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MISSING

The Canadian Engineer

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The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER.

NOTICES.

Those requiring the index of the 1904 volume of the Canadian Engineer for binding will receive it upon dropping us a card.

We have run short of the January Number, and if any subscriber who does not preserve the paper for binding will send us his copy of that issue we shall be pleased to extend his term of subscription a month.

TELEPHONE LEGISLATION.

As a result of the recent decision of the Judicial Committee of the Imperial Privy Council, by which the right of the Bell Telephone Company to erect poles and construct conduits on the streets of the municipalities without the consent of the local authorities, is confirmed, the Union of Canadian Municipalities is pressing the Dominion Government for the following legislation:—

1. The purchase by the Government of the long distance lines.

2. The amendment of all existing telephone charters, so as to provide that no companies shall erect poles or construct conduits on any road or street in a municipality without the consent of the council of such municipality, "and upon such terms as such council may approve."

With regard to the Government ownership and control of the long distance lines, while we endorse any movement for the public ownership of utilities, we believe it is far more essential at the present time, for the Government to call upon the Bell Telephone Company to give and receive connection over the long distance lines of its existing system with the subscribers of all local telephone services, without regard to the ownership of such exchanges. In other words, every telephone user should have the right of long distance service whether he is a "Bell" subscriber or not. The inevitable result of this would be that the monopoly would no longer be able to keep out local competition, municipal and independent exchanges would be established in all parts of the Dominion, and in a few years the demand for increased long distance telephone facilities would be such that the Government would be compelled to recognize the necessity of establishing a State-owned long distance system, either by duplicating or acquiring and extending the lines of the Bell Telephone Company.

We would point out that the charter of the Bell Company declares the works of that corporation to be "for the general advantage of Canada." That being so, the "Bell" Company has no more right to restrict the use of its long distance system to its own subscribers, than a railway company has to refuse to haul the cars of another system over its lines. We do not, of course, suggest that the company should not be compensated for the use of its lines by outside companies. A system similar to that in operation in Great Britain for the use of the Government long distance lines, could be arranged without difficulty. In Great Britain a subscriber to the Glasgow Municipal Telephone exchange wishing to speak to a subscriber of the National Telephone Company in London, Manchester, Liverpool, or elsewhere, would pay, in addition to the usual toll charge for the long distance line, a terminal fee to the National Telephone Company for the privilege of connecting with its local subscriber. In the case of a "National" subscriber speaking to a "Municipal" subscriber in Glasgow or any other town, a similar terminal fee would be paid to the municipality. This is a perfectly equitable arrangement, and it would be imposing no unfair conditions upon the "Bell" Company, if a similar arrangement was made compulsory in Canada.

In the petition to the Governor-General on this subject, reference is made to the fact that in Great Britain the long distance lines are owned by the Government. It is, however, overlooked that the conditions over there differ widely from those in Canada. In the first place the Government acquired this part of the system because of the inroads made by the telephone in the revenue of the Post-office telegraph department which was owned and operated by the State. Secondly, the purchase of the long distance lines on satisfactory terms was made possible by the fact that the right of the National Telephone Company to carry on a telephone exchange business, either local or long distance, ceases in 1911, after which date the company is entirely in the hands of the Government.

In the case of Canada, the Government does not

own the telegraph lines, and the Bell Telephone Company under their Act have a perpetual charter. In the absence of existing competitive exchanges to any number, where is the inducement for the Government to acquire the system, and what are the possibilities of making a satisfactory deal with a company having perpetual rights? These are points which have apparently not been considered by those asking for the proposed legislation, and we repeat that the only immediate and effective remedy is to restrict the "Bell" from operating its long distance system in the sole interest of its own subscribers, thereby enabling that monopoly to exact excessive rates from telephone users, the majority of whom require only the local service.

Regarding the proposal to give municipalities power to control telephone construction on the streets, we fully agree that the local authorities should have the right to grant or withhold these facilities, and to make proper regulations under which such work shall be carried on, but we hesitate to say that they should exact their own terms for such privileges. We are just a little afraid that councils are more eager to impose terms and conditions which are prohibitive than they are to encourage independent telephone competition for the benefit of the whole community.

The telephone has become as necessary to the farmer in the remote rural districts as it is to the merchant in the city, and it is in the interest of the people that the rapid spread of telephone systems in the country should be encouraged in every possible way. For this reason we do not think it would be wise to give local authorities absolute power to "hold up," or exact prohibitive terms from independent telephone companies desiring to do a legitimate business to the public advantage. Such a power vested in the local authorities would have a tendency to encourage interference by the "Bell" monopoly in a way that is not now possible. It would be far better if those interested in obtaining the proposed legislation were to consult with some competent authorities representing independent telephone interests here or in the United States, and draft a set of conditions which while adequately safeguarding the rights of the municipalities would be acceptable to independent companies desiring to do business in Canada.

In conclusion we would point out that the end to aim at in all proposed legislation is the immediate extension, improving and cheapening of the telephone service in every part of the Dominion. This is what the people want without further delay. Relief will not come from legislation, however satisfactory, which may take years to carry through Parliament. The remedy lies in the hand of the municipalities, who by establishing or introducing competition will do more to curtail the powers of monopoly than miles of petitions to the Governor-General, or innumerable deputations to the Government.

TELEPHONE COMPETITON vs. TELEPHONE MONOPOLY.

It is frequently asserted by the opponents of Independent Telephony that the telephone business is a natural monopoly, and that it is not in the public interest to introduce competition into this class of service. How far this statement is corroborated by facts is shown by the marvelous results achieved in the United States within the past eight years, and also in Great Britain within a much shorter period. In the beginning of 1896 the "Bell," and its subsidiary companies as a result of over twenty years undisputed possession of the field had less than six hundred thousand telephones in use in the United States, whereas to-day the Independent companies have over seven thousand exchanges with two and one-half millions of telephones, representing an investment of $200,000,000. Further than this, seventy-five per cent. of the cities having a population of over twenty thousand inhabitants are installed with a telephone system in competition with the "Bell." We need only enumerate such centres as Chicago, Cleveland, Philadelphia, Detroit, Pittsburg, Baltimore, St. Louis, Buffalo, Minneapolis and St. Paul; Portland, Me.; Louisville, Ky.; Los Angeles, Cal.; Salt Lake City, Utah; and Seattle, Wash.; to show that the most important cities in all parts of the United States appreciate the value and importance of telephone competition.

In Great Britain the growth of telephone competition has been limited by the fact that the Post-Office department which controls this business will permit only municipalities to establish competitive services, and then only after an exhaustive and expensive Government enquiry has been held, in which a formidable array of legal talent and expert evidence in opposition, has to be surmounted. This procedure cannot be said to encourage municipalities in their desire to obtain relief from the monopoly, but notwithstanding this, competitive systems have been established in Glasgow, Portsmouth, Brighton, Swansea, Hull, and in the islands of Guernsey. In each of these places the results have exceeded the anticipations of the most enthusiastic supporters. Manchester, Salford, and Stockport are also arranging for a joint municipal service, and other systems contemplated are Scarborough, Cambridge, Belfast, Oldham, Burnley, Aberdeen, and Barrow-in-Furness.

In order to throw some light upon the financial side of telephone competition we publish herewith some statistics showing results of the working of telephone monopolies in Great Britain and Canada, in comparison with those of competitive undertakings. These figures prove conclusively what it is possible for a company or municipality having a system that is well managed and legitimately capitalized to accomplish, as compared with a monopoly whose capital includes much watered stock, and whose obsolete plant is replaced at the expense of telephone users instead of being charged against the profits of the undertaking. It will also be noticed that on both sides of the Atlantic the comparisons between the monopoly and its competitor show almost identical results, the slight difference being in favor of the two United States Independent companies quoted. This is due to the fact that there are more subscribers within the same area, in American cities than in Great Britain. Another very significant fact is that the average capital per station of the monopoly (and especially is this the case in Canada), includes a large proportion of obsolete plant and single grounded lines; whereas the competitive systems are all modern plants comprising long distance telephones, copper metallic circuits, and a large percentage of underground wires. The figures for the United States and Canada include the long distance lines, which in Great Britain are owned by the State, therefore some allowance must be made in this respect, but it will be seen from the mileage of long distance wire per phone, that if the figures could be accurately dissected, it would not make the "Bell" compare more favorably with the "Independent" results. In the case of the revenue per phone, with the

"Bell" long distance line earnings eliminated, the exchange receipts still average $1.56 more per subscriber than those of the "National" Company in Great Britain, although in consequence of the greater cost of construction in the large English cities the latter has a very much higher capitalization per station. The proportion of watered stock in the British and Canadian monopolies is, however, about equal. The difference between the revenue per station of the monopolistic companies and that of their competitors is also strong evidence of the fact that telephone users are paying too much for their service.

FINANCE STATISTICS COMPILED FROM THE LATEST BALANCE SHEETS ISSUED BY THE UNDERNOTED TELEPHONE UNDERTAKINGS IN GREAT BRITAIN, CANADA AND THE UNITED STATES.

	National Tel. Co. (England).	Bell Tel. Co. of Canada.	Glasgow, Scotland (Municipal).	Portsmouth, England (Municipal).	Guernsey, Channel Isles (State).	Inter-State Tel. Co. Illinois.	Citizen's Tel. Co. Grand Rapids, Mich.
Total capital expenditure	$50,681,963	$8,000,000	$1,562,208	$155,329	$144,854	$969,915	$1,609,280
Average capital per station	$168.50	$139.93	$137.00	$93.62	$94.34	$96.99	$98.20
Revenue	$9,413,477	$1,877,605	$241,742	$29,137	$19,792	$150,410	$343,392
Revenue per station	$31.28	† $32.84	$21.19	$17.55	$16.22	$15.04	$20.95
Annual expenditure, including interest and dividends	$6,921,099	$2,407,634	$224,020	$23,215	$18,813	$114,971	$211,279
Annual expenditure per station	$23.01	‡ $42.11	$19.63	$13.00	$15.45	‡ $11.50	‡ $12.89
Interest and dividends	4.29 p.c. (average on bonds & stock)	5 p.c. on bonds 8 p.c. on stock	3.20 p.c. on bonds	3 p.c. on bonds	3 p.c. on bonds	5 p.c. on bonds 4 p.c. on stock	8 p.c. on stock
Set aside for Sinking Fund, depreciation, etc.	1.52 p.c.	3.28 p.c.	4.67 p.c.	6.06 p.c.	5 p.c.	3.66 p.c.	3.1 p.c.
Percentage of annual expenditure to revenue	73.54	95.45	92.66	79.67	95.05	76.43	61.53
Percentage of revenue to capital expenditure	18.57	31.52	15.47	18.57	17.23	15.52	21.34
Number of telephones	300,775	57,172	11,405	1,659	1,217	10,000	16,388 (5,605 in Grand Rapids)
Miles of long distance poles	Nil	7,685	Nil	Nil	Nil	7.97	1,116
Miles of long distance wire	Nil	30,967	Nil	Nil	Nil	2,215	2,453
Miles of long distance wire per telephone	Nil	0.54	Nil	Nil	Nil	0.22	0.15
Business rates:							
In cities—London	$82 79						
"	$48.70	$30 to $50	$25 57	$24 35	$24 35	$30 to $40	$30 to $36
"	$41 40	$15 to $25				$15 to $24	$12 to $24
In small towns							
Residence rates:							
In cities	As above	$20 to $30	As above	As above	As above	$18 to $24	$18 to $24
In small towns	As above	$15 to $25				$12 to $18	$9 to $18

Note.—The "Bell" rates in small towns cover, in most cases, a distance of only half a mile of single grounded line, and do not include long distance telephones.

* Including long distance receipts..... $2,522,275 † Including long distance receipts..... $44.12

‡ Includes expenditure on long distance lines.

As regards the situation in Canada, what has been accomplished in Great Britain and the United States should be achieved with equal success here, and our object in presenting these facts is to show how groundless are the assertions that telephone competition is not successful; and also to give encouragement to those who are endeavoring to obtain for the people a better and cheaper service by the introduction of municipal or independent systems. As we have stated before, while we are glad to notice the agitation in favor of Government ownership of the long distance lines, we are convinced that this can only be made possible by weakening the grasp of the present monopoly by the creation of a number of local competitive systems to an extent which will compel the Government to recognize the necessity of providing means of intercommunication which no company or individual can limit or control. There is a great future for competitive telephony in this country if those responsible for the provision of public utilities will unite in one common effort to meet the needs of the people, by the provision of local systems either by the adoption of municipal ownership or the granting of franchises, with reasonable safeguards, to responsible companies. So far as the public is concerned it is not so much a question of municipal telephones as of the securing a cheaper and better service, therefore every means towards that end should receive the unswerving support of our local authorities.

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—A paragraph has been going the rounds of the press stating that Joseph Wharton, the well-known metallurgist of Philadelphia, has demonstrated that there is a large percentage of palladium recoverable from the nickeliferous ores of the Sudbury district, there being about 3,000 ounces of palladium in 300,000 tons of nickel copper ore, and it is usually added that this metal is not mentioned in the reports of the mineral resources of the Dominion, though it is more valuable than gold. While the statement is correct in as far as it concerns Mr. Wharton, it is misleading in giving the impression that the discovery of palladium in Canada is a new thing. In the Government reports there are several references to this metal as occurring in very small quantities. An analysis of a specimen of platinum from Granite Creek, Similkameen River, British Columbia, showed palladium as well as other members of the platinum group in association, and is so reported in the Geological Survey's Annual Report for 1886. Its occurrence in Sudbury ores is in the mineral sperrylite which was discovered in 1888, by Francis L. Sperry, then chemist to the Canadian Copper Co. It was examined the next year by Profs. Wells and Penfield, of the Sheffield Scientific School at New Haven, Conn., who found it to be essentially an arsenide of platinum with other metals of the platinum group, including palladium, only a trace of this latter metal being recorded. The Geological Survey's publications of 1890 report the presence of palladium in these ores. In the same year in "Mining Industry" appeared an analysis by Titus Ulké, styled "a fair average analysis of the Canadian Copper Co.'s bessemer matte," which shows .25 oz. of palladium. At this rate 300,000 tons of ore carrying 3 per cent. nickel, would contain about 2,250 ounces of palladium, which is almost the same as Mr. Wharton's statement as given above. An analysis of bessemer matte from the Murray Mine, by Dr. T. L. Walker, made in 1896, showed a trace of palladium, and this is referred to in the Annual Report of the Ontario Bureau of Mines for 1903, and also in a report on the Sudbury district by Dr. A. E. Barlow, published by the Geological Survey last year. The presence of the platinum group (including palladium) in the Sudbury ores has been recognized almost from the beginning of mining operations in the district, but no statistics of production have been made public. The operating companies have not, until recently, admitted that any of

the gold, silver, or platinum metals in the Sudbury ores have been saved, and as yet no particulars of production are available. The platinum metals average about 1.25 oz., the gold 0.375 oz., and the silver is conservatively estimated at 7.5 oz. per ton. Dr. Barlow estimates the value of these metals produced from the beginning of operations to 1903, thus:—Gold, $305,460; silver, $195,286; platinum and allied metals, $805,429. There may, indeed, be more of these precious metals taken out of Ontario than we suppose, for those in control of our nickel deposits are probably not interested in proclaiming from the house-tops the value of their by-products.

"TRANSITE" ASBESTOS FIRE-PROOFING LUMBER.

The advent of modern fire-proofing precautions, the renewed demands for the safeguarding of the public at large, and the exigences of strict sanitary conditions, call for something in the line of building construction which will meet the requirements to a high degree of thoroughness and economical stability. The H. W. Johns-Manville Co., of 100 William St., New York, the largest manufacturers of asbestos and magnesia fire-proof materials in the world, have put forth their efforts to produce a material which can be adopted by the modern architect, builder, engineer, and mechanic; something, which, in itself, will take the place of wood and other inflammable materials; and they are now able to put upon the market an asbestos lumber called "Transite Asbestos Fire-Proof Lumber." It is made in varying thicknesses from ⅛-in. to ½-in., and in standard sheets 40 by 40-in., or 42 by 44-in. It can be built up in larger sheets or curved as desired. In its simplest form, "Transite" is a firm fire-resisting board. Its main claim to a standing in the building world is its adaptability to an almost unlimited variety of requirements. It has been adopted by the Interborough Rapid Transit Company of New York City, both in the elevated and subway cars, for lining switch panel boxes, for the complete floor covering of the underbody of the wooden motor car, and on their sheathed and steel cars it is used in the deflector boxes and ducts for the motor leads, and for all car wiring. "Transite" is also being used as a flash board behind the fuse box on the third rail contactor. The Montreal Street Railway Co. have just placed an order for 150 linings for Type K-10 Railway Controllers, together with equipments, as above named. The Canadian Copper Co., of Copper Cliff, Ontario, have just completed a roofing on their works made of "Transite," consisting of 900 squares, 42 by 44-in. each, put in like shingles overlapped with "Transite" strip moulding for the up and down joints. This, in factory construction, directly overcomes a defect, hitherto unconquerable, where there is danger of corrosion on account of fumes, such as sulphuric acid fumes, etc., to which "Transite" presents an impassable barrier. A smoke-jacket, made of this material, is now available for the purpose of carrying off the acid fumes engendered in blast furnaces, and where the use of soft coal is prevalent. "Transite" is impervious to the attacks of acid fumes, steam and the elements.

It may be interesting to state the results of tests given to this material by the Shawinigan Water and Power Co., Shawinigan, Que. A piece of "Transite" was boiled in water for fifteen minutes, then taken out and boiled again for ten minutes. The edges warped very slightly, indicating a minute degree of absorption. It was then subjected, in its wet condition, to a fifteen-minute heat test over a white hot blast. The material came out whole, excepting for a slight hardening and brittleness, but retained all its fire-proofing qualities. It was then tested as an arc deflector on a circuit of 500 volts at 150 amperes. It took eleven minutes of constant arcing to burn a hole through it. This piece was only ¼-in. thick. "Transite" was tested in conjunction with other boards of a similar character, and was the only one which stood the test; the others, after the boiling test, in the heat test, blew up, indicating the presence of much moisture which was absorbed during the boiling process.

Besides possessing these acid-, steam-, and moisture-proof properties, this board is absolutely vermin-proof, and in this regard its possibilities are unlimited for use in hospitals as a flooring, ceilings, walls, etc. Its non-absorbing qualities will practically eliminate the transfer of disease germs after thorough fumigation. "Transite" will take a screw or nail the same as wood, and can be sawed, cut, planed or otherwise manipulated to meet the requirements.

Further information may be obtained from The Fairbanks Co., 747-749 Craig St., Montreal, Que., who are sole Canadian sales agents.

POWER OF AN ENGINE.

Editor, Canadian Engineer:—

Sir,—As a subscriber to your paper for a number of years, I take the liberty of asking a few questions in regard to the Corliss engine. First, what power would be developed with a 24 by 36 cylinder with ninety pounds' steam pressure, speed ninety revolutions per minute, also 100 revolutions per minute, 115 revolutions per minute, and 125 revolutions per minute, same size cylinder and steam pressure to govern in each case?

It has also been stated by one of our leading manufacturers that the above engine equipped with an inertia shaft governor and double eccentric, running at a given speed per minute, with one hundred pounds' steam pressure, would develop 300-h.p.; while the same engine equipped with a double eccentric and an ordinary fly-ball Corliss governor would develop, with the same pressure and speed, 500-h.p. In other words, he claims that an engine with an ordinary Corliss governor would develop 200-h.p. more than the same engine with an inertia shaft governor. What has the governor to do with the development of power?

JOHN WHITE,
London, Ont. London Bolt and Hinge Works.

Prof. R. J. Durley, professor of mechanical engineering in McGill University, answers the question, as follows: "I am not aware that the style of governor will have any direct influence on the power developed by the engine, this quantity depending primarily on the steam pressure, back pressure, cut-off, and number of revolutions. I should estimate that a 24-in. by 36-in. Corliss engine working with 90 pounds' steam pressure by gauge, and with a back pressure of five pounds absolute per square inch, would develop approximately the following indicated horse-power:

R.P.M.	I.H.P.	
	½ Cut-off.	¼ Cut-off.
90	500	340
100	550	380
115	620	430
125	670	470

CANADA CAR CO.

An important industry is being established in Montreal by the Canada Car Company, who have recently commenced construction on extensive car shops west of the city. This company was recently organized with a capital of $3,000,000. The president is Mr. W. P. Coleman, of Montreal. On the board of directors are: Andrew Allan, Montreal; H. S. Holt, Montreal; E. L. Pease, St. John; Frederick Nicholls, Toronto; H. F. Hoffstodt, Pittsburgh, and E. A. Friend, Pittsburgh. Both American and Canadian capital is interested in the enterprise.

The company's shops, when finished, will have a capacity of fifteen freight cars per day, and ten passenger cars per month. Everything that enters into the make-up of a car will be manufactured. The plans show two main buildings, one 1,000 feet long by 280 feet wide, the other about 300 feet square. In one of these main buildings will be the pattern shop, foundries, and machine shop. In the other will be the planing mill, matching room, turning and upholsterers' shops and the erection shops. The arrangement of these shops provides for the most up-to-date and economical handling of the materials, and the machinery will be

of the highest class. Besides these two main buildings there will be a power house, store house, and office building. The power house will have boilers of about 1,800-h.p. capacity to supply the steam for the heating and power requirements of the various shops.

Work on the plant was started about the middle of October, and was pushed vigorously in order that the concrete foundations and drains might be completed before the cold weather set in. This work was successfully finished about the 1st of December, and the foundations are now ready to receive the steel superstructure which can be erected throughout the winter. The construction has been carried out under the directions of E. G. Cape, consulting engineer of Montreal.

The steel work on the power house is now almost completed, and this building will be closed during the winter.

The contract for the boilers has been let to the Babcock & Wilcox Company. The Canadian General Electric Company have secured the contract for the two 500-K.W. turbine-driven generators. The air compressors will be furnished by the Allis-Chalmers-Bullock Company. The contract for the steel work on the power house has been let to the Dominion Bridge Company, and that for the foundations and superstructure to the Forest City Paving Company, of London, Ont.

The advantages of the site are very apparent. It is a level stretch of ground lying between the Lachine Canal and the Grand Trunk Railway, just west of Montreal, so that the facilities for receiving and shipping could not be better.

The offices of the company are in the Board of Trade Building, Montreal, where the president and general manager, W. P. Coleman, and the assistant general manager, N. S. Reeder are to be found.

APPLICATIONS TO PARLIAMENT.

Notices of the following applications to Parliament have appeared since the last issue of the Canadian Engineer:

Temagami Railway Co.; to extend its line from Sturgeon Falls to the mouth of French River.

Montreal and Southern Counties Railway Co.; to extend time for beginning and completion of works, to increase capital, to absorb the Montreal and South Shore Auto Car Co., and to extend its lines to Montreal.

Woodstock and Lake Huron Railway; to incorporate a company to construct a line from Woodstock to a point near Kincardine.

International Terminal and Bridge Co.; to incorporate a company to construct a bridge across the Rainy River at Fort Frances, to operate a railway line thereon, to operate telephone and telegraph lines, and to have other powers.

Interprovincial and James Bay Railway Co.; to extend the time for starting and completing work.

Joliette and Lake Manuan Railway Co.; to extend time of construction.

Kingston and Dominion Central Railway; to build branches (1) from near Brockville to Montreal; (2) from near Westport to Ottawa; and to change the name to Montreal, Ottawa, Kingston and Georgian Bay Railway Co.

Montreal, Quebec and Southern Railway; to incorporate with power to construct from St. Guillaume to Sorel, and to acquire the lines and rights of the South Shore Railway, the Montreal-Longueuil Bridge Co., the Quebec Southern Railway, and the East Richelieu Valley Railway, and to extend time for completion of their works.

Ontario and Minnesota Power Co.; to confirm agreement between company and the Ontario Government regarding erection of power dam at Fort Frances, and for other powers.

Canadian Canals Corporation; to incorporate with power to construct waterways or ship railways from Georgian Bay to Lake Simcoe, and thence to Lake Ontario, and from Nottawasaga Bay to Lake Ontario.

Athabasca Railway and Oil Co.; to incorporate with powers to build from Edmonton to the junction of Clear Water River with the Athabasca River, and to drill for and deal in oil, etc.

Lebonk & Thunder Bay Railway; to incorporate with power to build narrow gauge railway from Thunder Bay to Loon Lake in McTavish Township.

Battleford and Lake Lenore Railway Co.; to change the location of its line so as to run through Saskatoon, Sask.

Moosejaw and Edmonton Railway; to incorporate with power to build from Moosejaw to the elbow of the South Saskatchewan River, and thence to Edmonton.

Edmonton, Yukon and Pacific Railway Co.; to extend time for commencement and completion of works.

Athabasca Northern Railway; to incorporate with power to build from Edmonton to Athabasca Landing, to operate telephone and telegraph lines, and with other powers.

D. R. Fraser & Co.; to incorporate with power to construct dams, wharves, piers, etc., on the Saskatchewan River, above Edmonton.

Calgary and Battleford Railway; to incorporate with power to build from Calgary to Battleford, and thence to Prince Albert.

Kettle River Valley Railway; to incorporate with power to build from Quilchena to the international boundary, and from a point on that line to a point on the C.P.R.

Medicine Hat and Northern Alberta Railway Co.; to extend by three years time for commencement and completion of works.

Lake Champlain and St. Lawrence Ship Canal Co.; to extend time of commencement and completion of works.

Niagara, St. Catharines and Toronto Railway Co.; to extend time for commencement and completion of its extensions.

Hudson's Bay and North-West Railways Co., and Manitoba and Keewatin Railway Co.; to confirm amalgamation, and to incorporate as the Great North-West Transit Co. of Canada.

Macleod, Cardston and Montana Railway Co.; to extend time of commencement and completion of its works.

Lethbridge Bridge Co.; to incorporate with power to build a bridge across the Belly River, near Lethbridge, and to operate railways to connect the bridge with other lines of railway.

Kootenay, Cariboo and Pacific Railway Co.; to extend time for commencement, extension and completion of main line and branches.

Algoma Copper Range Railway; to incorporate with power to build from Batchewana Bay to Superior Mines and thence to the line of the C.P.R., near Biscotasing, to operate vessels, to develop mines, and with other powers.

Brantford and Woodstock Railway; to incorporate to build from Brantford to Woodstock, Ont.

Algoma Central and Hudson Bay Railway Co.; to extend time for construction.

Manitoulin and North Shore Railway Co.; to extend time for construction.

Ontario, Hudson Bay and Western Railway Co.; to extend time for commencement and completion of works.

Bay of Quinte Railway Co.; to construct branch from Bridgewater to the Actinolite Mines, Addington County, and to extend time for construction.

DEPRECIATION IN AN ELECTRIC PLANT.

Editor, Canadian Engineer:—

Sir,—I think you have over-stepped the mark when you say on page 7, of the January issue of the Canadian Engineer, that "the annual cost of maintenance, including the interest and sinking fund is $14,802," while I would consider in these days of rapid changes and improvements that $14,802 would be scarcely sufficient for sinking fund and interest on $94,000. A great deal of standard apparatus five years ago is now fit for the scrap heap. That would be 18 to 20 per cent. depreciation. I have not heard of any transformers that were installed five years ago wound with 110 and 220 volt secondaries. Yet they were being discarded two and three years ago by many progressive companies. The revolving field generators in this country five years ago probably would not number half a dozen. I could give you many such illustrations if I had time to take the matter up.

J. M. Deagle,
Manager Cataract Electric Co.

Cataract, Ont., Jan. 16th.

ELECTRICAL THAWING OF BLAST FURNACES.

Editor, Canadian Engineer:—

Sir,—Could you inform me if electricity is being used successfully to burn out the tuyeres, cinder notches or iron notches of blast furnaces, when they become frozen? We would be pleased to have the names of any companies using electricity for this purpose, also description of apparatus.

Yours truly,

W. H. Pickles, Electrician.

Nova Scotia Steel and Coal Co., Limited.
Sydney Mines, N.S., Jan. 6th, 1905.

K. L. Aitken, consulting electrical engineer, of Toronto, to whom this enquiry was referred, replies as follows:

I have no information on plants where electricity is used for burning out tuyeres, etc. That it is used for this purpose is quite probable, however, as the electric arc furnishes a means of concentrating an intense heat at any desired point.

An "arc welder" of either the Bernardos or Zerener type might be employed—the former apparatus, when heavy currents are used, can weld two ⅜-inch iron plates together at the rate of six feet per hour.

If Mr. Pickles has a direct current generator available, an experiment might be tried, and at little or no cost. The positive wire should be connected to the tuyere, and the negative to an ordinary arc lamp carbon, suitably mounted on an insulated handle. In the negative lead there should be inserted a low resistance, probably two or three ohms will be serviceable for the trial if the generator voltage be 125. The continuous capacity of this resistance should be say, 50 amperes, and it can probably be made up easiest from 16 or 32 candlepower lamps connected in multiple. The carbon, when ready, should be touched to the tuyere, and an arc drawn. Mr. Pickles will no doubt be able to tell from the experiment whether the scheme will be of use when carried out on a large scale. In welding the plates previously mentioned, the Bernardos machine required about 250 amperes, at 150 volts.

The Zerener welder consists of two carbons, and the arc is drawn between them, and deflected outward by means of a small electro magnet. Thus the arc can be applied direct to the metal to be heated. It is doubtful, in my mind, if the same intensity of heat can be obtained with this latter machine. I would suggest that Mr. Pickles communicate with some of the manufacturers of electric welding apparatus—no doubt they have been called upon to deal with such propositions, and therefore will have definite information on the subject.

INDUSTRIAL NOTES.

Tillsonburg has granted a bonus to the Wind Motor Co.

Seaforth has loaned the Canada Furniture Manufacturers $20,000 for twenty years.

The new bridge across the west arm of the Lake of the Woods, which the Government built at a cost of $25,000, is completed.

The Canadian Shredded Wheat Company, Limited, have secured a plant at Niagara, Ont., where they expect to be in operation by May 1st.

Charlottetown, P.E.I., is to have a new railway station. The building will be three stories high and will cover an entire block. Construction is to commence in the spring.

A company is being formed to build a large wharf at Esquimalt, to accommodate ships of the heaviest tonnage, also a sawmill for the supplying of foreign markets. Iron works, too, are proposed to be built in close proximity to Esquimalt, in which proposition both Victoria and English capital is interested.

The Keewatin Flour Mills Co. have prepared plans for the construction and equipment of a first-class flour mill, with elevators, barrel factory, railway sidings, and all that is necessary to operate a mill of 5,000 barrels' capacity. Tenders will be called for at an early date, and work begun in the spring.

Alexander Barr's blacksmith shop and carriage factory, Pembroke, has been destroyed by fire. Loss, $4,000; no insurance.

A 30-ton electric crane has been installed in the new boiler shops of the Goldie-McCulloch Co., Galt, by the Morgan Engineering Co., of Alliance, Ohio.

Contracts for the foundations of the new elevator at Port Colborne have been awarded to Larkin & Sangster. The price is in the neighborhood of $200,000.

The main building of the Canada Carriage Co., at Brockville, was burned on January 4th. Loss about $250,000, largely covered by insurance. Company will rebuild.

Kaolin has been discovered on the farm of T. E. McWilliams, near Moose Jaw, N.W.T., and a company to make sewer pipe and china dishes is expected to be in operation in the spring.

The Lake Superior Corporation started the year with enough orders to keep steel rail mill running continuously till the end of September, and with the prospect of closing orders which would keep the mill in full operation till the end of the year. The largest customers will be the Canadian Pacific, the Canadian Northern, and the Grand Trunk.

The Canadian Canoe Co., Limited, Peterboro, have moved into the building lately vacated by the Martin-Orme Piano Co., and now have one of the largest and best equipped factories in Canada for the manufacture of small pleasure craft. Their goods are sold in all parts of the Dominion, also in England, Australia, and Germany. Since 1901 their business has doubled.

A cement works is being equipped at Todd Creek, Vancouver Island, and is expected to be in operation this month. It is said that $300,000 has been spent on the equipment. The location has the advantage of a convenient supply of excellent clay, and also of grinding stone, good shipping facilities, convenient markets, and water power at a distance of sixteen miles. A steam plant is now being installed, and during the summer the power of the Sooke river will be developed.

The Canada Launch Works, Toronto, has secured power to change its name to the Canada Launch and Engine Works, and has increased its capital from $40,000 to $100,000. New officers have been chosen as follows: B. W. Folger, president; M. M. Whittaker, vice-president and manager; and John Hendry, secretary-treasurer. The company has bought more land and is erecting a new machine shop 150 by 35 feet. A contract has been closed with the Lake Shore Engine Company, of Marquette, Mich., under which the Canadian Company will make the Marquette Company's motors here, and will be the only company in Canada manufacturing complete motor boats.

The competition and low prices now confronting cement manufacturers call for consideration of every phase of manufacture, in order to obtain economical production. That cement manufacturers are alive to the situation and are making important changes is shown by the recent orders received by F. L. Smidth & Co., of New York. Among the installations of kominuters and tube-mills being made by this company, may be mentioned those for the Lehigh Portland Cement Co., at West Coplay, Pa., and Southern Indiana; the Lawrence Cement Co., of Siegfried, Pa.; J. B. Speed & Co., of Louisville, Ky., who are erecting a new mill at Speeds, Ind.; the Elk Portland Cement and Lime Co., Elk Rapids, Mich.; and the Alma Cement Co., of Wellston, Ohio.

The plant of the Northern Iron and Steel Co., at Collingwood, which was recently acquired from the old Cramp Steel Co., is on a site of fifty acres on the harbor front, and is peculiarly adapted for shipments by rail and water. The plant consists of open hearth steel converting furnaces, and large rolling mills. The furnaces, which are each of 20 ton capacity, are of the stationary type, similar in design to those at the Carnegie works in Pittsburg. They are located in a steel building, 100 by 120 feet. The rolling mills are in a building 120 by 320 feet, and are completely equipped for rolling anything from a rod to a girder. A machine shop and hydraulic plant together with locomotives, cranes, etc., complete the equipment, which was designed by the Cramp Co., with the advice of some of the ablest steel authorities in America.

Chatham, Ont., ratepayers voted $41,000 for a new market building.

Chatham, Ont., has granted a loan of $20,000 to the Defiance Iron Works to establish works there.

James H. Rogers, of Montreal, has a contract for the construction of a bridge across Lachine Canal.

J. I. Case & Co., of Racine, Wis., manufacturers of threshing machines, will open a large branch in Calgary.

Moore & Whittington, contractors, of Victoria, have applied for waterfront privileges in order to erect a sawmill which is to have a capacity of 20,000 feet per day.

The wood-working factory of W. Currie & Co., Campbellton, N.B., has been burned. Loss, $50,000; insurance, $20,000.

The saw manufacturing concern of Walter Wilson & Son, St. John, N.B., established since 1845, have completed the erection of a large new brick factory on a site adjoining their present location. It is 39 by 105 ft., equipped with the most modern devices and thoroughly heated and ventilated.

The Canadian Shipbuilding Co. have about completed their plant at Bridgeburg, Ont., and machinery has been installed to the value of several hundred thousand dollars. The works are considered one of the most modern in the marine shop line in America. It is expected that the shops will be open early in the navigation season.

Engineers are at work upon plans to lower the level of Okanagan Lake in British Columbia to the extent of four feet. The main reason for the improvement is to afford relief to the town of Kelowna, which is flooded by high water every spring. It will be done by dredging the outlet connecting Okanagan Lake with Dog Lake, incidentally affording water transportation to a rapidly growing district.

The Canada Southern Bridge Co., who are applying to Parliament for extension of time within which to complete a bridge or tunnel from Amherstburg towards Stony Island across the main channel of the Detroit River, have already expended $1,450,000 on bridges in the locality. The time fixed by the agreement at present in force expires on May 7th next.

The bonus of $250,000 offered two years ago, by Sydney, N.S., to any company starting a shipbuilding industry, is being claimed by a company recently formed, of which J. T. Burchell is president, and William Hayes, of Sydney, secretary. The company says it intends equipping a plant capable of building a 15,000-ton steamer per year, and will also build a floating drydock to hold an 8,000-ton vessel, and will keep a wrecking steamer at the port. It is said that Alexander Johnston & Co., of Stockholm, and the Dominion Coal Co. are largely interested.

The Locomotive and Machine Company, Limited, Montreal, have elected directors for the ensuing year as follows: A. J. Pitkin, Pliny Fisk, G. R. Sheldon, W. M. Barnum, K. W. Blackwell, J. Reid Wilson, and D. W. Morrow. At a subsequent meeting of the board of directors, the following officials were elected: A. J. Pitkin, president; J. E. Sague, vice-president; R. J. Gross, second vice-president; Leigh Best, secretary; C. B. Denny, treasurer; C. E. Patterson, comptroller.

Under the direction of the Secretary of Agriculture for the United States, a number of experiments have been undertaken during the past year with a view to determining whether or not a thoroughly practical concrete fence post, reinforced with steel, could be made sufficiently cheap to be used by farmers. The advantages of such fence posts would be many. The price of wood, particularly of the varieties used for fence posts, is continually rising, and even now the price is almost prohibitory in some sections of the country. Further, a properly constructed concrete post would be permanent, as it would neither rot nor undergo disintegration. A variety of methods of reinforcement have been tried, and experiments are still being conducted. The results thus far are said to have been most satisfactory. Experiments of a similar nature are about to be begun on methods for making concrete drains, watering troughs, roofs and barns, with the hope that concrete construction, so rapidly developing in the large cities, can be applied with benefit to the farm.

The London Brass Works Co.'s premises were damaged by fire to the extent of $2,000. Cause unknown.

The C.P.R. will build a storage and cleaning plant of 3,000,000 bushels' capacity, at Fort William, Ont.

The New Glasgow Wire Factory, New Glasgow, N.S., will establish a branch of their business in Winnipeg.

It is said that the Grand River Metal Works will move from Galt. Several other towns are offering inducements.

Coal docks are to be built at Port Arthur, Ont., of such a size as to take care of the whole North-West coal trade.

A large cannery will be built at Esquimalt for handling the fish from the salmon fisheries on the Vancouver Island coast.

Montreal capitalists will erect a ten story hotel in that city at a cost of $3,000,000. President Hays, of the Grand Trunk Pacific, is said to be one of the promoters.

The Campbellton, N.B., sash and door factory has been destroyed by fire. Loss, $40,000, partially insured. This is the second mill belonging to this firm to be burned within a year.

La Fonderie de Plessisville, of Quebec, has had its powers increased so as to permit it to produce electricity and to run telephone or water works companies in the counties of Megantic and Arthabaska.

The Montreal & Ottawa Peat Co. has erected a new peat plant at Caledonia, Ont., with a capacity of 50 tons per day. A branch company has been organized to operate in Winnipeg, where they will turn out 150 tons per day.

The Government's subvention of $50,000 towards a Dominion Exhibition will be given this year to the city of New Westminster, on condition that the money will be expended in freight on exhibits from other provinces.

The Georgian Bay Engineering Works, Midland, Ont., are putting a new babbit metal on the market, called the "Midland" bearing metal. G. W. Thexton, manager of this company, was presented at Christmas with a handsome gold watch by his men.

The Toronto Roller Bearing Co., manufacturing the Henderson roller bearings, intend to establish a branch in Winnipeg, employing 60 to 100 men, with a daily output of $700 to $800, the factory to open next fall. Hon. A. G. Blair recently became managing director of the company.

J. Gunn & Sons have been awarded the contract for the Canadian Northern Railway Company's bridge over the south branch of the Saskatchewan River within fifteen miles of Prince Albert. The structure consists of nine spans of 150 feet each, the track being 100 feet above low water. The piers are to be built of concrete, and the trusses of steel. The structure is to be completed by September 1st.

A company of English capitalists propose erecting large cement works at Sydney. The city will grant a bonus of $10,000, and certain concessions. Operations are to commence in May. The plant will have capacity of five hundred barrels per day. There is to be a large cooperage in connection with the works. The cement will be manufactured from the slag, now a waste product of the Dominion Iron & Steel Company. The company is capitalized at half a million dollars.

The John McDougall Caledonian Iron Works Co., had a test made of their new Worthington turbine fire pump at the Canada Sugar Refining Co.'s works, Montreal, a few days ago, in the presence of a number of members of the Society of Civil Engineers. The visitors were very much interested in the test. The pump, which was driven by a Bullock direct-connected motor, has a capacity of 1,600 gallons per minute, against a pressure of 130 lbs. A description of this multi-stage turbine pump was given in this paper last year.

—We have received from Graham, Morton & Co., Limited, Leeds, England, 24-page booklet illustrating installations of all kinds of conveying machinery made by this company. They undertake the entire designing and construction of conveying, elevating, and other plants, and claim a world's speed record in the erection of their own plant. An interesting account of conveying plants, which had been installed by this company, recently appeared in the commercial supplement of the London Times.

RAILWAY NOTES.

It is again reported that the Grand Trunk is about to equip the Sarnia tunnel electrically.

The C.P.R. is installing the Pyle electric headlight on their engines. This light throws a powerful beam forward, and another vertically.

The Canadian Locomotive Co., of Kingston, has received the contract for four engines for the Temiskaming and Northern Ontario Railway.

The C.P.R. main line from Montreal to Winnipeg is now laid with standard 80-lb. rails. This equipment will be completed to Vancouver before the end of the year.

Edmonton is to be a divisional point of the Grand Trunk Pacific Railway, with repair shops and terminals. The city is to pay the company a bonus of $100,000.

The Railway Commission has approved the plans of the James' Bay Railway Co. for nine bridges across the Don, between the fourth and fourteenth miles out of Toronto.

On account of spread rails, a passenger coach on a Brockville, Westport and Northern train recently left the track and rolled down an embankment. The passengers were badly shaken up, but no one was seriously injured.

The proposal is taking definite shape for the building of an electric railway from the terminus of the Quebec Railway Light and Power Company's road, at St. Joachim, near Quebec, to Murray Bay, and perhaps as far as Saguenay River.

The Canadian Northern have completed the Prince Albert extension to the crossing of the South Saskatchewan, ten miles from Prince Albert. Here a 2,000-foot steel bridge is to be constructed. The Rossburn branch, 79 miles long, from near Neepawa to Rossburn, has also been completed this winter.

It is expected that a start will be made early in the spring on an extension of the Brockville, Westport and Northwestern Railway to Sault Ste. Marie. The line was taken over by New York capitalists about two years ago, and the roadbed and equipment have been very much improved since that time, so that it is now considered in a fit condition for the payment of the balance of subsidies, amounting to about $80,000, which had been withheld by the Government.

The Crow's Nest Pass Railway Co. have now taken over for operation the Canadian Pacific branch from Fernie to the mines at Coal Creek, B.C. This move is in connection with the Great Northern Railway construction which is progressing so rapidly in the district. The American line will thus have direct access to the fuel fields which are to supply Montana and other American points so largely hereafter. The Great Northern have just bridged the Elk River, and contracts for the depot, section-house and other buildings at Fernie have been let.

Final surveys are now being made for the Quebec and Lake Huron Railway, and if former surveys are verified, construction will commence this summer. The line is to run from Quebec to French River through northern Quebec and Ontario, a distance of 500 miles, shortening existing railway routes from the northwest by 140 miles. Hon. A. Turgeon, Minister of Agriculture for Quebec, is president of the company, which was organized about three years ago. Other directors are: R. J. Campbell, J. L. Greatsinger, and B. S. Hammond, all of New York.

Among the estimates presented by the Department of Railways and Canals for the present year are items for the Intercolonial and Prince Edward Id. Railways, amounting to over $3,000,000. These include nearly $700,000 for rolling stock, $380,000 for steel rails and fastenings, nearly $100,000 for new machinery for locomotive and car shops, $80,000 for brakes, couplers, etc., and $100,000 for double tracking parts of the line. Accommodation is to be increased or improved at Halifax, Moncton, Sydney, Levis, Stellarton, Riviere du Loup, St. John, Pictou, Truro, New Glasgow, Charlottetown, Georgetown, Kensington, and other places. The construction of spur lines, the strengthening of bridges, and other matters also call for considerable expenditures.

The St. Francis Valley Railway Co. is applying for incorporation in Quebec to build a line in Temiscouata and Kamouraska counties.

A proposal has been made to extend the franchise of the Montreal Street Railway for 32 years, in addition to the 18 years it has yet to run.

There are now 19,611 miles of steam railway in Canada, 534 miles of which were built in 1904. There are 767 miles of electric railways.

The C.P.R. have purchased the Esquimalt and Nanaimo Railway which runs from Victoria to Wellington, on Vancouver Island, a distance of 75 miles.

Application is to be made to the Quebec Legislature for the incorporation of the Longueuil Tramway Co., to build lines in Chambly County, connecting with Montreal.

The workshops of the Ottawa and New York Railroad are being moved to Ottawa, which city gave a bonus of $75,000 as an inducement for the location of the shops there.

The new Grand Trunk round-house at Mimico will be ready in the spring. This will mean a complete readjustment of the tracking system between Mimico and Toronto.

The Wolfe, Megantic & Lotbiniere Railway Co. will apply to the Legislature for an extension of time within which to construct its line from Lime Ridge to the Quebec Bridge.

The Toronto Railway Company will extend the Scarboro' Railway five miles to Highland Creek. The Metropolitan road will also be extended from Newmarket to Jackson's Point.

A railroad is to be built north from Vancouver through Lillooet and Cariboo and connect with the Grand Trunk Pacific and Canadian Northern Systems in the northern part of British Columbia.

The Quebec Oriental Railway Co. will apply at the next session of the Provincial Legislature for an extension of the time within which to commence and complete its construction, and for increased powers.

The property and privileges of the Montreal & Lake Maskinonge Railway Co., which have passed into possession of the trustees of the bondholders, will be taken over by the Joliette & Brandon Railway Co., which is applying for incorporation.

Application will be made by J. W. Molson, C. B. Cruchet, and J. Brosseau at the next session of the Quebec Legislature, for the incorporation of the Lake Achigan Electric Railway Co. to build electric lines in Terrebonne County, connecting St. Jerome with Lake Achigan.

The inquest on the death of Fireman Chambers, who was killed by an explosion on a C.P.R. locomotive, near Bobcaygeon, in December, showed that the engine was patched and defective, and the jury found the C.P.R. officials indirectly responsible for Chambers' death.

An agreement has been completed between the C.P.R. and the British Columbia Electric Ry. Co. for the latter to operate the Lulu Island Branch Railway, between Vancouver and Steveston, on the Fraser River. The road will be electrified and will be taken over by July 1st. Fares will be cut in half and the service greatly improved.

The Niagara, St. Catharines, and Toronto Railway, an electric line running from St. Catharines to Niagara Falls, and the Niagara, St. Catharines and Toronto Navigation steamers, Lakeside and Garden City, have been acquired by a Toronto syndicate, composed as follows: Frederic Nicholls, president; E. R. Wood, vice-president; D. D. Mann, H. G. Nicholls, Aemilius Jarvis, and Z. A. Lash.

The Canadian Pacific Railway is preparing plans for important improvements to its Vancouver harbor facilities. It is stated that a sum of $250,000 will be spent on the jetty wharf and $120,000 or so upon additional tracks and trestles along the wharf front. The idea is to accommodate not only C.P.R. steamers, but also vessels of other lines, for which greater facilities are needed on account of increasing business.

MINING MATTERS.

An oil boring rig capable of boring a 12-inch hole to a depth of 3,500 feet, has been installed at Pincher Creek, Alberta.

A rich vein of silver has been located north of Bruce Mines, Ont. Several carloads of the ore showed good values on test.

Frank, B.C., which was practically destroyed by the rock slide of May, 1903, is being rebuilt, and the mines are again working.

Arrangements have been completed for the resumption of operations at the Marion silver-lead mine, near New Denver, B.C.

A landslide occurred recently at York Harbor copper mine, C.B., partly destroying the engine house, and doing much other damage.

The Rossland Power Company's plant, at Trail, B.C., has closed for several months, awaiting new machinery and better conditions for handling ore.

A promising pyrite property, near Madoc, Ont., has been taken over by Toronto people, who will develop it and probably manufacture on the spot.

The Ontario Bureau of Mines is forwarding a collection of corundum and corundum-bearing rock, as a permanent exhibition for the National Museum, Paris.

A new mill has gone into operation at the Star of the East Gold Mine in Kaladar Township, Addington County. The shaft is down 150 feet, and the vein is strong and promising.

The New Brunswick Petroleum Co., operating around Memramcook and Dover, N.B., now have 20 oil wells producing about a barrel a day. They propose to sink 58 more, and to erect a refinery next year.

Fernie, B.C., which was swept out by fire, has been rebuilt, brick and stone taking the place of wood. The population is now 3,580; and there are 1,250 coke ovens in the town.

The Canadian Mining Institute will hold its annual meeting in Montreal, commencing on Wednesday, March 1st, and lasting three days. A record attendance is expected at this meeting.

St. Paul, Chicago, and Winnipeg capitalists are interested in the development of a large iron mine on the shores of Lake Winnipeg, twelve miles from the C.P.R., where 45,000,000 tons of ore are said to be in sight. From $1,000,000 to $2,000,000 will be expended in developing the mine and building smelters. As there is abundance of coal in the vicinity, the expense of running the smelters will be light.

The output of the Dominion Coal Co.'s mines in Nova Scotia for 1904 was 3,023,522 tons, the total shipments being 2,980,037 tons. At one of its collieries, the Hub, the output was comparatively small on account of the extensive construction work being undertaken. Harrow work is being largely prosecuted in several mines to give ample room in anticipation of a larger output when navigation opens.

R. Robertson and J. A. MacMillar, of Nelson, B.C., and C. J. Clayton, of Victoria, who recently made a discovery of specular hematite iron in the vicinity of Gray Creek, talk of erecting an electric smelting plant at Nelson for the reduction of the ore, which is believed to be extra high grade. An abundance of water power is at hand for the development of electricity, while the Crow's Nest Pass coal fields are only 150 miles away.

A company, to be known as the Gold Gravel Dredging Co., is being organized to work the gold placer deposits on the Upper Vermilion river, north of Sudbury, by the system of gold dredging successfully practised in California and New Zealand, and will shortly apply for incorporation with a capital of $500,000. The principal promoter is Robert H. Ahn, who has been engaged in preliminary work in the locality for the last three years, and has made an exhaustive examination by test pits. He reports that there is a large amount of ground that will yield 20 cents per cubic yard, and billions of yards of gravel that will yield a profit of 10 cents per cubic yard on treatment under improved methods. The feasibility of the proposition is confirmed by an official report of A. P. Coleman. The company has secured about 500 acres, on the Upper Vermilion and expects to begin operations during the coming season with a $50,000 dredge. So far the system has not been tried in Ontario with modern equipments.

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MARINE NEWS.

At the annual meeting of the Turbine Steamship Company, held in Hamilton, a satisfactory statement of affairs was made, and the directors and officers were re-elected.

The Toronto Ferry Co. is building a flat-bottom steamer 100 feet long and 20 feet beam, to provide for a service in Long Pond, Toronto Island. She will be covered all aft with a cabin, and will carry 400 passengers.

F. H. Peters, engineer, of London, has been placed in charge of the surveying party to examine Lake Nipissing in connection with the Ottawa and Georgian Bay Canal survey. It is expected the work will be completed in the spring.

Three steamers are at the Collingwood dock for repairs. The Macassa, of the Hamilton Steamboat Co.'s fleet, is to be lengthened thirty-six feet. The United Empire, of the Northern Navigation Co., is to be rebuilt, and the City of Midland, belonging to the same company, is to receive a general overhauling and steel arches in the hull. The work will require a large number of men for some months.

Among the estimates to be voted at the present session of Parliament are appropriations for canals as follows:—Cornwall Canal, enlargement, $7,000; Galops Canal, enlargement and completion of channel, $161,500; forming channel and building dam between Galops and Adams Island, $70,000; Welland Canal, improvements, construction of elevator at Port Colborne, and improvements of Port Colborne entrance, $987,000; Lachine Canal, improvements, machinery for shops, etc., $105,800; Rideau Canal, extension, $50,000; construction at Sault Ste. Marie, $100,000; Trent Canal, construction, $300,000.

The Canadian Government has decided, accepting the invitation of the United States, to appoint commissioners to an International Inland Waterways Commission, to enquire into cases where Canadian and United States interests come into conflict through diversion of water. W. F. King, Dominion astronomer; J. P. Mabee, K.C., and Louis Coste, formerly chief engineer of the Public Works Department, are to be the commissioners. Cases that may engage the attention of the Commission are the diversion from the St. John river to rivers of Maine; the diversion of water from Lake Ontario at Massena Springs, N.Y.; the deepening of the United States canal at the Soo; the proposed diversion of water from the Rainy River, and the use of the water of the Bow River, in Alberta, for irrigation purposes.

A floating drydock for Vancouver harbor is being constructed at the yards of Swan & Hunter, Newcastle-on-Tyne. The first section of the dock, which will be 276 feet in length, and capable of lifting 6,500 tons, will be in Vancouver and in operation by the end of the year. The dock is to be built in two sections, and each will be capable of acting independently of the other on the smaller classes of work. When large work is called the two sections of the dock may be linked together and a dock formed 510 feet in length, capable of lifting 11,300 tons and of capacity to receive a vessel 600 feet in length. The smaller section will be 234 feet in length.

The Government ice-breaker, Montcalm, which steamed successfully through ten inches of ice in December, has been working during the past month with the ice bridge at Cap Rouge, about ten miles above Quebec. At times the ice was formed to the depth of three feet, with ice rafted on top of this to a total depth of fifteen feet. This the Montcalm was able to pierce at one charge to the extent of her own length, and by repeated charges she has kept the channel open. At times the ice block has formed to even greater thicknesses, but up to time of writing the ice-breaker has dealt successfully with the situation. By preventing the formation of the ice bridge at Cap Rouge, it is thought that navigation on the St. Lawrence will open in the spring at least three weeks earlier than usual.

It is reported that the Allan Steamship Company will establish a regular service between Vancouver and Japan, in the spring, employing three vessels.

Quebec's new pier, which was begun last fall, has been badly damaged by the great quantity of floating ice in the St. Lawrence. The cement work has been pushed fully six feet out of place.

The Bertram Engine Co., Toronto, Ont., is building a Government dredge, the spuds for which were supplied by John B. Smith & Sons, Toronto. The spuds are 24 by 24 and 50 ft. in length, each stick weighing about 9,000 lbs. The timber is of superior quality.

The Fairfield Shipbuilding Co., of Glasgow, have the contract for two new steamers for the Atlantic fleet of the C.P.R. They will be 550 feet in length and of 14,500 tons' burden, and will be the largest boats that have ever visited St. Lawrence waters. They will have a speed of 20 knots, and will be so constructed as to be of service on the Atlantic or Pacific. They are to be delivered in May, 1906.

At the annual meeting of the Northern Navigation Co., held in Toronto last month, the following officers were elected: President, H. C. Hammond; directors, Col. J. S. Hendrie, F. A. Lett, W. D. Matthews, H. B. Smith, W. J. Sheppard, C. E. Stephens, Hy. Telfer, and C. D. Warren. H. N. Gildersleeve succeeds C. T. Long as manager, and C. H. Nicholson was appointed traffic manager.

LIGHT, HEAT, POWER, ETC.

In a serious explosion of dynamite which occurred at one of the shafts of the Toronto-Niagara Power Co.'s construction at Niagara Falls, one man was killed and eight others injured. Cause unknown.

The St. Lawrence Power Co., of Mille Roches, are putting in another generator of 1,250 horse-power, made by the Canadian General Electric Co., of Toronto. Chas. W. Kent is superintending the installation.

The Laurentian Water and Power Co. will apply to the Quebec Legislature at its next session for power to increase its capital to $500,000, to change its name to the Laurentian Hydraulic Co., and to acquire certain water powers.

E. A. Robert has obtained judgment against the Montreal Light, Heat and Power Co. for $260,000 arising out of an agreement for the purchase by one of the subsidiary companies of a water power property. The case will be carried to the Privy Council.

St. Johns, Que., is now lighted by the St. Cesaire Light and Power Co. The contract with the corporation is for one year or more at the discretion of the council, and is for eleven arc lights of 2,000-c.p. at $55 per annum and 55 incandescent lamps of 32-c.p. at $10 per annum.

Some time ago a company was formed, known as the Maine and New Brunswick Electrical Power Co., for the purpose of harnessing the Aroostook Falls. Arrangements have now been completed for the development of 4,000-h.p. at this point. It will be used for manufacturing purposes, and to operate a local electric railway.

The negotiations for the purchase of the gas plant of the Montreal, Light, Heat, & Power Co., having so far failed, a committee of the Montreal city council has reported on a municipal gas plant. The cost is estimated at $5,000,000, and it is estimated that gas can be distributed at 15 to 28 cents per thousand, and the coke can be utilized for the pumping station.

Allis-Chalmers-Bullock, Limited, of Montreal, celebrated their first semi-annual meeting on January 17th by tendering a dinner to their office staff and representatives from all parts of the country. The function passed off most successfully and enjoyably. Among those present were: B. H. Warren, president; W. Chalmers, and W. H. Whiteside, of the Allis-Chalmers Co., New York, Chicago and Milwaukee; J. S. Neave, of the Bullock Electric Co., Cincinnati; R. W. Chapin, Col. Henshaw, H. J. Fuller, J. W. Pyke, Alex. Pringle, Phelps Johnson and W. C. McIntyre, all directors of the company.

The electric light plant of the Fredericton Gas Light Co. is now in commission. The plant is capable of furnishing 6,000 lights.

Ellsworth Birkett, of the Brantford Electric and Operating Company, was instantly killed by a shock of 3,000 volts, received while fixing an arc lamp near the power house.

The Grand Prize at the St. Louis World's Fair was awarded to "Electra Carbons." The Canadian General Electric Co. are sole agents in Canada for these goods.

Under the management of W. A. McKay, the United Towns Electric Co., of Sydney, N.S., have installed electric lighting plants at Harbor Grace, Carbonear and Heart's Content, Newfoundland.

The American Conduit Co., Chicago, has a corps of experts in underground construction, and is prepared to furnish supervision of work if desired. While figuring to co-operate with contractors in underground construction, they will give estimates and take contracts for complete underground systems in any part of Canada.

CATALOGUES RECEIVED.

The following may be obtained from the firms named by mentioning The Canadian Engineer:

Powell-Colne, Bowling Green Bldg., New York; illustrated booklet describing the Tropenas convertor steel process.

Wm. Hamilton Manufacturing Co., Limited, Peterboro; Catalogue of improved shingle mill machinery. 20 pages, illustrated.

Clayton Air Compressor Works, Liberty St., New York; Bulletin C 201, 48 pages, illustrated, showing over twenty types of compressors, vacuum pumps, air lifts, etc.

Stark, T. L. & P. System, Limited, Toronto; booklet describing the combined telephone, light, and power installation system provided by this company.

Beardmore Belting Co., Montreal and Toronto; illustrated booklet describing waterproof cement leather belting, for use especially in paper mills, dye-houses, etc., where there is much dampness.

Jeffrey Manufacturing Co., Columbus, Ohio; Jeffrey pulverizing machinery, a 50-page book describing in detail pulverizing, crushing and shredding machinery. Fully illustrated.

Sheldon & Sheldon, Galt, Ont.; a 35-page booklet describing the Sheldon natural draft moist air lumber dry kilns. Fully illustrated with photographs and drawings. Contains list of recent installations.

The Fairbanks Co., Montreal; Catalogue No. 382, Power Transmission Appliances; containing descriptions and lists of shafting, hangers, pulleys, clutches, rope drives, conveying machinery, etc. 180 pages.

Austin Manufacturing Co., Chicago; large 84-page catalogue of gyratory crushers, screens, elevators, etc., which took two grand prizes and three gold medals at St. Louis. W. H. C. Mussen & Co., Montreal, are Canadian agents.

Marshall & Huschart Machinery Co., Chicago and Cleveland; catalogue of machine tools, 150 pages, 9 by 12, board covers; a fully illustrated list of the machine tools carried by this firm, who represent thirty manufacturing establishments.

Wile Power Gas Co., Rochester; "Producer Gas, Its Uses and Cost," a booklet giving a full account of producer gas and its advantages for fuel or power—"the cheapest form of energy from fuel." Also catalogue B, describing gas producers made by the Wile Co.

Charles Barber & Sons, Meaford, Ont.; tables for the Canadian turbine water wheels, showing head, R.P.M., quantity of water, and horse-power. These tables are for heads up to 100 feet and for wheels from 12-in. to 70-in. Dimensions and prices of wheels are also shown.

Savoie-Guay Co., Plessisville, Que.; catalogue of turbine water wheels, with tables showing method of measuring water-power, also showing horse-power, revolutions, and other details with various sizes of wheels. Cuts of woodworking machinery made by the same company are included in the catalogue. Pp. 22, paper.

Peter Hay Knife Co., Limited, Galt; Price list of machine knives, 18 pages, illustrated.

Westinghouse Electric and Manufacturing Co., Pittsburg; Circular 1,096, oil switches and oil circuit-breakers. 20 pages, fully illustrated.

Canadian General Electric Co., Toronto; a small circular giving description and price lists of special desk lamps. "Save Your Eyes" is the significant title.

Jeffrey Manufacturing Co., Columbus, O.; Bulletin A, a description of a novel coal and ashes distribution plant in Ohio. Interestingly written and attractively illustrated.

Henry R. Worthington, 114 Liberty St., New York; Pumping machinery, a 132-page catalogue of boiler-feed pumps, waterworks pumps, mine pumps, condensers, air pumps, feed-water heaters, turbine pumps, etc. Printed in two colors, with lined art cover.

Bolling & Lowe, 2 Laurence Pountney Hill, London, E.C., have issued a sheet showing rails, ties, fishplates, locomotives, dump-cars, etc., for light railways. The sheet is printed in both English and French, and contains tables of equivalents of metric and English measures and gauges.

Samuel Denison & Son, Limited, Leeds, Eng.; Catalogue of weigh scales,, including beam scales, platform scales, wagon and railway scales, crane scales, etc. Also booklet describing the Blake-Denison continuous weigher, for automatically weighing and recording material passing over a conveyor.

B. Greening Wire Co., Hamilton; catalogue of wire rope, giving a full list of many kinds of rope including Swedish charcoal, crucible steel, etc. Breaking strains and working loads are given, besides tables showing sizes of sheaves and wheels to be used, etc. Methods of splicing and notes on use of wire rope add to the value of the book. Illustrated, pp. 40, paper.

Canadian Westinghouse Co., Hamilton; Circular B-W, 1,000, description of Baldwin-Westinghouse electric locomotives for railroad service, industrial haulage, mining, etc. Also circulars 1,035, descriptive of Westinghouse No. 12a railway motor; 1,090, describing railway controllers; 1,093, self-contained direct current multipolar generator; 1,060, Westinghouse type N transformers.

Canadian General Electric Co.; The second section of the supply catalogue is now issued. It treats of cabinet panels, fuse blocks and cutouts, and contains about 60 pages.

Expanded Metal and Fireproofing Co., Toronto; The Expanded Metal System of Concrete Construction, a book fully explaining its subject. The theory and practice of the method is set forth; sectional drawings show construction of floors,, walls, ceilings, etc., and photographs of buildings built wholly or partially of concrete are reproduced. A division of the book deals with engineering uses of concrete. 65 pages, 9 by 12, board covers.

Automatic Electric Co., Chicago; General catalogue, descriptive of the Strowger automatic telephone, and including illustrations of their factory. Also four booklets giving opinions of users of the "girlless" telephones, in Dayton, O.; Grand Rapids, Mich.; Portland, Me., and St. Mary's, O.

Continental Iron Works, Brooklyn, N.Y.; Morison Suspension Furnaces for Internal Furnace Boilers, a similar with many drawings and photographs. Also Morison Suspension Furnaces for Internal Furnace Boilers a similar catalogue, containing designs for boilers of various horsepower, besides description, estimates, tables, etc. Both books 8 by 11, board covers.

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—The United States Circuit Court of Appeals has decided that the lubricator manufactured by the Sterling Lubricator Co., of Rochester, is not an infringement on patents held by Greene, Tweed & Co., of New York. Litigation has been going on for five years, and one year ago the Circuit Court granted the New York firm a perpetual injunction against the Sterling Co. This decision has now been reversed and the dispute finally settled, and costs, which have been very heavy, have been awarded to the Rochester company. The device in question is an automatic force feed lubricator for injecting oil into cylinders. It is claimed that it feeds the oil exactly as needed, and is rapidly becoming indispensable for engines, pumps, automobiles, etc.

MUNICIPAL WORKS, ETC.

Berlin will extend its sewage disposal plant.

Brantford will spend $50,000 on its waterworks.

Calgary will instal a municipal electric light plant.

Cornwall will spend $5,000 in waterworks extensions.

St. Thomas will purchase its gas and electric light plants.

Petrolia voters defeated the by-law to establish a gas plant.

Belleville is to improve its waterworks at a cost of $10,000.

A waterworks system will be installed at Pincher Creek, N.W.T.

Peterboro will spend $20,000 in waterworks improvements.

Kingston's waterworks closed the year with a surplus of over $3,000.

Ottawa ratepayers defeated the by-law providing for the purchase of the street railway for $3,000,000.

Stratford will spend $50,000 on waterworks improvements and $700 for sewage disposal.

At Lindsay, a by-law to instal a water filtering plant was defeated in favor of sinking artesian wells.

The price of gas has been reduced from two dollars to one dollar and fifty cents at Owen Sound under civic management.

Guelph will improve the street railway, and buy a park, at a cost of $30,000. $7,000 will also be spent in putting in a new filter and improving the waterworks.

The new fat stock building in Lansdowne Park, Ottawa, has collapsed for the second time within a year. The entire edifice, which cost the city $25,000, is a total wreck.

The Winnipeg by-law to take over the gas works and run them under municipal ownership was defeated. The Winnipeg Electric Street Railway Company now supply the gas.

Plans for a fireproof art gallery for the Toronto Industrial, prepared by Mr. Gouinlock, the Toronto architect, have been approved by the directorate, and have been handed on to the City Council.

The new waterworks system at Hull, which has been completed at a cost of about $300,000, has been opened. The pumps have a capacity of six million gallons a day, though only about two million gallons are being pumped.

Edmonton has purchased the telephone system formerly operated by the Edmonton District Telephone Co., for $17,000. The system includes four exchanges, at Edmonton, Strathcona, Fort Saskatchewan, and St. Albert, with 390 subscribers in all.

The electric light plant at Wingham has been owned by the town for a year. After paying all running expenses there is a surplus of $2,576.

Madoc, Ont., is installing a $10,000 municipal lighting plant. A 100-h.p. steam engine is to be used with a generator of 1,200 lights' capacity. Both arc and incandescent lamps are to be used for street lighting. The plant is now nearly ready for operation.

In an inves'igation into Chicago's lighting contracts, City Electrician Edward B. Ellicott, stated that the municipal lighting venture had proven so satisfactory that a second plant with double the capacity of the first, is now in course of erection. The new plant will cost $1,172,000, and will supply 4,500 arc lamps. The average cost per arc light during the past three years has been about $54 per year.

Pittsburgh, through its Director of Public Works, E. M. Bigelow, has awarded a contract for 5,000 water meters ranging in size from ⅝-in. to 6-in., inclusive, to the Pittsburgh Meter Co., of East Pittsburgh, Pa, to be filled with the well known Keystone Water Meter. It is the intention of the city to meter every water consumer in the near future, which will require in the neighborhood of 75,000 meters, so that the contract which has just been placed really represents but a small portion of the city's prospective purchase of meters. This initial contract represents between $50,000 and $60,000.

TELEPHONE AND TELEGRAPH.

The central exchange of the Merchants' Telephone Co., Montreal, has been destroyed by fire. Loss, $30,000; insurance, $18,000.

Orillia is negotiating with the Bell Telephone Co. for better terms before the contract is renewed.

Work has comenced on the installation of the telephone system in Fernie, B.C. The system will be in working shape in about two months.

The new telephone line between Vancouver and Victoria, Vancouver Island, is open for business. Its length is 100 miles of land lines and 14½ miles of cable.

The Manitoba Legislative Private Bills Committee has rejected a bill to incorporate the North-West Telephone Company and the Independent Telephone Company of Canada.

St. Mary's, Ont., has petitioned Parliament for legislation to prevent telephone companies from erecting poles or constructing conduits in any street without consent of the municipality.

The Bellechasse Telephone Co., of Levis, will apply at the next session of the Quebec Legislature for power to increase its capital to $250,000, with the right to further increase it to $1,000,000, and for other powers.

By the Artons system of wireless telegraphy it is claimed than an electro-magnetic wave message cannot be diverted from the point for which it is intended. Successful experiments have been carried on between Rome and Sardinia.

The Montreal Economic Association passed a resolution strongly recommending that all telephone wires be placed underground. It was contended that the wires interfered with the work of the firemen during conflagrations.

The annual meeting of the stockholders of the Central Telephone Co., N.B., was held recently at Hampton. The reports showed that there are 156 miles of line in operation. It was understood at the meeting that the directors will secure a Provincial charter and take up the general telephone business, special attention being paid to the automatic telephone system, on which they have secured important rights.

G. W. Webster, formerly divisional engineer of the Canadian Pacific, is now provincial representative in British Columbia of a United States company of railroad contractors.

—The Vulcan Iron Works Co., of Toledo, O., has issued a handsome diary for 1905, which contains, besides the usual data in such books, a quantity of useful information for users of steam shovels and dredges. A map of the United States is also included. The same company is issuing a monthly paper, The Steam Shovel News, of which the first number was recently received.

—The Hamilton Cataract Power, Light and Traction Company have recently started the two 5,000-kilowatt Westinghouse generators in their De Cew Falls power station in Ontario. Power is supplied from the Welland Canal feeders, tapped in about fourteen miles above the power station, and at the station the water has a head of 267 feet. The Westinghouse generators are of the two-bearing type, direct connected to Escher-Wyss water-wheels, and run at a speed of 286 R.P.M. They generate 3-phase current at a frequency of 66 cycles, and a pressure of 2,400 volts. The power is transmitted to Hamilton, where it is used for lighting, street railway and manufacturing purposes. A reserve steam-driven station is located at Hamilton, which contains two 1,000-kilowatt Westinghouse generators. The entire station and high tension apparatus are of Westinghouse design. The company has two separate three-phase transmission lines to Hamilton, a distance of about 35 miles. The high tension apparatus is designed for a pressure of 40,000 volts, but will be operated for a time at 20,000 volts. William C. Hawkins is general manager of the Hamilton company, and is also engineer in charge of the installation.

PERSONAL.

Reginald Aubrey Fessenden, a distinguished Canadian electrical engineer, who is at present resident in Washington, D.C., has been appointed to the Municipal Power Commission of Ontario.

George L. Rice, superintendent of the International Harvester Company's plant in Hamilton has been transferred to Chicago, where he will have the management of the company's twine factory.

R. S. Dahl has accepted the principalship of the King's School of Engineering, to be opened shortly in Sydney, C.B.

H. M. Wilson, who has been connected for a number of years with the Bay of Quinte Navigation Co., becomes manager for the Turbine Steamship Co., of Hamilton, the first of this month, succeeding Mr. Ellis.

A. F. Macallum, head of the department of drafting and design of the Technical High School, Toronto, has resigned, and will take charge of the Grand Trunk Pacific surveys in Eastern Quebec.

Capt. W. F. Van Buskirk, formerly city engineer of Stratford, Ont., and latterly of Rossland, B.C., died last month of cancer, aged 42. He was a graduate of the Royal Military College.

J. A. Jamieson, elevator engineer of Montreal, has accepted the superintendency of the Canadian Government's two million bushel elevator at Port Colborne, for which he had prepared the plans.

John S. Maclean, for nearly 14 years on the staff of the Toronto Globe, has been appointed to take charge of the publicity department of the Allis-Chalmers-Bullock, Ltd., Montreal. Mr. Maclean has an extensive experience.

No appointment has yet been made by the Canada Atlantic Railway to the position of chief engineer lately occupied by George A. Mountain, (now engineer for the Transportation Commission), but Robert F. H. Bruce, formerly Mr. Mountain's assistant, is now acting chief engineer.

The chairmanship of the Transportation Commission, rendered vacant by the death of John Bertram, is occupied by Robert Reford, of Montreal, promoted. Mr. Reford's place is taken by James Ashdown, of Winnipeg. At time of writing, Mr. Reford's resignation on account of ill-health has been submitted, and is being considered.

It is reported that J. R. Stephens, chief engineer of the Grand Trunk Pacific, whose appointment as an American was the cause of much criticism, and whose discrimination against Canadian engineers in the organization of the engi- Judge Winchester, will resign. Another rumor states that his title and duties will be changed.

K. L. Aitken has taken over the business of the Electrical Supervision Society of Toronto, and will carry it on in his own name, with offices at 164 Bay street. Mr. Aitken has made a study of hydro-electrical problems, and his description of the electrical developments at Niagara Falls, a summary of which appeared in the Canadian Engineer, showed a thorough grasp of the subject.

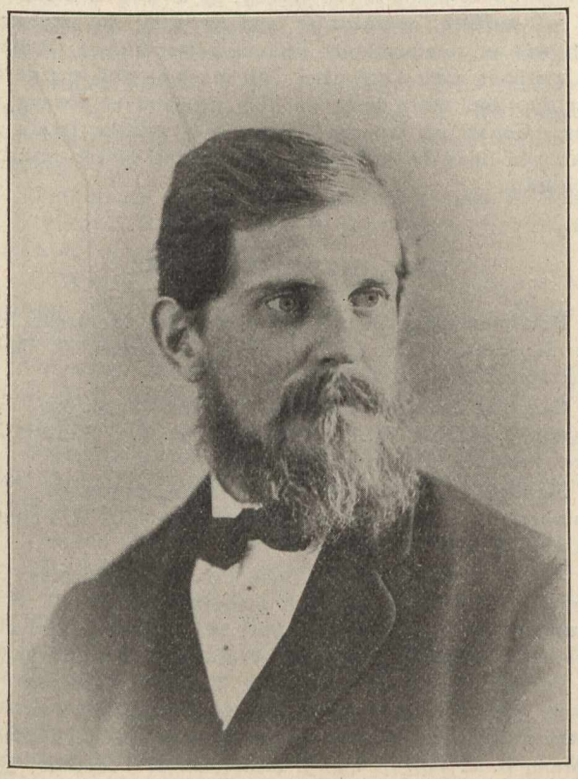
Cecil B. Smith, C.E., Toronto, has equipped a laboratory for the testing of cement in connection with his engineering practice. The growth of the Canadian cement industry and the numerous cement marl beds that are being discovered will make such a laboratory a great benefit. Mr. Smith was for years in charge of the cement testing laboratory of McGill University, and is therefore an expert in the work.

W. D. Baillairge, eldest son of Charles Baillairge, for thirty-two years city engineer of Quebec city, has been appointed to succeed his father as engineer of the ancient capital. Mr. Baillairge, Jun., has been trained since boyhood in the office of his father. In 1888 he was appointed assistant city engineer, and since the resignation of his father in 1898 he has been acting chief engineer for the city.

After a lengthy illness, George A. Simpson, Deputy Minister of Public Works for Manitoba, died on January 8th, at Winnipeg. The late deputy was born in Picton, Ont., and was sixty-three years of age. He went West in 1875, and was engaged by the Canadian Pacific Railway in prospect-

ing and locating work in the mountains. Later he was engaged upon block survey work for the Dominion Government. He succeeded the Hon. Mr. Sifton as chief clerk of the department, and J. A. Macdonell as chief engineer.

R. H. Barrett, a young civil engineer, fell from the attic window of a lodging-house in Toronto a few nights ago and was killed. He came to the house to provide shelter for five friendless Poles stranded in the city, and it being late, he and a friend, Fred. Heatherington, another engineer, took quarters in the attic room of the same house. His feet having been frost-bitten he was unable to sleep, and it is supposed he was leaning out of the window for air or to get snow for his feet when he fell. Mr. Barrett was 28 years of age, a graduate of the School of Practical Science, and was a young man of temperate habits and high character. He had been working on the Georgian Bay Canal surveys. His father is collector of customs at Amherstburg.



CHARLES D. EDWARDS.

Charles D. Edwards, for many years prominently identified with the business of Montreal, died last month at Stoughton, Mass., in his 64th year, and his remains were brought to Montreal for interment. Mr. Edwards was the pioneer safe manufacturer of Canada, having started in Montreal under the style of Kershaw & Edwards, both members of the firm being sons of the heads of the firm of Kershaw & Edwards, of Boston, one of the best known of the early safe-makers of the United States. After a few years Mr. Kershaw retired, and Mr. Edwards carried on the business alone. The first factory was started in 1857, and Mr. Edwards took over the business in 1859. It was on the site of the present Gazette building. Mr. Edwards was a very enterprising man, and at one time was the financial support of eleven other concerns in Montreal. The Edwards safes were noted for strength, being built to stand a fall from the highest buildings then in use. All the iron then used in making safes came from the Old Country, and cement was used for filling instead of plaster of paris. The latter material was adopted afterwards because of its capacity for absorbing moisture, so that in case of the heating of a safe in a fire the steam generated would form a protecting medium for the contents. Mr. Edwards was the first employer of labor to start early closing on Saturday, and his name will be held in kindly remembrance on this account alone. The deceased was the father of H. O. Edwards, advertising manager of the Canadian General Electric Co., and of the Canada Foundry Co.

LITERARY NOTES.

Mechanism, by S. Dunkerley, M.Sc., Associate M.I.C.E., M.I.M.E., 408 pages, 5½ by 8½, with numerous diagrams. Price, 9s. London: Longmans, Green, & Co.

Every machine is to modify force and motion. Some natural source of energy sets in motion a part of the machine called the driver, and this through a train of mechanism transmits the motion to the follower, where useful work is to be done. The follower has to move in a definite way, depending on the kind of work to be done, while the driver has to be adapted to the source of energy available. In designing a machine, a general outline of a suitable arrangement would first be sketched without any respect to the forms or proportions of the individual parts, and from that outline, by means of pure geometry, the displacement, velocity, and acceleration of each of the moving parts could be accurately determined. This operation belongs to the kinematics of machines, and is the subject dealt with in this book. The first chapter is descriptive, taking up various machine tools and mechanisms required for special purposes. The other chapters discuss straight-line motions, indicator mechanisms, quick-return motions, couplings, velocity diagrams, acceleration diagrams, link-motions, toothed wheels, etc., etc. A number of numerical examples are added at the end, and a complete index makes the contents of the book accessible.

Structural Designers' Handbook, by William Fry Scott, Member Am. Soc. for Testing Materials. 158 pages, 6 by 9. New York: Engineering News Publishing Co.

This book, to use the author's phrase, is a diagrammatic treatise of structural design, and is compiled with the object of shortening or eliminating much of the drudgery of computation necessary in such design. The book is divided into four parts, dealing respectively with the Mechanics of the Beam and Column, Beamwork, Columns and Truss Members, and Miscellaneous Matters. The last part discusses loads and stresses, and gives a full tabulation of the properties of stock shapes of materials. Over fifty diagrams and several tables are included in the book.

The Advance Advocate, the official organ of the International Brotherhood of Maintenance of Way Employees, published in St. Louis, is a creditable magazine. The January number, which is to hand, has nearly 70 pages of reading matter, consisting largely of correspondence from branches of the Brotherhood throughout the United States and Canada. To members of the organization the Advocate should be an interesting and efficient medium for the furtherance of their interests and the cultivation of a fraternal spirit.

The Mining World on January 21st, issued an annual number, which contains a great deal of valuable information, and reviews the past year, which it designates as the greatest mining year of the age. The coal, iron, and copper situations are reviewed in special articles, and the year in the United States is treated by states. Canada, Mexico, South America, Australia, and Africa are also dealt with at length. Bound with the magazine are eight full-page colored maps of continents and countries, which prove very convenient in connection with the special foreign articles.

The Engineer, Chicago, issued a special New Year's Day number, which contains 66 pages of reading matter, the whole paper covering about 250 pages. The number is devoted largely to the gas engine, an article on Current Practice in Combustion Engines giving illustrated descriptions of over twenty styles of engine now in use. Other articles deal with various aspects and problems of gas engine use. Gas producer systems of various kinds, and systems of conveying machinery are also described at length.

The Railway and Engineering Review devotes the 200 pages of its New Year's number to the Transportation Building of the St. Louis Fair. Detailed descriptions and copious illustrations make a perusal of this magazine almost equal to a visit to the fair. Everything connected with railroads, from ballasting to signalling, and from timber testing to machine tools, is to be found between the covers of this number.

Petrol Motors and Motor Cars, a Handbook for Engineers, Designers, and Draftsmen, by T. Hyler White, A.M.I.M.E. 187 pages, 5 by 7½, illustrated. London: Longmans, Green & Co.

This book, as the author announces in the preface, is written entirely from the designer's point of view, and is intended to provide, in accessible form, the formulæ and information required in the design of petrol motors. The mathematics introduced are as simple as compatible with a complete treatment of the subject, a point which will be appreciated by those not familiar with the higher branches. The book is divided into two parts, the first dealing with cylinder design, valves, carburettors, etc., and the second treating of matters for the automobile motor, such as transmission gears, brakes, bearings, etc. An appendix gives over forty pages of useful tables for reference. A complete index is provided, and a special index to formulæ, so that matter contained in the book may be readily located.

Rogers' Machinists' Library is the collective name applied to three books published by Theo. Audel & Co., 63 Fifth Avenue, New York. They treat of subjects connected with the machine shop in such a way as to be easily understood, and numerous illustrations add to the clearness of the text. While designed to be a set of progressive text-books for the machinist who desires to improve, each book is complete in itself. The "Progressive Machinist," the first book of the three, deals with materials, drawings, bench work, lathe work, etc. It is a book of 360 pages 5½ by 7½, with over 300 illustrations. The "Advanced Machinist," is a companion book as regards size and style, and treats of mathematics, measuring machines, boring, milling, screw cutting, and other machine operations, besides containing chapters on shop management, accessories and workshop recipes. The third of the series is "Rogers' Drawing and Design," which is a book of nearly 500 pages, 8 by 10. It is a fully illustrated text-book for the draftsman and treats all branches of mechanical drawing, and contains also an abundance of information of a technical nature, which is not usually included in such publications, but which is of vital importance to the designer. The books are all bound in cloth, with gold lettering and edges. Complete indexes add greatly to the value of the books as works of reference. The prices are $2 each for the two machinist books, and $3 for the Drawing and Design. The publisher has an easy payment plan, and anyone interested should write for particulars.

A novel idea in book-making is presented in the 1905 issue of the "Science Year Book," edited by Major B. F. Baden-Powell, and published by King, Sell & Olding, Ltd., 27 Chancery Lane, London, Eng. This consists in a square cut out of the front of the cloth cover, through which is seen a calendar of the first month of the year. On raising the cover there is disclosed a ruled spacing for memos for each day of the month. When the month has expired, the leaf is torn out and the calendar of the next month is shown through the square. This bright idea is not the only new feature of this admirable year-book which is the successor to the "Knowledge Diary and Scientific Handbook," noticed in the Canadian Engineer last year. The frontispiece is a full page portrait of Lord Kelvin, and the introduction to the diary proper consists of 168 pages of tables relating to the heavens and the earth, to physical chemistry, weights and measures, to the scientific progress of the past year, to scientific and technical institutions, etc. The book contains nearly 400 pages, 6 x 9 inches, and the price in cloth binding is only 5s. 8d., including postage to Canada.

American Tool Making and Interchangeable Manufacturing, by Joseph Woodworth, 530 pages, 6 by 9, illustrated with 600 engravings. Price, $4. New York: Norman W. Henley Publishing Co., 132 Nassau St.

This book, which is written by a mechanical expert, is intended by the author for all who are interested in the working of metals. It is for the man at the bench, and the designer in the drafting room. In it are described the small tools, fixtures and special appliances which are in use in the up-to-date machine shops in the United States. The author attributes the success of the United States in the mechanical field to the perfection of the manufacture of duplicate parts, and his aim is to describe the jigs and other devices which have brought about the modern method of manufacture. General principles for the design and construction of such devices are given, along with descriptions of particular typical examples. The book is written in a very readable style, and with the help of the numerous illustrations (which are from drawings by the author) the meaning is always made clear. While the author glories in the high achievement of the machinists of the present day, he sees an expanding field for the application of genius, and looks forward to the time when the same ingenuity which has produced a "dollar watch" will perfect the "automobile for the million;" and his final word is "Forward."

The Joseph Dixon Crucible Company began the new year with a special issue of their monthly house publication "Graphite," devoted to Graphite Lubrication. Graphite Lubrication is not a mere theory; it is a well established fact of modern engineering and growing in importance every day as its advantages become better known. Lubrication methods must keep pace with machine and engine construction, and more light on this problem is always welcome. Copies of January "Graphite" will be freely sent to all who may be interested in attaining better results in lubrication.

NEW INCORPORATIONS.

Dominion.—Canadian Ammunition Co., Montreal; $500,000. L. A. Boyer, H. D. Anthier, J. E. Lareau, D. Thibaudeau, and L. Boyer, of Montreal.

Canadian Builders, Limited, Toronto; $1,000,000 G. P. Magann, J. McKay, W. H. Blake Toronto; J. C. Stewart, New York, and C. F. Franson, Pittsburg.

Standard Construction Co., Ottawa; $1,000,000. E. J. Chamberlain, J. W. Smith, C. J. R. Bethune, G. E. Fauquier, and H. Christin, of Ottawa.

Nicola Valley Coal and Coke Co., St. Catharines, Ont.; $1,000,000. To mine coal and manufacture coke in British Columbia. E. A. Jukes, Toronto; W. S. McNamara, H. E. Larkin, F. N. Hara, and W. D. Woodruff, of St. Catharines.

Polson Iron Works, Limited, Toronto; $1,000,000. To acquire the ship and engine-building business now carried on by the Polson Iron Works. A. H. Jeffrey, W. B. Tindall, J. J. Main, B. F. Polson, and J. Miller, all of Toronto.

Ontario.—Canada Cycle and Motor Co., New Zealand; $50,000; head office, Toronto. T. A. Russell, E. B. Ryckman, C. W. Kerr, C. S. MacInnes, and C. C. Robinson, of Toronto.

Defiance Iron Works Co., Chatham; $60,000. To manufacture gasoline engines, farm implements, etc. W. S. Marshall, G. W. Foott, L. Howard, M. P. Sheldon, and W. M. Drader, of Chatham, and R. J. Barnes, of Buffalo.

Richelieu Cnstruction Co., Toronto; $200,000. J. W. McDonald, R. L. Brackin, and E. A. Francis, all of Toronto.

The Plating and Specialty Co., Brantford; $40,000. To do all kinds of plating and deal in hardware specialties. G. W. Markle, C. J. Farr, and F. Munro, all of Brantford.

The Pioneer Mining Co., of Arizona, is licensed to do business in Ontario to the extent of $50,000. G. H. Draper, Rat Portage, attorney.

The Hammond Typewriter Co., of New York, is licensed to do business in Ontario to the extent of $55,000. J. B. England, Toronto, attorney.

Lake Orion Oil and Gas Co., of Arizona, is licensed to do business in Ontario to the extent of $40,000. H. F. Slater, Leamington, attorney.

Commercial Oil Company of Hamilton; $100 000. J. C. Person, W. J. Morrison, G. L. Person, W. C. Person, of Hamilton, and C. Goring, of Homer.

Eureka Planter Co., Woodstock; $50,000. J. A. Straith, S. Best, C. N. Choate, A. McNee, and P. J. Freeman, of Toronto.

Universal Spring Motor Co., Toronto; $250,000. G. H. Campbell, W. B. Bentley, L. F. Askton, of Toronto; W. J. Johnson, Springfield, Ohio; W. G. Morden, Montreal, and S. Metcalfe, Galt.

Brick Manufacturing and Supply Co., London; $40,000. W. Tytler, R. G. Wilson, T. Jones, H. Sing, and J. Whittaker, all of London.

Dailey Rotary Engine Co., Galt; $100,000. C. Hetherington, R. W. Roelofson, A. J. Oliver, C. Turnbull, and F. E. Brown, of Galt.

Canada Cabinet Co., Gananoque, is increasing its capital by $25,000.

Stratford Mill Building Co., Stratford; $200,000. W. Preston, J. B. Greig, E. Preston, W. Jeffrey, and A. J. Jeffrey, all of Stratford.

Acme Manufacturing Co., Toronto; $40,000. To manufacture implements. J. T. Eastwood, N. Murphy, E. E. Wallace, F. Hodgson, and A. J. Walker, of Toronto.

Toronto Pressed Steel Co., Toronto Junction; $100,000. J. R. L. Starr, J. H. Spence, T. E. Wilson, A. A. Rogers, and S. Whittaker, of Toronto.

French River and Nipissing Navigation Co., Sturgeon Falls; $25 000. J. A. Clark, J. W. Hendrie, of Sturgeon Falls; J. M. Harris, W. Hendrie and W. Hendrie, Jr., Hamilton

Premier Electric Light and Power Co., Wallaceburg; $40,000. W. D. McRae, F. C. McRae, E. McDonald, M. Stonehouse, D. C. McDonald, and H. A. Stonehouse, of Wallaceburg.

Wilberforce Lumber Co., Durham; $40 000. G. Sparling, A. S. Hunter, D. Jamieson, S. J. Sparling, E. Hunter, and I. Jamieson, all of Durham.

A. Weller & Co., Toronto; $40,000. Builders and contractors. W. Weller, J. Weller, J. Stares, A. Weller, and A. Weller, all of Toronto.

Canadian Corundum Wheel Co., Hamilton; $40,000. L. Sherk, H. E. Sherk, G. F. Webb, W. Bell, and A. S. Devine, all of Hamilton.

Nipissing Mining Co., Toronto; $250,000. E. P. Earle, New York; D. Fasken, H. Armstrong, A. T. Struthers, and W. H. Syms, of Toronto.

Toronto Gas and Gasoline Engine Co., Toronto; $300,000. J. Laishley, L. C. Laishley, R. B. Dargavel, H. H. Milburn, of Toronto; and R. Hunter, of Toronto Junction.

Madoc Mining Co., New Jersey, U.S. Licensed to operate in Ontario. Capital not to exceed $40,000. H. J. Mills, Madoc, attorney.

Canadian Shredded Wheat Co., Niagara Falls; $100,000. J. Henderson, J. Hewitt, D. Fasken, H. E. Rose, and A. T. Struthers, of Toronto.

Bonanza Creek Gold Mining Co., Toronto; $1,750,000. J. Payne, R. Credicott, W. Gilchrist, A. Foster, and T. Taylor, of Toronto.

St. Mary's Quarries, Limited, St. Mary's; $200,000. A. Douglas, T. T. Garner, J. W. Graham, of St. Mary's; D. Bonis, of Blanshard; and A. Calley, of Toronto.

Buffalo and Leamington Oil and Gas Co., Windsor; $100,000. E. Wigle, Leamington; C. L. Meyer, Pelee; L. J. Gemmell, Perth; F. D. Davis, Windsor, and P. W. Resseman, Buffalo, N.Y.

Canada Tin Plate and Sheet Steel Co., Morrisburg; $1,500,000. N. D. Lewis, Cardiff, Wales; J. A. Meldrum, W. D. Cavendish, A. E. Panter, and B. D. Cole, of Toronto.

Quebec.—King's Asbestos Mines, Limited, Quebec; $300,000. H. M. Whitney, Boston, Mass.; E. Slade W. S. Thomas, A. H. Cook, K.C., Quebec; and B. Bennett, Thetford Mines.

New Brunswick.—New Brunswick Iron Co.; $1,000 000. J. S. McLennan, Sydney, N.S.; C. W. Young, St. Stephen; L. B. Knight, St. John; A. D. Wetmore, Truro; and C. V. Wetmore, Sydney.

British Columbia.—Skylark Development Co., $250 000.

Fraser River Sawmill Co.; $500,000.

Nelson Copper Syndicate, $10,000.

Similkameen Waterworks Co.; $10,000. To construct and operate a waterworks system at Hedley.

Gold Bug Mining Company; $250,000.

Forty-Nine Creek Mining Co.; $600,000.

N.W.T.—Egg Lake Oil Co.

Assiniboia Gas and Oil Co.

Saskatchewan Wood Manufacturers' Co.

Taber Coal Mining Co.

Alberta Building Block Co.

Moosejaw Firebrick and Pottery Co.

Exchange Telephone Co., incorporated in N.W.T., is to be dissolved in March.

MUNICIPAL TELEPHONE PLANT AT NEEPAWA, MANITOBA.

Independent telephony in the States, since its incipiency just nine years ago, has so thoroughly developed the telephone business, and has placed the service upon such a reasonable basis that it has become a great convenience to a large majority of households and a necessity to practically all business houses, in place of its being a luxury of which but a select few are able to avail themselves, as was the case during the period in which the Bell monopoly had complete control of the business through its patent protection on the fundamental apparatus.

During these nine years of competition in the business independent companies have sprung up in almost every large city, country town, village and hamlet throughout the States. There is scarcely a section in the entire country where farmers do not have their connection by telephone over their own local system, and then by trunk line and toll line to the nearest village, and from there to the larger business centres, so that the most widely scattered rural districts are within instant communication with each other and with the largest cities.

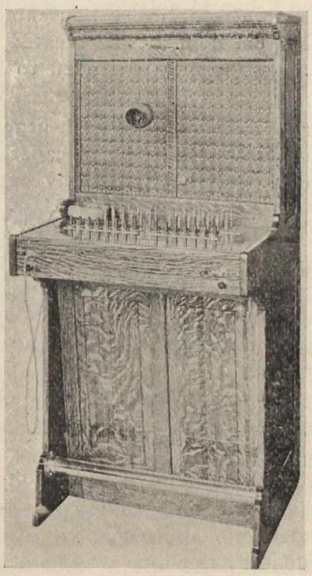


Fig. 1.—Self-Restoring Drop Switch-Board.

Since the opening of the independent telephone business in the States, there have been established more than 7,000 individual companies, having in operation nearly 2,500,000 telephones, with a capital investment of more than $250,000,000.

During this marvellous growth of the telephone field in the States, under competition through independent telephony, our Dominion, with but very few exceptions, has remained in the clutches of monopoly. Through unreasonable charges for unsatisfactory service over equipment antiquated in many cases, the Bell Company is giving connections in our cities with less than one for every sixty inhabitants, while in towns where competition prevails, as well as throughout the States, in the smaller towns and rural districts, there is one telephone for less than 20 inhabitants, showing that if independent telephones were once well established here, we would have from three to four times as many telephones in use, which would make the service we do have just that many times more valuable to us, to say nothing about the increased efficiency of the service.

What independent telephony can do in this country has

been thoroughly demonstrated by a number of our municipalities. The first to successfully set up telephone competition was the town of Neepawa, Manitoba, and an account of their system will be of interest, especially at this time when our municipalities are petitioning the Government to take over the long-distance toll line business, or at least to force the railways to be a common receiver of telephone communications, as well as common carriers of goods for transportation, so that independent competition may be safely set up.

Neepawa, Manitoba, a town of about 1,600 inhabitants, is about 100 miles west of Winnipeg, in one of the most prosperous and rapidly growing sections of the Dominion. While it had a limited telephone service with connection throughout the North-West over the Bell system, as far back as 1899 the municipality applied to the Legislature for power to establish a system of its own, to be operated under municipal control. After securing the power, it immediately threw off the yoke of the monopoly and established its own public service system.

Although the municipal exchange started with a small number of patrons, the central office equipment was first installed with a capacity for 150 lines, the officials feeling that this number would meet all future demands. The apparatus used was of the type in which the subscriber must turn a crank to signal the central office.

It was aimed to fix the rental charges upon a purely maintenance basis, so that the user of the system would not be required to contribute to the city's support in excess of the non-users, and so the ratepayers of the town not using the telephone system would not be required to bear any of the expense of the system. It was determined to fix the charge at $1 per month for domestic service and $2 a month for business use. This reasonable rental placed the service within the reach of almost every household and business, which made the system popular and created a great demand for the service, and it rapidly extended to its full ultimate capacity.

About a year ago the city had such urgent demand from many new subscribers, far above the capacity of the plant, that it was deemed advisable to greatly extend the system and enlarge the plant. On April 29th last, the council decided to not only enlarge the service, but also at the same time to thoroughly modernize its plant by putting in a full central energy system so that a subscriber might signal the central office automatically by simply taking the receiver from the hook, and so there would be no batteries at the subscribers' telephones.

Unfortunately, the day following, the town sustained a severe loss caused by a heavy flood destroying the town water-power dam, which it was necessary for the municipality to replace at once. This necessitated cutting all their appropriations, including a reduction of several thousand dollars in the telephone appropriation, which made it impossible to rebuild the telephone plant and put in the complete central energy system at that time. However, being determined to extend the system to meet the immediate demands, it was decided to equip the central office with a larger switchboard, and tenders with samples of the apparatus proposed were called for. After a careful consideration, the contract was awarded the International Telephone Manufacturing Company, of Chicago, U.S.A., including the rebuilding the outside line construction and the erection of a large quantity of lead-covered cable and terminal boxes.

The equipment installed embodies many new features, a description of which will be of interest to those contemplating the re-equipping of old exchanges or the building of a new plant where it is not possible to install a central energy system at first, but where in time it might be desirable to change to central energy.

Figure 1 shows the front view of a 200-line section of "International" self-restoring drop magneto-call switchboard, arranged for central energy system. Each line equipment consists of an answering jack and a mechanical self-restoring drop. The drop is of the tubular type, constructed of a magnet coil with fine silk-covered magnet wire wound over a soft iron core, with the spool encased in a soft iron tube to absolutely insure against cross-talk or induction between the lines in the switchboard. The armature is pivoted on the rear of the drop and is provided with a long pin forming a latch through the shutter at the front of the board, so that at the slightest impulse of the generator at the subscriber's instrument, the shutter is unlatched and indicates the call. A small trigger is placed in the spring jack in the path of the plug and so arranged that when the plug is inserted into the jack, the trigger automatically restores the drop shutter. The restoring trigger is mounted on a heavy German silver compensating spring, so as to make the restoration of the shutter positive at all times, even after long-continued usage, and the ordinary wearing of the parts. These combined drops and jacks are mounted in strips of ten, on heavy steel strips properly insulated with mica sheet and hard rubber screw bushings. The line equipments are held in position on the strip by the ferrule of the jack which screws into the jack base, firmly clamping these parts. These line equipments may be readily removed with a friction wrench placed in the jack ferrule on the front of the board. In this way the jack ferrules may also be readily removed and replaced, if necessary, after worn from long continual usage. The strips of ten line equipments are each mounted on the form of the board on a heavy steel frame, properly braced to make the board strong and rigid. The clearing-out drops or "disconnect" signals are placed in the bottom row and immediately above the cord circuits.

The board is equipped with fifteen pair of connecting appliances, each pair consisting of a ringing and listening key with ring-back key, a pair of plugs, cords, pulley weights, cord terminals, and necessary wiring. The plug-shelf is covered with heavy belt leather to provide a cushion for the plugs when returned after disconnection, and also to prevent the top of the board from being marred from the continual impact of the plugs. The plugs are compact but are of sufficient size to enable every part to be strong and durable. Each plug is provided with an insulating sleeve so mounted that it will turn upon the plug body, so that when the operator twists the plug when inserting, it will not break and kink the connecting cord, which greatly reduces the strain on these parts.

The combination ringing and listening key and ring-back key are compactly mounted upon one base. The long key, shown toward the front of the board, is a regular ringing and listening cam. It is so connected that when an operator inserts a plug into any of the subscribers' line jacks and presses the corresponding cam toward the board, it throws in and connects the operator's instrument with the particular line. (To be Continued.)

* * *

—The plant of the Dominion Brass Works, Ltd., at Port Colborne, was put up at auction on the 22nd ult. It was knocked down in three parcels for a total of about $15,000. The chief parcel consisted of the land, machinery and buildings, for which $13,000 was bid subject to a mortgage of $10,000. This bid was made in the name of McDowell, Stocker & Co., machinery dealers of Chicago, but we learn from the firm that this bid was made without their authority. The validity of the sale is contested, and the chances are that another sale will have to be called in the near future.

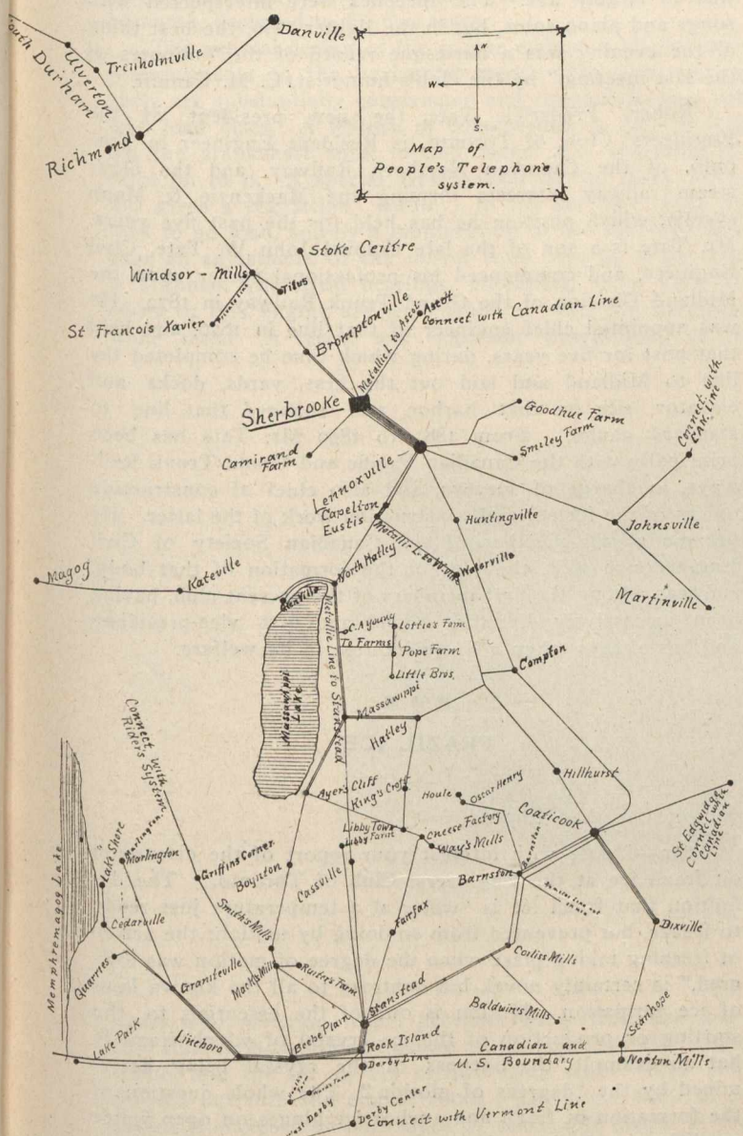
—The Geometric Drill Company, being organized under a charter granted by the State of Delaware, which was limited in its duration, decided to reorganize as a Connecticut corporation under the name of the Geometric Tool Company, with a capital stock of one hundred thousand dollars ($100,000), under an arrangement whereby the stock of the new company was to be issued for the property of the old, and the stockholders of the old company were to receive stock of the new company in proportion to their respective holdings. The laws of Connecticut are very favorable to the management of such corporations, there being no annual franchise tax; and as the stockholders were mostly resident in and about New Haven, it was considered much more convenient, as well as economical, to have the corporation located there. The transfer has already been made, the new company assuming the obligations of the old. The balance sheet shows an actual valuation of property in excess of the amount for which the new company is capitalized.

A SUCCESSFUL INDEPENDENT TELEPHONE COMPANY.

BY C. SKINNER, GENERAL MANAGER, PEOPLE'S TELEPHONE CO., SHERBROOKE, QUE.

The various articles that have appeared in your valuable monthly relating to telephone matters, lead one to believe that you regard the subject of some importance to your readers. Just how far I may be able to contribute to their interest in this line by anything I may say is not altogether clear.

The writer has been actively engaged in the telephone



Population of principal places included in the People's Telephone System:—

Sherbrooke	12,000	Barnston	500
Coaticook	3,000	Compton	500
Richmond	3,000	East Hatley	500
Magog	3,000	Dixville	500
Windsor Mills	2,500	Ayer's Cliff	500
North Hatley	1,800	West Hatley	300
Lennoxville	1,000	Stanhope and Norton Mills	800
Bromptonville	1,000	Rock Island, Derby Line, Stanstead and Beebe Plain (combined)	4,000
Danville	1,000		
Waterville	800		

field for the greater part of the time since the invention was placed before the public in 1878, first by installing private lines, and later employed by the Bell Company to establish an exchange in Sherbrooke, Que. At this time telephone rates were $30 and $35 per annum, and telephone service was understood to include only business hours, from 8 a.m. until 9 p.m. In 1882 the Dominion Telephone Company was organized by Eastern Township men, who proposed to compete for the City of Sherbrooke business by offering a $17 and $20 rate, and were so far successful as to secure nearly every subscriber from the Bell Company. At the same time the Dominion Company brought an action to annul the Bell Telephone patents, and without much delay succeeded in annulling the patent for the Bell receiver. This so discouraged the Bell Company that they were disposed to abandon Sherbrooke to the enemy.

Acting upon my advice, the Bell Company finally consented to give me a chance to reinstate them in business. The new company had progressed so far as to give continuous service day and night, and in many ways educated the public to believe that they had not been getting value for their money, hence it became no easy task to induce them to return to the Bell Company—much persuasion, competing rates, and one year free service, finally secured them upon a three-year contract—and in a few months bankruptcy overtook the Dominion Company, and they forever disappeared. In 1886 a Montreal company, who had in a small way commenced the manufacture of telephones, and being threatened by the Bell Company for infringing their patents, proceeded to bring suit to annul all the patents pertaining to the telephone, and owned by the Bell Telephone Company, which resulted within a very few months in the telephone and all its parts being declared free from any patent restriction.

When it is known that decisions upon matters relating to patents are vested entirely in the Commissioner of Patents, or better known as the Minister of Agriculture, from whose decision there is no appeal, it will explain the limited time taken to terminate this important case. About the year 1887 the Federal Telephone Company was organized by Montreal men and was the first to introduce metallic circuit lines. This company became strong competitors, and after continuing for about three years was bought out by the Bell Telephone Co. at a fair value. Next in order was the People's Telephone Company, organized by the writer, in August, 1888, with head office in Sherbrooke, originally with $5,000 subscribed capital, later increased to $25,000, and now with authorized capital of $100,000. This company has passed through all the obstruction intended by the Bell Telephone Company for independent companies, such as opposition in the Legislature, manipulating municipal councils, obtaining exclusive privileges for telephone service and exclusive privileges to connect with railway stations, obtaining injunctions, securing protests, cutting rates, obstructing the building of telephone lines, tampering with lines and telephones, and employing agents to deceive and mislead subscribers. Having failed in all that goes to make up the catalogue of unfair dealing, the Bell Company have, as a last resort, decided that they must improve their wretched service or go out of business.

The People's Telephone Company is the oldest company now competing against the Bell Company, and it is supported by public sentiment and capital provided by many of the most influential men of the City of Sherbrooke and surrounding towns. Its system extends over all the country in the immediate vicinity of Sherbrooke, includes nine telephone exchanges, and 400 miles of toll lines. Recently the whole plant in Sherbrooke has been replaced by an up-to-date central energy or common battery system, being the first of its kind in the province. The switchboard necessary for this improvement, with a capacity of 550 telephones, was made and installed by Messrs. Couch & Seeley, of Boston, and its complete efficiency in every particular is a credit to the firm.

There are many towns and cities in the Dominion who are smarting under the excessive rates and questionable methods usually applied by the Bell Company, where competition has not come to their relief. But there is not always a clear way to obtain capital or experienced men to successfully launch a company into the independent telephone field.

The facilities offered at the present time by telephone manufacturers for the supply of equipments for complete and up-to-date telephone systems is an advantage that early companies did not enjoy. Public sentiment, capital, experience, and push, is all that is required for the success of any business, and the telephone is no exception to this rule.

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The roof of the Ontario Power Company's power-house, Niagara, is steel and concrete, and is kept warm by a specially designed electrical apparatus so that ice does not form from the constantly falling spray.

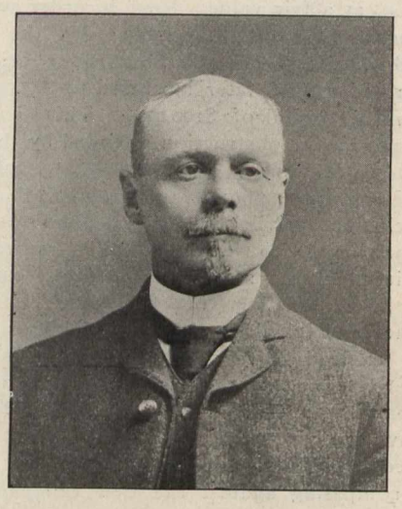
ENGINEERS' CLUB OF TORONTO.

The annual meeting of the Engineers' Club was held in their rooms on January 12th, the president, Captain Gamble, in the chair. Reports of the standing committees were read and adopted.

The proposition that the Canadian Society of Civil Engineers should establish a branch in Toronto in connection with the Engineers' Club, was discussed briefly. The Society would make a grant to the Club, for a reference library, and the Club would elect as president and secretary only members of the Society. The matter was laid over for the February business meeting.

The election of officers resulted as follows: President, R. F. Tate; first vice-president, F. L. Somerville; second vice-president, C. B. Smith; directors, A. B. Barry, G. R. Mickle, W. H. Patton; auditors, T. B. Speight, J. S. Fielding; treasurer, W. J. Bowers; secretary, Willis Chipman.

At the meeting of January 19th, President Tate delivered his inaugural address. He reviewed the past year in the history of the club, pointing out as special features of the year the visit of the club to De Cew Falls, and the visit of the British Institute of Civil Engineers, in September, when Sir William White took part in the discussion of the evening. The future of the club he considered very bright, in view of the place Canada is taking in the engineering world. At Niagara Falls there is the largest aggregate of electrical



R. F. Tate, President Engineers' Club of Toronto.

power in the world, while in steam railway projects we are ahead of any other country. The speaker also referred to the proposition of affiliation with the Canadian Society of Civil Engineers, and emphasized the importance of the question.

The annual dinner of the club was held at the club rooms on the 5th January, Capt. Gamble, president, in the chair. There was a large attendance of members and guests, and the dinner was the most successful in the history of the club. After the toast of the "King and Queen," the chairman proposed "Our Profession," which was responded to by Major Henry A. Gray, Cecil B. Smith, C. H. Rust, and R. G. Black, each congratulating the club on its progress. "Our Guests" was proposed by R. F. Tate, vice-president, and replied to by Prof. C. H. McLeod, secretary of the Canadian Society of Civil Engineers; Dr. Geo. Kennedy, president, and Dr. J. J. McKenzie, secretary, of the Canadian Institute; John Gemmell, president, and W. R. Gregg, secretary, Ontario Association of Architects; Henry Sproatt, president Toronto Architectural Eighteen Club, and Prof. C. H. C. Wright, of the School of Practical Science. The speakers were warm in their appreciation of the educational and social benefits of the club. Prof. McLeod, in particular, assured the club that the society he represented would co-operate with this and all such institutions having as their aim the advancement of the profession. The bond of these two institutions was specially close as they had a large membership in common and worked in a common cause—the cultivation of the higher interests of the engineering profession. While Canada needed and would welcome the best engineering talent the world can give her, the engineers of this country have nothing to fear from the competition of talent. We welcome our immediate neighbors, but we were not prepared to kill the fatted calf for them alone. We expected them to extend the same friendly welcome to us that we do to them. We do not forget that we in Canada are representatives of an Empire which has always stood for freedom—a fair field and no favor. Among the volunteer toasts was one to the secretary, Willis Chipman, to whose enthusiasm and unremitting work all admitted the success of the club was so largely due. The speeches were interspersed with songs and piano solos, but in the lighter vein, the best thing of the evening was a burlesque record of the "minutes of the last meeting," by the club's humorist, C. M. Canniff.

Robert Frederick Tate, the new president of the Engineers' Club, of Toronto, is Resident Engineer in Toronto, of the Canadian Northern Railway, and the other steam railway interests forming the Mackenzie & Mann system, which position he has held for the past five years. Mr. Tate is a son of the late Colonel John W. Tate, Civil Engineer, and commenced his professional career upon the Midland Division of the Grand Trunk Railway in 1872. He was appointed chief engineer of that line in 1876, and held that post for five years, during which time he completed the line to Midland and laid out the first yards, docks and elevator site on that harbor, and changed that line to standard gauge. From 1881 to 1899 Mr. Tate has been principally with the Canadian Pacific and Grand Trunk Railways, in charge of surveys, and also chief of construction offices of the former and construction work of the latter. He became a full member of the Canadian Society of Civil Engineers in 1887, the year of the formation of that body, and was among the first members of the present club, having been successively director, second and first vice-president, and has always taken a lively interest in its welfare.

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FRAZIL ICE.

Editor, Canadian Engineer:—

Sir,—I note with interest your report of the discussion on frazil ice at the Engineers' Club of Toronto. The definition that frazil ice is "water at a temperature just ready to freeze, but prevented from so doing by motion; the action of freezing taking place when the degree of motion was lowered," is certainly novel, but contrary to all the known laws of ice formation. Motion is one of the essentials to the starting or production of the ice crystal of which frazil is but an example, the fineness of the crystal being determined by the "degrees of motion." The whole question of the formation of frazil and anchor ice hinges on open water conditions, agitation, admixture and temperature of air, and to a certain extent on the clearness of the water and sky. The same physical laws governing the change from the liquid to the solid state, which are known in the laboratory, are operating on a large scale in our Canadian water-ways, and everywhere we witness the tremendous struggle going on in nature beween ice and water. When such minute temperature conditions as a hundredth of a degree determine the immense formation of ice crystals in places too turbulent for surface ice to form, and render the effects of the ice disastrous to engineering works, we certainly witness a wonderful spectacle of the delicate poising of the forces of nature. I do not propose to take up space in your valuable paper in discussing the formation of frazil ice, the less since I have already done so in the issue of the Canadian Engineer for May, 1897, as well as in many other publications. Personally, I am delighted to see by your report that the two terms frazil and anchor ice are coming to be more generally used as pertaining to two distinct types of river ice. The more we become familiar with the differences in the origin of these two kinds of ice, the clearer will be our handling of difficult engineering problems. There are few-

subjects which give rise to such copious discussion or have such diverse theories proposed, probably on account of the varied character of the observational evidence.

H. T. BARNES,

McGill University, January 18th, 1905.

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GENERATING SET WITH NEW FEATURES.

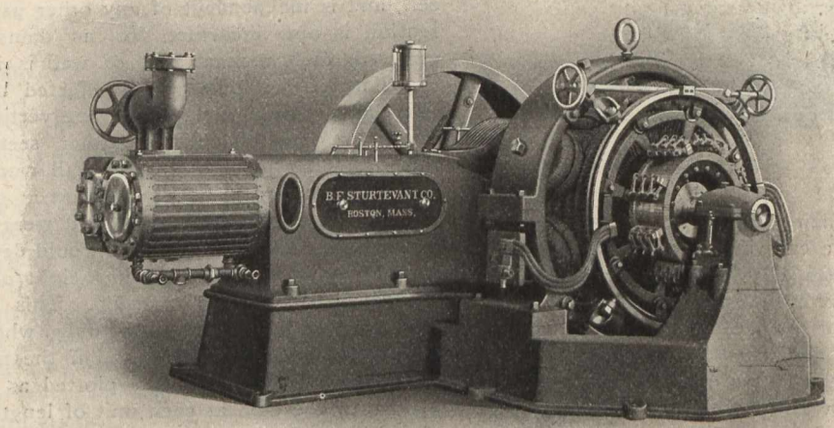
In response to a growing demand for an efficient generating set at a reasonable price, the B. F. Sturtevant Company, of Boston, Mass., are manufacturing a type, illustrated herewith, designed to fill this want.

The general design of the engine embodies all the latest improvements to the horizontal type. The reciprocating parts are substantially constructed and counterbalanced with lead load discs. A feature of construction is that of forging the crankshaft solid in one piece and shrinking the discs on to it. A special arrangement of the Rites' governor gives a regulation within 1 to 1½ per cent. from full load to no load, and by a modification of the Marshall valve gear an adjustment of the cut-off from zero to 70 per cent. is attained. The main bearings, crankpins, valve stem and slides of this engine are well babbitted with the Sturtevant white metal. A recent and important improvement is the water-shed partition which prevents water from the piston rod stuffing box from reaching the interior of the engine frame, and the oil on the reciprocating parts from being thrown out into the engine room. The main body of the engine is enclosed on both sides by removable plates, as may be seen from the cut, and the crank webs are enclosed by a cast-iron hood having two holes with removable covers, one for the purpose of cleaning the crankpin box, while it is in motion, and the other for removing the box without taking off the large hood. Between the watershed partition and the front end of the cylinder is a hand hole for reaching the stuffing-box bolts without communication to the oil spaces.

There are two oiling systems for this type of engine, the gravity or tank system and that by forced pump lubrication. With the gravity or tank system, shown in the illustration, an oil tank supplies the pipe leading to the parts to be oiled. At each point, where the oil is delivered, is a little gauge glass and valve for regulating the flow at that point. A valve just below the tank regulates the entire oiling systems.

With the pump, or forced lubricating system, a pump is located in the base of the engine and is operated by the crankshaft. Oil is delivered from this pump to the main bearings and from the main bearings through holes in the crankshaft and web to the crankpin. From this point the oil is conducted up through a hole in the connecting rod to the crosshead pin. A separate set of pipe conveys the oil from the crosshead guides to the valve stem guides. The pressure of oil in the bearings under this system will vary from 12 to 18 lbs. per square inch. The mechanical efficiency of the engine is so materially increased by this system of lubrication that its demand is rapidly increasing. Practically all engine builders will soon be obliged to provide for it to keep abreast of the times.

The generator of this set is of the eight-pole type, and is capable of carrying momentary over-loads of 50 per cent. without any shifting of business or flashing of the commutator and an overload of 25 per cent. for a period of two hours without undue heating. After a continuous run of ten hours at full load, the increase in temperature above that of the surrounding air never exceeds 40 degrees C. upon the armature and field coils, and 45 degrees C., upon the commutator. The average temperature rise is about 33 to 35 degrees C. Before being shipped, the generator is given a break-down test of 1,500 volts, alternating for sixty seconds between the conductors and the frame of the machine to test the insulation. The magnet frame is of the best cast-iron, split horizontally. The pole pieces are of wrought iron with cast-iron shoes or horns, and are secured to the magnet frame by through bolts. Any of the pole pieces may thus be removed to repair the field coils. The latter are wound up in two sections, with an air space between the shunt and series coils. The shunt winding is of double cotton covered magnet wire of highest conductivity, thoroughly insulated and so treated as to be practically waterproof. The series winding is of solid copper bars insulated in the same manner as the shunt coil. The armature is of the ironclad, form wound, ventilated drum type, having a core built up of charcoal iron plates, which plates after being japanned are mounted upon a cast-iron spider and securely held in position by end flanges. No belts pass through the armature laminations. The armature spider has an extension upon which is mounted the commutator, making the armature and commutator one unit. The armature conductors are solid copper bars, without joints except at the commutator end. When these bars are formed they are insulated by material said to be scarcely affected by heat or moisture. In the construction of the commutator, only drop-forged or drawn segments are used, these being secured in cast-iron shell of spider construction and clamped in place with a steel ring. The segments are insulated with mica of a degree of hardness to allow the mica and segment to wear uniformly. The end insulation consists of micanite rings, and the whole commutator is assembled while hot, under great pressure. Carbon brushes only are used, the commutator being so proportioned and the brushes of such size as to allow at least one square inch of brush area to every 30 amperes carried. These brushes are carried in holders of most approved construction, each mounted upon a self-contained brush rigging so arranged that the entire set of brushes may be rotated completely around the commutator. Hand wheels



are furnished for adjusting the brushes in position, these hand wheels being so located that the brushes may be adjusted from either side of the generator.

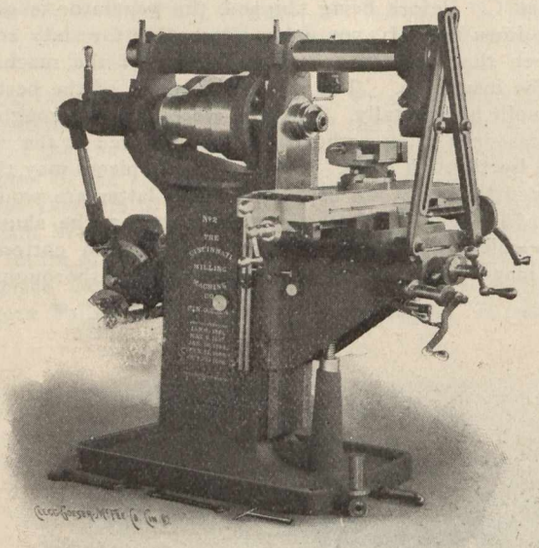
MACHINE SHOP NOTES FROM THE STATES.

BY CHAS. S. GINGRICH, M.E.

XII.

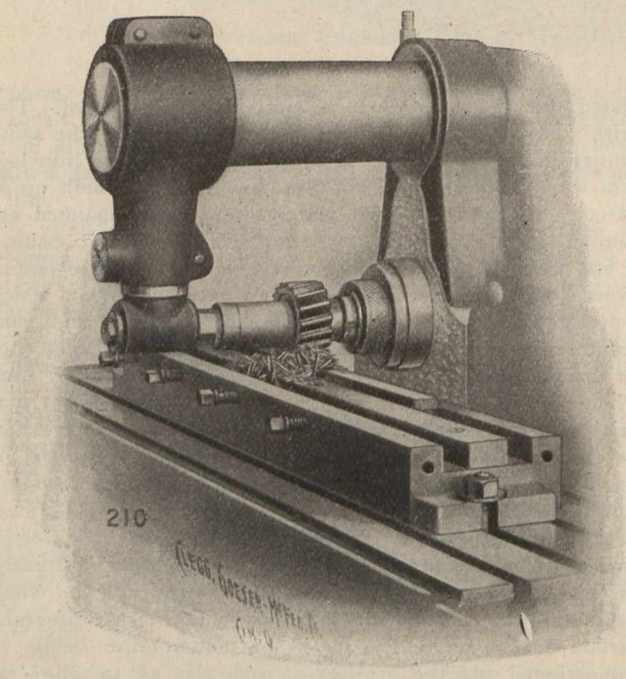
High Speed Milling.

We are used to listening to tales of what is being accomplished with the new high-speed steels, that we are no longer surprised at results that several years ago would have seemed utterly impossible. Indeed, many of us who are not actually engaged in producing these results, accept



the reports without fully realizing what it all actually means in the machine shop. Take a case in point:

In your January issue one of your advertisers gave an illustration of some rapid milling work, together with data on same. The writer had an opportunity to see this work being done several days ago, and when he saw the chips being plowed away ahead of the cutter, realized for the first time what a tremendous advance has been made in this direction. The illustration is reproduced herewith, and



shows a No. 3 Plain Cincinnati Geared-Feed Miller fitted with a high speed steel cutter, taking a roughing cut across grey iron bars, which run from ¾-in. to 3½-in. in width. The regular rate for doing the work is from 27 to 30-in. per minute table feed. A picture of the machine itself is also reproduced herewith. This machine is kept busy day after day at this terrific speed, and has been doing it for over a year without any apparent injury to the machine or any signs of distress. When the writer saw it at work, it was milling bars 3-in. wide and 26-in. long, and feeding 30-in. per minute. The cutter had been doing continuous work for three days without being sharpened. This cutter is run at about 80 ft. surface speed, and then is loaded up with all the feed that the machine can carry.

One of the remarkable things about it all is the fact that this fast feed does not cause the cutter to heat nearly so much as when taking the extremely slow feeds that were in vogue a few years ago, in fact, a cutter never gets so hot that it cannot be comfortably handled.

Now, that such results as these have become every-day practice, it is little wonder that the miller is replacing small planers and shapers in up-to-date machine shops.

ESSENTIAL ELEMENTS IN THE DESIGN OF DAMS.

JOHN S. FIELDING, C.E., TORONTO.

(Continued from last issue.)

Unequal Loads Affecting Top of Dam.

Earlier writers upon this subject held that a dam was a beam supported against the banks at its ends and uniformly loaded. Recent authorities deny this, and assert that each vertical foot of the dam is a unit which must take care of itself, and is independent of any other part. This latter contention is also incorrect, for, as dams are usually constructed, each vertical foot of wall is intimately joined to the abutting sections, and is affected by the action of its neighbors. If we assume that one vertical foot of a dam is under pressure, and all the other sections are unloaded, this particular piece of loaded wall would have a tendency to move forward a certain amount at the top, diminishing to zero at the bottom, providing it were free to move at all. The amount of this movement would depend upon the compressibility of the bottom, the height of the structure, and the nature of the workmanship. This will be uniform for each vertical foot of the dam only when all of these conditions are exactly similar, and if the maximum movement at the top of the dam were plotted as a straight line, the section of the dam at each unit of length would have to be varied to meet the controlling factors mentioned above. As this latter condition would be an impossibility, the line of movement at the top of the dam would really be represented by an irregular line, or a curve. A uniform movement, such as would be represented by a straight line, could not take place without one part having an undue tendency to move forward, being assisted by parts not so affected, and this would give a case of unequal loading.

It is well known in structural design, that unequal loading can be taken care of only by the employment of some form of member adapted to the taking up of diagonal stresses, acting in conjunction with components which are at right angles to the line of pressure—in other words, in the dam there would be a push and a pull in the upper and lower fibres of the wall, and also a diagonal stress, all in a horizontal plane, and for as many horizontal planes as it is convenient to take in the vertical height of the wall. The top of the wall would be most in need of this triangular construction, and the bottom would require the least. The logical conclusion from this theory would be, that the wall would have to be wider at the top; but the requirements against overturning also demand that it be wide at the bottom, and it would seem that there is need for considerable width at all parts of the dam.

It is true that if the bottom be rock, the compressibility of the bottom may be very small. If the material used in the dam were granite, the compressibility of this material would also be small, and in a greater or less degree, the effect of varying workmanship may be slight; but the height of the wall is at all times a distinct and powerful factor in determining the resistance to destructive effort. In the case of a foundation inferior to rock, there

may be great differences in the ability to resist compression, and where it is impossible to estimate accurately the value of this foundation, it would be well to adopt a form of dam that would be able to transfer a portion of this load from weaker to stronger points. Water flowing over the dam would impose an additional loading by its weight and impact, and this further loading will not be uniform because the centre of the current will have a greater velocity than other parts, and the position of this centre may vary from time to time with floods. In the design, therefore, all of the foregoing conditions have to be carefully studied and provided for; but there is this advantage with the truss formation over older forms, that if any one point be loaded to near the breaking point, the employment of tensile members in the downstream face, and compressive members in the up-stream face, used in conjunction with diagonals, may enable us to transmit a portion of the overload to such parts of the dam as are better bedded, or not so hard pressed by the current.

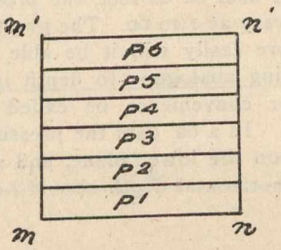


FIG. 6

SECTION

By moving and unequal loads I do not refer to moving water over the crest. I refer to one vertical foot of the dam being better bonded, or one vertical foot having a better co-efficient of sliding than another, and am simply assuming that all portions of the dam, consisting of the parallelogram, ABCD (see Figure 7), are not under precisely the same internal stresses, nor do they act precisely to the same percentage of their ultimate strength as other parts. It is fair to assume that such is the case; as each vertical foot of the dam, getting its power to remain where it is (against the pressure of the water), by its contact with the bed of the stream, must necessarily get a varying amount of such power, taking one vertical foot, as compared with its neighbor. To be more explicit, let us assume that we have twenty different slices of the wall, m m' n' n being a section, (see Fig. 6), and ABCD (see Fig. 7), being a plan on a plane corresponding to the elevation of m n. Now, if the co-efficient of friction in the base m n at t k k' t' is 40, is it not likely that at $t^5 k^5 k^6 t^6$, it may be 36, and so on, and possibly at some point, such as $t^{10} k^{10} k^{11} t^{11}$, it may be 50? Now, if the pressure of the water be assumed as concentrated at p^3, one-third of the height n n', and this pressure being uniform, it is clear that one portion, such as $t^5 k^5 k^6 t^6$, with a co-efficient of sliding of 36, has an advantage over another portion, such as $t^{10} k^{10} k^{15} t^{15}$, with a co-efficient of sliding of 50. The "nominal" strength of each is similar; the work they have to do is similar, but the conditions under which they do their work are different, consequently there is unequal loading. The safety factor of the one is 100/36; of the other 100/50 = 2.77 and 2, or as 1 is to .722.

If the construction of the wall at the point $t^{10} k^{10} k^{15} t^{15}$ be inferior to $t^5 k^5 k^6 t^6$, in the proportion of 90 to 100, then the case becomes worse, for we then have the relative strength of the two portions of the wall represented by:

$$\frac{2.77 \times 100}{100} = 277 \text{ and } \frac{2 \times 90}{100} = 180,$$ or, as 1 is to .65

It seems easy to believe that such could be the case, and if the co-efficient of friction should change during the course of time, being either a short or a long period, we would then have unequal loads, and changing position of such inequality of loading.

Now, is it not clear that a rectilinear section, such as m m^1 n^1 n is well adapted to transmit unequal loads along its whole length? The excess of load in one portion would be just so much effort tending to force that portion past its neighbor; would this not set up internal stresses acting in horizontal planes, as diagonal forces with components acting as a push and a pull in the up-stream and down-stream faces respectively? Now, let us divide the height of n n^1 into six horizontal planes, called P^1 to P^6. In this we will have nothing to do with overturning moments, nor with co-efficient of friction, but merely with strength to pass along in horizontal planes the unequal pressures set up by varying conditions in the wall, caused by different co-efficient of friction on the base. In the cross-section under consideration, the lowest plane would be under the greatest pressure, and the plane P^6 under the least.

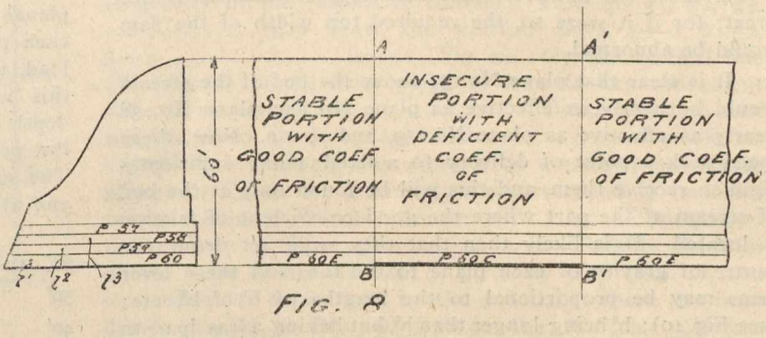


FIG. 8

Calling the weak part of the wall v v', it is likely that the diagonal stresses will go horizontally in a direct line to the nearest point (Fig. 7) of strength that will take up the unequal pressure. If v v' should be less than m n, then the horizontal diagonals will be less than 45°, but if v v' should be greater than m n, then the horizontal diagonals will make an angle greater than 45°, and will thus become a dangerous factor, producing large tensile stresses as horizontal components, acting on the down-stream face of the wall.

Discussion upon Unequal Co-efficient of Friction at Different Parts of Length of Dam.

Now, assume that the portion having a poor co-efficient of friction is separated from the portion having a good co-efficient of friction by straight definite lines A B and A^1 B^1, in Fig. 8. Now, the lower plane will have the greatest pressure upon it, the plane above it will have less, and the plane above that less still; but we can also see that the lowest plane delivers its load upon a plane that has immediate contact with the bed of the stream, as plane 60 C to planes 60 E; the next plane delivers its load to a plane that is removed by some distance from the bed of the stream, as plane 59 C to planes 59 E; the next plane delivers its load upon a plane that is farther still from the bed of the stream, as plane 58 C to planes 58 E. Now, the distances of these planes from the bed of the stream form new lever arms,

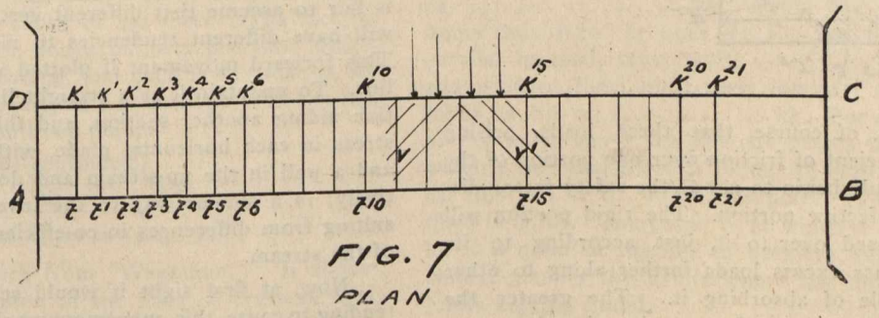


FIG. 7

PLAN

l^1, l^2, l^3, etc., and the effort of each plane in delivering its load to the bed of the stream at the point where a good co-efficient of friction exists, may be represented as follows, viz.:

Plane..... $60 \times l^1$
" ..... $59 \times l^2$
" ..... $58 \times l^3$
" ..... $57 \times l^4$
" ..... $56 \times l^5$
" ..... $55 \times l^6$
" ..... $54 \times l^7$
" ..... $53 \times l^8$
" ..... $52 \times l^9$

We can easily see how this will act; it is clear that if loads have to be delivered over in that manner, that the upper portions of the dam get greater work to do than the lower portions, and consequently will require a proportionate horizontal depth to enable them to do so.

It must be, however, that the ratio of increase is not great; for if it were so, the required top width of the dam would be abnormal.

It is clear that plane No. 59 above the bed of the stream would be nearly as effective as plane No. 60; plane No. 58 nearly as effective as plane No. 59, and so on. Now, these loads seek a point of delivery to a fixed point sufficiently rigid to receive them, and this will be found only at the bed of stream at the part where the good co-efficient of friction is located. It is likely then that they will act from the centre of gravity of each plane to the toe, and these lever arms may be proportional to the lengths of b^1, b^2, b^3, etc., (see Fig. 10); b^2 being longer than b^1, but having a less load to

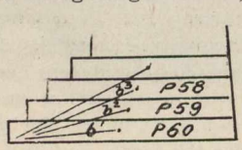


FIG. 10

deliver to A, etc., or instead of one line, as b^1, b^2, etc., these pressures may be represented by innumerable lines at an angle of 45 deg. (see Fig. 11). Whichever way it may act, it is likely that the pressure upon $P^{59} \times b^2$ or c^2 will be greater than $P^{60} \times b^1$ or c^1. This would indicate that the width of plane P^{59} should not be less than that of P^{60}. Even if it be claimed that we do not have to deal with lever arms of the length of b^1, b^2, but merely of a length d^1, d^2, etc., which will equal the height of each plane and all would thus be of equal length; it must still be admitted that we have to do with b^1, b^2, or c^1, c^2, etc., for resilience, and decrement of length under pressure, and that these decrements of length will be cumulative, and that this special loading of this part of the wall will be additional to its ordinary loading as a unit of the structure.

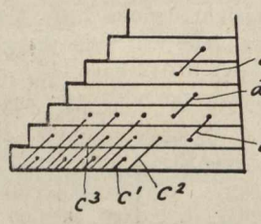


FIG. 11

It is understood, of course, that these loads, arising from defective co-efficient of friction over one portion of the bed of stream will only begin to act as the safety factor disappears from the defective portion. The rigid portion will absorb the load passed over to it, just according to its capacity, and will pass excess loads farther along to other rigid portions capable of absorbing it. The greater the width of each plane the greater the capacity of each to pass loads along in this manner without distortion.

Now, the bed of the stream being a rigid mass may be compressed vertically, but not horizontally, and has been under compression for ages. When we build a dam and place the sub-layer of masonry in position, we must give it its first compression when the dam is finished, consequently it gets its first decrement of length at this time. The resilience of bed stream, and of wall is not at all likely to be uniform, and there is likely more difference in resilience between the stream bed, and the wall, than between different portions of the wall. The co-efficient of friction in lowest plane of the dam is for this reason the most uncertain, and if any change takes place in the component parts of the sub-layer and stream bed, considered combined as a unit, then the co-efficient of friction will be changed, and the forces which we have been discussing will come into action.

If we go higher up in the wall, the probability of a defective co-efficient of friction will be lessened. We must, however, keep the upper portions free from distortion stresses passed up to it by the deficiencies or troubles of the sub-planes, or give it extra strength for taking up these distortion stresses.

Now the portion B, B', (Fig. 8), has been assumed to be deficient in strength, and of being under the obligation of relying upon the adjacent sections for assistance in order to maintain its position, as an integral part of the structure. If the height of the dam be 60 feet, the pressures upon the planes 1 to 60 will vary as 1 to 60. The greater the width of each plane, the more easily will it be able to transmit its load, this width being analogous to depth in a girder, and this width may for convenience be called the horizontal depth of the plane. In a 60' dam the pressure will be 3,750 lbs. per sq. foot upon the lower plane, and zero at the top. The square of the horizontal depth should be proportionate, and at:

60'	the	pressure	3750	represented	by	$\sqrt{3750}$	= 61.23
50'	"	"	3125	"	"	$\sqrt{3125}$	= 55.90
40'	"	"	2500	"	"	$\sqrt{2500}$	= 50.20
30'	"	"	1875	"	"	$\sqrt{1875}$	= 43.30
20'	"	"	1250	"	"	$\sqrt{1250}$	= 35.35
10'	"	"	625	"	"	$\sqrt{625}$	= 25.00
9'	"	"	562.5	"	"	$\sqrt{562.5}$	= 23.71
8'	"	"	500	"	"	$\sqrt{500}$	= 22.36
7'	"	"	437.5	"	"	$\sqrt{437.5}$	= 20.91
6'	"	"	375.0	"	"	$\sqrt{375.0}$	= 19.36
5'	"	"	312.5	"	"	$\sqrt{312.5}$	= 17.70
4'	"	"	250.0	"	"	$\sqrt{250.0}$	= 15.81
3'	"	"	187.5	"	"	$\sqrt{187.5}$	= 13.68
2'	"	"	125.0	"	"	$\sqrt{125.0}$	= 11.18
1'	"	"	62.5	"	"	$\sqrt{62.5}$	= 7.9

This gives a parabola as the line of the down-stream face of the dam, as shown in Fig. 9.

But we must go farther afield, for other agencies are at work upon the dam.

All materials are elastic, and give under pressure, and stone is no exception to this rule; so that when the full pressure is upon the dam, each vertical foot will have a tendency to move forward at the top. The elasticity of the bed of the stream will increase this movement; the inequalities of the nature of the wall will also increase it. Now, it is fair to assume that different vertical sections of the dam will have different tendencies to move forward at the top. This forward movement if plotted would show an irregular line. To maintain it as a straight line would entail one section aiding another section, and this would entail diagonal stress in each horizontal plane, with components of a push and a pull in the up-stream and down-stream faces respectively; in a similar way to the investigation just made, resulting from differences in co-efficient of friction on the bed of the stream.

Now, at first sight it would seem as if the pressures tending to cause this movement would be greatest at the bottom and least at the top. But if plane P^{60} should move over X distance, it would have to carry the top plane P^1 or P^{10} with it; in other words, plane P^{60} would be assisted by all planes above it, and so on. It is easy to see that if plane P^{10} were hard pressed to keep its alignment in plan, that plane P^{50} or P^{60} would not come to its assistance, and from these deductions, without going into any mathematical refinements, which must be more or less of a guess at best, we can see that the top planes would have to do the bulk of

the work, and should necessarily have for this purpose the greatest depth measured horizontally. Now, the strength required to resist the stresses caused by unequal co-efficient of sliding friction in the base may be assumed to be taken care of by the horizontal depths shown in the parabola (Fig. 9.) The excess strength that may possibly be required at

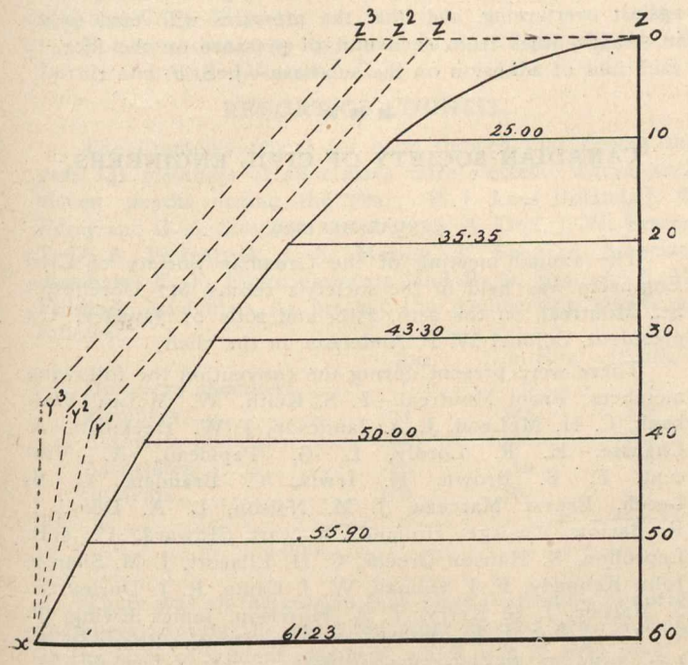


FIG. 9

some unknown points to take up the action of the lever arms mentioned and shown on Figs. 10 and 11, may be taken care of by increasing the section at the base, as, $x-y^1$, $x-y^2$ or $x-y^3$. The inequalities of forward movement at the top may be taken care of by $z-z^1$, $z-z^2$, or $z-z^3$, varied according to the length of the structure on crest. Joining y^1-z^1, etc., will complete the section.

A modern profile gives a top that is like a whip, or a line fence, and must be perfectly helpless to preserve a straight line from end to end, and is altogether dependent upon the resistance of the lower portions, and the river bed at the toe, as to whether it shall shear itself or remain intact.

The case of the Groiz Bois dam is an instance of the forward movement of the top of such a dam. Wegmann says: "When the water had reached a depth of 57.25 feet, its pressure produced a fissure at the intersection of the dam with the tower of the gate-house. It was noticed that the wall deflected a few centimeters down-stream under this pressure, and, upon the reservoir being emptied, returned almost to its original position. This fact proves that masonry has considerable elasticity.

The same writer also gives the case of the Bouzey dam, the upper portion of which before failure formed a curve with a vers. sine of 1.1 feet. If there was uniform loading what would force a stone wall into a curve on plan with a vers. sine of 1.1 feet to a chord of 444 feet? The fact is, there was unequal strength, and a uniform pressure, which is equivalent to unequal loading, and such is the case in all dams, and all should be equipped for such pressure in the way and for the reasons outlined herein.

(To be continued.)

Explanation of Plate 2, (page 52.)

This plate is reproduced from "Wegmann." It shows Bonnanno's graphical solution of the lines of pressure in a scientific profile. It is given here in proof of the fact that present construction recommends a narrow top to a dam, and because it is in itself a very useful graphical demonstration of the pressures of which it treats.

None of the mathematical formulæ used to obtain the lengths of the lines a—a, b—b, c—c, — — — — — k—k, will be reproduced here, for the reason that the writer cannot recommend the results which they give and because they have no special reason for existence.

The method of development of the graphical solution of the probable lines of pressure, as given by Wegmann, is as follows, viz.:

"Reservoir Empty.—Profile MNQP (Fig. 1), is divided into 10 courses, 1, 2, 3, ... 10, by the horizontal joints aa, bb, cc, ... kk. The centres of gravity, g1, g2, g3, ... g10, of courses 1 to 10 are found in the usual manner, the vertical section of each course being assumed to form a trapezoid or rectangle. The centres of gravity, g1, g2, g3, ... g10, and the centre points of the joints aa, bb, cc, ...kk, are connected by a line which will be the medial line of the profile MNQP.

Find next for each joint, aa, bb, cc, ... kk, the resultant of the forces acting in the wall above it. The points where these resultants intersect their respective joints will lie in the line of pressure. When the reservoir is empty, the only forces acting on the wall are the weights of the different courses 1 to 10, each being applied at the centre of gravity of the respective course. Through g1, g2, g3, ... g10 draw the vertical lines 1—1, 2—2, 3—3, ... 10—10 (Fig. 3). On the vertical line OZ (Fig. 2) of the force polygon, draw to any convenient scale Ow1, Ow2, Ow3, ... Ow10, equal to the weights above the joints aa, bb, cc, ... kk, respectively. Assuming any point P as a pole in the force polygon (Fig. 2), we can obtain the corresponding funicular polygon (Fig. 3), which gives for each joint the position of the resultant of the weights resting on it. Thus for the joint hh the value of the resultant is given by Ow8 (Fig. 2), and its position is determined by the point S8, where the lines drawn parallel to PO and Pw8 in the funicular polygon (Fig. 3) intersect. The point S8 (Fig. 1) at which a vertical line (W8) passing through S8, intersects the joints hh, is one point in the line of pressure, reservoir empty. In a similar manner the points where this line intersects the other joints were found.

Reservoir Full.—The position of the line of pressure, reservoir full, can be determined, as follows:

Lay off the force polygon on the horizontal line OH the distances Ot1, Ot2, Ot3, ... Ot10, which represent construction recommends a narrow top to a dam, and aa, bb, cc, ... kk, respectively. (The vertical component of the water-pressure is neglected.) The lines w1t1, w2t2, w3t3, ... w10t10 will represent the resultants acting on the joints aa, bb, cc, ... kk, when the reservoir is full. To find the points where these resultants are applied to their respective joints, draw horizontal lines through the points r1, r2, r3, ... r10, through which pass the resultant water-pressures for the vertical depths: Na, Nb, Nc, ...NQ. The points r1, r2, r3, ... r10 are at 2-3 of the vertical depths of their respective joints below the top of the dam.

The horizontal lines through r1, r2, r3, ...r10, are produced until they intersect the vertical lines W1, W2, W3, ... W10, which represent the resultant pressures of the weights of the courses on the joints aa, bb, cc, ... kk. From the intersection points found thus draw the lines R1, R2, R3, ...R10, parallel to t1w1, t2w2, t3w3, ...t10w10, and produce them until they intersect the corresponding joints aa, bb, cc, ... kk. For instance, the thrust of the water above the joint hh passes through r8, through which a horizontal line is produced, until it meets the vertical line W8 in V. From this point draw a line parallel to t8w8 (Fig. 2). The point V' at which it intersects the joint hh is a point in the line of pressure, reservoir full. In a similar manner the points where this line crosses the other joints may be found.

Factor of Safety Against Overturning.—To test whether the profile MNQP has at all depths a factor of safety of 2 against overturning, imagine the reservoir to be filled with a liquid having double the density of water and exerting, therefore, twice the horizontal pressure of water. The line of pressure for this assumed liquid is found in precisely the same manner as for water. In the force polygon (Fig. 2, lay out the new horizontal pressures in the line

OH. Draw dotted lines (See Fig. 2), from the points w1, w2, w3, ... w10, to the corresponding points in the line OH. The dotted lines will represent the new resultants. From the points where the horizontal lines through r1, r2, r3, ...r10, meet the vertical lines W1, W2, W3, ... W10 (Fig. 1), draw lines respectively, parallel to the dotted lines (Fig. 2). The points where these lines intersect the corresponding joints aa, bb, cc, ... kk are points on the line of pressure for a liquid having a specific gravity of 2. The fact that this line lies entirely within the profile MNQP proves that this profile will ensure at all depths a factor of safety of 2 against overturning.

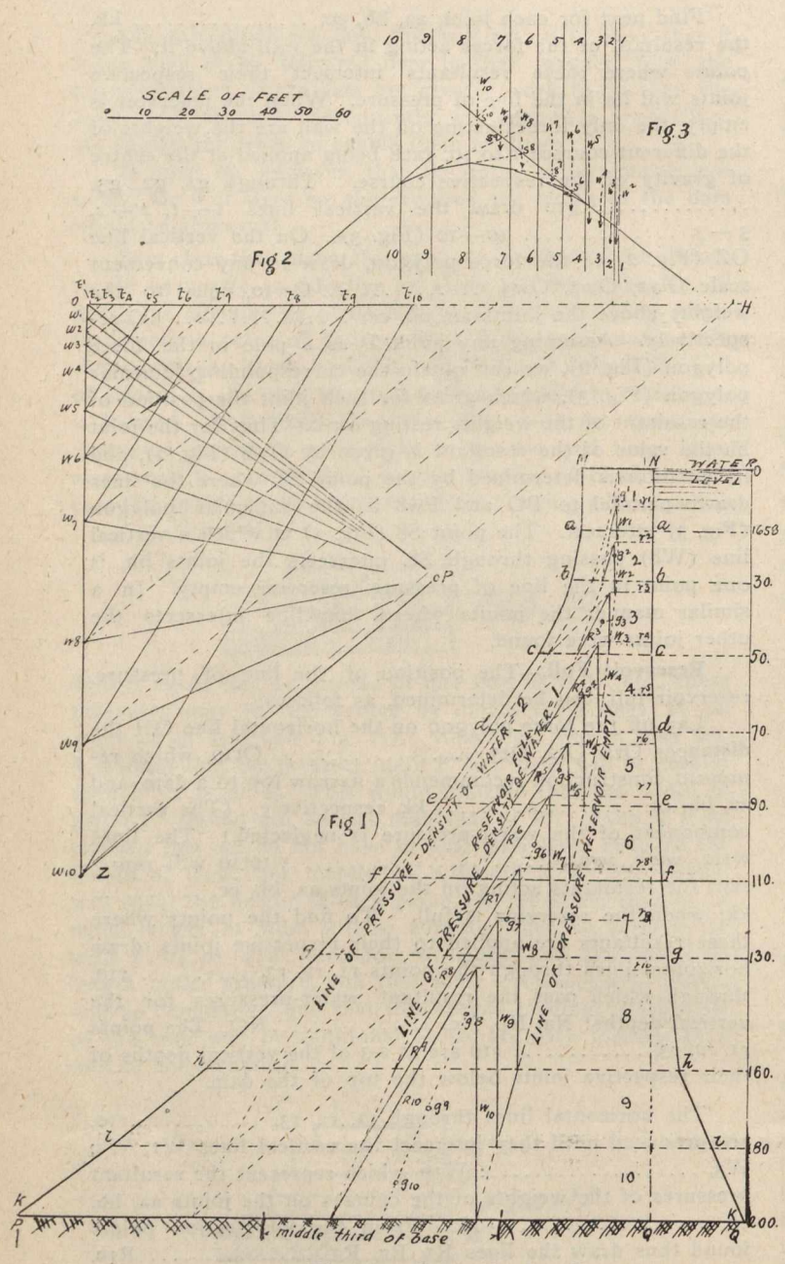


Plate 2.—Scientific Profile.

This plate was referred to in text of this article on page 14 of January issue.

The resistance which this profile offers against sliding or shearing is found by measuring the angles which the resultants (reservoir full), make with vertical lines. Thus for the joint hh the angle to be measured is that between R8 and W8. So long as the tangent of these angles is less than 0.75 the dam will have ample strength at the corresponding joints against sliding."

The advocates of the scientific profile emphasize the importance of the lines of pressure terminating reservoir full or reservoir empty, upon the sub-base within the middle third of the width of base. (Shown in plate No. 2).

It is commonly understood that this is the one important point in the design of a dam. I shall endeavor to show, however, that other points are so important, that they loom up very large when given their proper significance, by which time it will be found that the termination of the line of pressure is not of as great moment as has hitherto been assumed.

It is well to remember also that this "theoretical resultant centre pressure line" is but a comparison line, that it has a decreasing importance, as the dam is given a safety-factor against overturning, and that the pressures will tend to go in straight lines from each unit of pressure on the face, to each unit of adhesion on the sub-base.—J. S. F.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

ANNUAL MEETING.

The annual meeting of the Canadian Society of Civil Engineers was held in the society's rooms, 877 Dorchester St., Montreal, on the 24th, 25th, and 26th of January, the president, Colonel W. P. Anderson, in the chair.

There were present during the convention the following members: From Montreal.—F. S. Keith, W. McLea Walbank, C. H. McLeod, J. A. Jamieson, J. W. Heckman, A. Chaussé, H. R. Lordly, L. G. Papineau, A. Vincent, F. B. Brown, H. Irwin, C. Brandeis, C. S. Leech, Ernest Marceau, J. M. Nelson, L. A. Désy, J. R. Barlow, George Holland, Stewart Howard, C. deB. Leprohon, N. Hanson Greene, C. H. Ellacott, J. M. Shanly, John Kennedy, F. J. Gilman, W. J. Camp, R. J. Durley, E. S. Mattice, J. G. Kerry, T. A. Morrison, James Ewing, T. W. Lesage, G. Janin, D. Macpherson, D. W. Ross, R. S. Lea, John T. Farmer, Ernest Belanger, Henry Goldmark, James S. Costigan, E. G. Fiset, H. T. Bovey, J. A. U. Beaudry, F. E. Came, L. A. Herdt, J. B. Porter, R. M. Hannaford, L. H. Cole, J. F. Robertson, R. A. Weagant, M. C. J. Beullac, C. F. Bristol, W. Arch. Duff, L. A. Amos, N. Cauchon, K. B. Thornton, C. N. Monsarrat, F. R. Judah, D. A. Murphy, Charles T. Chaplin, G. H. Blanchet, Henry Hadly, T. C. McConkey, D. G. Black, N. F. Pedley, E. E. Clawson, G. Eric McCuaig, N. J. Slater, H. C. Kennedy, H. G. Rogers, John G. Dickenson, R. P. Cowan, W. G. B. Brown, H. M. Lamb, G. E. Cole, A. Burnett, A. A. Blanchard, D. W. McLachlan, A. Tremblay, W. McNab, F. P. Shearwood, A. Stansfield, P. Johnson, G. H. Brunner, A. B. Ritchie, K. W. Blackwell, U. P. Boucher, J. J. Macnab, O. H. Coté, H. W. Jones, G. B. Ashcroft, A. Massey, L. E. Geoffrion, W. R. Duckworth, W. H. C. Mussen, E. G. M. Cape, W. M. Reid, W. J. Sproule, W. Chase Thomson, W. V. Taylor, F. L. Fellowes, F. H. Pitcher, A. McMeekin, A. F. Byers, A. E. Smaill, C. H. Sutherland, E. Malo, C. H. Wright, S. A. Baulne, A. P. Joseph, E. McG. Quirk, F G. Dunning, N. M. Campbell, E. L. Chadwick, S. F. Rutherford, G. B. Glassco, J. G. Beaubien, H. L. Price, E. J. Leonard, F. L. Gagnon, E. E. Gagnon, J. M. McPhee, E. N. Martin, C. H. McDougall, H. L. Forbes, A. M. Hamilton, M. B. Atkinson, C. N. Coburn, F. C Jewett, George Kydd, E. O. Jost, J. H. Edgar, C. M. McKergow, J. T. Bertrand, Lewis Skaife, C. L. Trimmingham, H. R. Ives, J. M. R. Fairbairn, J. Duchastel de Montrouge, A. W. Robinson, R. A. Ross, H. L. Auclair, C. Amireault, A. P. R. Kerr, A. L. Sharp, E. A. Wallberg, H. L. Jordan, W. W. Benny, J. D. Black, P. B. Motley, F. C. Laberge, Gordon Sproule, D. C. Findlay. From Toronto.—C. W. Dill, E. A. Stone, C. E. Goad, J. C. T. Crofts, C. H. Rust, R. J. Parke, C. B. Smith. From Ottawa.—W. P. Anderson, C. H. Keefer, G. A. Mountain, M. J. Butler, H. D. Harris, O. M. Stitt, Capt. T. E. Naish, John Murphy, E. E. Perreault, W. J. Stewart, C. R. Coutlee, O. O'Sullivan. From Quebec.—W. D. Baillairge, Thomas Breen, Armitage Rhodes, E. A. Evans. R. B. Rogers, Peterboro; M. Neilson, St. John, N.B.; G. H. Dawson, Vancouver; J. H. Sullivan, Valleyfield; F. Crossley, Winnipeg; J. A. Tremblay, Montmagny; J. L. Morris, Pembroke; G. H. Frost, New York; E. M. Archibald, Halifax; R. W. Leonard, St. Catharines; G. J. Desbarats, J. D. Lachapelle, Sorel; J. M. Farley, Hull; S. H. Parker, Woodstock; T. L. Smith, Milwaukee; J. E. Sirois, Ste. Anne de la Pocatiere; W. B. Mackenzie, Moncton; A. H. Larochelle, Levis; T. Tremblay, Sherbrooke; H. O'Sullivan, Indian Lorette;

After the secretary had read the minutes of the last annual meeting, the president nominated the following as scrutineers of the various ballots:

For election of officers and members of council: J. Ewing, W. J. Camp, C. S. Leech, N. H. Greene and W. D. Baillairge:

For Nominating Committee: J. M. Nelson, G. H. Dawson, and C. H. Ellacott.

For amendment to by-laws: L. G. Papineau, H. R. Lordly and Arthur Vincent.

REPORT OF COUNCIL.

The Council's report for 1904 showed that during the year 141 members of all classes were elected. There were eleven deaths during the year: P. J. Lees Boland, J. R. Perry and G. A. Simpson, members; J. A. Duff, J. W. Fraser, J. D. A. Fitzpatrick, J. A. Marion, J. Spenard, associate members; C. F. Eicks, associate, and B. O. Bay and S. H. Fillmore, students. At present the membership stands as follows:

	Res.	Non-Res.	Total.
Honorary members	1	9	10
Members	63	323	386
Associate members	94	288	382
Associates	19	19	38
Students	150	287	437
Total			1,253

There was an increase in each class (excluding honorary members) during the year, the most marked growth being in the class of student members, which was 77 over 1903.

There were seventeen meetings of the Society held during the year; five business meetings and twelve sectional meetings.

The report, after enumerating the papers read during the year, gave an account of the reception and entertainment given to members of the Institution of Civil Engineers of Great Britain, who visited Canada last September.

The Gzowski medal for the year 1903-04 was awarded to J. A. Jamieson for his paper upon "The Pressure of Grain in Deep Bins, and the Problem of Grain Bin Design."

The examiners appointed for the reading of students' papers have reported recommending the following as the best papers in the several sections:

Electrical.—"An Investigation of a 16-K.W. Constant Current Transformer,' by C. H. Wright.

Mining.—"The Centre Star Mine, Rossland, B.C.," by L. Heber Cole.

General.—"Port Colborne Harbor Works," by J. M. Hogan. The awards have been made.

The examiner for the Mechanical Section has reported that none of the papers submitted merited a prize.

Acting on the resolution of the last annual meeting, viz.: "That the Council be instructed to consider with as little delay as possible the establishment of branches of this society in the larger centres of Canada, and be authorized to provide the financial aid necessary to establish and maintain such branches," a committee of the Society has been engaged for the past few months in forming a branch in Toronto. The Council has under consideration a scheme for rendering the Society's library available to non-resident members. It especially commends assistance in the establishment of the nuclei of libraries in connection with branches.

In view of the report of the secretary that owing to the very great increase in the clerical work of the office, arising from the growth of the Society, and its importance as a national institution, additional provision should be made for the carrying out of the secretarial duties, the Council has submitted a ballot embodying its views on the question.

Owing to the necessity of having a representative of mining engineering amongst the resident members of Council, Cecil B. Smith resigned his position as councillor, and Dr. J. B. Porter was appointed to fill the vacancy thus created.

In accordance with By-law 28*a*, the following were appointed officers of the sections to hold office from 1st June, 1904, to 1st June, 1905:

General.—D. Macpherson, president; C. H. Keefer, vice-president.

Electrical.—R. B. Owens, president; W. McLea Walbank, vice-president.

Mechanical.—Phelps Johnson, president; M. J. Butler, vice-president.

Mining.—J. B. Porter, president; K. W. Blackwell, vice-president.

The attention of Council has been called to the importance of enquiry into a general system of engineering standards for Canada, and the appointment of a Standards Committee is recommended to report in conjunction with similar committees of other national societies.

Treasurer's Report.

The treasurer's report showed that the finances of the society still continue to be in a satisfactory condition. The receipts were $1,126 less than those of 1903. The arrears of fees received during 1904 were $728 less than the arrears received during the previous year, and the remainder of the deficiency, amounting to about $400, is distributed over the other items. The treasurer observed in his report: "If we increase our ordinary expenditure on account of the secretary's office by the amount of say $1,000 per annum, it will be necessary for all members to pay their fees promptly."

The financial statement showed that receipts from arrear subscriptions were $1,131, from current subscriptions $4,311, from subscriptions in advance $237, and from entrance fees $840. The total from all sources was $6,769. The following are some items of expenditure: Transactions and advance proofs, $1,470; printing, stationery, binding and diplomas, $593; books, magazines and library expenses, $56; postage, post cards, and telegrams, $371; secretary's salary, $300; assistant secretary's salary, $600; caretaker's wages, $420; expenses at ordinary meetings, $119; expenses during annual meeting, $244; legislation expenses: Dominion, $62; Quebec, $40; Manitoba, $5; total, $107. The total expenditure was $5,736. There was a cash balance in the bank of $3,238.

The Library Committee reported that committees of the several sections aided in preparing a list of additional books needed to give the Society a good working library. This list has been prepared and revised, and at the Council meeting held on 10th inst., $600 was appropriated for the purchase and cataloguing of the most desirable of the books recommended. As soon as the books are received, a catalogue of them, and of all other modern books in the library, will be prepared and sent out to members. The collection of trade catalogues suggested at the last annual meeting is nearly completed. The publications of over 400 engineering firms, amounting to a total of about 1,800 books and pamphlets, have been secured and placed in cases in a special room in the basement. A card index of these catalogues, arranged by subjects and firms, is in preparation, and the room will soon be thrown open to members. The system of filing and indexing these catalogues is such that additions and renewals can be easily and quickly entered and rendered available. A small collection of library catalogues and bibliographies, and the engineering index to current periodicals, are being placed where they can be consulted. Several plans have been considered for rendering the library of greater use to non-resident members, and it is hoped that a satisfactory scheme may soon be formulated. In the meanwhile arrangements have been made whereby members can have references looked up and articles copied or abstracted by competent persons at a cost not to exceed 60 cents per hour.

Some discussion took place in regard to additions to be made to the library, and Mr. Lordly called attention to the agreement under form "D," wherein members engage to present to the society an original communication or some scientific work for the library within one year after election. Upon motion by R. B. Rogers, seconded by H. Irwin, it was resolved to recommend to Council that a list of books urgently required be sent to members.

Mr. Irwin called attention to the desirability of forming libraries for the benefit of non-resident members in places where branches should be established.

At 1 p.m. a luncheon was held in the up-stairs reading-room for the benefit of outside members.

There was no meeting held in the afternoon.

In the evening the meeting re-assembled to hear the address of the retiring president.

PRESIDENT'S ADDRESS.

After thanking the society for conferring upon him the highest honor to which any Canadian engineer could aspire, the President referred to the visit of the members of the Institution of Civil Engineers from Great Britain, as one of the most notable events of the year, and one of the notable events in this society's history.

"Our visitors," he went on to say, "appeared specially interested in the great development of electrical energy which we have achieved, and which has already placed Canada second only to the United States in the total horse-power used. They were likewise impressed with the possibilities for future advances in the same direction. The three great plants under construction at Niagara naturally aroused their greatest interest. It is questionable whether we, who live amongst these forces of nature, fully appreciate our privileges as citizens of a country containing such abundant and inexhaustible water powers. To take one instance alone, that naturally presents itself to me as a resident of Ottawa; within thirty miles of the capital there is sufficient power going to waste to run all the mills and factories on this Continent, only awaiting the enterprise of man to be harnessed to his use. As a recent English writer points out, we are not, in utilizing water power, drawing on capital account, as England is obliged to do by her serious consumption of her coal deposits for power production. The completion of the Georgian Bay Canal, now reasonably probable, besides being in itself a noteworthy engineering feat, will open up another district abounding in water powers and capable through their utilization of infinite mineral and industrial development.

"A further source of prospective riches to Canada is the plentiful presence of the constituents of Portland cement, in places convenient of shipment. The substitution of concrete for wood in structural work, especially for wharves, piers and buildings liable to rapid deterioration by alternate wetting and drying, is coming to the front more prominently every year. It is needless to insist here on the superiority of concrete over timberwork, but it is surprising how widely the habit of using timber in wharves still persists in Canada. In the early days of the country, when money was scarce and timber plentiful, masonry expensive, and skilled laborers difficult to secure, it was only natural that timber structures should be used. It was at that time profitable to employ timber for such works, because the first cost was so reasonable that they could be repaired and replaced for less than the interest and sinking fund on the cost of more solid structures, but now that cement has become plentiful, good and cheap, and especially during the last two or three years, when the price of lumber has very largely increased, and it is impossible to secure wood of the same quality as that used twenty years ago, it is little less than a crime to continue the construction of wooden wharves. There are circumstances under which timber can still be used to advantage in cribwork foundations under water, where its employment obviates the use of caissons or of costly diving operations, but in any other situation concrete will cost very little more in the first place, while its permanent nature will materially reduce charges for maintenance and repairs. The splendid quality of Portland cement now made by several Canadian manufacturers supplies an additional argument in favor of its universal adoption. Our society has prepared a general specification for Portland cement, which seems to meet with the approval of engineers using that product. It is desirable that our members should keep this specification in mind, both to adopt it in their own practice, and also to suggest changes and improvements, as their individual experiences may suggest.

"We do not appear to have reached finality in the process of cement manufacture. The advantages claimed for silica cement are worthy of attention, and the claims lately put forward for slag cement will, if endorsed by experiment, lead to still further cheapening of concrete construction. The reinforcement of concrete structures by the inclusion of steel in their members is becoming widely practised, but it is to be feared that a great deal of steel so used has not been disposed in such a manner as to give the best results, and we have yet to learn how the permanence of such structures may be affected through the corrosion of the steel within the concrete. The question of the best method of shaping, connecting, protecting and placing the reinforcing steel requires more attention than it has yet received. Papers on this subject, and particularly papers describing the failure of any concrete or reinforced concrete design, if such were procurable, would be of great value to the society.

"Concrete is now largely used in Canada to replace the more expensive cut stone previously used in heavy foundations, in bridge abutments, etc. A great many piers, abutments and culverts have been built in concrete on the Canada Atlantic and other railways; and illustrations will occur to every member, of works in which concrete has been used in place of masonry with most satisfactory results. This applies particularly to a country in which masons or skilled laborers of any kind are scarce and expensive, and the resultant quality of masonry questionable.

"Quite lately the industry has been begun of moulding building blocks from cement, and working them into buildings as ashlar masonry. This use of one material to simulate another, though perhaps commercially successful, rather grates on one's aesthetic sense. The Department of Public Works is now experimenting with reinforced concrete beams for pier construction, laid and connected like timbers. Such a plan appears to forfeit the advantage of mass gained by the usual practice of laying concrete in large blocks, and at best is only adapted to locations in which it would be difficult to deposit concrete in bulk.

"The most important event of the year in Canada, from an engineering point of view, has been the inception of another transcontinental railway. In view of the immediate and wonderful success that attended the completion of the C.P.R., and the mighty effect that it has had on the development of the Western and Northwestern portions of our country, it is not surprising that Canada undertakes the construction of this new road with feelings of greater confidence than existed when the Canadian Pacific scheme was submitted to the public. The new line will open up a country in parts hitherto inaccessible, and cheering reports respecting its fertility, its forest and mineral wealth, the easy gradients obtainable, and the light character of work required have already been received. Members of our society are now engaged in large numbers in the preliminary work of location, and this great national undertaking will for many years to come create a demand for the services of engineers of all grades, that cannot but be stimulating to our profession. In this connection casual reference may be made to the complaints entered against the Grand Trunk Railway Company for the employment on their surveys of alien engineers. While it is quite proper for Canadian engineers, as individuals, to claim preference in employment on purely Canadian works, and while the Government should be expected to restrict to citizens employment by the Government, or by lines which it subsidizes, in accordance with the practice in other countries, yet it would be improper for a national society of engineers to take up a narrow position in dealing with engineering work. This society has, therefore, not interfered, but has properly decided that the question was one for settlement between the company concerned and the Government, and it has adopted the catholic policy of welcoming to its ranks qualified practitioners, without respect to nationality. Notwithstanding this, however, it is an important function of this society to advise the Government as to the qualifications of the engineers who should be employed on works, either directly or indirectly of a national character, and one of which the Government should not be slow to avail itself. It was gratifying to find that the General Manager of the Grand Trunk Railway recognized the status of this society as being the final arbiter of the fitness of the engineers employed on their works of construction. This speaks well for the eminence our society has attained within eighteen years of its organization, and proves that the high standards and conservative policy aimed at have secured the confidence of the public.

"During the year the several sections which were authorized at our last annual meeting have been fully organized,

and papers have been discussed by the branches to which they specially belonged. The decision to broaden our methods so as to draw closer together members of each of the divisions of engineering, into which modern conditions have tended to specialize the profession, has met with success. It is obviously preferable to have our electrical, mechanical and mining brethren members of one large society with common interests and federated strength, than to have separate and independent organizations. Another reason favoring this joint work is the difficulty of drawing distinctly the lines between the several classes of work; the mechanical engineer must to-day be an electrician, and the mining engineer needs the experience of the general civil practitioner. It would be a mistake to encourage the foundation of separate societies for the several branches. If any objections exist to the general policy of our society, the proper course is to bring them up in our own body and be governed by the decision of the majority, rather than to form new organizations. Our council has abundantly shown its readiness to discuss reforms in the direction of extending our usefulness. That this policy has been successful is attested by our balance-sheet and by the fact that the very creditable home which we occupy has been acquired without any difficulty in meeting the extra expense. Much credit is due to the successive councils of the society, and particularly to the members resident at headquarters, for the broad-minded and progressive policy they have pursued with such beneficial results, and the indefatigable work of the secretary and other officers also merits the highest consideration of all members, and has been of the utmost assistance to your president.

"The society should look forward to increasing, at no distant day, the number of its working rooms, and, without usurping the functions of a social club, offer members further accommodation."

The president, in the course of his address, suggested the establishment of a central bureau for the registration of plans of all surveys made in Canada, also a systematic graditic survey for the whole country, as the surveys made in the older provinces are all compass work and many of them glaringly inaccurate. The growth of the country renders this work urgent. Whether it should be done under the Department of the Interior, or, as in Great Britain, under the military authorities, or by a special organization, he would leave the Government to determine. He also again urged the importance of fixing and recording triangulation stations and bench marks so that they can be used by engineers and surveyors at any time.

As it might be of interest, and in keeping with the practice of previous presidents, to refer to works with which he was personally connected, he alluded to the progress of engineering work relating to the Department of Marine and Fisheries, sketching the work of past years. At the time of the Confederation there were in Canada 227 lighthouses at 198 stations, and only two of these were equipped with steam fog whistles. Since 1867 there have been established in the Dominion, 769 new lighthouses at 598 different stations, 71 power fog alarms, 15 fog bells, 10 explosive fog signals, 89 signal buoys, and 106 gas lighted buoys, numbers far exceeding the total establishment of any country in the world except the United States of America, and very little inferior to the aggregate in that country of great wealth and magnificent distances. A majority of these appliances were designed and put in operation under the superintendence of himself, who for a long time enjoyed the distinction of being the only lighthouse engineer in Canada. Of late years attention has been turned to improving aids rather than to rapidly increasing their numbers. In lighthouse illumination catadioptric lenses are rapidly being substituted for the older-fashioned, simpler, and less expensive paraboloidal reflectors, and petroleum vapor burnt under incandescent mantles is taking the place of the ordinary oil light. These petroleum vapor lights are very efficient and economical. Photometric tests show that ten times as much light can be got from the vapor burnt under mantles as from the same oil burnt through wicks. The possibility of increasing the power of our Canadian lights is unfortunately limited by the capacity of our lightkeepers. As long as these officials are put in charge of stations without any previous instruction in their duties, so long will it be necessary to limit the size of the lamps to such as can be managed by ordinarily intelligent men. To place lamps with large, intensely hot flames in the hands of uninstructed keepers is to invite destruction of the buildings and apparatus. Until the appointment of lightkeepers can be restricted to young men nominated to go through a course of preliminary training under competent instructors, with the power of instant dismissal for breaches of duty in the hands of the inspectors, it will be impossible to much further improve our lighthouse installations. Most of our gas buoys and some of our small fixed lights are now using acetylene in compressed form as an illuminant, but there are difficulties, not the least of these being its cost, that will militate against its general adoption, especially in the face of a rival so formidable as petroleum vapor. Electricity has never been used to any great extent in our lighthouses for many reasons, one being the liability of the machinery to break down, another the untrained lightkeepers we are obliged to employ. In the vicinity of towns having municipal or private electric plants, electric lights have in a few instances been installed, and operated by the municipal power station. An important advantage of electricity, where it is available, is the facility with which occultations can be produced. With the increase in the size and draught of modern steamships has come the necessity for widened and deepened channels, as well as for the better demarcation of those channels. In the River St. Lawrence, between Quebec and the sea, the 30-foot ship channel is now marked, not only by splendid range lights in the axes of all the deepened cuts, but also by gas buoys replacing the old unlighted buoys at all salient points, so that it should be possible to bring a large ship up to Montreal by night almost as readily as by day. The wonderfully ingenious Pintsch gas buoy, with its equally ingenious automatic occulting attachment, has done more to render night navigation safe than any previous invention, and Canada now has these buoys established at all critical points between the Saguenay River and the head of lake navigation, marking the 14-foot channel in the canalized stretches of the St. Lawrence, as well as the sea-going ship channel. In exposed positions on the sea coasts whistling buoys on the Courtenay principle, another clever invention, and the old-fashioned bell buoys, are used more extensively than gas buoys, being better adapted to stand the shock of the waves, and requiring no special attention beyond periodical lifting to remove sea growths and renew the moorings. The work of placing and renewing the 89 signal buoys now in commission, and the thousands of smaller buoys, studding all our harbors and rivers, employs quite a fleet of steam tenders.

A modern lightship, such as those lately moored off Anticosti, and off Lurcher shoal, in the Bay of Fundy, is a perfect battery of ingenious mechanisms. From the electric lights at her mast heads, automatically occulted by clockwork making and breaking the current produced by a dynamo in the engine room, to her moorings, connected with powerful automatic buffers and steam windlasses to relieve the strain on her bows, she is full of interesting machinery. She is self-propelling, provided with a powerful fog alarm, a submarine bell, and a Marconi telegraph instrument. For the design of these latest vessels we are indebted to the United States Lighthouse Board, whose plans were adopted under the conviction that its long experience with lightships in the open Atlantic was too valuable to be ignored.

The first Canadian fog alarms were steam whistles. About 1873 reed horns were substituted, from motives of economy, a very simple and fairly effective arrangement, patented in Canada, being adopted. In these machines the lifting of a piston in a steam cylinder compressed air in a larger cylinder immediately above, and forced it through the horn, so that the length of blast was regulated by the stroke of the steam piston. One of these horns has been heard 26 miles under favorable conditions. They were not, however, considered first rate fog alarms, and when larger grants became available, syrens of the Scotch and English types were adopted as the most powerful sound producers obtainable. A first-class English syren at Belleisle is operated by air compressed half a mile from the syren house, the power being obtained from a Pelton wheel run by water led from the lakes on the hills of the island. This installa-

tion has run successfully for many years, the cost of maintenance being a mere trifle.

The Government is now substituting diaphones for all the types of instruments previously used for fog alarms. These instruments are claimed to give a very penetrating sound. They have the advantage over the syren that they can be kept at a constant pitch, and if the Canadian patentees succeed in producing perfect resonation they will doubtless prove superior in sound-carrying capacity to any signal yet invented. They are run by compressed air, and we are installing oil engines to operate them, because it is frequently difficult to obtain sufficient fresh water for steam engines at our fog alarm stations. The sound is produced by the free vibration in a slotted cylinder of a very light slotted piston, the air being admitted in rear of the piston, and escaping through the slots, which are alternately opened and closed sufficiently fast to produce a pure musical note.

A survey of the tides and currents of the Dominion is being conducted under the charge of Dr. W. Bell Dawson, one of the society's members. This survey, although having marine information for its more immediate object, yet requires to be based on engineering methods for its successful accomplishment. Its problems include construction and mechanical appliances, and questions in astronomy, physics and hydraulics require consideration to make the work effective. Tide tables, based upon very complete gauge records, are now issued for the whole Dominion. The velocity and direction of currents have been determined in the St. Lawrence as well as upon the most dangerous parts of the Atlantic coast, and the results placed in the hands of mariners.

The tidal results have already proved valuable in connection with harbor construction, docks and dredging. Mean sea level, which the modern method of reducing tidal observations determines so accurately, affords the only trustworthy plane of reference for geodetic surveys. The Tidal Survey, by maintaining a uniform datum for the observations from year to year, has already referred mean sea level to bench marks established at Quebec, Halifax, and St. John, N.B. There are now also bench marks and sufficient tidal record for this purpose at a number of widely separated points in the area extending from the St. Lawrence to Newfoundland, and from Labrador to Nova Scotia. These isolated bench marks ought to be connected by continuous levels. Some admirable work has already been accomplished in this direction by R. Steckel, of our society, and it is unfortunate that the pressure of more urgent duties has prevented the prosecution to completion of this scientifically important connecting link. The same data are also being determined on the Pacific coast at Victoria, Vancouver, and Port Simpson.

For hydrographic charts, Canada was for a long time dependent upon the surveys made in the early part of the last century by that well-known hydrographer, the late Admiral Bayfield. The immense quantity of work accomplished by that distinguished naval officer, and the wonderful accuracy of his charts, considering the rapidity with which he must have worked, and the clumsy vessels at his disposal in those early days, are beyond praise, but naturally these early charts became more or less unreliable with the introduction of deeper draught vessels and steam navigation. In 1887 this department borrowed from the Admiralty the services of a hydrographic surveyor, Staff-Commander Boulton, who organized a re-survey of the Great Lakes, which has since been continuously carried on. We now have modern charts of the Canadian shores of all the Great Lakes, except Ontario, and portions of Lake Superior unfinished. On Captain Boulton's retirement he was succeeded by W. J. Stewart, his pupil, and a graduate of the Royal Military College, and also one of our members who has lately been put in charge of all our hydrographic surveying. Last year this department took over from the Department of Railways and Canals a hydrographic survey of Lake St. Louis, and also took over from the Public Works Department the staff engaged on the re-survey, nearly completed, of the ship channel between Montreal and Quebec. There is no lack of work in this branch ready for attention when such can be given to it. The Maritime Province shore of the Gulf of St. Lawrence requires re-surveying, and a great deal of detail work is also required on our Pacific coast. If the advocated railway to Hudson Bay for the shipment of North-West grain by that route ever becomes an accomplished fact, the Marine Department will also be called on for extensive work both in surveying and establishing aids to navigation in that remote Canadian sea, for existing charts of its coast lines are merely the roughest kind of sketches.

Several small hydrographic surveys have been made by the department, the most extensive of these being a survey of the whole of Lake Winnipeg, which has occupied Mr. Stewart or one of his assistants for the past three years. We have not yet undertaken the publication of charts, these being engraved and published by the Imperial Admiralty without cost to us, but there is a staff for the collecting, editing and publication of descriptions of aids to navigation, sailing directions, hydrographical notes and other information of value to mariners, that is doing very creditable work.

The experience of this department with ice-breaking steamers is worthy of a word of reference, but most of the facts were brought out in papers and discussions before this society some years ago, and need not be enlarged upon here. We have had charge, since the inception of the enterprise, of the winter ferry between Prince Edward Island and the mainland. The first boat used for the service was built from the plans of Edmund Sewell, of Quebec, and embodied the results of his experience in the winter ferry service at that place. The Northern Light was a wooden steamer and performed the service with a fair degree of success. It was replaced by a Scotch built steel boat, the Stanley, which was, I believe, the first boat built of steel used as an ice-breaker. The Stanley in turn has been replaced by a larger, more strongly protected and more powerful steamer, the Minto, which has done the best work of the three, but all have at times been caught in the heavy fields for periods varying from a few days to a few weeks.

The great quantity of grain now grown in our North-West has made shippers anxious to extend inland navigation to as late a date in the autumn as it may be possible to force a passage through the making ice, and the department has been strongly urged to assist the movement by extending the limit of time for removing buoys and all other floating aids to navigation, and by breaking ice where necessary. This autumn the lights in Lake Superior were kept open a fortnight later than usual, necessitating special arrangements for the removal of the isolated keepers, and Fort William and Port Arthur harbors were kept open by employing ice-breaking tugs. This allowed shippers to get out by the cheap water route a considerable portion of this autumn's crop.

Two ice-breaking steamers, built in Scotland for the department have been put in commission this winter, the one to maintain a ferry between Pointe aux Originaux and Murray Bay, the other to keep the river open, if possible, between Quebec and Montreal. This last proposition is rather in the nature of an experiment, as no one is quite sure how much can be accomplished or what the effect would be of preventing the ice bridge from forming.

The maintenance and improvement of the ship channel between Quebec and Montreal, begun by the Montreal Harbor Commissioners, and later assumed by the Department of Public Works, was last year transferred to the Marine Department, for the sake of consolidating control of the work. This channel is now 30 feet deep at low water, except over St. Augustine bar, where the least depth is 23 feet, but where there is a rise of the tide of 16 feet. The immediate aim of the department is to complete the depth to 30 feet throughout, to make the least width 500 feet, and to light the whole extent for night navigation. The only serious work remaining to accomplish this is the widening from 300 to 500 feet of Cap à la Roche cut, an excavation in limestone. Judging by past experience, this work will no sooner be accomplished than a further widening and deepening will be asked for, to accommodate the ever-enlarging steamers seeking the St. Lawrence trade.

The address concluded with a reference to the improvements in the harbor of Montreal.

The address was enthusiastically received, and Colonel Anderson was complimented on his choice of subject.

On Wednesday, 25th January, the members assembled at Bonaventure Station and were conveyed by special train, courteously supplied by the Grand Trunk Railway, to the works of the Dominion Bridge Company, at Lachine, where they were received by P. Johnson, general manager. The party also visited the works of the Dominion Wire Manufacturing Co., the Dominion Wire Rope Co., and the Allis-Chalmers-Bullock Co., and were hospitably entertained at luncheon by the Dominion Bridge Company.

In the evening the annual dinner was given in the Windsor Hotel, and was a very successful reunion. Over 100 were present. Colonel Anderson occupied the chair, having on his immediate right Mr. Wade, chairman of the Transcontinental Railway Commission, and on his immediate left Dr. Haanel, Superintendent of Mines, Ottawa. Following the toast of "The King," that of "The Sister Professions" was submitted by G. A. Mountain, of Ottawa, who remarked that heretofore the several departments of engineering had worked together in harmony, and he trusted that they would continue to do so for the benefit of all, and the advancement of science. This toast was responded to by Dr. Haanel, who remarked upon the great strides taken in engineering during the last century. Dr. Haanel said that he thought it was pretty clearly understood in these modern times that the prosperity of a nation largely depended upon the achievements of the engineering profession in all its branches. He advocated the formation of a Canadian Engineers' Institute in which might be housed all the different sections of engineering. Such an institution would naturally have great effect upon the Government, and should be able to publish a magnificent periodical which would be of aid to all. C. H. Keefer then proposed "Our Guests," which was acknowledged by Mr. Wade, who spoke of the very close and pleasant relations which had existed between himself and engineers ever since he received his first retainer from a railway company twenty-seven years ago. Mr. Wade went on to discuss the great work that was taking place at the present time in building the new Transcontinental Railway. When commencing this work it had been determined to accomplish it, if possible, with the aid of Canadian engineers alone. Whether this would be realized or not remained to be seen, but the idea was to exhaust the home supply before seeking for others abroad. In this connection he did not believe there had ever been a time when there was so great a necessity for the work of the society as at present, for upon it rested the duty of supplying the demand for engineers of the highest grade and class. He considered that the Canadian engineers were better adapted to the conditions and circumstances in hand than engineers imported from abroad, for the simple reason that the latter had to learn the conditions which were already known to engineers of this country. He therefore wished to assure the society that in the work it had undertaken it would receive the unbounded support of the Commission he represented. The object of the society was not to create a close corporation, but to make the profession more efficient, and in so doing it would accomplish a great good. J. L. Harrington chief engineer of the Locomotive and Machine Company, proposed a toast to "The Profession," remarking on the indebtedness of a country to its engineers for its prosperity. This toast was responded to by M. J. Butler, assistant chief engineer of the Transcontinental Railway Commission, who touched upon the strides made in the engineering profession in the Dominion. The remaining toasts were: "The Retiring President and Council," and "Our Visiting Members."

On Thursday morning the election of officers took place and resulted as follows: President, Ernest Marceau, Montreal. Vice-presidents, C. H. Keefer, Ottawa; D. Macpherson, Montreal, and G. A. Mountain, Ottawa. Councillors: John Kennedy, W. F. Tye, G. A. Keefer, C. H. Rust, A. E. Doucet, Phelps Johnson, R. W. Leonard, P. W. St. George, W. B. Mackenzie, Prof. R. B. Owens, M. J. Butler, Prof. R. J. Durley, G. J. Desbarats, Dr. J. B. Porter, and H. C. Burchell.

Nominating Committee: For Ontario—G. A. Mountain, C. H. Rust, and Prof. J. Galbraith; for Quebec—F. Shearwood and W. McLea Walbank; for North-West Territories—G. H. Webster; for Maritime Provinces—F. W. W. Doane; outside of Canada and Newfoundland—H. Irwin.

The amendments to by-laws were carried, and are as follows:

To amend By-law 4 by omitting the word "any" in the eighth line, and the whole of the last line.

To amend By-law 27 by omitting the words "a Librarian" in the second line, and changing the words "fifteen" in the fourth and fifth lines to read "twenty."

To amend By-law 31 by changing the third and part of the fourth line to read "by the Council, or by the Finance, or Library and House Committee."

To omit By-law 32.

To amend By-law 33 so as to be numbered 32.

To amend By-law 34 to be numbered 33, and to read: "The Council shall meet within one week after its election, and shall appoint, firstly, a standing committee of five on Finance, which shall have supervision of the accounts of the society; secondly, an auditor, who shall audit the books of the treasurer, and shall certify to his annual report; and, thirdly, a Library and House Committee of five, which shall have supervision of the rooms and library, and shall expend for the purchase of books or other articles of permanent value to the society such sums as may be granted for that purpose. The Council shall also appoint a secretary, a treasurer and such subordinate officers as may be necessary for the proper conduct of the business of the society at such salaries as it may deem fit. All officers having the funds of the society in hand shall be required to give adequate bonds. The secretary and treasurer shall have seats and votes on the Council."

To add a new By-law to be numbered 34 to read: "Three members of a standing committee shall constitute a quorom thereof. Any member of a standing committee who shall have failed to attend all regularly called meetings of the committee during two months may be replaced by a vote of the Council."

To amend By-law 35 by omitting from the fifth line the words "Treasurer, Secretary, Librarian," by substituting the number "31" for "34" in the ninth line, by omitting the words "one for Treasurer, one for Secretary, one for Librarian" in the tenth and eleventh lines, by changing the words "eight" to "ten" in the 14th and 15th lines.

To amend By-law 44 (A) by changing the words on the fifth line, "verified by the Committee on Finance" to read "certified by the Auditor."

To amend By-law 44 (C) to read: "Ordinary meetings of the society or of one of the sections thereof shall be held on such Thursdays as may be arranged by the Council at eight o'clock in the evening during the months of October, November, December, January, February, March and April; but it shall be in the power of an ordinary meeting to make such special changes in these dates as may be deemed advisable."

Mr. Marceau, the newly elected president, took the presidential chair amid applause. The retiring president spoke highly of Mr. Marceau's record and referred to his zeal for the advancement of the society. He said that it was meet that the French-Canadian brethren should have recognition, and that the society was especially fortunate in having Mr. Marceau to fill this position.

Mr. Marceau modestly disclaimed greatness or fitness for the position, but said he would be stimulated by the examples which had been set him by his predecessors, and not least by that which had been set by the retiring president, Colonel Anderson.

During the morning a paper was read by E. M. Archibald on "The Effect of Load Factor on the Cost of Electric Power."

At the close of the morning session, a party of the members were taken to see the turbine fire-pump at the Canada Sugar Refinery, on the invitation of the John McDougall Caledonian Iron Works Co., Limited, of Montreal.

The meeting reassembled in the afternoon at 3 p.m. In the absence of the president, the chair was taken by C. H. Keefer.

The motion introduced at the last annual meeting: "That the Council be requested to ask the members of this society to see that their lines of levels are in all cases con-

nected with permanent bench marks and that these, where possible, be connected with sea level datum; further, that the Council take into consideration the best method of securing permanent records in regard not only to levels, but also to all trigonometrical surveys, and to confer with the Government with a view to having them instruct their officers to mark all bench marks permanently" was recommitted to Council with instructions to interview the Government. The matter was discussed by Colonel Anderson, Messrs. Kennedy and Lordly. Mr. Lordly explained that it was difficult to get permission to put in permanent bench marks. Mr. Kennedy said that all could assist in this matter by making bench marks as permanent as possible.

At the close of the business meeting, Cecil B. Smith, Toronto, read a paper descriptive of the Canadian Niagara Power Co.'s plant at Niagara Falls. The paper was illustrated by numerous lantern slides.

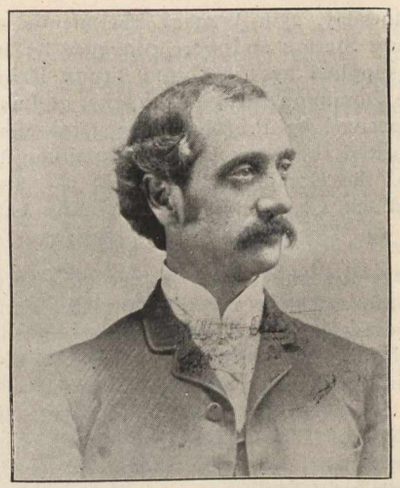
Votes of thanks were passed to the various railways and to the companies visited at Lachine.

At the evening session an address was given by James White, Geographer of the Dominion Government,, Ottawa, on "Maps and Map-Making in Canada." Mr. White first gave a brief review of mapping in Canada and outlined the work which has been done by the various departments of the Dominion Government in publishing maps. Owing to the fact that the several departments of our Government have been working independently, the results obtained up to this time are not as satisfactory as could have been desired, and obviously the interests of the country demand that a general scheme for the Dominion as a whole should be promptly undertaken. The department has already done a considerable amount of work in this direction, and is preparing plans whereby it is hoped that all the information available may be utilized to the utmost. In connection with his address, Mr. White exhibited a most instructive and interesting collection of maps of North America, and Canada in particular, dating back as far as 1505, this being the date of the first map on which the name "America" appears.

At the close of Mr. White's address, Dr. E. Haanel, Superintendent of Mines, read a paper on "The Electro-Thermic Production of Iron and Steel," in which he summarized briefly but most lucidly the work of the Commission recently appointed by the Department of the Interior to examine the leading smelting plants of Europe and the Ruthenburg plants in the United States. Each plant was described and its working costs were re-calculated for Canadian prices of material, labor and electric power. Dr. Haanel then showed conclusively that electric manufacture of high grade steel is already commercially practicable; that the manufacture of ordinary steels, if not yet practicable is likely to become so almost immediately, and that in localities having good ores and ample water power even pig iron can now be made at a cost but little greater than that of pig iron made with coke. In conclusion, Dr. Haanel predicted a rapid development of electric methods. The older ways of making iron and steel have probably almost reached their limit of economic development, and no very startling reductions in cost are probable, whereas electro-thermic methods, although new, have already been so successful as to justify the belief that they will soon become of great commercial importance. In this event, Quebec and Ontario, and probably some of the more northern parts of Canada, will benefit enormously. Ores occur abundantly in many localities, but their use is impossible because of the lack of cheap fuel. Whenever we could replace fuel by electric energy we shall have an unprecedented development of our mineral resources, and in the opinion of the lecturer this day is not far distant.

Votes of thanks were passed to the authors of the papers.

The members of the Canadian Society of Civil Engineers to the number of 150, visited the new works of Allis-Chalmers-Bullock, Limited, Montreal, on January 25th. They expressed surprise at the progress of the company, and at the amount and character of electrical work under construction. They were given an interesting demonstration on the construction and operation of drills, coal cutters and compressors. On leaving each member was presented with a handsome leather card-case as souvenir of the visit.

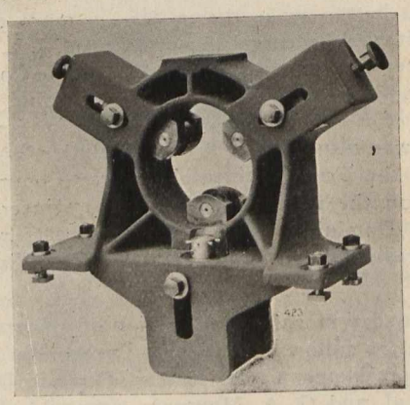


ERNEST MARCEAU.

A biographical sketch of Ernest Marceau, president-elect of the Canadian Society of Civil Engineers appeared in our issue of February, 1897. An appreciative sketch also appeared in the Engineering News, New York, in its issue of 26th ult. It regards Mr. Marceau's election as a "good index of the harmonious co-operation of the French and English races which distinguishes the eastern provinces of the Dominion of Canada." Like Lieut.-Col. Anderson, the retiring president, he has been in public service throughout his professional career, and both are identified with navigation service, though in different branches; Lieut.-Col. Anderson is at the head of the Dominion Department of Marine and Fisheries, while Mr. Marceau is in charge of the canals of the Province of Quebec. Mr. Marceau is descended from an old French family of Poitiers, one of his forefathers having established in Canada at the beginning of the eighteenth century. Mr. Marceau was born at Danville, Que., in 1852. He studied engineering at the "Ecole Polytechnique," Montreal, and got his first Government appointment as assistant to the resident engineer of the Grenville Canal in 1877. He received the Gzowski medal for his paper on the Carillon Dam, a portion of which he rebuilt. He is one of the faculty of arts of Laval University, and president of the Ecole Polytechnique de Montreal, and is a member of the Société des Ingénieurs Civils de France. He has been a member of the Canadian Society since its foundation in 1887.

HIGH SPEED FOLLOWER REST.

Experience has shown that for roughing, bars of even as great as 8-in. diameter require some substantial support (a Follower Rest), to obtain the greatest possible results from high speed steels. After using several different metals for



the jaws of such a Follower Rest, only to have them cut out, the Lodge & Shipley Machine Tool Co., of Cincinnati, hit upon the roller plan, clearly shown in the illustration. The rollers are hardened tool steel and are mounted upon hardened and ground steel shafts, upon which they are fixed by screws through the face of the rollers. Liberal oiling facilities are provided for the journals of the roller shafts. A

sensitive adjustment for the jaws is provided by the knurled knobs, so that they cannot be forced down too tightly. At an extra charge special cases are provided for, so that the pad at the top of the rest can be planed and an angle bracket carried from this to attach to the wings of the carriage on the opposite side, to ensure great stiffness and rigidity. So arranged, the results obtainable on heavy bars from one of this company's high speed lathes, can be doubled over the results from the same lathe without such a rest.

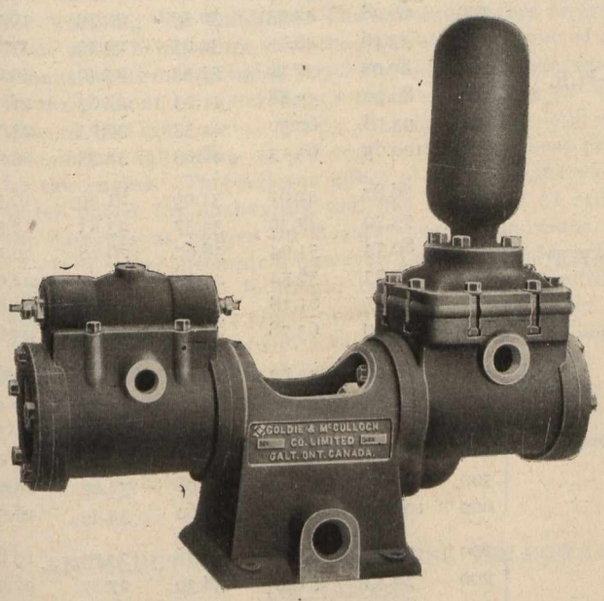
INDEPENDENT AIR PUMP AND JET CONDENSER.

We herewith give an illustration of an independent air pump and jet condenser, made by the Goldie & McCulloch Co., Limited, Galt, Ont. The exhaust steam from main engines, pumps, etc., is admitted into the top of the condenser, and on its descent is met by a fine spray of cold water coming in the opposite direction through a spray pipe. By this process a complete mechanical mixture of the steam and injection water is obtained. A vacuum is thus formed by the water depriving the steam of nearly all its latent heat and condensing it. The air pump removes the condensed steam from the condenser, the action being continuous. An automatic vacuum-breaking device is provided, consisting of a copper float and valve opening to the atmosphere.

Where water is available, a great saving of fuel or corresponding increase of power can be obtained by the use of one of these condensers. It is a well known fact that the atmospheric resistance, together with the back pressure in exhaust passages and pipes, is so much power taken from the steam on the engine piston. When the steam in an ordinary non-condensing or high pressure engine has performed its work in the cylinder, it is ejected into the atmosphere against atmospheric pressure, usually reckoned at 15 lbs. to the square inch.

The work of the condenser is to remove this back pressure and form a constant vacuum, equal to 13 or 14 lbs. per sq. in., on the exhaust side of the piston, and the steam can consequently be expanded to nearly the absolute zero of pressure, thereby obtaining its full expansive power. The use of a condenser will, therefore, cause a saving of from 20 to 25 per cent. or increase the power from 20 to 25 per cent.

An independent air pump and condenser has an advantage over a direct connected or belted air pump, as it can be started and vacuum obtained before the engine is started.



Another advantage with this condenser is that when a close heater of any pattern is already located, it need not be discarded, as it will act as a surface condenser between the engine and independent condenser and increase the temperature of the feed water so it can be returned to the boiler at a temperature of about 130 degrees. A single condenser can be used for two or more engines, pumps, etc., one or all of which may be stopped without interfering with the action of the condenser. This condenser will work as well with marine engines as with stationary, and it can be used as an independent bilge pump when necessary. No steam pump is required to lift its injection water. It will lift from any point that can be reached by pumps in general use. The water cylinder lining, stuffing boxes, gland and nuts are brass. The piston rod is Muntz metal. The valve seats are brass, but the valves are rubber with brass springs.

The Goldie & McCulloch Co., Limited, manufacturers of the above, issue interesting catalogues of both pumps and condensers, and would no doubt be pleased to send these to any one interested.

THE VALUES OF WATER POWERS AND DAMAGES CAUSED BY DIVERSION.*

BY CHAS. T. MAIN, BOSTON, MASS.

(Continued from last issue.)

Approximate Cost of Water Power Development.

In connection with the preceding diagram is printed a table showing approximately the cost per horse-power of water power plants, not including dam, canal and buildings, for different heads, distances from feeder to end of tail-race and horse-power of development.

It is not expected that this table will cover all cases, but it will give approximate figures for ordinary conditions, and is useful in making rough preliminary estimates.

Extra Length of Time Which Steam Plant Must Run on Account of Diversion.

If the power of the stream is worked out before and after diversion, it will probably be found that the auxiliary power plant must be run for a longer time after the diversion.

This would be shown in full months in the tables showing the power before and after diversion, but it would not show fractions of a month.

The method of ascertaining the extra length of time is to make a diagram in which the ordinates show horse power, which the whole stream can produce, and the abscissæ the number of working days. By plotting the horse-power which can be developed before and after diversion and drawing diagonal lines from month to month, the extra number of days when the auxiliary plant must run is shown where the diagonal lines cross the horizontal line of wheel development.

Steam or Other Power Plant to be Used in Making Good the Power Diverted.

In order to determine the damage it is necessary to estimate the cost of replacing the power taken away, not necessarily by the auxiliary plant already existing in the mill, for such a plant may be an extremely uneconomical one, and the mill which had the poorest plant would get the most damages, but by a fairly economical plant of the size

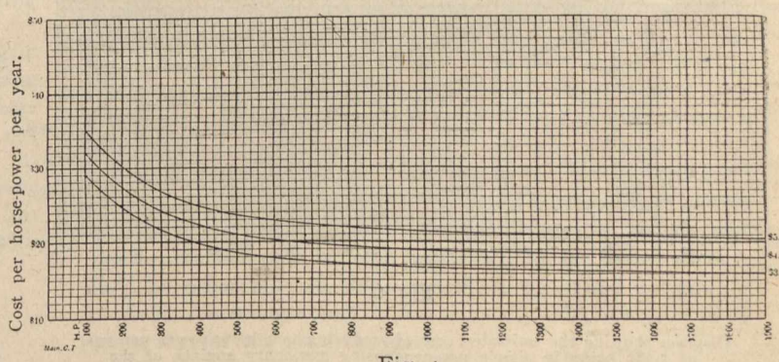


Fig. 4.

Diagram showing the estimated cost of producing one horse-power per year of 3,080 hours, in compound condensing engines of the capacity given, with coal at $3, $4, or $5 per long ton.

and character, such as the business under consideration would naturally use. Unless this method is pursued with a series of mills, the one which had put itself into the best shape would receive a smaller amount of damage than its neighbor where things were in bad shape.

*A paper presented at the New York meeting (December, 1904) of the American Society of Mechanical Engineers.

It is improbable that a concern would go on putting in each time it renews its plant an uneconomical plant, and it is highly probable that the low grade engine will be improved in efficiency.

As the damages are figured forever, it will add very little to the damages for the short time which the uneconomical plant will be obliged to run.

Privileges with no Auxiliary Plant.

The basis on which the damages should be estimated in these cases, where there is no auxiliary plant, is the same

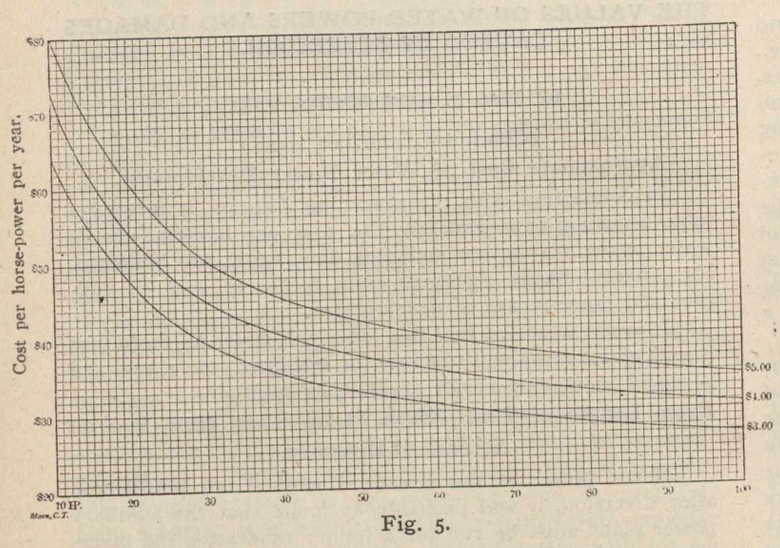


Fig. 5.

Diagram showing the estimated cost of producing one horse-power, per year of 3,080 hours, in simple condensing engines of capacity given, with coal at $3, $4 and $5 per long ton.

as for any other. The mere chance that an owner can manage in some way to run his business in accordance with the fluctuating flow of the stream, does not entitle him to any greater damage than his neighbor, who is fitted up to run continuously. A small amount of power diverted will not in most cases make the conditions sufficiently bad to require the addition of a supplementary plant for that reason alone. An allowance, however, should be made in estimating the

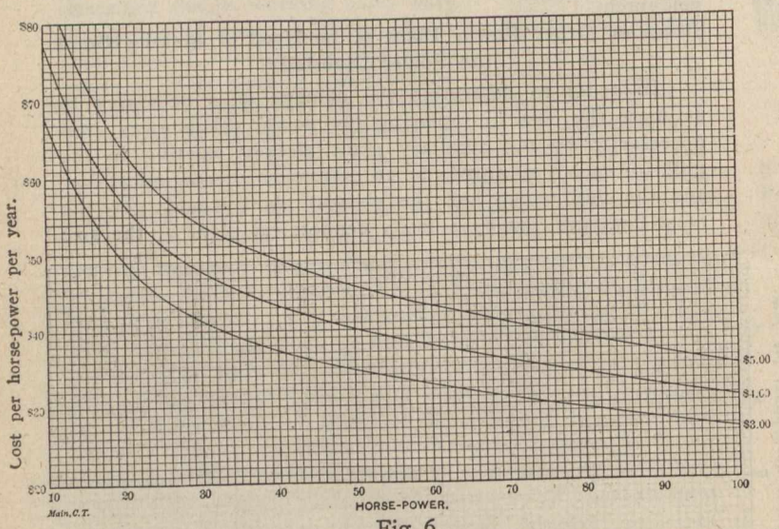


Fig. 6.

Diagram showing the estimated cost of producing one horse-power per year of 3,080 hours in simple non-condensing stationary engines of the capacity given, with coal at $3, $4 and $5 per long ton.

damages in such cases for such portion of a steam plant as would ordinarily be installed to produce a uniform power as is equal to the power diverted in the dry month and the running expenses should be estimated on a plant of full size and not on a very small plant.

The proper method of ascertaining the damages to a plant of this sort is to find the difference in value before and after diversion, and this is obtained by finding the cost of producing a uniform power before and after diversion.

Table of Estimated Costs Per Horse-Power of Water Power Plants

Having Horizontal Turbines, Steel Penstocks, and Walled Tail-Races—Dam and Buildings not Included.

	Feet. "L."	10-ft. fall.	15-ft. fall.	20-ft. fall.	30-ft. fall.	40-ft. fall.
1,000-H.P.	100	$65.14	$40.92	$29.37	$19.40	$14.59
	200	71.91	45.48	32.84	21.70	16.38
	300	78.66	50.05	36.30	24.01	18.17
	400	85.43	54.62	39.77	26.32	19.95
	500	92.20	59.18	43.23	28.63	21.74
	600	98.96	63.75	46.69	30.94	23.53
900-H.P.	100	65.35	41.00	29.56	19.56	14.79
	200	72.08	45.58	33.04	21.85	16.60
	300	78.80	50.16	36.53	24.14	18.41
	400	85.50	54.74	40.01	26.41	20.22
	500	92.24	59.32	43.49	28.70	22.02
	600	98.96	63.91	46.97	30.99	23.84
800-H.P.	100	65.48	41.10	29.65	19.68	14.99
	200	72.22	45.68	33.12	21.98	16.78
	300	78.95	50.26	36.68	24.28	18.57
	400	85.70	54.84	40.04	26.56	20.35
	500	92.43	59.41	43.52	28.87	22.14
	600	99.15	64.00	46.98	31.17	23.93
700-H.P.	100	65.72	41.19	29.87	19.90	15.12
	200	72.48	45.75	33.35	22.19	16.93
	300	79.23	50.30	36.82	24.49	18.73
	400	86.00	54.86	40.29	26.77	20.54
	500	92.74	59.42	43.77	29.07	22.34
	600	99.50	63.97	47.25	31.37	24.16
600-H.P.	100	65.86	41.56	30.00	20.02	15.37
	200	72.64	46.14	33.49	22.34	17.20
	300	79.42	50.72	36.97	24.64	19.04
	400	86.20	55.30	40.45	26.95	20.87
	500	92.98	59.88	43.94	29.27	22.70
	600	99.76	64.47	47.42	31.57	24.54
500-H.P.	100	66.00	41.70	30.24	20.24	15.52
	200	72.82	46.32	33.78	22.56	17.31
	300	79.64	50.94	37.28	24.86	19.10
	400	86.46	55.56	40.80	27.16	20.88
	500	93.28	60.16	44.34	29.48	22.66
	600	100.10	64.80	47.84	31.80	24.44
400-H.P.	100	66.28	42.03	30.55	20.79	16.00
	200	73.16	46.65	34.05	23.10	17.82
	300	80.03	51.26	37.53	25.40	19.64
	400	86.90	55.88	41.03	27.73	21.45
	500	93.78	60.50	44.53	30.03	23.27
	600	100.65	65.13	48.03	32.35	25.08
300-H.P.	100	66.87	42.67	31.09	21.49	16.50
	200	73.70	47.30	34.57	23.83	18.33
	300	80.54	51.94	38.07	26.18	20.16
	400	87.33	56.54	41.54	28.53	22.00
	500	94.17	61.18	45.04	30.88	23.83
	600	101.00	65.78	48.51	33.22	25.67
200-H.P.	100	68.50	44.22	32.45	22.61	17.60
	200	75.35	48.84	35.97	24.97	19.47
	300	82.25	53.45	40.04	27.33	21.34
	400	89.10	58.10	43.56	29.70	23.21
	500	96.00	62.70	47.08	32.06	25.08
	600	102.85	67.35	50.60	34.43	26.95
100-H.P.	100	71.39	46.64	34.76	24.75	19.80
	200	78.43	51.37	38.39	27.17	22.00
	300	85.47	56.10	42.02	29.59	24.20
	400	92.51	60.83	45.65	32.01	26.40
	500	99.55	65.56	49.28	34.43	28.60
	600	106.60	70.28	52.91	36.85	30.80

Note: "L"—Distance from feeder head to end of tail-race. Cost of canal, if any, not included.

Allowance for Permanent Power Diverted.

If any power is diverted which can be depended upon all the time, an allowance should be made for this. If the

diversion is comparatively small the fixed charges should be allowed on the cost of a portion of the large plant equivalent to the amount of power diverted. Thus, supposing 5 horse-power is diverted in a dry month, and the cost of the steam plant is $60 per horse-power. 5 × $60 = $300. $300 at 12 per cent. = $36. This capitalized at 5 per cent. = $720.

If this allowance is made the owner may increase the capacity of his plant by 5 horse-power when he renews it, and will have been recompensed for this expense.

If the interest charges are not included in the fixed charges, the cost of the plant, $300, should be added to the capitalized sum.

If the diversion is a comparatively large amount, it may be necessary to remodel and increase the existing steam plant, or to put in a new one. Allowance should be made in the same way for this.

Cost of Steam Power.

The cost of steam power usually has an important bearing upon the settlement of damages. The following Figs., 4, 5 and 6, have been prepared, which show the yearly cost of producing steam power under various conditions and cost of coal when running ten hours a day and six days a week with a fairly steady load. They are intended to show the expense of running under everyday conditions on such a plant as a prudent man would instal and run with ordinary skill.

Th cost of 24-hour power for 365 days a year is about 2.2 times the cost of 10-hour power for 308 days.

The cost of 24-hour variable load cannot be stated without knowing all the conditions.

Coal Consumption Used in Estimating Damages.

The coal consumption used in estimating damages when the power diverted must be made good under a varying load contingent upon the fluctuation of the water power, should be somewhat larger than the coal consumption for a fairly steady load. I have usually added about 20 per cent. to the coal consumption required for a steady load. The fluctuation of the water power will usually not be great for a single day, but the variation covers longer periods, as weeks or months.

Effect of Use of Steam for Other Purposes.

In many textile and other mills low-pressure steam and hot water can be used in the manufacturing processes, and for warming the buildings. The amount varies largely, in some cases being more than the equivalent amount of steam exhausted from an engine large enough to run the work, or to the amount of water required for condensing for an engine of the same size. Rarely ever in a textile mill would the amount fall below 20 per cent. of the total heat rejected by the engine. This has the effect of reducing the value of water power for such mills, and has the effect of reducing the damages as figured on straight power conditions.

It is never attempted, however, to estimate this effect in units for damages. It should be considered in estimating values, and it has its effect upon the selling value of water powers, making them of less value for industries having use for low-pressure steam and warm water.

All the varying conditions of different industries have an effect of producing a sort of average selling value for water powers, but each case requires examination and estimates of its own.

AN ELECTROLYTIC WIRELESS TELEGRAPH DETECTOR.

The De Forest Wireless Telegraph Co. has been making some record performances during the last few months. A short time ago we reported the sending of messages from St. Louis to Chicago, a distance of about 300 miles. More recently a powerful station has been opened at Kansas City in the hope of communicating with Chicago; and not only was this realized, but messages from the new station were picked up by the Cleveland station at a distance of 700 miles. This is a new record in overland transmission, and it is estimated that it is equivalent to transmission through about 1,400 miles over water. Experts of the company are jubilant over the progress made, and are looking for even greater achievements in the near future. A factor which is held to be in a large measure responsible for the recent success of the De Forest system is the adoption of the electrolytic detector. It is used exclusively now, and its advantages over the old magnetic detector are many, the chief probably being the possibility of tuning the receiver to the transmitter with satisfaction. This detector is described in a recent number of the Electrical World and Engineer by James E. Ives, Ph.D., of the De Forest Research Laboratory. His description is as follows:

In a paper read before the recent International Electrical Congress at St. Louis, Dr. Lee de Forest described a form of electrolytic oscillation detector used by the De Forest Wireless Telegraph Company.

This detector is an electrolytic cell, in which the anode is a very fine platinum wire dipping to a slight distance beneath the surface of the electrolyte, and the cathode is a heavier platinum wire immersed to a considerable distance.

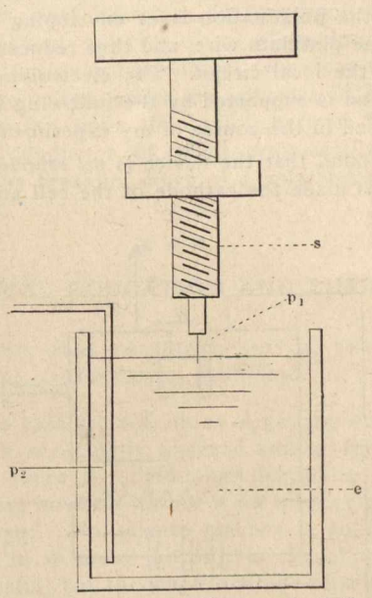


Fig. 1—Simple Form of Cell.

A simple form of such a cell is shown in Fig. 1, where s is an adjustable screw, e, the electrolyte, p_1, the very fine platinum wire, p_2, the heavier platinum wire.

Any aqueous solution may be used as the electrolyte, but solutions of the alkaline salts give the best results.

The distance to which the very fine platinum wire should be immersed depends upon its diameter. For a wire about 40 millionths of an inch in diameter, a depth of immersion of about 3 thousandths of an inch gives the best results. The greater the diameter of the wire, the smaller must be the depth of immersion. The fine platinum wire may have a diameter anywhere from a few millionths to a thousandth of an inch.

A diagram of the local circuit containing the detector, D, a telephone, T, potentiometer, P, and battery, B, is shown in Fig. 2. When receiving wireless telegraph signals one side of the detector may be connected to the aerial wire, a, and the other side to the earth wire, e. When a signal is received a musical sound is heard in the telephone, its pitch being that of the sending spark.

Dr. Lee de Forest, as already stated, holds that this device is electrolytic in its nature, and operates in virtue of the electrolytic action within it. Prof. Fessenden holds that it operates in virtue of heat generated in the electrolyte surrounding the immersed portion of the fine wire when a Hertzian oscillation passes through the detector. W. Schloemilch (*Elektrotechnische Zeitschrift*, November 19, 1903) is uncertain whether it operates in virtue of its polarization capacity or its ohmic resistance. M. Reich (*Physikalische Zeitschrift*, June 15, 1904) believes, as a result of his experiments, that it acts by the polarization of the small surface

of the immersed portion of the fine platinum wire. This opinion is shared, both on experimental and theoretical grounds, by M. Dickmann (*Physikalische Zeitschrift*, August 15, 1904). F. K. Vreeland ("The Principles of Wireless Telegraphy," McGraw Co., 1904, pp. 188-191) believes that it is an electrolytic device depending for its action upon polarization.

To determine the precise nature of the action, experiments were carried out by the author in the Research Laboratory of the American De Forest Wireless Telegraph Company. While conducting these experiments the writer was indebted for valuable suggestions to Dr. Lee de Forest, and to Mr. Greenleaf Whittier Pickard. Mr. Pickard has also made a series of experiments, the results of which are in complete accordance with those here described. These experiments show beyond a doubt that the detector is electrolytic in its action, and not a heat operated device. Its operation apparently depends upon the polarization by electrolysis of that portion of the surface of the fine platinum wire which is in contact with the electrolyte. The ability of the device to detect wireless telegraph signals is explained if we assume that the e.m.f. generated in the aerial wire by the received Hertzian waves causes a partial breaking down of the polarization layer enveloping the immersed part of the fine platinum wire, and thus reduces the apparent resistance of the local circuit. The electrolytic polarization theory of action is supported by the following facts, which I have ascertained in the course of my experiments:

1. It is found that the device is *not reversible*; that is, if the fine wire is made the cathode of the cell and the stouter

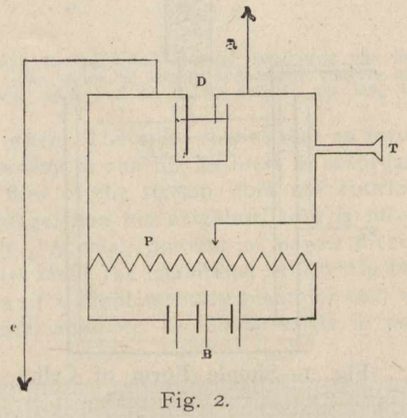


Fig. 2.

platinum wire the anode, the device responds only very faintly to Hertzian wave signals. This fact shows that it cannot be simply a heat-operated device, for if it were the heat generated would depend only upon the rapidly oscillating current flowing through it, and this would be independent of the polarity of the cell.

2. I find that the fine wire forming the anode of the cell must be made of a metal which is chemically inert in the electrolyte. Since the fine wire is the anode of the cell, oxygen is liberated at its surface. It is found that if the metal of the wire is of such a nature that the oxygen liberated at its surface combines with it, the device will not respond, even although the wire be fine enough to respond if it were of platinum. For instance, I found that, using fine wires or filaments of the same diameter, platinum, carbon and aluminum will respond, whereas iron will not. Aluminum probably responds in virtue of the existence of the well-known film of oxide which is formed upon it. These facts seem to show that a film of gas or its equivalent is necessary at the surface of the fine wire to produce the result. If it were a heat effect a slight chemical reaction at the surface would not have any appreciable effect upon the heat produced by the rapidly oscillating current passing between the surface of the fine wire and the surrounding electrolyte.

3. The device, when used in the usual manner with a local battery, has a very high *apparent* resistance, very much greater than that which could be due to its true ohmic resistance. The value of this apparent resistance also depends upon the method of measuring it, having its smallest value when the cell does not have an opportunity to become polarized. It is also found that this apparent resistance depends upon the amount of the e.m.f. in the local circuit, apparently *increasing* very rapidly as the local e.m.f. is *decreased*. It may increase from a few thousand ohms for a local e.m.f. of four volts to several million ohms for a fraction of a volt.

4. I find, after most careful and elaborate experiments, that the sensitiveness of the device to Hertzian waves depends only upon the *area* of the minute platinum surface forming the anode and not upon its *shape*. For instance, it is found that if a one-mil platinum wire is sealed into a capillary glass tube, and the end of the capillary tube is filed off squarely, the cross-section of the one-mil wire which is exposed will form an anode which is quite as sensitive as an anode formed by a fine platinum wire 3/1000 of an inch long and only 38/1,000,000 of an inch in diameter. Although the shape of these two surfaces is entirely different, the area is of the same order, namely, about one-millionth of a square inch.

5. From the behavior of the detector in the field, it appears to be a potential-operated device, and not a current-operated device, as it should be, if its action were due to a heat effect. It is found that this detector will respond very well without any ground connection, which it would not be likely to do if it were a current-operated device.

6. It is found that the detector will respond when the electrolyte in which the fine wire is immersed is actually boiling. This could not happen if its action were due to heat, as is believed by Prof. Fessenden, since the electrolyte being at or near the boiling-point, the heat alleged by him to be developed at the anode by the Hertzian currents would cause a boiling of the liquid at the minute surface of the anode and thus interrupt the action. The apparent increase of resistance of the device when receiving is actually very great, and can be approximately estimated by observing the *change* in the current in the local circuit when the instrument is responding. The apparent change in resistance, of course, depends upon the intensity of the incoming Hertzian waves, and therefore upon the intensity and distance away of the source. Under ordinary circumstances the resistance often drops to one-half or one-third of its original value. If the device were heat-operated such a change as this in the resistance would represent a considerable amount of heat developed at the anode, and if the electrolyte were already at or near its boiling-point, it would certainly cause an evolution of vapor at the anode and a consequent interruption of the action. This, as I have stated, does not occur, even when the electrolyte is boiling violently, if proper precautions are taken in making the experiment. If a fine platinum wire is used, dipping just beneath the surface of the electrolyte, trouble may be experienced owing to the fact that when the liquid is boiling violently, its surface is disturbed, and the point may fail to make contact with the liquid. This difficulty may be overcome by using an anode of a form already described, namely, a one-mil platinum wire sealed into a capillary glass tube, and filed off squarely at the end. It is found that when this is immersed to a slight depth beneath the surface it will respond with perfect regularity, no matter how violently the electrolyte may be boiling.

7. A beautiful proof that it is not a heat device is an experiment that I have performed showing that it will work perfectly even when the electrolyte has a zero temperature coefficient of resistance. For this purpose I used 2½ per cent. solution of hypophosphorous acid. The electrolyte has a zero temperature coefficient of resistance at about 60° C. Below this temperature its resistance coefficient is negative, and above it positive. I observed the response of the device when using this electroylte, from temperature of room (about 30° C.) to its boiling point, in the neighborhood of 100° C. There was no trace of a minimum of response, much less was there a zero point of response, anywhere between these temperatures. I determined the temperature of minimum resistance for this electrolyte by a separate experiment.

8. I will now describe what I regard as the most beautiful and conclusive of all the experiments. It is well known that when two bright platinum surfaces are im-

mersed in an electrolyte and an e.m.f. is applied to them, they become polarized. It is also well known that this polarization can be destroyed by coating the bright surfaces with platinum black, platinum black being a powder-like form of platinum. When the ohmic resistance of an electrolyte is measured between two platinum electrodes, these electrodes always have to be coated with platinum black to get rid of apparent resistance introduced by polarization. Since coating by platinum black is a well-known cure for polarization it occurred to me that if the action of the detector depended upon the polarization of the fine platinum wire forming the anode, coating this fine wire with platinum black should render it inoperative. At the same time, the thin coat of platinum black could not interfere with the heat action, if such existed, if it were made so thin as not to appreciably increase the diameter of the fine wire. I accordingly platinized the fine wire by the usual method, making it one of the electrodes, of an electrolytic cell containing a solution of platinum chloride. Examination under the microscope showed that a smooth coat of platinum black had been deposited upon the wire, the thickness of which was not greater than one-tenth of the diameter of the fine wire itself. Since the fine wire, in this case, had a diameter of 38/1,000,000 of an inch, the thickness of the coating of platinum black was not more than 4/1,000,000 of an inch. Such a thin coating as this could not sensibly change the heating effect in the electrolyte if such heating actually occurred. The diameter of the fine wire when platinized could not have been more than 56/1,000,000 of an inch, and I have found that a wire 90/1,000,000 of an inch in diameter is practically as sensitive as the 38/1,000,000 wire. Even a one-mil wire will respond if only the end of it is immersed in the electrolyte. It was found that the coat of platinum black entirely destroyed the sensitiveness of the detector. In fact when the fine wire was completely coated it would not respond at all. The experiment was performed by noting the response before platinizing and after platinizing, under exactly the same conditions with respect to the electrolyte and the depth of immersion in the electrolyte. In order to do this the electrolytic cell was placed under a microscope, so that the fine platinum wire could be carefully observed at every stage of the experiment. In this experiment the fine wire was usually immersed to a depth of about 4/1,000 of an inch, or to about 100 times its diameter. When carefully platinized, no response could be obtained even if the amount of immersion was made the very smallest possible.

From the preceding experiments I think it is evident that this detector of Hertzian waves is electrolytic in its action, depending upon the polarization of the fine platinum wire forming the anode of the cell.

Although its use as a Hertzian wave detector does not apparently depend upon the rectification of the Hertzian currents in the aerial wire, it is capable of being used as a rectifier. Mr. Pickard has actually observed these rectified Hertzian currents. As a rectifier it is essentially similar in structure to Pupin's electrolytic rectifier (see Bulletin American Physical Society, Vol. I, p. 21, 1900; U.S. Patent Specification No. 713,045). In this device the anode consists of a one-mil platinum wire sealed into a capillary glass tube, ground off squarely at the end, and the cathode consists of a small platinum plate. The use of this device as a rectifier and also as a Hertzian wave detector depends upon the existence of a polarization layer upon the small surface of the anode.

I find that to get good results with this detector the surface of the cathode should be much greater than that of the anode. If the surface of the cathode is made very small the sensitiveness of the device is very much decreased, and the response in the telephone is very faint. This is probably due to the fact that the effective electric valve action takes place only at the anode, and consequently the only result of reducing the surface of the cathode is to decrease the local current through the detector, and consequently to decrease its sensitiveness. It is interesting to note that the effective valve action is at that electrode at which oxygen is liberated. It is well known that oxygen is *absorbed* by platinum; that is, is condensed upon its surface. Such an action would undoubtedly give rise to a polarization film. It is a question as to whether such a layer of oxygen is in a gaseous state or in a liquid state, or is perhaps in a condition of unstable chemical union with the platinum.

Most of the experiments described were carried out in such a manner that the fine wire could be seen under a microscope. In this way its depth of immersion and its behavior in the electrolyte could be accurately observed. It was noticed that when a signal was received by the aerial wire one or more bubbles of gas were usually formed at, and set free from, the fine wire. The stronger the signal, the more bubbles were formed. For a weak signal only one bubble might be formed. This bubble was usually formed at the same place on the wire each time, but not necessarily at its end. Weak signals could be received and heard in the telephone without the apparent formation of any bubbles.

There is an interesting resemblance between this detector and the Wehnelt interrupter, the two devices differing principally in the magnitude of the quantities involved. In both the anode is very small compared with the cathode, and the action is due to the formation of gas at the surface of the anode.

I would suggest that this electrolytic detector might be called a *polariter*, since its action depends upon the polarization and consequent polarity of an electrolytic cell. The *coherer* depends upon the tendency of two clean and dry metallic surfaces to cohere under the influence of Hertzian impulses; the *barretter*, upon the heat generated by Hertzian currents in a conductor of small cross-section; and the *polariter* upon the breaking down of a polarization film in an electrolytic cell.

TECHNICAL EDUCATION AND BUSINESS.*

BY J. SWINBURNE, PAST PRESIDENT, BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.

One of the greatest difficulties in getting on arises from the idea, which is carefully fostered among English science teachers, that there is something degrading in applying science, and that business ability is an inferior quality which is to be despised. No science teacher is so foolish as to tell his pupils in so many words that the object of science is not to be useful; but the whole attitude of science teachers in this country is that of contempt for practice and admiration for unapplied science. All teaching is hopelessly unpractical, and the teaching even of science is very unpractical. This is not due to a curious perversity among schoolmasters in general or science teachers in particular; it is a perfectly natural and, I believe, quite unavoidable result.

If you imagine a school or college which somehow came into existence and gave a good education, teaching the things that are useful in a useful way, and imagine that after a time new masters have to be chosen out of the old pupils, who will get the appointments? The old pupils will consist of clever men who absorbed the education in a practical way, and equally clever men who absorbed the information but gave it a less practical turn. It will also consist of less able men of each kind. The ablest practical men will have gone out into the world, doing its work, and so will many of the less able practically minded men. The able men with a slightly unpractical bent will thus become candidates for the new posts. The next generation of teachers is thus less practical, and the education becomes more and more unpractical as time goes on. There is thus an unavoidable tendency for education to become more and more unpractical.

It is but human to glorify one's own office. The result is that the attitude of the science teacher in this country is that of a real though unavowed antagonism to the scientific development of the industry of the nation. Science, for which no use has been found, or which is not applied, is called "Pure Science," whereas it is really the raw material and should be called "raw" or "crude science." There is

*Extracts from an address before the students of the Institution of Electrical Engineers.

an assumption of superiority in the term "Pure Science," and generally the term "Science" is appropriated by workers in raw science in much the same way as the term "working man" is appropriated to the exclusion of brain workers. There is supposed to be something noble and superior about "Raw Science," and its study is treated as the unselfish devotion to the interests of man, which is obviously entirely the wrong way round. The so-called "scientific man" thinks that engineers and manufacturers are ignorant and unscientific, and that their practical knowledge is of no account; and that the cure for all industrial evils is more technical education, more universities and more power to the science masters. Though there are in existence a few practical science teachers they are rare. Perhaps no one would be more surprised than the average science master if you told him he is unpractical, and is, by attitude and example, hindering science. He does not mean to. He is as keen as possible to do just the reverse, and is generally exceedingly anxious for the spread of science or technology; but, unfortunately, he has got a wholly wrong view of the relations of science and business. There is no more baneful influence on the technical advancement of this country than the Royal Society ideal in science.

I would earnestly urge any of my hearers who has the idea that there is something noble and superior about "Raw Science," or who thinks little of business men, to get rid of all such notions if he hopes ever to get on. If you look round the electrical industry, or round the industries generally, who are at the top? Always the business men. The men at the head of large industries generally know very little science. A man may run a large electrical industry with the most vague ideas as to the true relation of the electrostatic and electromagnetic systems of units; in fact, he may think power, force and energy are very much the same kind of thing if looked at in a broad common-sense way without any scientific prejudice. If he wants good technologists he employs them. If he wants practical men who can take commercial responsibility, he pays good salaries, if he wants men full of book knowledge he pays low salaries, but he does not generally want them. Raw scientists, to coin a horrible word for a most estimable class, tell him he knows nothing about science, and therefore does not know how to run a scientific business, and tell him to subscribe to universities, which are so inefficiently worked that they have to beg, like hospitals, and to employ young men from the technical colleges. He either takes no notice or he gets annoyed at their superior attitude, and discharges a couple of scientific men and puts their saved wages towards the salary of a new practical chauffeur, and enjoys himself. Yet the science teacher looks down with contempt on the engineer as an ignorant rule-of-thumb inferior person, and the engineer in his turn looks down on the business man as a money-grubbing being with no brains and no lofty ideals. But this is all topsy-turvy. The business man is at the top, the practical engineer in the middle, and the unpractical engineer, or the raw scientist at the bottom. The business man may have no knowledge of the ways of nature, but he has a knowledge of the ways of man, a knowledge which is infinitely more difficult to acquire and infinitely more difficult to employ well. His brain may be different from that of the scientific man; but there is no reason to suppose that it is less. Its convolutions may be different, but the probability is that they are even more complex than those of the scientific man.

A man's value to the world at large may generally be roughly estimated by the income he earns. Where position is earned at the same time, the money income is in proportion less for a given usefulness; but taking such disturbing elements into account, the rule is broadly true. The business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant. Just as the raw scientist looks down on the engineer, and the engineer looks down on the business man, so the business man has a contempt for the engineer; and the engineer in his turn looks on the raw scientist as an unpractical crank. So much is this the case that the business man will not trust the engineer more than he can help. He assumes that if you know anything about anything you cannot possibly be a business man. I remember a board of directors finding fault with a report of mine because I said that making a certain article would pay. They said such a statement was outside my province altogether, as I was a scientific man, and therefore could not possibly know whether a manufacture would pay, as that is a business question. As a matter of fact, I had at one time charge of a factory for making the article in question, but that did not matter; I was scientific, and therefore it was not possible I could have any commercial sense. Now, how has such an idea come about? Is it not because scientific people profess such contempt for business that they do not trouble about it, and thus remain so useless that such ideas as those of my board are based on a foundation of truth.

If you examine the large industries you will, as I say, find the commercial or business man with little or no technical knowledge at the top of the tree. If you confine your attention to engineers you will find the engineers who make the biggest incomes and occupy the most important and responsible positions are those who have most business or practical knowledge. Our leading consulting engineers do not spend a large portion of their lives plotting curves, counting electrons, or even making anything more than arithmetical calculations. They spend their time dealing with large questions on purely commercial lines; and as a rule the bigger the engineer the more he knows about practice and business, and the less he knows about text book science. I do not mean for a moment to say that text book science is not of priceless value; of course it is; and the more scientific knowledge you or I, or still more, the leading engineers have, the better; but most of us suffer from too little common sense in proportion to our scientific knowledge.

In the charter of the Institution of Civil Engineers, the engineer is defined as "Directing the Great Sources of Power in Nature for the Use and Convenience of Man." With all respect to this august body, and their often quoted definition, I would humbly suggest that it is inapt. It is really the definition of a scientific man. It is incomplete as applied to an engineer, because it does not take into account the sordid element of price. An American definition is much better: "An engineer is a man who can do for one dollar what any fool can do for two." This is not poetical, and is useless for oratorical purposes; but it is right. It is no use being able to design most complicated alternating-current machinery, or being able to explain it with the help of a wilderness of clock faces and several issues of the technical journals, unless the machinery, when made, is cheaper than its rivals. Every design, every engineering manufacture, and every piece of engineering is only a question of price. It is unpleasant, perhaps, but it is a hard fact and we have got to face it. If one of us does £150 worth of work a year, and earns £100, he is efficient; if he only does £90 worth, he is an inefficient machine, and will come to grief. He is like a 90-K.W. alternator which takes 100-K.W. to excite; though the analogy is not close. If he does £15,000 worth of work and gets £10,000, he is an efficient machine of much larger size, and his efficiency is much more satisfactory to himself. I may mention, in passing, that an efficient man must do more work than he is paid for. This is not always realized. A man who only does what he was paid for would be of no use to the world at large. His efficiency is zero; his consumption being equal to his output. The man who does £15,000 worth of work and gets £10,000 consumes two-thirds of the work himself; so his efficiency is only 33 per cent.; which is very high, even for an engineer.

We see, then, that the business man is the master; the engineer is his good slave; and the raw scientist is not good enough even to be the slave of the engineer; he has no market value at all, except as a teacher of more raw science. The raw scientist will remain at the bottom of the tree until he gets rid of the professional cant which pretends that raw science is pure, or nobler and superior to science as a whole; and the engineer will remain in the middle position as long as he takes the middle view and considers engineering as something superior to money considerations, and as long as he looks down on business and commercial methods.