prominently on the market, will open commodious quarters at 419 St. James street, Montreal. A competent staff will have the new branch in complete running order by January 15th.

The Goldie & McCulloch Co., Galt, Ont., have installed a light and power plant in their factories, comprising 400 incandescent lights, 80 arc lamps, and a number of Bullock variable speed motors. The motors are geared direct to large lathes and planers, and are reversible, and can be run at any speed by means of a controller within reach of the machine hand. Current is generated at 250 volts, direct current, but through the medium of a balancer is delivered to motors at three different voltages. The firm furnished their own material and the entire plant was installed by H. F. Strickland, Toronto.

C. M. Rudel, late of the American Tool Works Co., of Cincinnati, has accepted the position of machinery department manager of the Fairbanks' Company, for Canada, with headquarters at Montreal. When connected with the Cincinnati firm, Mr. Rudel had charge of the railway business and contract department. He has been identified with the machine tool business for some time, and the experience and ability which he brings into his new position will no doubt result in still further augmenting the rapidly increasing business of this progressive firm.

The Fairbanks Co., 41 Front Street West, Toronto, have been awarded the contract for the installation of a steel waggon scale, to be placed in the roadway directly west of the King Edward Hotel. As traffic would be constantly passing over this scale, and as it is about thirty feet above the floor of the boiler-room below, the problem presented was somewhat difficult, but it has been satisfactorily solved. A coping of 18-in. "I" beams around the scale is provided, to which the corner irons of the scale are rivetted. The scale levers hang from these corner irons; and a novel protection device is added in the shape of structural steel material hanging from the coping just below the levers of the scale, so that if at any time, through accident any of the pivots of the scale should break, there will be no danger of the scale dropping through to the basement below. The scale platform, of structural steel, is built by means of "I" beams running in both directions, and the whole platform is covered with ⅜ inch boiler-plate, on top of which are put asphalt paving blocks, the top platform of the scale being on an angle to conform to the curvature of the roadway. The double beam will rest on a short iron pillar outfit in the boiler-room below. The total weight of steel and iron in this scale is over 9,000 pounds.

The Westinghouse Company have secured, through Westinghouse, Church, Kerr & Co., an important export order from the Manila Construction Company, an American corporation, operating in Manila, P.I., for a complete city traction power equipment, comprising the following machinery: Three 750-K.W. Westinghouse turbo-generator units, two compound engine exciter units, one motor-driven exciter unit, three 500-K.W. rotary converters, one 300-K.W. rotary converters, four 250-K.W. oil-insulated transformers, complete switchboard, and one series booster mounted on the extended shaft of one of the rotary converters. The car equipments will comprise ninety double No. 68 C. outfits, and ten double No. 56 outfits, using standard Westinghouse controllers. The first turbo-generator unit will be delivered in about nine months. The turbine will operate at 150 lbs.' steam; 26-in. to 27-in. vacuum, and 150 deg. superheat. It is fitted with the usual by-pass for securing an overload capacity of 50 per cent. It is also equipped with a quick-closing throttle valve. The turbo-generators will furnish three-phase, 60 cycle current at 380 volts; part of the current will be converted to D.C. by the power house railway sub-station, and the remainder will go to transformers for supplying high-tension distributing system. The transformers are oil-cooled and connected in the two-phase, three-phase, or Scott system for three-phase transmission. The turbine machinery will also furnish current to the local light and power system.

MINING MATTERS.

The Brookfield Mining Co. will erect a cyanide plant.

The Oderin copper mine, Newfoundland, will be worked in the spring.

The Pugwash River Company, of Gloucester, Mass., will develop copper areas at Upper Pugwash, N.S.

The Dominion agent, at Birmingham, is enquiring for mica boiler coverings and asbestos in large quantities..

The McDonald corundum mine, near Palmer Rapids, Ont., promises a big yield. P. Kirkegard, Delora, Ont., is manager.

Cape Breton, N.S., has six collieries under the water, Broad Cove, Mabou, Port Hood, Old Sydney, Sydney No. 2, and Newcastle.

The Acadia Coal Company are sinking two shafts at Ford Pit, N.S. They also will build a wharf at Pictou Landing to cost $40,000.

The New Brunswick Petroleum Company, Limited, of Moncton, will erect a refinery with a capacity of 300 barrels a day, at Memramcook.

L. Merritt, of Duluth, is exploiting for iron ore on Hunter's Island. In the spring drills will be put in operation if the best test pits warrant it.

It is stated that the antimony mines, at West Gore, N.S., will employ one hundred men at the beginning of the new year. An up-to-date plant has been installed.

An important discovery of asbestos has been reported to the Bureau of Mines by Willis Brown, of Buffalo. The property is in the township of Kaladar, Addington County.

It is reported that garnets, opals, and tourmalines have been found near Lac du Bonnet, forty miles from Winnipeg. An expert says the clay formation is the same as at Kimberley, and diamonds may yet be discovered.

Councillor Stoness, of Kingston, Ont., reports a movement on foot to extend the northwest branch of the Rideau Canal from Tett's Mills to Desert Lake. This will open up a large zone of mica, phosphate, iron, and feldspar beds.

Fire destroyed the machine shop of the Rarig Engineering Company, at Sydney Mines, last month. Loss, $30,000, and two hundred men out. The company was constructing blast furnaces for the Nova Scotia Steel Company. All the machinery was ruined.

The Craig mine, near Bannockburn, Ont., will run again soon. The Rand Drill Co., of Sherbrooke, Que., are installing a compressor plant, boilers, hoists, etc. A 20 ton stamp mill will be erected next spring. W. A. Hungerford is superintendent.

The Deputy Commissioner of Mines states that from present indications, the find of nickeliferous copper at Cheticamp in the northern part of Cape Breton will rank among the largest copper mines in the world. The ore appears to be an almost solid mountain of mineralized rock, the ledge rising over a thousand feet.

A new lead smelting plant has been installed at Bannockburn, Ont., by the Ontario Mining and Smelting Company.

One hundred and fifty coke ovens are now in operation at Morrissey Mines, B.C. The remaining hundred will be completed in the spring.

The annual convention of the Canadian Institute of Mining Engineers will be held at the King Edward Hotel, Toronto, from March 4th to 6th next. Eugene Coste is president.

The mine at Cordova, Ont., has been closed down for investigation, the company in England having become dissatisfied with the management. It is reported that work may be recommenced again in the spring.

A company with a capital of 1,500,000 rupees (about $750,000), is being formed in Calcutta, India, to develop a very rich copper mine recntly discovered in the Himalayas. Seventeen American mining engineers are prospecting in that district.

Reports of the Nova Scotia Coal and Steel Company show the coal output at Sydney to be 80 per cent. greater than last year, and at Marsh mines 75 per cent. It is estimated that 700,000 tons will be produced next year. The steel output has also increased.

The shaft of the Iron Mask mine, Kamloops, B.C., will be sunk another 200 feet, and to equip the mine with the necessary machinery, plant, valued at $100,000, has been ordered, mostly from Canadian houses. A concentrating plant of 200 tons daily capacity will be erected.

John Galt, C.E., reports a discovery of anthracite coal near Banff. A company will commence operations at once. The C.P.R. has let contracts for a spur line to the pit mouth, including extensive sidings. This discovery, it is stated, should cut the present price of anthracite ($12 to $14 per ton), in that district, in two.

J. L. Greatsinger, ex-president of the Brooklyn Rapid Transit Company; Peter Kimberley, Sharon, Pa., and associates, have proved a valuable copper mine 65 miles west of Port Arthur, Ont., and 14 miles south of the C.N.R. It is said much of the ore is 30 per cent. copper, and carries $11 in gold per ton. A smelter will be erected.

The International Coal and Coke Company, Coleman, Alberta, have placed contracts for plant to maintain an output of 2,000 tons daily. The Westinghouse Company will supply the electrical equipment, including motors, generators, locomotives, etc. The boilers and structural steel will be purchased in Canada.

I. Matheson & Co., New Glasgow, N.S., have installed a new tandem compound engine at the Sydney Mines plant of the Nova Scotia Steel and Coal Co., for operating a Capell mine fan. The fan has a diameter of 20 feet, and making 150 revolutions per minute, supplies 200,000 cubic feet of air at a 5½-inch water gauge pressure.

The Granby Consolidated Mining Company, Granby, B.C., propose to drive a tunnel into the foot of the mountain, four miles from Phoenix, and 4,000 feet below it, until it reaches a point directly under the mines, and to excavate from the tunnel upward. This will greatly reduce the cost of mining and eliminate the expense of hauling freight cars up the mountain. The work, for which legislation has been applied, will take some years to accomplish.

H. DeKeyser, who has erected a test furnace at Vancouver, B.C., of 50 tons daily capacity at a cost of $13,000, has threatened proceedings against Dr. Hendryx, should he establish works at Republic and the Arlington mine, alleging that the latter's process is an infringement of his invention, which has been patented in all countries. The DeKeyser company will, when satisfied with the present test, build a 5,000-ton per diem smelter.

P. B. Ball, Government agent in Birmingham, Eng., for Canada, states that the Welsh, Scotch and English mines are using Swedish, Norwegian, French and Spanish pit props, and he sees no reason why Canada should not share the trade. Two million tons of pine a year is used. He will try and interest some Canadians in Welsh coal, and if so, the return journey with pit props would reduce freight. They are now 17s. to 19s. per ton, ex-ship, Barry or Cardiff.

Rich veins of gold-bearing quartz are reported at Webbwood, Ont.

Pyrites, carrying 40 to 50 per cent. sulphur, have been found in the Steep Rock district, Ont.

The new Science Building, in Toronto, will contain departments of mining engineering, applied chemistry, mineralogy and geology, and will include a small blast furnace for smelting iron, a stamp mill, ore-crushing rolls, a reverberatory roasting furnace, and a special equipment in ore-dressing machinery. A room is provided for the geological museum, to contain the combined collections of the School of Science and the University, under Professors Coleman and Walker.

A company has been organized to exploit the corundum fields of Eastern Ontario. They have secured 600 acres in Raglan, Renfrew County, and will erect one of the largest corundum plants in the world. Connected with the project are: W. B. Rankin, president Canadian Niagara Power Company; H. P. Coburn, Sawyer-Massey Co., Hamilton; J. H. Tilden, Gurney-Tilden Co., Hamilton; J. H. Jewell and H. H. Dewart, Toronto, and a number of Buffalo and New York men. Mr. P. Kirkegaard will be manager.

Representatives of the New York and Ontario Mining Company and New York and Canadian Copper Company, comprising H. Seibert, of the Brooklyn Upper Transit, president; H. Inman, of the Inman Company; W. W. Flower, of Flower & Co.; Ira Kipt, Jr., of the New York Stock Exchange; S. W. Albrey, and H. Folger, late secretary to Senator Flower, have been visiting their properties in the Rainy River District, seventy miles north of Port Arthur. They state that the gold and copper workings will prove the most valuable in Ontario. A stamp mill and smelter will be working by March 1st.

The Government has appointed a commission to go to Europe to inspect the various electric processes for the smelting of iron ores and the making of steel. The commission consists of Dr. Haanel, Superintendent of Mines, and C. E. Brown, of the Canadian General Electric Co. A steel expert and a draughtsman will be selected in Europe to assist them. The Italian Government have successfully experimented with water power for electric smelting. At Livet, France, what are known as the Harmet and Keller processes are in use, and at Gysinge, in Sweden, steel is made from scrap and pig iron by electricity. In electric smelting, a purer pig iron and a better class of steel are obtained.

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TELEPHONE AND TELEGRAPH.

The M. Welsh telephone line, Bristol, N.B., has been extended to Florenceville.

The telephone system between Blyth and Auburn, Ont., is now in working order.

Edmonton and Calgary, N.W.T., are now connected by "Bell" long distance lines.

The Vernon and Nelson Telephone Co. have spent $10,000 in improving the system at Phoenix, B.C.

The Bell Telephone Company has reduced the rates in residences at Cape Vincent, Ont., to $12 a year.

John Peverley has purchased the wires and instruments of the telephone service between Cartier and Geneva Lake, Ont.

The New Brunswick Telephone Company have connected St. John with Andover and Grand Falls. The company's long distance service, with the exception of Restigouche, Gloucester, and Madawaska, covers all the counties in the province.

Nesbitt, Gould & Dickson, Hamilton, Ont., have entered action to quash the civic by-law giving the "Bell" Co. an exclusive franchise on the ground that the Provincial Legislature has no power to authorize the city to grant such a privilege, and further, that it creates a monopoly restraining trade and commerce. It is also alleged that unlawful means were used to influence the passing of the by-law.

The residents of Hall's Mills and Union Hall, Ont., propose to extend the Clayton telephone service to their locality, and those interested will contribute liberally to the scheme.

The Toronto World states the farmers ten miles north of Guelph have a system, with phones costing $2.50 each, and wire proportionately low, maintenance costing $1 a year.

The Canadian Telephone and Telegraph Co. will apply to Toronto for a franchise early in the year. The rates are not yet announced. The same company also want a franchise in London, Ont.

The Nova Scotia Telephone Company's long distance line, between Halifax and Sydney, has been completed to Port Hawkesbury, and will connect with Sydney early in the year.

A long-distance telephone line is being constructed from St. John, N.B., to Fredericton, via Belleisle Narrows, White's Cove and Chipman. It will be completed next spring.

Ahearn & Soper, of Ottawa, are building for the Government a telegraph line from St. Peter's to Scatarie Island, N.S., via Gabaruse, Mainadieu, Scatarie, and North Sydney. It will be completed shortly.

To keep the 30,000 odd miles of telegraph line in order in Great Britain, and provide for the proper despatch and delivery of millions of messages every month costs about $11,250,000 a year, including $7,500,000 for salaries.

Long distance telephone communication was inaugurated on December 15th, between the Kamouraska Telephone Company's exchange, at River-du-Loup, Quebec, and Toronto, 600 miles distant.

Willian von Siemens, of the Siemens-Halske Company, Dr. Franke, Dr. Thomas, and Dr. Erkhardt have completed, after several years' work, a new telegraph instrument which will transmit 2,000 words per minute over long distances. Perforated paper ribbon is used in the apparatus, and the message is received on a strip of sensitized paper, which emerges with the letters fully developed.

H. A. Bryan, a labor organizer, stated at Fort William, recently, that he had acted as agent for the Bell Telephone Company to discredit the town's civic management, and so influence municipal elections against local telephone systems. He asserted that the company supplied him with a petition asking for Government audit of municipal accounts. He implicated Capt. Hilmes, and Mr. Scott, of the Bell Company, in the matter. The general superintendent admits that the petition was circulated with the company's approval, but denies the assertion regarding municipal elections.

RAILWAY NOTES.

W. Anderson, secretary of the Hamilton and Caledonia Electric Railway, states that work will be commenced early in the spring, the power houses at Caledonia and Indiana, Ont., being started first.

An order-in-council has been passed canceling the order of Sept. 7 last, remitting temporarily the duty on certain materials of Canadian manufacture used in the construction abroad of locomotive engines for railways in Canada.

Henry O'Sullivan, C.E., and Sirois, C.E., are surveying the territory for the line of the Gaspe Railway. Mr. Sirois is working between Paspebiac and Port Daniel, while Mr. O'Sullivan is on the Gaspe section in the direction of Barachois and Perce.

A new surface contact transportation system was tested recently in Atlantic City. The inventor is Leon W. Pullen, of Philadelphia, . His system eliminates the third rail, overhead wires, poles, open conduits, and cables. A large trolley car carrying 100 people was used for the experiment. Beneath the car is attached a series of magnets which make the contact as they pass over the boxes, which are in the centre of the tracks, 16 feet apart. In appearance the contacts are like inverted saucers and are alive only at the time of the passage of the car over them. It is claimed eighty miles an hour can be attained.

The C.P.R. will erect a palatial hotel, costing $500,000, on the James' Bay flats, Victoria, B.C. F. M. Rattenbury is the architect.

The Stonewall, Man., Gazette says: Rumor has it that application will be made at the next session of the local house for a charter to build an electric line from Stonewall to Winnipeg. Several local men are interested, and there is a fair prospect that the rumor may materialize.

A petition is being circulated between St. Jerome and St. Sophie, Que., asking for a loop line from St. Antoine to Charlemagne, taking in the towns of St. Anne and Mascouche. This extension to the Great Northern would open up a new bit of country, and would give a more direct route from the West.

The North Lanark Railway Company will shortly begin to make surveys. The route proposed is from the High Falls on the Madawaska to Arnprior, thence to Galetta and Fitzroy Harbor, and thence to Ottawa. James Bell, of Arnprior, secretary, states that there is no truth in the report that an effort will be made to sell the charter.

LIGHT, HEAT, POWER, ETC.

The Hull Electric Co. propose developing a water power and lighting plant at Quyon, Que.

The first eight months' working of the Edmonton, N.W.T., municipal electric light system showed a profit of $3,069.

Capitalists represented by Mr. Van der Voort, of Toronto, propose to develop power at Petawawa and transmit electricity to Pembroke, Ont. A franchise is applied for.

Ottawa citizens obtain electric light for eight cents net per 1,000 watts. This is understood to be the lowest rate in Canada, and is due to competition and water power facilities.

Sherbrooke, Que., will apply to the Legislature for power to submit to the whole electors, instead of the ratepayers only, a by-law for the loan of $200,000 to instal a municipal electric lighting plant.

Capitalists represented by Mr. Dingman, of Toronto, propose to exploit natural gas at Edmonton, N.W.T. The council will grant a franchise on certain conditions, providing work is commenced in six months.

J. E. Doyle, of Hamilton, Ont., has been fined $25 for using the current of the Cataract Power Company without their knowledge. His service had been discontinued owing to a dispute, but he reconnected it.

The Electrical Development Company, Niagara Falls, Ont., will erect for the Toronto and Niagara Power Co. one of the largest power houses on this continent. It will be of solid granite, 425 feet in length, 200 feet wide, and will cost $400,000. E. J. Lennox, Toronto, is the architect. Tenders will be called for immediately. A gallery will run round the building, from which visitors can see the plant in operation and view the Falls.

The finding of the jury in connection with the acetylene explosion at Ridgetown, Ont., was to the effect that the disaster was due to an escape of gas through the V-shaped water seal, and contributory negligence of the attendants. Further, the machine was not of a type in accordance with the specifications of the Canada Fire Underwriters' Association, and it was recommended that Parliament enact legislation to isolate acetylene gas plants and place them under Government supervision.

Legal proceedings have been taken to quash the two by-laws passed by the Peterborough, Ont., town council granting franchises to the Light and Power Co. and the Radial Railway Co. on the ground that another company tendered to do the lighting for ten years at $1,500 per annum less; hence the town is indirectly giving a bonus of $14,000 for the introduction of the railway. Judge Meredith made an order quashing the electric light by-law, and the motion regarding the railway company was adjourned to enable the council to amend it. The council has amended the electric light by-law, but will appeal the decision regarding the railway.

The Montreal city council have received a report from Charles E. Phelps, chief engineer of the Electrical Commission of Baltimore, placing the entire cost of putting all wires in the city underground at $1,205,100.

The electrical committee of the Toronto city council have adopted a by-law and agreement to govern the municipalities interested in the municipal power scheme. The agreement provides: 1. For the confirming of the commissioners in their appointment, R. A. Ross, electrical expert included. 2. For the payment to R. A. Ross a sum of not over $1,500, the other four commissioners to serve free. 3. For the apportionment of the cost of the report, according to the assessment of the municipalities interested. 4. That the total cost of the report should not exceed $15,000. 5. That in case of death or resignation of any of the commissioners their places could be filled by others. 6. That the agreement shall not come into effect until seven municipalities were pledged to the scheme, Toronto included. The combined assessment of the other six municipalities to be at least $36,000,000. The by-law is merely to authorize the execution of the above agreement.

MR. GOSSLER RETURNS TO NEW YORK.

P. G. Gossler, general manager of the Montreal Light, Heat and Power Co., will go to New York in the spring, where he will be general manager of the operating department of J. G. White & Co., the large electrical and engineering contractors, who are doing a part of the work of the big Pennsylvania Railway tunnel, and who operate electric lighting and power systems in Manila and Porto Rico, as well as in the United States. Mr. Gossler takes his new position at a considerable advance over the salary received in Montreal. Coming to Montreal in 1895, as engineer and superintendent of the power department of the Royal Electric Co., he was retained with increased powers when that company was amalgamated with the Canadian General Electric Co., and later merged into the present large corporation. His management of the larger concern, with its varied interests and intricate requirements, has been as signally successful, as in the case of the smaller company. This is a striking testimony to the abilities of so youthful a manager, when it is borne in mind that Mr. Gossler had not only to deal with many questions in the operating department that were new to Canada, but had recently to face serious labor difficulties which were settled with less than the usual irritation arising from wages disputes. In the Canadian Engineer for July, 1899, a biographical sketch was given of Mr. Gossler, from which it appeared that when only twenty years of age he had taken the responsibilities of assistant chief engineer for the United Electric Light and Power Co., of New York. Mr. Gossler, who is only now in his 33rd year, was last year president of the Canadian Electrical Association, being the youngest man, so far elected to that position. No successor has yet been decided upon to take his place in the Montreal Light, Heat and Power Co.

P. G. Gossler.

General Francis V. Greene, of New York, has been appointed general manager of the Niagara and Ontario Power Company, Niagara Falls, Ont. He will have full power to direct the company's affairs at the new plant now building on the Canadian side of the border.

PERSONAL.

Albert A. Honey, of Chicago, inventor of the underground trolley, is dead.

J. W. Leonard, assistant C.P.R. manager for lines west of Winnipeg, has resigned.

Arthur M. White, civil engineer, of St. John's, Nfld., died suddenly in Boston last month.

H. S. Williams, Sarnia, has been appointed superintendent of the Guelph, Ont., gas works.

P. D. Brunnelle, a well known steamboat inspector, died last month at Quebec, aged 74.

Beuth Sims, recently engineer of the Ottawa and Northern, has been appointed resident engineer of the C.P.R., at Regina, N.W.T.

John Watson, sr., founder and president of the John Watson Manufacturing Co., died at Ayr, Ont., on December 14th, aged 84.

R. A. Ross, electrical expert, of Ross & Holgate, Montreal, has been appointed fifth member of the Ontario Municipal Power Commission.

Robert Grimes, formerly president of the Elmira Bridge Company, and one of the most noted bridge builders in the country, died on December 12th.

W. P. Roper, manager of the Charlottetown Light and Power Co., has resigned, to be assistant manager of the Montreal General Electric Co.

E. A. Williams, superintendent of rolling stock for the C.P.R., has accepted a position with one of the big American roads.

I. McMichael has been appointed general manager of the Great Northwestern Telegraph Company. He was forty years in the service of the Western Union Telegraph Company.

Frank T. Craven has resigned his position with the C. J. Field Conduit Company to represent the American Conduit Company of 170 Broadway, New York, Chicago, and California.

Capt. Albert H. Clinton, manager for twelve years of the large fleet of the D. B. I. and W. Ferry Company, died on Dec. 11th, aged sixty years. The deceased was born in Ancaster, Ont.

E. H. McHenry, engineer-in-chief of the C.P.R., has been appointed by Sir Thos. Shaughnessy to represent that company in connection with the new railway department, at the McGill College.

W. G. Ross, second vice-president and director of the Montreal Light, Heat and Power Company has resigned. Senator L. J. Forget is elected a director, and Rodolphe Forget second vice-president.

H. F. J. Porter, assistant manager of the publishing department of the Westinghouse interests for the past year, has been made second vice-president of the Nernst Lamp Company, of which enterprise George Westinghouse is president.

L. J. Forget has resigned the presidency of the Dominion Coal Company, and is succeeded by J. H. Plummer. It is also announced that H. M. Whitney, vice-president, has resigned, and retires from the board of directors. He is succeeded by J. Reid Wilson, of Montreal.

Sir Frederic Bramwell, F.R.S., D.C.L., LL.D., the eminent engineer, died on November 30th, at the age of 85. He was president of the British Association in 1877, and was one of the earliest advocates of the treatment of large steel forgings by hydraulic pressure.

Graham Fraser, recently a director and manager of the Nova Scotia Steel and Coal Co., is now general manager of the Dominion Iron and Steel Company.

F. W. Wanklyn has resigned the positions of vice-president and general manager of the Montreal Street and Montreal Park and Island Railways. K. W. Blackwell will, it is understood, replace Mr. Wanklyn as vice-president of these companies, while W. G. Ross, the present secretary, will become managing director. Duncan McDonald will be the manager of the two systems, and P. Dube, secretary.

George S. Hodgins, for many years connected with the mechanical department of the C.P.R., the latter part of the time as locomotive inspector, and afterwards mechanical engineer for the Canadian Locomotive Co., Kingston, has been spending the Christmas holidays with his father, Dr. J. George Hodgins, librarian of the Ontario Education Department, Toronto. Mr. Hodgins is now associate editor of Railway and Locomotive Engineering, New York, in which vocation he has brought to bear an extensive practical experience of all questions relating to motive power.

F. T. Wilkes, sec.-treasurer of the Waterous Engine Works Company, Brantford, Ont., died suddenly from paralysis, on Dec. 17th. Deceased was in his 56th year. He was the son of Judge Wilkes. He went to Brantford thirty-five years ago, entering the employ of the Waterous Company. Here he gained in a large measure the practical business ability which in after years contributed so greatly to his success as controller of enormous industrial interests. In the local Board of Trade he was a prudent adviser and a regular attendant at all the meetings. He leaves a widow, and three sons.

T. C. Frenyear, sales manager of the new Canadian Westinghouse Co., died of typhoid fever at Fort William, Ont., on December 10th. Deceased was the son of the Rev. T. C. Frenyear, and was born at Middleton, Vt., on March 16th, 1865. He began business with the Boston Electric Company at the age of 15, serving subsequently with the Thompson-Houston and Brush Electric Companies. From 1892 to 1895 he was superintendent of the Cayadutta Electric Railway, resigning that position in 1895 to enter the service of the Westinghouse Electric & Mfg. Co., with whom he remained until Nov. 1st last, when he was placed in charge of the sales department of the Canadian Company. In conveying news of the death to the officials of the Westinghouse Company, Vice-President Taylor said: "The management desires to place on record its thorough appreciation of his able and loyal service and of the loss to the Westinghouse interests by the untimely removal of a young and zealous official, whose future seemed so full of promise." A widow and three children survive him.

RADIUM.

Sir Wm. Ramsay's recent lecture before the London Institution on "Radium and the Periodic Law" was perhaps chiefly remarkable for his declaration that the transmutation of elements as a theory was by no means absurd. The lecturer briefly sketched the outline of the periodic law, which is beginning to suggest some root identity between the various elements, and then told of some practical results that had followed the discovery of this law. Sir William traced the various steps which led to the discovery of radium. Mendelieff, the great Russian chemist, ranged the elements—hydrogen, oxygen, carbon, nitrogen, sodium, the metals, and the other substances of which all things were composed—in the order of their atomic weights. Thus arranged, he showed that substances which came in certain classes had certain properties in common, as, for example, flourine, chlorine, iodine, and bromine. But there were gaps in this scheme, and Mendelieff predicted that new elements would be discovered to fill the vacant spaces. The fulfilment of that prophecy was one of the greatest scientific achievements of recent years, and each new kind of atom had fallen into and fitted an empty place. In 1894, Lord Rayleigh and Sir W. Ramsay detected argon in the air. Next year Sir William discovered helium, which had been revealed in the sun by the spectroscope before it was found on earth. Two years later, 1897, when the British Association met in Canada, Sir William Ramsay ventured on the prophecy that other elements like argon and helium would be discovered. He and a scientific colleague justified the forecast. They searched high and low, and finally by means of liquid air they isolated three new elements in the atmosphere—krypton, neon, and xenon—belonging to the same class as helium and argon. and like them inert bodies with no discoverable affinity for others. The professor showed what gases of these substances were like by sending through them an electric current. Their spectra were thrown on the screen, that of xenon, or "the stranger," showing in its entirety the remarkable number of 2,000 distinctive lines. These, it had been said, were inert elements. Their discovery had been followed by the revelation of a class of elements that were remarkably energetic. In 1896 Rontgen discovered the X-rays, and Prof. Ramsay showed a radiograph, the first taken in London by the Rontgen rays. Simultaneously, Becquerel, in Paris, discovered that uranium would discharge the electroscope. Madame Curie, following up the investigation, revealed the existence of polonium in pitchblende, and in the same mineral Monsieur and Madame Curie made the momentous discovery of radium—now universally known as the most energetic of all radioactive bodies. But not the only one; there seemed to be six in all—uranium (found by Becquerel), polonium and radium (Monsieur and Madame Curie), thorium (Schmidt, of Breslau), tinium, and an unnamed element (by Gresel). As to what became of radium ultimately, Sir William gave it as his opinion that the infinitely small particles that it threw off eventually lost their radioactivity, and then gave the spectrum of helium. It seemed as if this intensely active element at last turned into helium—thus bearing out the theory of transmutation.—Electrical Engineer, London, England.

CALENDARS FOR THIS YEAR.

We have to acknowledge with thanks the receipt of serviceable calendars for 1904 from the following firms: B. Greening Wire Co., manufacturers of wire rope and wire cloth, Hamilton, Ont.; M. Beatty & Sons, manufacturers of dredges, hoisting machinery, and contractors' plant, Welland, Ont.; Kerr Engine Co., makers of power pumping machinery, hydrants, and valves, Walkerville, Ont.; Ashton Valve Co. valves and gauges, Boston, Mass.; Hale Bros. publishers Orillia Packet, Orillia, Ont.; Mutual Life Insurance Co., New York and Montreal; Daniel Kahnweiler's Sons, makers of life-saving apparatus, 437 Pearl St., New York; The Pittsburg Meter Co., East Pittsburg, Pa., makers of gas and water meters; The Royal Insurance Co.

The Robb Engineering Co., of Amherst, N.S., have installed a new boiler for the Fredericton municipal electric light system, recently purchased from the local company.

—Christmas fires were responsible for the following losses: J. Inglis & Co., Toronto, pattern shop and offices, $40,000. The National Table Factory, Owen Sound, $60,000. Aitchison's sash and door factory, Hamilton, $20,000. The Canada Cabinet Co., Gananoque, Ont., dry kiln, $10,000. The Moose Jaw Machine Works, N.W.T., $5,000.

Col. McMullen, of New York, president of the Ottawa River Railway Company, representing American capital, proposes to construct an electric railway from Ottawa to Montreal, through Argenteuil, Two Mountains, Terrebonne, Laval, and Jacques Cartier counties, with branches to St. Rose, St. Ann and St. Genevieve. They offer to sell ten tickets for twenty-five cents for local city service. The cost is estimated at from $10,000 to $13,000 a mile. The directorate is composed of F. D. Monk, M.P.; T. W. Raphael, Thos. Christie, M.P.; J. A. Ethier, M.P.; J. E. Leonard, M.P.; Thomas Gauthier, and Mr. Wells, of New York.

A new supplement to catalogue No. 77 has just been issued by Arthur Koppel, manufacturer of narrow gauge railway materials, 66-68 Broad Street, New York. The supplement gives further data concerning the firm's standard track materials, mainly switches and turntables. These data will assist in making up plans for tracks in large buildings, factories, boiler rooms, etc. A copy of this supplement will be sent to all interested parties mentioning this paper.

THE EVOLUTION OF THE TELEPHONE EXCHANGE.

BY F. DAGGER, TORONTO.

One of the most convincing arguments employed by telephone companies, in support of the high rates charged to subscribers in large cities, is to the effect that the cost of construction and operation of large telephone systems increases at a ratio far greater than that of direct proportion to the number of subscribers. To the mind of the average business man, whose experience teaches him that the greater the quantity produced, the cheaper the cost of production is, this argument seems to be totally opposed to reason; yet, the telephone manager fully realizes its truth from actual knowledge of the facts.

The cause of this increased cost is to be found in the central office equipment, where it is necessary to provide not only for the terminals of the subscribers' lines, but to so arrange the switchboard that each individual operator can, by a movement of the hand, connect the calling subscribers on her section with any one of the total number of lines on the exchange. For example; on an exchange of 5,000 telephones, an operator to whom is allotted the duty of attending to the calls of 80 subscribers, must have within arms' length 5,000 jacks or connecting springs, into which she can insert the plug attached to the cord connecting with the calling subscribers of her section of the switchboard. In order to accomplish this the switchboard is divided into sections, each of which comprises 200 answering jacks, and a number of connecting jacks equal to the total capacity of the exchange. Thus: on the switchboard of 5,000 lines there would be 25 sections, each containing 5,200 jacks, or a total of 130,000.

A 10,000 line switchboard would be divided into 50 sections, or 10,200 jacks each, or a total of 510,000, while an exchange into which all the subscribers' lines in New York were concentrated, namely, 100,000, would necessitate 50,-100,000 jacks, a problem which would stagger the most sanguine telephone engineer.

In consequence of this unalterable law of multiplication in connection with the growth of a telephone exchange, it is generally conceded that when the capacity of a manual switchboard exceeds 5,000 lines, it becomes too expensive and too complicated to provide a good service at low rates.

In large cities the general practice has been to divide the city into sections, and to place in each section an exchange of 5,000 lines. For the purpose of connecting the subscribers throughout the whole system, trunk or junction wires have to be provided between the exchanges, and, in order to provide a prompt service, these trunk wires should be equal to 20 per cent. of the total number of lines on the system. This entails not only an increased cost of construction, but more complicated apparatus, and a large number of expert operators to handle the traffic over these trunk wires, in addition to the ordinary operating staff.

In view of the additional expense attached to all this, it may be said that the telephone charges of the independent companies in large cities in the United States have touched "rock-bottom" figures, and with respect to manual switchboards, these have reached the maximum of perfection as regards their ability to handle economically large numbers of subscribers.

Recognizing the fact that, if the use of the telephone was ever to become of universal benefit to the community, it would be necessary to eliminate the ever increasing expense which the manual operating of a large telephone exchange involves, inventors have been at work since 1879, endeavoring to devise a system which would connect telephone subscribers without the meditation of the "hello girl," or in other words, to produce a telephone-operating machine.

The development of automatic telephony has been necessarily slow, and although much has been done experimentally, in the past, it has remained for two natives of the birthplace of the "Bell" telephone, Messrs. J. H. and G. W. Lorimer, of Brantford, Ont., to produce a machine which, while costing less to manufacture than a manual switchboard, will perform all the functions of a telephone exchange, with a promptness and decision not equalled in any manually-operated system in the world.

The operating machine comprises a number of sections each accommodating 100 subscribers. On each of these sections are five connecting divisions, any one of which automatically performs the same functions as a telephone operator handling a pair of connecting cords. In combination with each section is a "Decimal Indicator" and "Division Starter," which control the section to which they belong, and pilot each subscriber's call to an idle division, which completes the connection with the subscriber called.

A remarkable feature of this exchange is, that should the whole of these divisions be in use when a call is made, it is stored until the release of one of the divisions, when the waiting call is completed without any further effort on the part of the calling subscriber; hence, no call once made is lost nor neglected.

Each section is capable of handling 360 calls per hour, and inasmuch as the average calls per 100 subscribers, during the busiest hour of a large exchange, is computed to be 125, it will be seen that this machine can deal with traffic far in excess of known requirements.

The number of connecting divisions can, like the connecting cords of a manual switchboard, be arranged to meet the traffic requirements of an exchange. The percentage of cords of a manual exchange is usually ten per 100 subscribers, which enables 20 subscribers out of each hundred to converse at one time. In exchanges where the traffic is light, this number may be reduced, and where it is heavy the percentage is increased. This principle has been carefully followed in the "Lorimer" system, thereby enabling the maximum of service to be given at the minimum of cost.

The connecting divisions being for the common use of all subscribers it is only necessary to provide a sufficient number for each section to fulfil the demands of the service at the busiest hour of the day. The experience of manual exchanges proves that in the majority of cases ten, or even a less number of divisions in a section are sufficient. Hitherto it has been found necessary, in other automatic systems, to provide a set of individual connecting apparatus for each subscriber, with the result that at all times 90 per cent. of the apparatus of the exchange was always out of use. For this reason such systems are so costly and complex that they offer little inducement to the telephone companies to discard the manual system, but by the saving of the 90 per cent. of apparatus effected in the "Lorimer" exchange, the end of the manual switchboard is in sight.

Another point in this machine worthy of special mention is the fact that every line on the exchange is tested once in four seconds without intermission, and if a line becomes out of order, the fact is at once announced by the ringing of an alarm, when the attendant in charge can at once locate the faulty line, and isolate it until the defect is right.

Each section of the machine is completed at the factory, and is sent out fully wired and tested as an individual unit, thereby enabling the capacity of a telephone system to be increased or diminished by adding to or taking away any number of sections, without interfering with the working of the exchange. The wiring between each section is so simple that a youth with the merest elementary knowledge of wiring could complete the connections between any number of sections without assistance. This is an advantage absolutely unattainable by the builders of manual exchange equipments.

The subscriber's outfit consists of a long-distance central energy telephone set, in combination with which is an automatic device for transmitting the impulses necessary to operate the central machine. These impulses are controlled by four pointers, working on an indicator plate, arranged to be moved up or down four vertical rows of numerals, representing units, tens, hundreds and thousands. These pointers may be set to indicate any number from 0 to 9999. For instance, if 4,567 is wanted, the pointers are set thus: in the thousands row, at 4; in the hundreds at 5; in the tens at 6; in the units at 7. The subscriber then pulls down a

lever, which releases the automatic signal transmitter, and when the lever regains its normal position, he removes the receiver from the hook, rings the subscriber called by pressing a button, and commences the conversation. Should the number wanted be engaged, the calling subscriber is aware of this by the fact that as he presses the button he cannot hear the alternations of the ringing current in his receiver, which would be perfectly audible if the line wanted was not in use.

This exchange is adapted for "central energy" working, and can be installed in connection with existing telephone systems without necessitating any interference with the plant outside the central office.

One of these exchanges is in operation on the premises of the Canada Machine Telephone Company, who are the owners of the patent rights for Canada. Arrangements have been completed for the establishment of a large plant in Toronto for the manufacture of these machines.

WATER POWER FROM GLACIERS.

An interesting case of water-power development from glacial streams is illustrated in the Chicago Western Electrician. The power is to be obtained from mountain glaciers, which yield a continuous flow the year round. The plant is now in course of construction at Electron, and the water is to be taken from a stream thirty-five miles from Tacoma, 1,900 feet above sea level, and within nine miles of the first glacier. In all five glaciers feed the stream. A large dam will be constructed and the water will be diverted through an 8-ft. square flume, cut through solid rock, and suspended across canyons, a distance of more than ten miles, to an elevated and precipitous bank of the stream, where a large reservoir is to be constructed. The water will be conducted at a decline of 7 ft. to the mile, and at the end will be dropped at an angle of 45 deg. through steel pipes 1,700 ft. in length down the slope to the river bank, a fall of 888 ft. and a pressure of 400 lb. to the square inch being secured. The reservoir is to be provided in order to cope with fluctuations in the stream, and as a reserve power in case of accidents to the flume. With a fall of 888 ft. the water will rush down through penstocks of steel and strike the buckets of the waterwheels of which there will be nine, at a velocity of 240 ft. a second. From 3,000-h.p. to 4,000-h.p. will be developed. The work is being hurried on as much as possible, and a temporary electric lighting plant has been installed, so that operations may be continued night and day. A great part of the electric power developed will be used in the operation of about seventy miles of electric tramways, but the company will have a surplus of from 10,000-h.p. to 20,000-h.p. above the requirements of its own lines, which will be sold for industrial purposes. The Electrical Engineer, London, commenting on this enterprise, says: Experience with harnessing glacier-fed rivers on the Continent has proved that there is want of water during hard winters.

COBALT-NICKEL DISCOVERIES IN ONTARIO.

The recently discovered deposits of cobalt-nickel in North Ontario are of great importance. Like the great nickel deposits of the Sudbury, they were the outcome, not of a search for minerals, but of blasting out a railway cutting. The present deposits were disclosed during the building of the Temiskaming and Northern Ontario Railway, and the road runs over some of the veins. They lie five miles south of the village of Haileybury to the north of Lake Temiskaming, about 106 miles north of North Bay, and ninety miles northeast of the Sudbury nickel mines.

The discovery is the subject of an interesting article in the Engineering and Mining Journal, by Prof. W. G. Miller, provincial geologist of Ontario. He says: "When I visited the locality recently, four veins or deposits had been located in the vicinity of a small body of water, known as Long Lake. Each of the four veins visited was found to carry cobalt. Nickel also appears to be present in all of them; but as the weathering of the cobalt compounds masks at times the nickel colors, this latter metal was not definitely recognized in two of the deposits, although it doubtless occurs wherever the cobalt is found. Three of the veins are rich in native silver. Very little work has been done on any of the veins, and as the surface is pretty well filled by moss and soil, it is impossible to state what is their horizontal extent. All of the veins cut through one or both of the formations known in the district as Huronian slate and breccia-conglomerate."

The ore has a massive appearance, and a rather dark grey color, where not coated with cobalt bloom. When examined in hard specimens, especially if a polished surface be examined with a magnifying glass, it is seen to be a mixture of a grey material, which is chiefly nickelite, and the reddish material, niceolite. Minute, brilliant silver-white or tin-white crystals occur sparingly, embedded in the wall-rock, and in the ore. The crystals occur in cubes, and in combinations of this form with the pyritohedron. The ore is somewhat porous, spaces being left between the globules, which are tarnished almost black on their surfaces. Where not coated with cobalt bloom, the weathered surface of the ore has a dark color, not unlike that of the wall rock. On a fresh surface the more massive ore resembles unspickel, but is somewhat darker in color.

The ore of Sudbury is of a different character from that of the Haileybury deposits, being essentially pyrrhotite and copper pyrite. The rock associated with the Sudbury deposits, which are not veins, but deposits of irregular shape, is norite, a variety of gabbro; the ore itself is claimed by most writers to be of igneous origin. There is little in common between the ore bodies of the two localities, except that nickel is the chief metal of each. On the Quebec side of Lake Temiskaming, about nine mines to the northeastward of the Haileybury deposits, there is a deposit known as the Wright silver mine. This was discovered many years ago by some of the early explorers of that region. During recent years this deposit has been worked for its lead and silver contents. The deposit is unique in character, the wall rock being Huronian breccia-conglomerate, the fragments of which are, at times, cemented together by argentiferous galena.

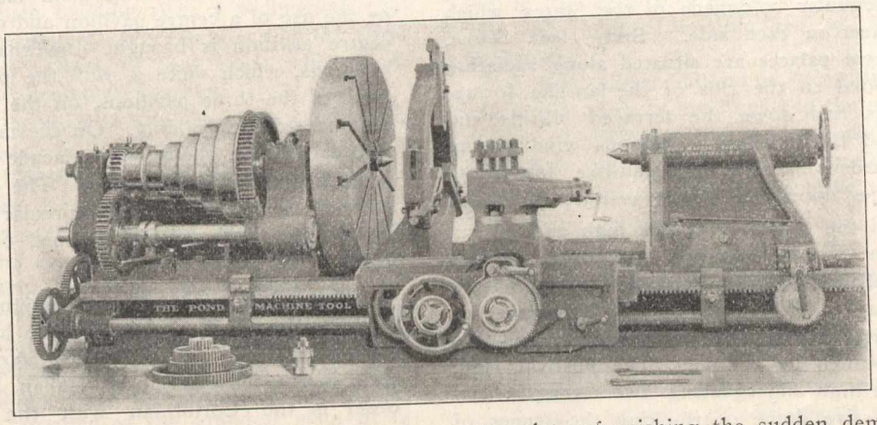
Cobalt is used in the arts, chiefly in the form of oxide. It is obtained from New Caledonia, Australia, and Germany, and smelted in France, Germany, and Great Britain. Cobalt oxide is produced at one plant in the United States. The ore of New Caledonia, which is the world's largest producer, shipping about 3,000 tons yearly, is cobaltiferous wad, containing from 25 to 30 per cent. manganese and 2 to 8 per cent. of cobalt oxide. The ore of New South Wales is similar in character. In both countries the cobalt ore is a decomposition product, and occurs in irregular deposits, similar to those of bog iron ore..

At the end of 1901 and the beginning of 1902 the price of cobalt ore, containing 4 per cent. cobalt, in New Caledonia was fixed up higher than circumstances warranted. The black oxide of cobalt sells at from $2.26 to $2.30 per pound, or the metallic cobalt in the compound brings about $3 per pound. It would thus seem that the refiners should make a much larger profit than the miners. The market will not, however, stand a greatly increased production without the prices materially decreasing. It is claimed that there has been a combination among refiners to keep up the prices of the artificial cobalt products.

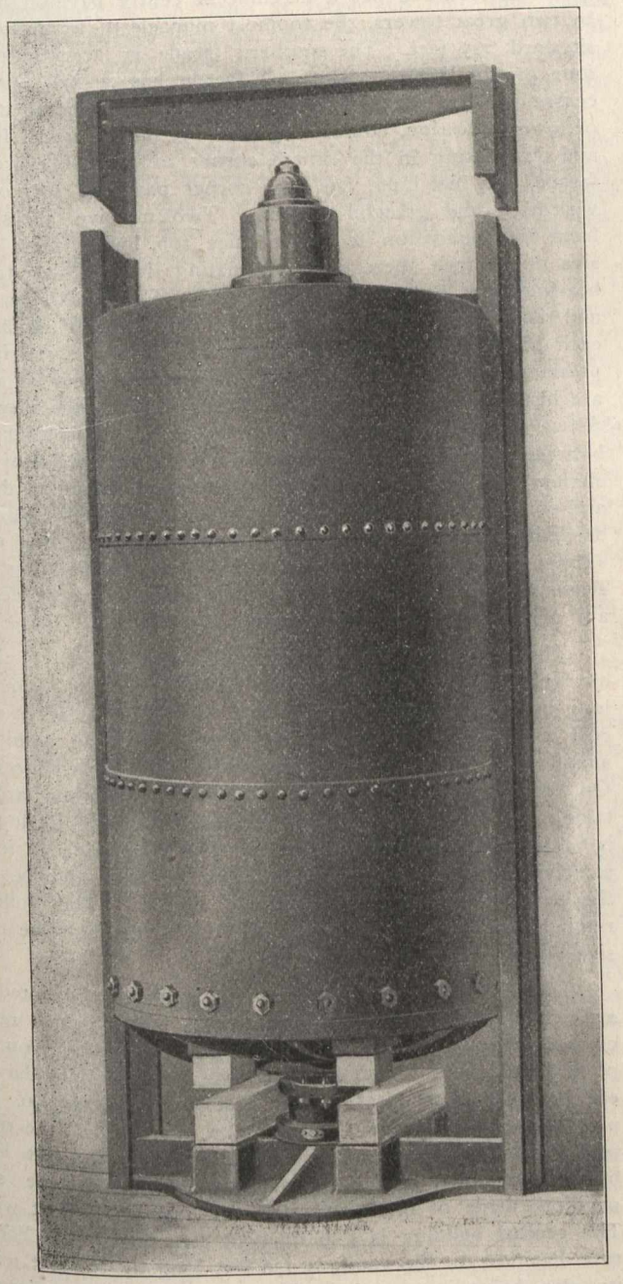
NILES-BEMENT-POND LATHE AND HYDRAULIC ACCUMULATOR.

Referring to the recent description of the Montreal Locomotive and Supply Co. Works, the following is a description of the 54-in. lathe and the hydraulic accumulator supplied for those works by the Niles-Bement-Pond Co., of New York: The 54-in. lathe is one of the company's standard lathes, built by the Pond Machine Tool Works. It swings over bed 55-in. and over carriage 45½in. with 16½-ft. bed will turn 6-ft. 4-in. between centres. The spindle is of large diameter and has twenty changes of speed.

The spindle bearings are lined with bronze. The carriage is fitted with compound swiveling tool slide, and has screw cutting attachment, and longitudinal, cross and angular feeds. The feeds are entirely independent and their direction may be changed at the carriage. The bed is of box



form and wide enough to prevent the tool over-hanging the front when turning full swing on the lathe. This lathe is designed for use of modern high-power tool steels and is an especially powerful machine.



The Hydraulic Accumulator was built by the Bement-Niles Works. The piston is 12 inches in diameter. The sheet iron tank shown in the illustration is bolted to the platform and holds the punchings, scrap iron, or other material used as a weight. It is designed to be used at a water pressure of 1,500 lbs. per square inch. It has a check valve at the base, and a rod is provided for regulating the action of the pump. The use of an accumulator in an hydraulic plant is of an immense advantage, as the pump may be of comparatively small size and run continuously, the accumulator furnishing the sudden demand for water. In the accumulator, illustrated below, the sheet iron tank as it moves up when water is pumped in, is held in position by guides.

MAJESTIC ARCHITECTURE.

Miles of Magnificent Buildings for World's Fair Uses. Facts about the Exhibit Palaces.

St. Louis, Mo., when the gates of the Louisiana Purchase Exposition swing open on April 30th, 1904, an achievement which reaches the highest climax in the display of art and industry, will mark an epoch in the history of civilization.

In immensity this Exposition far excels all others ever dreamed of during any nation's progress. This World's Fair of 1904, occupies one thousand two hundred and forty acres, situated on the beautiful undulating ground of the far-famed Forest Park. A few comparative figures reveal this wonderful immensity at a glance. The World's Columbian Exposition, at Chicago, covered 633 acres; the Exposition of 1900, at Paris, 336 acres; the Pan-American, at Buffalo, 300 acres; the Centennial, at Philadelphia, 236 acres, and the Trans-Mississippi, at Omaha, 150 acres. So, it is seen, that the World's Fair of 1904, at St. Louis, embraces within its boundaries an acreage equalling three-fourths the aggregate of all these named, and is equal in size to the Columbian Exposition, the Paris Exposition, of 1900, and the Pan-American, combined.

Pursuing these comparative figures further, it is seen that the roofing of the main exhibit buildings at St. Louis covers 128 acres, while Chicago had but 82 acres; Buffalo, 15, and Omaha, 9. Any one of the four single buildings at St. Louis embraces more exhibit space than was found in the entire Pan-American Exposition. Then, too, the Louisiana Purchase Exposition introduces an elaborate feature which was practically slighted in all other expositions, and that is the large space devoted to outdoor exhibits. These open-air displays cover more than 100 acres at St. Louis, and many of them challenge the indoor exhibits for popularity and attractiveness.

However, while the scope of the World's Fair of 1904 comprehends the art and industry of the entire world of to-day, yet it is not an Exposition of "dead" products alone, but pre-eminently one of life and motion. Beside the finished products, the hum of whirling machinery is heard, as skilled workmen from the four quarters of the globe are busy showing how these products are made. The World's Fair of 1904 stands uniquely alone in this phase of activity.

The first impression of any Exposition is produced by the architectural outline of the buildings. And in this feature the Louisiana Purchase Exposition has never been excelled. The main group of Exposition palaces, twelve in number lies in the northwestern portion of the grounds. These buildings are arranged in a way to take the best pos-

sible advantage of Nature's gifts and make the rolling hills harmonize completely with the architectural plan of the Exposition. Other writers have aptly described this plan as one suggesting the lines of a fan. From a central point on the summit of the dominating hill stands Festival Hall, midway in the semi-circular colonnade of the States, which stretches away 750 feet on each side. Sixty feet below, eight of the magnificent palaces are situated along radiating avenues that correspond to the ribs of the fan-like formation. These cascades rush down the terraced hillside and are lost in the Grand Basin below. Lagoons wind among lawns and flower gardens across this fan-like formation, and ornamental bridges adorn the broad avenues of travel.

The Colonnade of the States is 52 feet high and over a quarter of a mile in length, bearing sculptural images symbolical of the twelve States and Territories formed from the Louisiana Purchase. At the ends of the Colonnade are circular restaurant pavilions 130 feet in diameter and 140 feet high, each surmounted by a dome. The Festival Hall, in the centre, 200 feet high and covering two acres, is surmounted by an impressive dome overlooking the scenes of activity in the entire Exposition.

On one of the radiating avenues below the hill, where stands the Festival Hall, is situated the Palace of Education and Social Economy. It is on the east side of the main lagoon, facing the Grand Basin. This building is of the Corinthian style of architecture. Its ground plan is in the form of a keystone. The two equal sides are 525 feet long, the south front 460 feet and the north front 758 feet. The principal entrances are upon the axes of the building, and resemble triumphal arches. At each angle of the building is a pavilion forming a supplementary entrance, and these are connected by a monumental colonnade. The four elevations are similar in character, and a liberal use of monumental and historical sculpture lends a festal character to the otherwise somewhat severely classical exterior.

The Palace of Electricity, also facing the Grand Basin, excels in the majesty of its proportions and the beauty of its architectural details. It is entirely surrounded by lagoons crossed by ornamental bridges. It has a frontage of 758 feet toward the north and 525 feet toward the east, and is also in the shape of a keystone, the design being a bold columnated treatment of the Corinthian order. The facades are well accentuated by eleven pediments with groups of columns and tower effects, affording opportunity for the ample sculptural decoration. The fenestration is bold and appropriate, giving ample light, and on top two sides of the building the loggias add pleasing effects of light and shadow. This palace covers eight acres, and cost $399,940. It was designed by Walker & Kimbell, of Boston and Omaha.

The Palace of Manufactures is of the Corinthian order of architecture, and faces the entrance to the main boulevard. It has a frontage to the north of 1,200 feet, with a depth of 525 feet, and covers 14 acres. It was designed by Carrers & Hastings, of New York, and cost $720,000. The four main entrances at the centres of the main facade are elaborately ornamented with sculptural groups, etc.

The Varied Industries Palace is a magnificent structure on the outer perimeter of the picture representing the main plan of the Fair. The visitor is awe-struck at the magnificence of this building when he passes through the main entrance gate of the Exposition. It presents a facade of 1,200 feet on the north and 525 feet on the east, giving nearly 14 acres of exhibition space, all on the ground floor. It is a columnated design embodying a free treatment of the Ionic order. Aside from the numerous entrances on the facades, there is a specially featured entrance at the centre of the south front. This entrance is thrown back and magnificent colonnades formed on either side. Van Brunt & Howe, of Kansas City, are the architects.

One of the most imposing and artistic structures ever erected is the Palace of Liberal Arts, designed by Barnett, Haynes & Barnett, of St. Louis. It cost $500,000. It is 750 feet long, 525 feet wide, and covers nine acres. While the style of architecture is a severe treatment of the French Renaissance for the exterior facade, it will adhere very closely to classic lines in many respects. The long facade, especially, will show a magnificent entrance, almost pure Corinthian. It has been the endeavor of the architects to depend largely on sculpture in the decoration of the building, refraining from the over-use of stereotyped architectural ornamentation. The long main facade is made interesting by the use of a centre pavilion and of two end pavilions. The centre pavilion is brought somewhat above the connecting buildings, which unite it with the pavilions on either side. Each of the three pavilions, on the fronts, forms an elegant entrance to the building. On the main facade are three entrances and on the 525-foot facade are two entrances, one in each of the end pavilions. The main entrance is in the form of a hemi-cycle, with circular colonnades. The ceiling of this hemi-cycle is frescoed on a background of old gold.

The Palace of Machinery, designed by Widmann, Walsh & Boisselier of St. Louis, is 1,000 by 525 feet in area, and covers ten acres. It cost about $600,000. The architectural style is the fully developed Italian Renaissance. The main order is the Corinthian with the columns, accordingly, plainly treated in the shafts. This building is a model of grace and beauty, and has a prominent place on the western arm of the main transverse avenue of the Exposition. The north facade of this palace stretches east and west one thousand feet, and has a magnificent centre pavilion flanked by two great towers, the topmost pinnacle of which reaches skyward 265 feet. The southern facade is accentuated by four ornate turrets. The east facade has a tall, massive centre pavilion 300 feet long, flanked by two short curtains of lower elevation, conforming to those on the north facade, and terminating in the ornate corner towers. The western facade, 300 feet long, has two corner pavilions surmounted with high and graceful towers. Two massive piers rise from the foundation to the cornice top, losing their massive appearance there and terminating in pointed turrets bearing long and slender flag-staffs. These massive piers and the corner pavilions carry the three great archways, each 48 feet wide. The main entrance in the north facade presents an arcade of five bays, the massive piers of which are highly ornate. Above the three central bays rises an Attica feature, accentuated by pairs of Corinthian columns between which are three large panels. The Palace of Machinery presents on each side an entirely dissimilar design and contour, and this is owing to the architect's plan of departing from the rectangular shapes adopted in the other exhibit palaces in the main picture. Thus the building possesses a diversity of architectural features not accorded to any of the other great buildings.

The Palace of Transportation, designed by E. L. Masqueray, Chief of Design for the Exposition, is 1,300 feet long by 525 feet wide, and covers over fifteen acres. It cost more than $700,000. The facades show an admirable adaptation of the French Renaissance style of architecture. On the east and west fronts are three enormous arches, taking up more than one-half the entire facade. Each arch is 64 feet wide and 52 feet high. The decoration is found principally in the impressive massing of large details, and the general treatment is extremely simple. The building reminds one of a great railway station, as through the massive archways run 14 railroad tracks.

The Palace of Art surpasses the structures devoted to art exhibits at all previous expositions. This palace really comprises four massive buildings, the aggregate frontage of three of them is 836 feet, the two side pavilions having each a depth of 422 feet. Their cost is over $1,000,000. The plan of the palace is in the shape of a capital "E," the open part facing the south. The central building, 340 feet long by 160 feet wide, is of stone and separated from the side pavilion, made of brick and staff, by avenues 44 feet wide. The central building is a permanent structure. The Sculpture Pavilion on the south is 150 feet long by 100 feet wide, its plan being rectangular with an exedra or semi-circular bay at the east and west ends. The interior of the quadrangle is laid out as a garden for flowers, shrubs, fountains and statuary. The Art Palace stands on Art Hill to the south of and above Festival Hall. The main facade of the structure fronts north toward the main picture of the Fair.

The group is designed in the graceful Ionic style, accentuated at the main entrance of the central building by a Corinthian order of majestic proportions, thus giving the structure the characteristic appearance of an art building. To the centre of the main building rises a pedimented construction to a height of 40 feet. The architect of the three larger structures is Cass Gilbert, of New York, while E. L. Masqueray designed the Sculpture Pavilion.

The Palace of Agriculture is 1,600 feet long, 500 feet wide, and covers 20 acres. It cost $529,940. It was designed by E. L. Masqueray. The fronts of the building are practically a successive series of windows, each 75 feet long and 27 feet high, each window being placed 14 feet from the floor, so as to allow the use of the wall space inside for exhibits. Triangular monitor windows supply skylight, while they cut off the direct sunlight, which would quickly spoil many exhibits which this building will contain. The grand nave, 106 feet wide, which runs through the entire 1,600 foot length of the building, rises to a height of 60 feet and supplies what is here regarded as the grandest vista of installation space of any building ever designed for exposition purposes. Some idea of the immensity of this building is obtained when it is known that the Madison Square Garden, of New York, covers only two acres, and that the Palace of Agriculture is ten times as large, and that this palace also covers twenty times as much ground as the hotel Waldorf-Astoria, forty times the space covered by the Planters' Hotel, in St. Louis, and is more than three times the size of the Coliseum of Rome.

The Palace of Horticulture, designed by E. L. Masqueray, is 800 feet long, the main central section being 400 feet square. The east wing of the building is a conservatory 204 by 235 feet in area and 40 feet high, the west wing having the same proportions.

The exhibits of Forestry, Fish and Game are in a building having a frontage of 300 feet north and south, and 600 feet east and west. This building and those devoted to Agriculture and Horticulture are in line south of the Administration Building.

The Palace of Mines and Metallurgy is 750 feet long, and 525 feet wide, and covers about nine acres. It is 60 feet high to the cornice. It cost about $500,000. It was designed by Theodore Link, of St. Louis, the designer of the St. Louis Union Railway Station. This building is situated in the southwest portion of the grounds, and is the largest structure provided, thus far, for mining exhibits at an exposition. The entrance shows Egyptian style, but the building in its entirety is an expression of the modern Renaissance. The building is divided into eight oblong parts almost equal in area.

The building for the exhibits of the United States Government is the largest structure ever built by Governmental authority for any exposition. In size it is 800 by 250 feet, and $450,000 were set aside for its construction. It occupies a commanding site in the extreme eastern part of the World's Fair grounds. Southeast of it lies the high plateau on which are situated various State buildings. The Government building faces to the northwest, overlooking the main picture of the Fair. On the terrace in front of the building a flight of steps, 100 feet from side to side, leads through a flower garden to the main entrance. The general style of the building is Pseudo Classic. The central pavilion, surrounded by a broad dome, is connected with pavilions on the ends with a colonnade of Ionic columns five feet in diameter and 45 feet high. The central pavilion, with the colonnade on either side, forms a portico 15 feet wide and 524 feet long, 50 feet above the level of the other buildings. An attic 15 feet in height, embellished with statues, surmounts the colonnade of Ionic columns. The dome surmounting the central pavilion is 100 feet in diameter, and is designed after the Pantheon at Rome. The top to the quadriga, which surmounts it, is 175 feet above the ground. The building was designed by James Knox Taylor, supervising architect of the Treasury Department. He also designed the Government Fisheries Pavilion, situated south of the Government Building, and connected with it by a grand stairway. This pavilion, 135 feet square, is a reproduction, line for line, of a Roman dwelling house of the Pompeiian type.

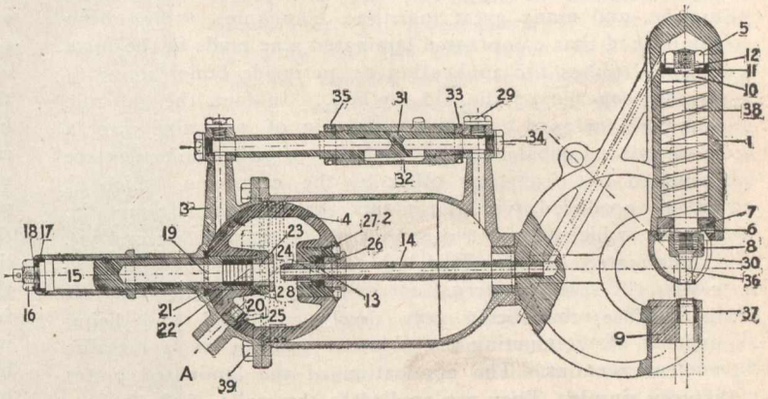
The various magnificent Palaces of the Louisiana Purchase Exposition are all part of a harmonious scheme worked out by the architects assembled together as a commission. The style adopted is described as "A free treatment of Renaissance."

A half million dollars is being spent for the sculptural adornment of these buildings and the grounds, and the genius of the architect and the sculptor and the painter will be fused into one harmonious picture—the greatest exposition achievement of all time to open the twentieth century.

A. C. CANTLEY.

CASKEY PNEUMATIC PUNCH.

This device, recently placed on the market by the Chicago Pneumatic Tool Co., 1010 Fisher Building, Chicago, is another of the constantly increasing examples of the successful application of compressed air to mechanical work. The first Caskey punch ever built, while of crude design and entirely different from the finished product of the market to-day, actually punched 90 per cent. of the holes in two torpedo boat destroyers. It was not until two years later that these machines were placed on the market, and the interim was devoted to perfecting and improving them. Their legitimate field is apparently unlimited, but they are of particular value in the machine shop, and a glance at the illustration will bring to the mind of the engineer, foreman, or superintendent, numerous cases where such a punch would prove economical. Portability, speed, accuracy, lightness of weight, and convenience are a few of the numerous advantages they possess. The method of operation is as follows: The ball piston, No. 4, carrying tail rod or intensifier 15, is seen in extreme rearward position, the extremity of the stationary hollow rod 14, being at the approximate centre of the ball piston, when the piston begins its stroke, impelled by the constant air pressure from A, the rod 14 telescopes into tail rod 15, and by this movement effectually seals all communication between the tail rod and the interior of the piston proper. As the piston and rods 14 and 15 are kept filled with oil, it will be apparent that the entire air pressure back of the piston is concentrated upon the column of oil contained in rod 14, and the passages leading to the punch ram chamber. Further, the volume of oil so moved at each stroke being just sufficient to depress punch 36 the proper distance, as soon as the hole is punched no further downward motion is possible. It will be clear that all jarring and undue strain on the parts are thus prevented, and a steady, yet positive action gained. When the piston has completed its working stroke, a slight turn of the valve 32, admits the air to the other end of the cylinder, thus equalizing the air pressure on both sides of the piston; but the area of the stationary rod 14 being less than that of the tail rod 15, the ball piston is forced back into position for another stroke. A great saving in air consumption is effected by this arrangement, the same air being utilized to drive the piston in both directions. Owing to the peculiar construction and arrangement of the ball piston and parts co-acting therewith, it is impossible for any air to get into the high pressure passages, unless the oil level in piston is



permitted to fall below the top of the opening in the tail rod, when the piston must be refilled at once. A great drawback incident to the use of some nydro-pneumatic tools, is thus entirely eliminated. In the construction of some parts, an alloy of aluminum is used to secure lightness.

FOR THE STEAM ENGINEER.

The Montupet water-tube boilers have been subjected to tests on French warships. It is found that the tubes can be very quickly removed and replaced. In one of the trials, which lasted four hours, the fires were reduced, the steam pressure lessened, the boilers emptied, and a tube removed—all in the space of 15 minutes. The tube was then replaced and the steam pressure immediately restored. The total interruption to the proper working of the boiler lasted 40 minutes, and of this only eight to ten minutes were employed in removing and replacing the tube. Later, when the fires were out and the boiler had cooled, 32 tubes were removed in one hour and twenty minutes. All the tubes were found to be in good condition.

The use of zinc to prevent the oxidation of the iron and the incrustation in steam boilers has greatly increased during recent years. Heretofore, zinc has been employed for this purpose only in the shape of raw pigs, but after many experiments made by the society of "Mines et Fonderies de Zinc de la Vieille Montagne," which have since been confirmed by the British Admiralty, by the national French marine, and many great maritime companies, it has been established that compressed laminated zinc made in the form of thick plates for application as an inside boiler lining is greatly superior to the old method. In fact, the galvanic current developed transforms the pig of raw zinc into a more porous substance, in which the metallic molecules are insulated one from the other by the corrosion which is quickly produced, resulting in this, that the intimate metallic contact, which causes the generation of the electric current, is eliminated. Compressed laminated zinc, on the contrary, resists the spongy internal corrosion, as it corrodes only on the surface, thus being very slowly consumed and being capable of conducting the current as long as a metallic nucleus remains. The application of the laminated plates is very simple. They are applied to the walls of the boilers by means of strips and are so distributed that the galvanic action is exercised in an even way, when possible, over the entire surface of the iron. When oxidation is produced in any part of the boiler, it is because the nearest zinc plate is too far away. By this employment of pressed zinc the incrustation of the boilers is avoided, and at small cost.

The methods of disposing of city refuse are costly and wasteful. There is an immense amount of power in the refuse which might be turned to account if proper methods were employed. In Great Britain, by the use of what are called destructors, the stuff is converted into fuel at such a high temperature that no gases escape to infect the surrounding air, and everything is consumed but a small residuum that has in some cases been used as a filtering material. The temperature is carried as high as 2,000 degrees Fahrenheit. The bulk of the fuel is the refuse itself, and the heat is converted into power, just as coal might be, to run pumping engines and electrical plants for lighting and traction. These destructors are of various types and their use is rapidly extending.

It is the custom of some engineers to shut all of the valves in their plants at night, while others only close those that are absolutely necessary. Some close all valves on their lubricators, others only shut off the supply of oil. Both think they are right, but the one who shuts all never regrets his action, while he who does not sometimes finds a glass broken, and damage done by hot oil thrown around promiscuously. One experience of this kind usually is sufficient to show him the error of his ways. The same difference in practice is found about shutting off water columns when leaving them at night, for while one engineer will carefully shut them off every night, another leaves them just as they are used. After a man has come into his boiler room in the morning and found that a broken gauge glass has allowed water and steam to be blown into it during the greater part of the night, he usually decides that it is a good plan to shut the valves before he goes away. This certainly is the safest way, and the only objection to it that we have heard of is that he may forget to open them in the morning and find out where his water-level is.

As a rule, the cross compound engine is more desirable than the tandem where uniform speed is essential because it has two cranks set at right angles, therefore the force is supplied to the crank shaft in a nearly uniform manner, which prevents the changes which are inseparable from a tandem compound or a simple engine, where the whole of it is applied to one crank.

WHAT CONSTITUTES A GOOD BOILER FURNACE?

In order to burn the fuel as most firemen like to see it burn, the total air space of the grate must be as large as possible, while the metal is reduced to the smallest size consistent with ample strength. The surface of the grate will be smooth, offering no obstructions to the use of the slice bar and rake. A furnace in which a long time is required for the perfect combustion of the fuel will be made larger, as well as the combustion chamber and flue. Where a high temperature is desired, sufficient air must be supplied, and to realize this, both time and space become important factors if thorough combustion is had. The walls of the furnace will have very few openings, such as doors and vents, because every break in the solid wall increases the tendency toward cracks, which can seldom be avoided entirely, and which cause air leaks that interfere with economy. The walls will be built double with an air space of ample size between them, so that any air that may leak through the outer half of the wall will become more or less heated before reaching the furnace, and will thus tend to aid rather than hinder combustion. The furnace will be lined with a quality of fire-brick combining great refractory power with hardness, and a degree of toughness sufficient to resist the abrasion due to the fire tools and the clinker. The lining of fire-brick will extend from two to four feet beyond the bridge wall, depending upon the size of the boiler and furnace, beyond which ordinary brick will be used. The walls will be firmly held together by suitable anchor bolts because neither fire-clay nor mortar is entirely reliable for binding the brick together and especially when subjected to the high temperatures of the furnace. All joints between the boiler and the walls will be kept tight—as nearly air tight as possible—by means of a properly built wall and suitable filling material between the constantly moving shell and the walls, and lastly, the space back of the bridge-wall and the floor of the ashpit will be paved, which not only makes the furnace work better, but enables the fireman to work better also.

THE HOT WATER METER FOR BOILER EVAPORATIVE TESTS.

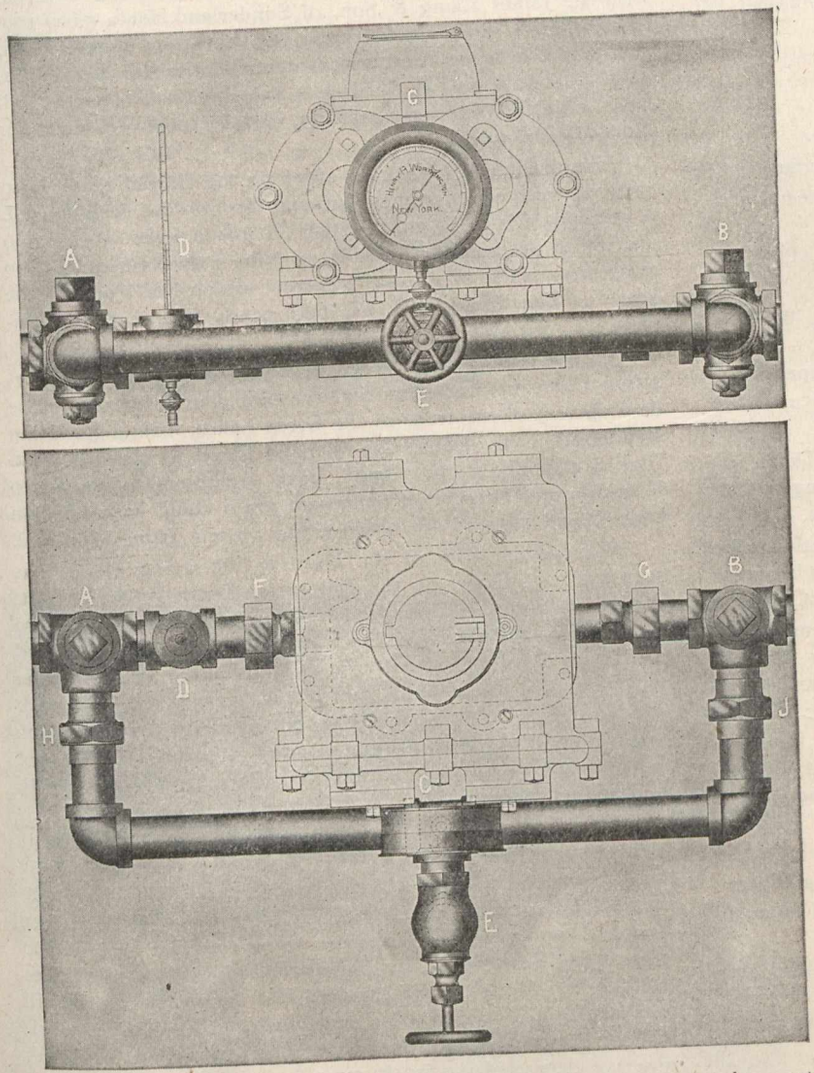
BY JOHN A. DREW.

Every engineer, who has control of a boiler plant, must feel the necessity of having some simple device by which the amount of water fed to the boiler can be accurately measured. With such an appliance, it is easy to test the evaporative values of various coals.

There was a time when it was not necessary to keep a close record of the cost of operation of large power plants, but now the ever-increasing competition and the necessity of lowering the cost of production demand the very closest scrutiny into every possible source of economy. With the introduction of electricity and the consequent installation of large central power stations, and in large manufacturing establishments, where the cost of power is an important item in cost of the product, a very careful record should be kept of the performance of the boiler plant, and there are but few, if any, plants to-day that do not keep a close record of the coal consumption. But while this is valuable information in itself, it is only part of the data that should be obtained. If the amount of water evaporated is not known, there is no way of separating the performance of the boiler

itself from the balance of the plant. This separation shows when the boiler is affected by scale or soot, and determines the most economical fuel, as well as the best method of firing, either by hand or by mechanical stokers. In the past, the customary method of determining the amount of boiler feed water has been by weighing or measuring it. This is a very laborious method, even for short tests, and is utterly impracticable for daily work. The use of the feed water meter, on account of its simplicity, accuracy and reliability in evaporative tests, is now adopted by engineers for daily work, as well as for trial tests.

The most reliable test meters are of the positive displacement type, the duplex pattern of which measures water by means of two chambers alternately filled and emptied by the motion of their pistons. These meters are so constructed that it is impossible to pass water without a corresponding registration, for in order to pass through the meter, the water must be displaced by the motion of the pistons and therefore recorded by the counter attachment. The pistons are closely fitted and move in parallel lines. The design, arrangement and construction of valves and parts is such that the strokes of the two pistons alternate, the valves actuated by one admitting pressure to the other. At end of each motion, the pistons are brought to rest by adjustable buffers which determine the length of the stroke. One of the pistons is constantly in motion, giving uniform flow of water, free from pulsation or shock. The meters are perfectly noiseless in their performance. These test meters are designed and constructed of materials uniformly affected by expansion and contraction from varying of temperatures, thus further assuring their accuracy as measuring devices.



For an ordinary test, one of these meters was calibrated. By deducting the weight of water, as found by the meter registration from the actual tank weight, the figures showed the meter to be correct to within one-fifth of one per cent. To obtain correct results, these tests meters should be properly applied for operation, the size selected should be ample for the service, insuring slow piston speed, and pipe connection should be made so that at any time the meter can be cut out for examination or repairs without shutting down the boilers.

The accompanying cut shows the plan and elevation of a test meter, by Henry R. Worthington, New York.

A and B are three-way cocks to pass water through the meter and to the boiler, or, for calibration, to allow water to pass by the angle valve "E" to a tank placed on scales for weighing. By this arrangement it is possible to test the meter as frequently as desired. By setting the cocks "A" and "B," and breaking the couplings, "F" and "C," the meter may be removed without interrupting the operation of the boiler plant in any way. "C" is a gauge for indicating pressure; "D" is a thermometer for indicating the temperature of the water; "H" and "J" are pipe couplings. These connections should all be made of brass.

MACHINE SHOP NOTES FROM THE UNITED STATES.

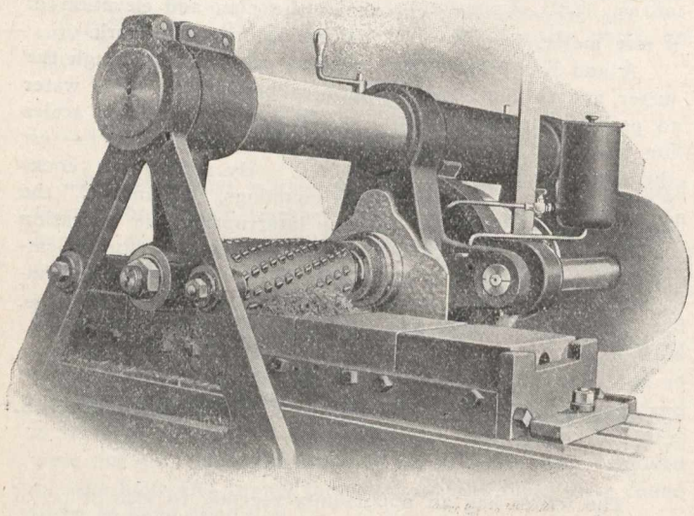
BY CHAS. S. GINGRICH, M.E.

The writer had an opportunity recently to visit some of the large machine shops in the States and found some very interesting things in the manner in which the work was being done and the rate at which they were doing it. One of the greatest surprises was the milling machine.

The great volume of business that has been coming to machine shops, during the past few years, has been the means of bringing about a more thorough investigation of cost reducing methods than has ever taken place heretofore, and has resulted in the re-designing of machine tools. Space does not permit of going into the details of all the new tools, and we will confine ourselves to the milling machines which we saw and which are doing work in about one-half the time formerly required to do the same work on shapers and small planers. Among the improvements that were made, the most noticeable was the method of driving the feed. The feed belt and feed cones have been superseded by mechanisms which transmit power from the spindle to the table of the machine entirely through gearing. The result is, that there is absolutely no slippage between the spindle and the table of the machine, and instead of limiting the rate of feed to suit the efficiency of the feed belt, these machines are now worked up to the limit of the main driving belt. The result is, that heavier and faster cuts are being taken than were before dreamed possible.

An illustration is here given of one of the Cincinnati Milling Machine Co.'s machines in operation, surfacing cast iron pieces 8¼ in. wide. In manufacturing these pieces it is necessary to take a first roughing cut, and then a finishing cut; whether the work is done on a planer or a miller; and it is, therefore, considered good practice to take the roughing cut by the fastest means possible. It is this roughing cut that is shown in the illustration. The cutter is 4½-in. in diameter, and is of the inserted tooth variety. It takes a cut about ⅛-inch deep so as to get under the scale, and this work, 8¼-in. wide, is actually fed past the cutter at the rate of 8⅛-in. per minute. It might be also of interest to note here that the teeth of the cutter are made of ordinary carbon steel. The writer has data in hand of a similar piece of work having been done on this machine with a cutter having teeth made of "Novo" steel, in which case the rate of feed was 10½-in. per minute. The pieces were finished on this same machine, feeding about 1½-in. per minute, and producing a highly finished surface. We had the privilege of seeing the pieces after the roughing cut had been taken, and were surprised to note that although they were done at the remarkable rate above mentioned, the surface was one

that would be admirably adapted for brackets, pedestals, bearing caps, and similar work requiring an even surface, but not a high grade of finish.



Evidently a large amount of work that engine builders and general machinists are now planing or shaping can be done on a miller at the above rate.

MARINE NEWS.

It is proposed to erect a big coal dock at Port Arthur, Ont.

A large steel floating dry dock is to be erected at St. Johns, Newfoundland.

A new steamer is being built at Sturgeon Falls, Ont., by Captain Gridley for Cockburn & Sons.

Reid & Co. are building an extension to their machine shops at the dry dock, St. Johns, Newfoundland.

It is understood the Star Line Steamship Company, St. John, N.B., are seeking a new boat to take the place of the David Weston, recently burnt.

The Collingwood Bulletin states that E. J. Davis, of Toronto, and Captain F. X. Lafrance intend putting a fast boat on the Owen Sound and Sault Ste. Marie route.

The Hudson's Bay Company have in contemplation the building of an up-to-date, commodious steamer to ply between Prince Albert and points on the Upper Saskatchewan.

The Western Lakes Transportation Co. are contemplating the building or purchasing of another steel steamer for the lake freight trade between Fort William, Goderich and Collingwood.

P. P. Young will build a new excursion boat for the Kawartha Lakes at a cost of $11,000. Length, 96 feet; beam, 18 feet. The hull and machinery will be constructed by Bertrams, Toronto.

Tenders for a new dry dock will be received up to February 3, 1904, by the Imperial Dry Dock Company, 3 Water Street, St. John, N.B. Plans and specifications can be seen at the office of the company.

The J. T. Hutchinson, with a cargo of flax valued at $190,000, which got on the rocks on November 30 at Keewenaw Point, Lake Superior, and was feared would become a total loss, has been floated.

G. A. Tomlinson, Duluth, has ordered from the American Shipbuilding Company a boat 494 feet long, 52 feet beam and 29 feet deep. The vessel will be the largest freight carrier on the lakes, and will cost $350,000.

The new battleships Libertad and Constitution have been sold by the Chilian Government to the British Government for nine million dollars. The Libertad is the fastest battleship afloat, having a speed of 20.3 knots per hour.

A new wrecking steamer, built by J. McGill, for the Provincial Wrecking Co., of Cape Sable Island, was recently launched at Shelburne, N.S., and is being fitted with powerful engines by the New Burrel Johnson Iron Co.

A tug 80 feet long for the Sincennes-McNaughton Co., Montreal, has been launched at Sorel, Que. She will have fore-and-aft compound engines, cylinders 18 and 36 in. by 24 in. stroke, and Fitzgibbon marine boilers carrying 150 lbs. of steam.

The largest full-rigged ship afloat recently arrived at St. John, N.B., to load lumber for Australia for Cushing & Co. She is the Lansing, and was originally a steamship. Her dimensions are: Length, 405 feet; beam, 48 feet; depth, 23 feet; net tonnage, 2,605.

Capt. Coates, of Fort Frances, Ont., together with several business associates, will engage in steamboating on the Saskatchewan river next year. The first boat, a stern wheeler, is to be constructed this winter. Length, 150 feet; beam, 28.

The breakwater at Port Colborne has been completed. The structure cost $515,000. It is built of timber, covered with concrete, is 4,400 feet long and 50 feet wide. It has a head block of 60 feet in width, upon which a lighthouse of steel and concrete has been erected.

A company is being formed in London, Eng., to build a fleet of twelve specially designed vessels for grain carrying between the Great Lakes and Montreal. Capital, $1,500,000. The directors are J. Torrance, R. Bickerdike and A. Racine, of Montreal; C. Carpenter and Jos. Mellows, of London, Eng.

The Quebec Steamship Company has placed a contract with Sir James Laing & Son, of Sunderland, for a 5,000 ton, 16 knot, twin screw steel steamer, 425 feet long, 50 feet beam, and 36 feet 6 inches deep, with accommodation for 240 saloon, 32 second class and 48 third class passengers. The vessel will have large cold storage capacity, and is to be delivered on November 1, 1904.

The preliminary work of widening the United States ship canal above the Government locks at the Soo has been started. A coffer-dam is to be constructed. At present the canal is too narrow to accommodate traffic, and the improvement will do away with much of the swift current which has troubled the vessels. The filling work will take nearly two years to complete.

J. A. Cuttle, general manager of the Montreal Transportation Company, considers that the best course for the future development of the trade of the Great Lakes, from a Canadian standpoint, is to deepen the Welland Canal to eighteen feet. This would allow the Great Lake freighters to come to Kingston and Prescott, from where grain could be carried in barges, and shipped by ocean-going vessels from Montreal.

A successful trial of the Doenvig life-saving globes has been made at Skaw, on the dangerous North Jutland coast. During a storm the inventor, with four other persons, were launched from the cruiser Heimdal in a globe, which cleared the breakwaters and shoals and drifted safely ashore.. The apparatus is made of light steel plates, surrounded by a cork fender. It has a flat, double bottom, containing tanks, which can be filled with fresh water and used as ballast. There are also compartments for stores. The sphere can comfortably hold sixteen persons.

Extensive additions will be made to the Government docking facilities at the Canadian Soo. The present dock is to be extended 300 feet out into the river, and built in an "L" shape, so that there will be 300 feet of frontage, with 22 feet of water, and a landing frontage along the east side of 700 feet, 22 feet deep at the outer corner, and varying to 12 feet towards the shore. Three hundred feet on the west side will be available for use by tugs and smaller boats. The work will cost $30,000, and will be rushed all winter. Geo. A. Boyd, who has charge of the work, expects to have it completed by the spring. A warehouse, 70 x 250 feet, will also be added to those already in use.

The Minister of Marine, accompanied by the Deputy Minister, Hugh A. Allan and Andrew Allan, has inspected a system of electrical submarine signals which may be introduced on the St. Lawrence. By this system signals can be made between vessels a distance from each other, and between vessels and lighthouses. The tests were made from the steamer H. M. Whitney, which had been specially equipped for the purpose. The best demonstration was off the Boston lightship. When seven miles away from this lightship signals could be distinctly heard, though the vessel from which it came

was hull down. Another demonstration was given, when those on board the Whitney were notified of the proximity of a sister ship on her way from Boston to New York by the ringing of the bell, although some miles distant.

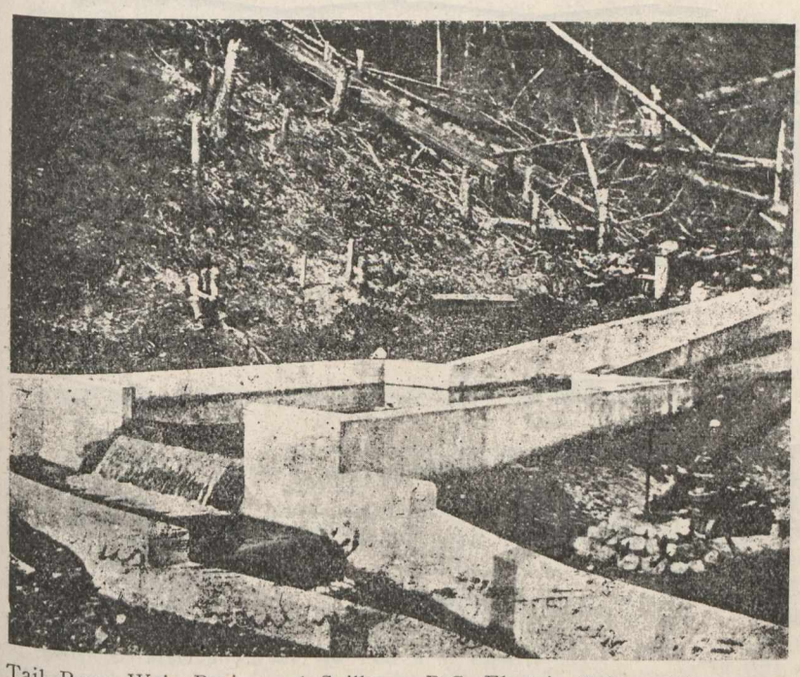
A novel vessel for the United States navy was launched recently from the yards of the Gas Engine and Power Company, and Charles L. Seabury & Co., Consolidated, at Morris Heights. Length, 80 feet; beam, 18 feet, and draught, 3 feet 6 inches. When loaded she will displace 72 tons. It is for use on transports, and is built in five sections, each watertight and box-like in form. The plating of all is ¼-inch ship steel, with lap points. In putting the vessel into commission, the boiler section will be floated first, establishing the water line, and the others will follow in order, working either fore or aft. They are fitted with sea valves, and sea water is admitted into their bottoms until they reach the common water line. When the sections have been fastened together the water ballast will be removed, and the boat will be ready for service.

The two new vessels being built for the fisheries protection service will be cruisers, for their size equal to anything in the British navy. Their speed will be seventeen and sixteen knots respectively. The largest vessel is for the Atlantic coast service, and will be built by the Vickers-Maxim Company. She will be a twin-screw steamer of 700 tons, 200 feet long and 25 foot beam, and will carry sixty bluejackets. She will have armoured decks and a searchlight of 4,000 candle power. Her armament will consist of several pom-poms and Maxim-Nordenfelt quick-firing guns. The second cruiser will be built by the Polson Iron Works, Toronto. She will also be a twin-screw, 176 feet long, 22 feet beam and 540 tons. Her crew will number 45 men and her armament will be pom-poms and Nordenfelts. She will outvie in speed and armament anything on the Great Lakes. These cruisers are to be ready in six months, and they will have the unique distinction of being the first two vessels of the Canadian navy.

GOLDSTREAM-VICTORIA WATER POWER AND ELECTRICAL TRANSMISSION.

BY E. JACOBS, IN THE B.C. MINING RECORD.

The British Columbia Electric Railway Company operates its system in Victoria by electricity generated by water power obtained from the head of Goldstream where, at a distance of 17 miles from the city, there are three lakes.



Tail Race, Weir Basin, and Spillway, B.C. Electric Railway Company.

The Esquimalt Water-works Company, which holds the water right, some years ago built substantial dams for water storage purposes. From these dams the water flows along the bed of Goldstream two and a half miles to the balancing reservoir, which has a capacity of 220,000,000 gallons and is at an altitude of 655 feet above that of the power house. The supply pipe-line, which is 7,920 feet in length, is of rivetted sheet steel, and for the first part of its length is 33 inches in diameter, afterwards being 30 inches. The water is delivered at the generating station at a pressure of 285 lbs. per square inch.

The power house is a fire-proof structure, with walls of brick and concrete and roof of tar and gravel. Its dimensions are, length, 56 feet; width, 42 feet, and height, 24 feet, and it is sub-divided into three compartments, viz., a water wheel room, a generator room and a transformer room. The plant installed in it consists of two 38-inch Pelton iron-mounted type impulse water wheels, each developing 600-h.p., and one 54-inch fitted with Dodd buckets and developing 900-h.p. Lombard automatic hydraulic governors are used in connection with all these wheels. The speed of the large wheel is controlled by a needle valve and deflecting nozzle, that of one of the smaller wheels by a deflecting hood, and that of the other by a cut-off hood.

The water-wheels are direct-connected to Canadian machines, and the larger to a 500-kilowatt revolving field alternator. The 12½ kilowatt exciters for the General Electric 60-cycle three-phase generators, the two smaller to two 360-kilowatt rotating-armature smaller generators are belt-driven, whilst a 20-kilowatt exciter is direct-connected to the larger generator. The capacity of each exciter is sufficient to admit of its operating the whole plant and the switching arrangements are such as to provide for its doing so in case of need. The current, after being generated at 700 volts' pressure, is led to a switchboard having five marble panels—three for the generators, one synchronizing, and one total output—and thence to three sets of step-up transformers, which raise the voltage to 17,300 volts, at which pressure it is delivered to the transmission lines. The high-pressure side of these transformers is connected with the neutral point grounded at the generating station only. An air blast is supplied to the transformers by two Buffalo blowers, one 50-inch and one 80-inch, driven by direct current motors of 4-h.p. and 8-h.p., respectively.

The transmission line is thirteen miles in length. It consists of two three-phase circuits of No. 4 B. & S. copper wires mounted on 22,000-volt insulators. Both are strung on the same pole line. For the first mile the line passes through a rough timbered country to the Esquimalt and Nanaimo Railway, along the right of way of which it runs eight miles, and thence four miles to Victoria. Owing to there being many high trees along the route of the line, the right of way has been cleared, where necessary, to a width of 600 feet, to guard against interruptions to the service from falling trees. The difference in elevation between th generating station and the city is about 475 feet.

The sub-station in Victoria is a commodious brick building, formerly the power house when steam was used for generating the electric current. The steam-power plant, consisting of six horizontal return tubular boilers, a cross-compound Corliss engine and a high-speed Ball automatic engine, together with an electric equipment including alternating generators with a total capacity of 400 kilowatts, for lighting, and 360-kilowatt 500-volt direct current machines, for railway purposes, switchboard and other requisite electrical appliances, is kept here in reserve in case of accident to the water power. The conductors are led into the sub-station from the front of the building through 12-inch glazed tile pipes, set at an angle of forty-five degrees as a protection against bad weather. They are taken thence through a separate wire well to lightning arresters and re-actance coils, situate in the basement, where there are high potential switches so arranged that any set of transformers may be

connected to either of the two transmission lines. There are six 125-kilowatt transformers which lower the pressure from that at which it is received to 1,040 volts, for lighting purposes; also six 125-kilowatt transformers reducing the voltage to 350 volts, the secondaries of these being led to two three-phase, 300-kilowatt, 60-cycle, rotary converters, these supplying the direct current for the electric railways and for other purposes, there being about 100 motors of various sizes in use in the city.

In connection with its lighting system, the company has some 40,000 incandescent, 200 Nernst, and 50 commercial arc lamps. In Victoria, the company's patronage is chiefly for commercial and residential lighting, the corporation of Victoria having its own electric street lighting system. The local electric railway system comprises some fifteen miles of track, including the lines from the city to Esquimalt. The British Columbia Electric Company, Limited, is an English organization, with head office in London. Its operations cover electric railways and lighting in Vancouver, as well as Victoria, and railways in and to New Westminster and Vancouver. The Vancouver branch of the company's enterprise is by far the most important. The chief officers of the company, at Vancouver, are: J. Buntzen, general manager; R. H. Sperling, general supt.; W. F. Gitchell, comptroller; B. W. Slocum, chief engineer, and J. B. Rannie, superintendent of traffic, at Victoria; A. T. Goward, local manager; G. M. Tripp, superintendent.

ISOLATED SEWAGE DISPOSAL PLANT.*

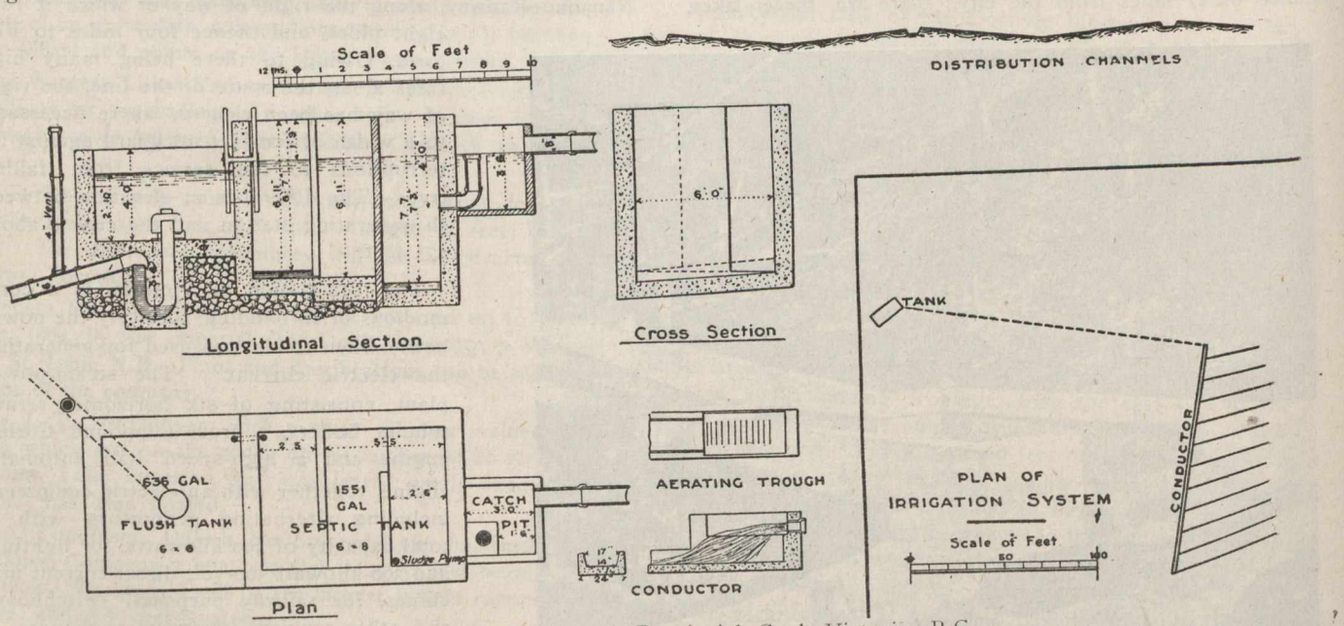
In October, 1901, the author received instructions to design and construct a sewage disposal system for the Provincial Gaol at Victoria. It was found that to connect with the city sewerage system would involve a large expenditure, and it was finally determined to dispose of the sewage on the gaol property of about twelve acres. An examination of the existing work showed it to be in a most offensive and dangerous condition. This discharge was into an untrapped brick cesspool, the overflow from which ran into a field. Near the cesspool the ground was excrement sodden; and the odor three or four hundred feet away was something phenomenal when wafted on a favoring breeze. The pipes, of six-inch diameter, from the gaol had been laid regardless of grade and direction, and a very considerable percentage of them were broken. Under the circumstances, the prevalence of disease was not surprising.

The daily flow of sewage varied from 1,200 to 1,800 gallons a day, which it was supposed to dispose of by surface irrigation. The soil was not an ideal one for such purpose, as it consisted of a stiff clay fit for brickmaking, with practically no loam on the surface, and it was with fear and trembling that surface irrigation was resorted to. Had that failed, double contact beds would have been the next method adopted. In the first place, the cesspool and old pipes were entirely abandoned. New eight-inch pipes, properly jointed, and laid true to grade and alignment, connected the buildings with a catch pit, about 250 feet distant. From the catch pit the sewage flowed into a septic tank of 1,550 gallons' capacity, the effluent from which passed into a 636 gallon flush tank, discharging about twice a day. The contents of the tank, after passing through an aerating trough, charged a concrete conductor, from which the distribution channels on the surface of the ground were fed.

The catch pit is of brick in cement, three feet square, and is fed by an 8-inch sewer from the gaol. Its effluent discharges into the septic tank, at 2 feet 3 inches below water level, through a six-inch trapped pipe set in concrete in one corner. The catch pit might perhaps have been dispensed with, but, bearing in mind the mischievous proclivities of prisoners, and the strong probability that all sorts of foreign substances would be wantonly thrown down the closets, it was considered advisable to construct one, and its adoption has been amply justified by results. The pit is cleaned out at short intervals, and its miscellaneous contents buried.

The septic tank is built of five parts of sea shingle and sand to one part of White's Portland cement. It is 6 ft. by 8 ft. inside, with nine-inch walls, and is smoothly cemented. The floor has a fall of 1 in 18 towards the inlet. There are two half brick baffle walls to prevent any direct current between the inlet and outlet, and also to increase the length of channel, and afford better opportunity for the deposition of the matters in suspension. This plan appears to the author to combine the advantages of the usual long narrow tank with economy. The outlet is of two-inch wrought iron pipe, H shaped, with an entering limb 2 feet 3 inches below the horizontal discharge, the end of which in the flush tank is tapped, and, as the ends are open, no syphonage can occur, and any obstruction is easily removed.

The flush tank is 6 feet square, and discharges when a depth of 2 feet 10 inches is attained. The syphon is a six-inch Miller, discharging through a six-inch sewer pipe into the aerating trough. In the drawing it is shown when about to discharge.



Plan of Sewage Disposal, Provincial Gaol, Victoria, B.C.

The trough is a box of No. 26 galvanized iron, provided with slits in the bottom and end, set 15 inches above the conductor, and fed by the 6-inch pipe before mentioned.

The conductor is a level concrete trough, of which a cross section is shown on the drawing, and has ample capacity for one discharge of the flush tank. It is provided with eleven tapering outlets, furnished with stops so as to divert

*From a paper by E. Mohun, C.E., read before the Can. Soc. of Civil Engineers.

the flow to such distribution channels as require irrigation. The tanks and catch pits are provided with plank covers.

Owing to some misapprehension, the channels were not placed, as shown in the drawing, but small gutters were cut below the general surface of the ground. It is, however, intended to carry out the original plan this year after the removal of the crops. Before the sewage was turned upon the land, about a quarter of an acre was thoroughly dug, and the sewage has generally been applied to this area, though occasionally diverted to an adjacent piece under cultivation.

The sewage was first turned into the tank on the 20th December, 1901. All the sewer gas has been completely cut off between the catch pit and the gaol, and there is a marked improvement in the sanitary condition of the building. The surface scum in the septic tank was of very slow growth; indeed, the tank was working fully six months before a complete coating was formed. During that period the effluent was very turbid and somewhat offensive. Since then there has been a marked improvement. Though not absolutely clear, it is inoffensive, except when confined for some hours in the conductor. The surface in the septic tank in May, 1903, was completely covered with a coating about two feet thick from which no offensive odors arise. On the 18th May, 1903, a sludge pump was placed in position in case there should prove to be a considerable amount of sludge deposited during the eighteen months' work of the tank. In that period from 650,000 to 800,000 gallons of sewage must have passed through the tank. The pump has a 2½-inch suction, reaching 8½-in. above the bottom of the tank. On starting it, no sludge deposit was found at that depth, the discharge being precisely similar to that of the catch pit. The pump was placed in position, so that, in the event of the tank area available for liquid sewage becoming restricted, it would always be possible to remove a few yards of sludge without disturbing the surface scum, and with the least possible trouble and annoyance.

The character of the soil, which, as before stated, was an unproductive clay, appears to be much improved. Sweet corn, peas, cabbages, beets, carrots and leeks have been raised of excellent quality, and it appears not improbable in the future that the value of the crop might equal the interest and sinking fund for the original outlay. The cost of the whole plant—common labor being furnished by the prisoners—has been as follows, and includes tearing up and replacing the old sewers and trenching, about 150 feet of which was in rock:

Lumber and haulage	$ 50 78
Cement (32 barrels at $3.50)	112 00
Haulage of cement, shingle and sand	52 55
Syphon and freight	37 50
Sewer pipes	138 80
Aerating trough	12 45
Labor and superintendence	164 75
Sludge pump	21 00
	$589 83

MONTREAL, THE GREAT ELECTRIC POWER CITY.

BY ALTON D. ADAMS, IN THE "ELECTRICAL WORLD AND ENGINEER."

Montreal consumes more electrically-transmitted water power than any other city in the world. This power is drawn from three generating stations located on the rivers St. Lawrence, Richelieu and St. Maurice, at distances that range up to eighty-five miles from the central sub-station in the city. With the vast drainage area of the Great Lakes, the Champlain Basin between the Green and Adirondack Mountains to gather water for the Richelieu, and a great stretch of northern Canada to supply the St. Maurice river, the reliability of electrical supply from water power is assured in Montreal. At Chambly power house, on the Richelieu river, seventeen miles by the transmission line from Montreal, the combined capacity of the main electric generators is 16,800-K.W. The Lachine power house, on the St. Lawrence, five miles from the city, contains main generators of 6,000-K.W. total capacity. Both of these power plants are devoted exclusively to the operation of the Montreal system. Neglecting the total equipment of the great power house at Shawinigan Falls, on the St. Maurice river, which is operating under a head of 145 feet, and in which three turbines, of 6,000-h.p. each. are installed, with generators of 3,750-K.W., the energy being transmitted 85 miles to a sub-station in the suburbs of Montreal, the transformer capacity of which is 5,000-K.W., requiring about 6,000-K.W. in generator capacity at the Shawinigan plant. The total rating of the present generators in water-power stations, supplying Montreal, is thus 28,800-K.W. This capacity will shortly be increased in two directions. A fifty-year contract requires the Shawinigan Company to deliver up to 20,000-h.p., and another water power is about to be developed at Soulanges, on the St. Lawrence, for the city system.

In anticipation of this increase of capacity, the sub-stations in Montreal have been equipped beyond immediate requirements. Besides that of the Shawinigan system, already mentioned, there are two sub-stations in Montreal devoted to general electrical supply. At one of these, known as the McCord Street sub-station, the total transformer capacity receiving the high-tension transmitted energy is 7,000-K.W. In the main or central sub-station, the total capacity of transformers connected to the transmission lines is now 27,500-K.W. with room for an increase. Including the 5,000-K.W. at the Shawinigan sub-station, 4,750-K.W. of which is entirely devoted to the Montreal system, the combined capacity of stepdown transformers is thus 39,500-K.W. or 52,000-h.p. It is safe to say that no other city in the world has an equal capacity of stepdown transformers delivering energy from water powers to an electrical supply system.

Besides these water power plants and sub-stations, the system includes steam power stations at five points, with a combined capacity of 5,700-K.W. These plants are in large part a legacy of former conditions, and are held as a reserve for the water power system. The largest of these steam-driven stations is on Queen street, has a capacity of 2,400-K.W., and has been remodelled during the past year.

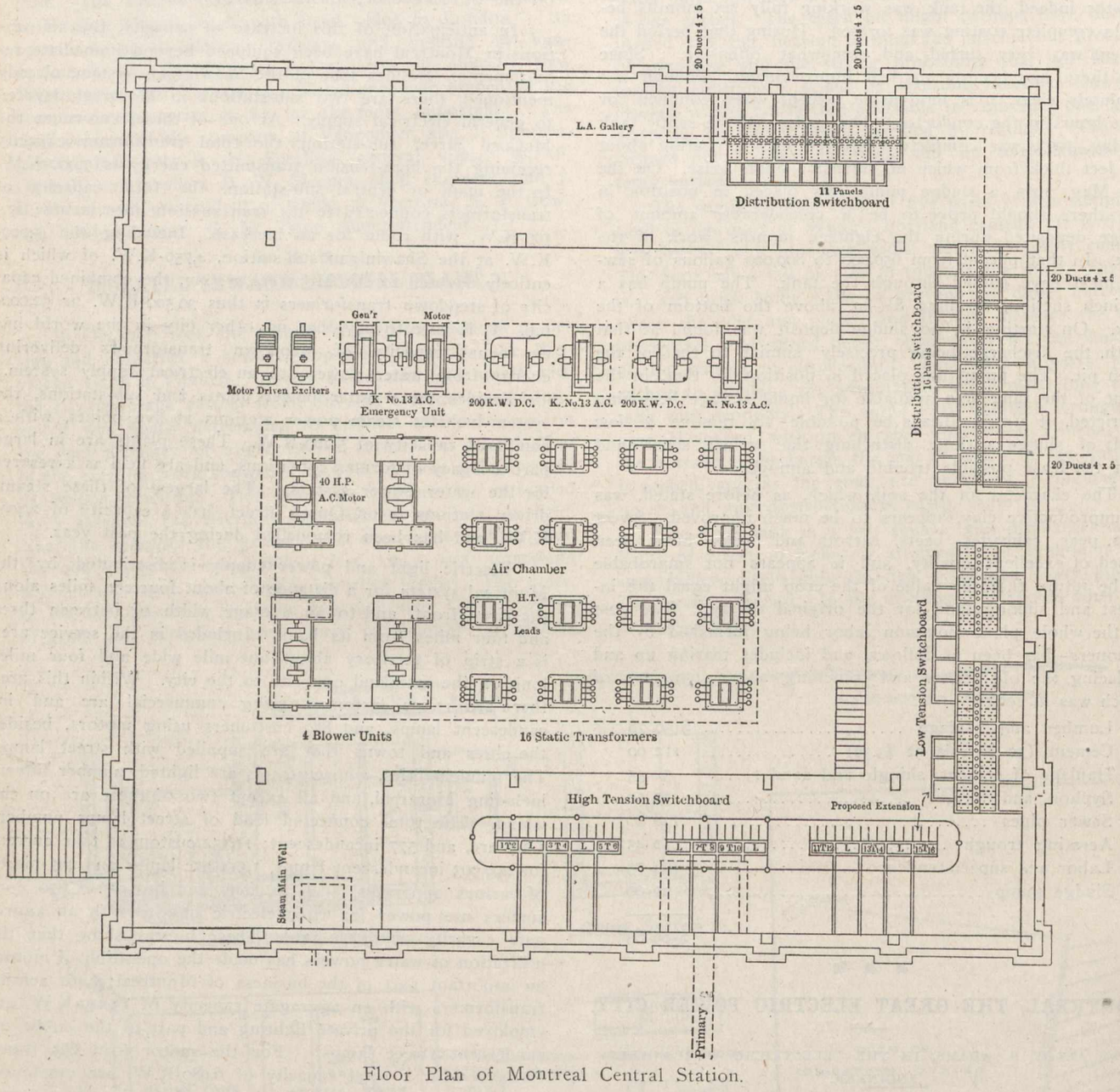
Electric light and power supply is distributed by the Montreal system for a distance of about fourteen miles along the river front, and to an average width of between three and four miles from its bank. Included in the service area is a strip of territory about one mile wide and four miles long on the mainland opposite to the city. Within this area there are 11,152 customers using commercial arc and incandescent lamps, and 870 customers using motors, besides the cities and towns that are supplied with street lamps. The municipalities, whose streets are lighted, number fifteen, including Montreal, and all except two of these are on the island. The total connected load of street lamps numbers 1,717 arc, and 577 incandescent; 11,152 customers take current for 299,903 incandescent lamps, 1,514 arc lamps and 405 pieces of various apparatus, such as fans and heaters. 870 consumers use power for 1,109 electric motors with an aggregate capacity of 19,172-h.p. These figures show that the utilization of water powers has made the operation of motors an important part of the business of Montreal; 2,161 service transformers with an aggregate capacity of 13,249-K.W. are employed for the private lighting and part of the public incandescent street lamps. For the motor load 695 transformers with a total capacity of 6,980-K.W. are employed, but these do not operate all of the connected motors, many being of the direct-current type, and many of the alternating motors operating at the full voltage of distribution.

This system, which constitutes the only public supply of light and power in Montreal, has been welded together out of diverse elements. The Montreal Light, Heat and Power Company, the owner of the system, was incorporated in March, 1901, for the purpose of consolidating all the gas and electric companies doing business in the city. In conformity with this purpose, it is authorized by its charter to acquire plants for the supply of gas, electricity or other source of light, heat or power. The company may also lease and operate all or any part of the plants of any other company engaged in the supply of light, heat and power, and

may acquire and hold the stocks and bonds of any such corporation. When this company has acquired the plant of any other company, it may exercise the charter rights and franchises of such other company. The company has also the right to construct lines under or over the public streets of any place within one hundred miles of Montreal in any direction.

Pursuant to these liberal and important powers, the Montreal Light, Heat and Power Company acquired a majority of the stock of each of the following companies: The Montreal Gas Company, the Royal Electric Company, the Montreal and St. Lawrence Light and Power Company, the Imperial Electric Light Company, Limited, the Lachine Rapids Hydraulic and Land Co., Limited, the Standard Light and Power Company, the Citizens' Light and Power Company, Limited, and the Temple Electric Company. The Montreal Light, Heat and Power Company, together with the subsidiary companies just named, controls the entire supply of gas and electrical energy in that city and its suburbs.

The Royal Electric Company, one of the before-mentioned subsidiary corporations, is the oldest of those engaged in electrical supply in Montreal, its formation dating from 1884. It would be interesting, if possible, to trace the increase of electric loads among all the companies at Montreal during the past years, but the facts are not at hand for any of these companies save the Royal Electric. Figures for the loads of this company are, however, no doubt more representative and larger than figures for any of the other companies. Direct-current arc lamps connected to the circuits of the Royal Electric Company numbered 1,287 in the year 1890; 1,666 in 1895, and 1,859 in 1900, showing an increase of 44 per cent. during the ten years. During the same period the load of arc and incandescent lamps on the alternating-current circuits rose from an equivalent of 1,835 incandescent lamps of 16-c.p. each to an equivalent of 93,498. In other words, the load of arc and incandescent lamps on alternating circuits was 59 times as great in 1900 as it was in 1890. Direct-current motors first appeared on the circuits of the company in 1892, when their total rating was only 50-h.p., but by 1900 this capacity had risen to 1,253-h.p., or twenty-five times the rating in the earlier year. The latest factor in the electric load was the alternating-current motor, which did not appear in the returns until 1897, and was then credited with a combined rating up to 18-h.p. In 1900, the capacity in connected motors of this type reached 3,417-h.p., representing an average addition of more than 1,100-h.p. in capacity yearly. It is hard to believe that this rapid increase of electrical loads was not due in some measure to the utilization of water power, for between May 31st, 1899, and May 31st, 1900, the Royal Electric Company secured control of the hydro-electric plant at Chambly, energy from that plant was delivered at Montreal in August, 1899, and the rise of electric loads was more rapid during the year between the two dates just named than in any other of the decade. Thus, during the twelve months that ended May 31st, 1900, the increase of the Royal system of the equivalent load of 16-c.p. incandescent lamps was 14,460, and the rise of capacity

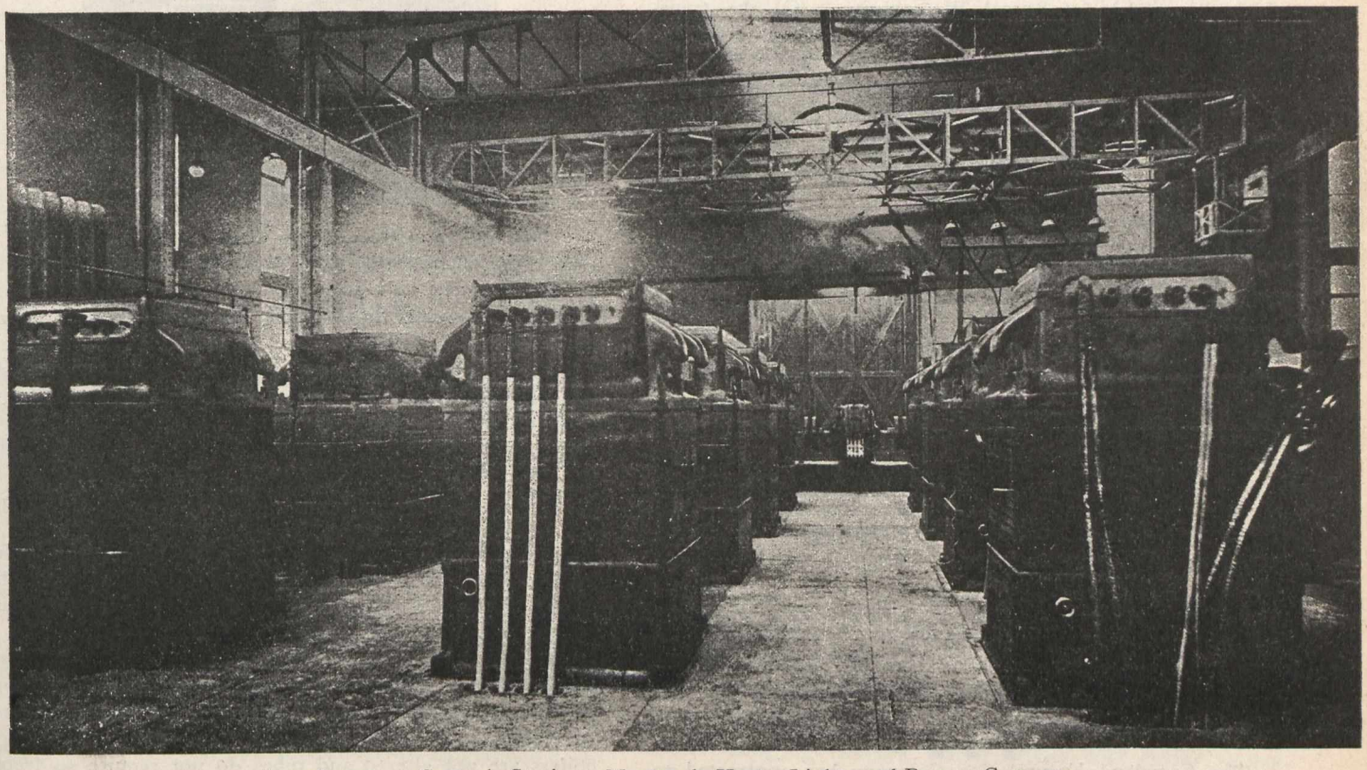


Floor Plan of Montreal Central Station.

in connected motors was 116-h.p. for those of the direct-current, and 2,176-h.p. for those of the alternating type. To water power must also be traced the strong tendency to consolidation that culminated in 1901.

Electrical supply in Montreal and its suburbs is distributed from three sub-stations, the central, the McCord street, and the Shawinigan sub-station respectively. The central sub-station is nearest to the business centre of the city, the McCord street sub-station is about one-half mile to the west, and the Shawinigan sub-station is approximately three and five-eighth miles to the east. At each of these sub-stations the energy transmitted from the water power plants is transformed or transformed and converted to alternating current at 2,400 volts, 63 cycles per second, and either two or three-phase. At the central sub-station a portion of this 2,400-volt alternating current is transformed to 4,000-volt constant current for the series arc lamps and another portion of the 2,400-volt current is transformed and converted to direct current at 250 volts for a three-wire system of 500 volts between outside wires, that carries a part of the motor load. All three of the sub-stations are tied together by the 2,400-volt feeders, so that the energy received from either water power plant may be delivered to consumers on any part of the distribution system. Constant, direct current is supplied for a part of the series street lamps by means of motor-driven arc dynamos.

an aggregate capacity of 16,556-h.p. giving an average capacity of 28.4-h.p. each,average being 1.36 motors and 38.8-h.p. per customer. This large average horse-power per motor, and per customer, shows the extensive use of alternating motors in manufacturing operations. Some of the alternating motors are of the synchronous, but the greater number is of the induction type, and all are supplied with current of 63 cycles and either two or three-phase. Most of these motors are operated from the 2,400-volt circuits through transformers at a voltage of about 550; but some of the large sizes receive the full line voltage in their windings. 529 direct-current motors are in use by 444 customers, and have an aggregate capacity of 2,616-h.p., the average capacity being almost 5-h.p. each, and the average per customer 1.2 motors and 6-h.p. The average power per customer, and per motor, is nearly six times as great for the alternating as for the direct-current type, thereby showing that the alternating type of motor is more generally applied for large powers. The two largest customers, the Montreal Street Railway Company and the Dominion Cotton Mills Company, use 21 motors of the alternating type of an aggregate capacity of 8,005-h.p., besides some smaller sizes. If these motors and their total capacity are deducted from the total figures for all motors of the alternating type, the result shows a balance of 559 with a combined rating of 8,551-h.p. These last figures correspond to an average capacity of 15.3-h.p. per



Transformers, Central Station, Montreal Heat, Light and Power Company.

Of the arc street lamps, 1,333 are enclosed series alternating, and 384 lamps series open direct-current; all of 2,000-c.p. each. The enclosed alternating arcs operate nominally on 80 volts and 7.5 amp. each, or 480 actual watts. On the direct-current arc lines the rating is 9.6 amp.

Of the 577 incandescent street lamps, 106, 65-c.p., and 273, 32-c.p., are on the constant alternating-current lines, 37, 32-c.p., are on direct-current circuits, 50, 32-c.p., are in multiple on the 220-volt system, and 91, 32-c.p. and 18, 16-c.p. each are in the multiple at 110 volts. As a proportion of the 299,903 incandescent lamps in commercial service are below 16-c.p., the average candle power would be less than 16 per lamp. The constant-potential commercial arc lamps number 1,277 on alternating circuits. Commercial service also includes 23 constant-current, enclosed alternating arcs and 214 direct-current series open arc lamps.

Most notable in this system is the load of stationary motors, because of their large number, great aggregate capacity and the unusual average capacity of each. 580 motors in use by 426 customers are of the alternating type and have

motor, or 2.5 that of the like average for all of the direct-current motors. This again brings out the fact that the alternating motors have been more generally selected for large amounts of power.

The Montreal Street Railway Company has a larger capacity in motors connected to the system than any other users. This capacity amounts to a total of 4,915-h.p. and is made up by seven 2,200-volt, two-phase motors that operate with alternating current of 63 cycles per second. Six of these motors are of the induction type and rated at 700-h.p. each, while the seventh is a synchronous motor of 715-h.p. For the supply of energy to these motors, seven two-phase circuits are run from the central sub-station to the generating station of the Street Railway Company. These motors are believed to be among the largest of this type in use anywhere. It is believed that they require less skill in their operation, and cause less fluctuation of voltage in the electric supply system than synchronous motors of equal capacity. On the other hand, one disadvantage of induction motors, that of a very short air gap between the rotating

and stationary parts, is here illustrated. Thus, in these motors of 700-h.p. each, the air-gap for each of two is said to be only 3-32-in., and the air-gap for each of four only 0,0285 in. from iron to iron. Each of these motors is direct-connected to a continuous-current generator that supplies the street railway system at about 550 volts.

The plant of the Dominion Cotton Mills Company is probably one of the largest of its kind that draws its power from a public system of electrical supply. In these cotton mills the total number of electric motors is 27, and their combined rating amounts to 3,412-h.p., divided as follows: Number of motors, 5 of 300-h.p. each, 1 of 240-h.p., 5 of 200-h.p., 1 of 150-h.p., 2 of 100-h.p., 2 of 75-h.p., 1 of 50-h.p., 1 of 30-h.p., 1 of 20-h.p., 2 of 15-h.p., 2 of 10-h.p., 1 of 7-h.p., 3 of 5-h.p. All of these motors in the cotton mills are of the induction type, save one of 200-h.p. capacity, which is synchronous. The fact that the Montreal electrical supply system is able to furnish power for this great manufacturing plant on terms that make it unprofitable for the latter to operate with steam is a striking illustration of the advantages of transmitted water power.

Of the transformers used for lighting, 1,068 are of less than 5-K.W. capacity each, 314 have an individual rating of just 5-K.W., and 779 transformers are rated at 7½ to 60-K.W. each, all having a combined rating of 13,249-K.W., and of this total those of less than 5-K.W. each represent 2,222½-K.W., of just 5-K.W. each, 1.570-K.W., and of more than 5-K.W. each an aggregate of 8,930-K.W. capacity. Of the transformers used for power service, 273 are rated at less than 5-K.W. each, 98 have just this individual capacity, and 324 are of larger sizes up to 170-K.W., and their combined rating of 6,980-K.W. used for power purposes is divided into 620-K.W. for those of less than 5-K.W. each, 490-K.W. for those of just 5-K.W. rating, and 5,867½-K.W. capacity in those of from 7½ to 170-K.W. each.

Comparing the lighting and the power transformers, the average rating of all the former is 6.1-K.W., and of all the latter 10.0. Of the aggregate rating of 3,249-K.W. for all lighting transformers, 67 per cent. is in units of more than 5-K.W. capacity each, while of the 6,980-K.W. of total capacity in power transformers, 85 per cent. is represented by those of more than 5-K.W. each. These figures bring out one desirable feature of a motor load, namely, that the transformers required for its operation are usually of larger average capacity and consequently of higher efficiency than those used for lighting. Large motors of 100 or more horse-power each have the further advantage that they may take current directly from the distribution lines, and thus require no service transformers whatever.

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The Public Works Department, Ottawa, Ont., has advertised a sale of the electric lighting plant at the foot of Parliament Hill. The Government find that the light can be had more cheaply from the Ottawa Electric Company, and the equipment is now being sold out.

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The Crowland Natural Gas Company has contracted to supply gas to the Niagara Falls Gas Light Company, and a main will be laid to Montrose bridge. The Clifton company is also pushing its pipe laying. It has leases in the Crowland field, but is laying a main from the Winger field, where it has developments.

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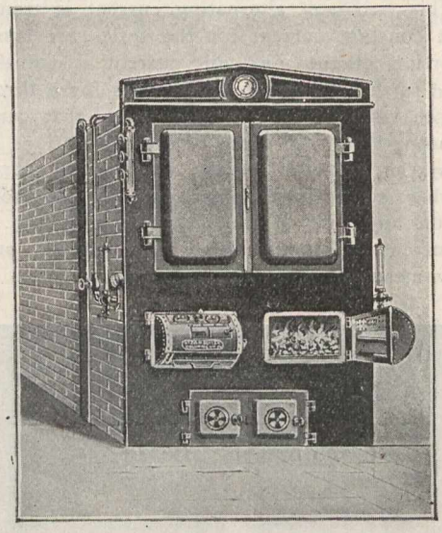
"HYDRO-CARBON" SYSTEM OF COAL BURNING.

The Steam Boiler Equipment Co., of New York, have appointed P. E. Durst & Co., Yonge St. Arcade, Toronto, as their agents in Canada for the "hydro-carbon" system of coal burning. The claims made for this system, as stated in the company's literature, are as follows:

"The system is based upon natural laws and accomplishes its results in a simple manner, and its apparatus is easily equipped to any type of boiler for any steaming purpose, at a very moderate cost, without any change in the setting of the boiler or in the fire chamber or of the grate bars, and can be used or discontinued at any time without disturbing the fires. A specially designed patented door apparatus is substituted for the ordinary fire door, so arranged that the air is heated first and passed into the fire chamber over the fire, and by a peculiar arrangement distributed in proper proportions (suited to varying conditions of fuel used or requirements), to form an induced draft, supplying to the carbon from the coal the needed amount of free oxygen to change the conditions of the combustible gases from carbonic oxide to di-oxide and monoxide gases—thus obtaining from every pound of coal burned nearly double the amount of heat units, largely decreasing the temperature of escaping gases in the chimney, and leaving in the ash pit only the clay residuum of the coal. The carbon laden smoke from soft coal is prevented as the carbon is turned into combustible gases and heat units, in the fire chamber. In addition another element of heat is added to the coal, by superheating a small amount of steam in a heavy metal retort (of special design



and material to withstand the heat), and disassociating the steam, thereby forming hydrogen gas which is ejected into the fire chamber, in combination with the induced draft, thus forming a powerful adjunct and increasing largely the ratio of evaporation, owing to less frequent firing and use of slicing bars, less deposit of soot in or on tubes and shell, and less ash to remove; labor is saved, often dispensing with coal passers or giving the firemen more time for other duties. It is a well established fact that bituminous or soft coal will produce more heat units than anthracite or hard coal, and is therefore preferred for steam production, but in ordinary methods of burning soft coal so much objectionable smoke is produced by escape of free carbon, that it has been largely prohibited in the cities, and always is an exhibit of money and undeveloped power wasted in the atmosphere."

Among the points claimed for the system are: There is no disturbance of the fire box or change of grate bars in installing the apparatus; no building of fire walls or ducts or interference with steam pipes, nor are blowers required; the boilers are not altered and tubes do not require so frequent cleaning. This system has been installed in the new Flett-Lowndes Building, and the J. F. Brown Co.'s new building, in Toronto, and other installations are under way. Further information can be had from P. E. Durst & Co.

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According to the Victoria, B.C., Times, it is not likely the Grand Trunk Pacific terminus will be located until next summer. The chief engineer of the company on the Pacific coast, Mr. Van Arsdol, says no decision has been reached as to a terminal point. He took parties to points along the northern coast a few months ago, and these are conducting a reconnaissance survey. They are spending a good deal of time on water, and the harbors are being examined from the standpoint of their suitability for water communication. It is announced that 250 miles of coast line is being examined, and it is, therefore, assured that the company will consider harbors at least as far south as Kitimaat. With the Yukon trade in view, the company may seek a point as far north as practicable. Some of the parties now in the field, it is said, are making a careful survey of the mouth of the Skeena.