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The Canadian Engineer.

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Editorial matter, cuts, electros and drawings 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.

A NEW DEPARTURE.

After June 1st, 1905, The Canadian Engineer will be issued and conducted under new auspices; both as regards ownership and the editing of its columns. For twelve years this journal—with its familiar red cover—has been published by Biggar-Samuel, Limited, having business office at Montreal, and editorial headquarters in Toronto.

With the conservatism characteristic of Canadian enterprise, and a wise selection in the subject matter of its issues—supplying the wants both of the Engineer as theorist, and of the practical man in the workshop —The Canadian Engineer has made for itself a solid and permanent position in the industrial field of Canada. The steady rise in its circulation, and the gradual increase in the number and standing of its advertisers, has encouraged those responsible for its existence with the warranted belief that a bright future is ahead. But to make it worthy of its proud position as the leading Engineering Journal of Canada, and in order to meet the demands of the new era of prosperity in iron and steel, which one can hear coming on every passing breeze, increased capital is necessary for gathering the latest and best data on engineering enterprise in all parts of the world; whilst renewed energy, and a wide resourceful experience on the editorial staff is of vital importance, if the journal is not only to maintain its high standard, but to keep abreast of these times of startling transition in the domain of engineering.

The Canadian Engineer is now owned by The Monetary Times Printing Co., Ltd., proprietors of "The Monetary Times,"—the chief Financial Review in the Dominion; also "The Canadian Machine Shop," "Pulp and Paper Magazine," and "Canadian Journal of Fabrics." The President is Mr. Thomas Robertson, (Robertson Bros., Ltd.), a successful business man, with an international reputation as the inventor of confectionery machinery now in extensive use in the United States, Europe, and the British Colonies; Vice-President, Mr. James Hedley, for 25 years editor of "The Monetary Times," who has a wide acquaintance with the commercial and financial interests of the country; Secretary-Treasurer, Mr. Edgar A. Wills, for twenty years secretary of the Toronto Board of Trade, whose knowledge of Canadian business affairs is a guarantee that the business side of the journal will be in wise hands.

The new editor, Mr. Samuel Groves, is a trained English Engineer, with a ripe knowledge of the best modern engineering practice, gathered in some of the largest industrial establishments in England, the United States and Canada. He is an expert in Metallurgical Science, and was 1904 Lecturer on "Mines, Furnace, and Foundry" to the Carnegie Technical Schools, Pittsburgh.

Under this new regime, it is hoped to make The Canadian Engineer a fertile field of *suggestion*, where the wide-awake Civil, Mechanical, or Electrical Engineer, enterprising Manufacturer, and intelligent Mechanic, may gather reliable data, which will aid them in solving many a problem in Applied Science, and by the association of ideas, enable them to design, with greater ease and precision, appliances, structures, and plants for developing the great natural resources and boundless mineral wealth of the Dominion.

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—The investigation into the telephone question by the special committee of the House of Commons is being continued, and the evidence collected from many quarters shows not only that the Bell Telephone Company has in many instances given unsatisfactory service at rates much higher than would be charged by independent companies, or by a service owned by municipalities, but that the general policy of the company has been inimical to the interests of the public and the municipalities whenever its monopolistic purposes have been interfered with. Indeed the president of the company in responding to the toast of his health at Montreal, where the Bell Company entertained the members of the parliamentary committee with princely hospitality the other day, frankly avowed that the study of the company was the profits to shareholders, and not necessarily the public benefit. "I do not hesitate to say," observed the president, "that the shareholders have been considered first, and the public second." It is quite right that shareholders should look for a return upon their investment, but when the public advantage and convenience are the very basis of the success of such an appliance as the telephone, and when the processes of stock watering through which the Bell Company has gone render it impossible to pay dividends and give a service to be compared with that furnished by independent companies with legitimate capital and modern apparatus, the plea of the president that the people of Canada should continue to tax themselves for the benefit of a few stock operators will hardly find justification. Meantime the public will note the effusive hospitality of the company in entertaining the members of a parliamentary committee whose report will affect the future of the company's monopoly. The good taste of members of the committee who accepted such hospitality when on such a mission is questionable, but it is to be noted that some of the more responsible members of the committee absented themselves from these seductive festivities.

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—For the third or fourth time the Ontario Legislature has thrown out the bill promoted by the Ontario Association of Stationary Engineers acting in combination with the Canadian Association of Stationary Engineers, and the rejection of the bill this session puts the two political parties on the same platform with regard to this measure. It must occur to the Associations interested that there are at least grave doubts as to the practical working of a license bill, or that most of the legislators are convinced that some injustice would result from a compulsory license law. The bill if passed would prevent any but holders of certificates from the Association taking charge of any steam plant above a certain horsepower. The claim of the Association is that men who are placed in charge of stationary steam plants have the lives of occupants of factories and office buildings as completely at their mercy as engineers of steam boats who are compelled to pass an examination and take out a license before they can be legally placed in charge of a marine engine. The same arguments that apply to the engineering of a steamer will apply equally well to the management of the power plant of a factory or office building. If we get down to the principle on which medical men and lawyers are authorized to carry on their profession there is as much to be said in favor of a license for stationary engineers as for the license of doctors, dentists, or lawyers. In each case the bill creates a close corporation, but in every one of those fields it must be confessed that the mere possession of a diploma, certificate, or license does not confer upon the holder the gift of any special judgment or common sense which he did not possess before he was enrolled in the corporation. This is the weakness of all close corporations, and it is still a debatable point whether these institutions are not narrowed rather than broadened by a reliance on a paper document which does not of itself confer sense or discretion upon the holder. One argument used in favor of a license is that it would be a safeguard to the public. This is questionable, because such a bill would tend to transfer the responsibility from the owner of a plant to the man who operates it, whereas the responsibility should rest upon the proprietor rather than upon the employee. The British method of fixing this responsibility is the wisest, and the proof of this is evident from the fact that no country has such a large number of steam plants in proportion to its population as Great Britain, and in no country is the ratio of accidents from boiler explosions and mishaps to machinery so small. The British law leaves the selection of an engineer or superintendent entirely to the owner of a factory or power plant, and when an accident occurs an investigation is held by the Board of Trade, and if the owner is found to be negligent by reason of using unsafe machinery, or by employing an incompetent man, he is assessed damages for the loss of life and property. This is responsible government carried into the realm of steam engineering and the management of power plants, and it is the only true solution of the chief problem arising out of the bill which has been rejected by the Ontario Legislature. It would be better, however, if legislation on this question were uniformly applicable over the whole Dominion, and hence it would be well if the provinces could unite in relegating this subject to the federal authorities.

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MAJOR H. A. GRAY.

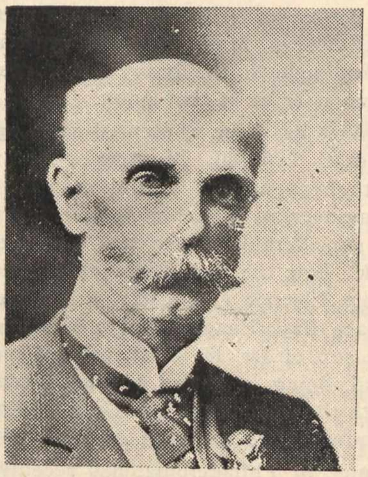
Major Henry A. Gray, the Dominion Government engineer in charge of the Public Works Department for Eastern Ontario, died at his home in Toronto on the 23rd as the result of pneumonia, which developed from a cold. He had been ill only a couple of weeks. Major Gray was not only a genial gentleman, but an efficient officer, and his death is regretted by a wide circle of friends in the profession and outside. He was for many years a member of the Institution of Civil Engineers of Great Britain, of the Canadian Society of Civil Engineers, and was for a term president of the Engineers' Club of Toronto, of which he was one of the founders. Major Gray was born at Edgbaston, near Birmingham, England, 1843, and was the son of

Major H. A. Gray.

Edmund A. Gray, for many years a prominent educationist connected with the Anglican Church, and an artist of considerable repute. He came to Canada in 1866, joining the engineering staff on the location surveys of the Intercolonial Railway, acting on surveys location till 1871 as assistant engineer. He was appointed to the Public Works Department of Canada under Sir Charles Tupper in 1878, and was placed in charge of the Western Ontario division, with headquarters at Stratford until 1886.

From 1888 to 1889 he was resident superintendent for Canada in the Maritime Provinces, and in 1889 he was recalled to take charge of the district of Western Ontario. A widow and three sons and three daughters survive.

J. G. Sing, a member of the Canadian Society of Civil Engineers, and now engineer in charge of the Public Works of Canada in Western Ontario, will succeed Major Gray, whose assistant he was in Toronto for five years. H. J. Lamb, C.E., has been appointed as acting engineer in charge at London. Mr. Sing has been on the staff of the chief engineer of Public Works for a number of years, and has had charge during that time of many important works on



J. G. SING.

the Great Lakes. Mr. Sing is also a member of the Association of Ontario Land Surveyors, and was county engineer of Grey for twelve years. Among many other works he made the survey of the islands on the north shore of Georgian Bay for the Dominion and Ontario Governments.

THE TURBINIA.

As the steamer Turbinia, of the Turbine Steamship Co., of Hamilton, was the first vessel in North American waters to be propelled by steam turbine, and as she is still the only steamer of this kind on the Great Lakes, a review of her work now that she has commenced her second season will be of interest. During the last season she ran 203,280 miles, making 528 trips without any mishap. Her coal consumption last year averaged 2.21 tons per hour under a speed of twenty-three miles, or 1.48 pounds of coal per indicated horse power per hour, compared with 1.58 as the best result under like conditions with reciprocating triple expansion engines. It must be borne in mind, however, that the Turbinia did not reach Lake Ontario till June last year, and was immediately put into commission without being overhauled after her sea voyage, so that she ran under a disadvantage. A little overhauling during the winter has enabled her to eclipse her performances of last summer, and her coal consumption has been reduced this season to 13½ tons per twenty-four hours against 15 to 16 tons last year. In making comparisons with transatlantic steamers it must be remembered that the Turbinia now uses Pennsylvania coal. With Welsh coal, Albert White, her engineer, who has had experience on both sides of the Atlantic, says her consumption would be only about nine tons per twenty-four hours. Her average last year was 9.01 miles per ton of coal consumed. Her average consumption of coal per indicated horse-power is now 1.3 pounds, against 1.46 to 1.5 pounds in the better class of reciprocating triple expansion engines. The Turbinia is a vessel of 1,086 tons, and her engines develop 3,400 h.p. at 680 revolutions per minute. The only criticism offered by passengers last year was that some hot days the heat from the engine-room added to the sultriness of the weather when the boat was lying at the dock, but this drawback has been got over by putting up a partition at the foot of the gangway, thus closing off the engine-room from the cabin and decks. The heat will be more completely taken out of the engine-room also at the end of this season by means of a fan. Generally speaking, the Turbinia has been most successful as a passenger steamer. Her smooth running, the absence of vibration, her steadiness in rough weather and her swiftness combine to make her an ideal steamer, either for excursionists or for those travelling between Toronto and Hamilton on business. She can make the run from city to city when necessity arises in 1 hr. 22 min., and she has made on occasion twenty-five miles per hour, though her makers guarantee only twenty miles.

Speaking generally, Mr. White considers that the Turbinia and other turbine ships have demonstrated the following points of superiority over vessels propelled by reciprocating engines: less space taken up in the vessel by engines and machinery; less weight of machinery, and that weight better placel in the ship, as it rests lower in the hold; less vibration, and consequently less stress on the plates and frame of the ship; fewer parts of machinery, and less loss by friction, also less liability to accident and disorder; fewer skilled hands in the engine-room; and finally, greater economy of coal at the normal speed for which the vessel is designed, there being 125 expansions in the turbine engine against 27 in the triple expansion reciprocating engine.

Tests of the British cruiser Amethyst, fitted with turbines, show that when at full speed the steam consumption on the main turbines was under 13 pounds per h.p. per hour, a result never before recorded with reciprocating engines. In the sister ship, with reciprocating engines, the best results were 15½ lbs. of steam per h.p. per hour. At 10 knots the turbine ship seemed to require more steam by five pounds per indicated h.p. per hour, while at 14 knots about one pound less. This apparent lack of economy at reduced speed may be made up by the use of exhaust from the auxiliaries. In any case, this decreased economy will not affect merchant vessels, as turbine engines can be designed for any determined speed. At 18 knots the turbine required about three pounds less steam per h.p. per hour; at 20 knots, 5¼ pounds; at full power the economy was still more marked, the reduction being over 30 per cent. The coal consumption in the Amethyst at 10 knots was higher than her sister ship, at 14 knots about the same, and at 18 knots it was 20 per cent less, at 20 knots it was 0.8 pounds, or 30 per cent. less, and at full power one pound per h.p. per hour, or 40 per cent. less. At 20 knots the cruiser with triple expansion engines would travel 2,140 miles, and the turbine cruiser 3,160 on an equal quantity of coal.

CATALOGUES RECEIVED.

The following catalogues have been received since last issue, and may be obtained from the respective firms by mentioning the Canadian Engineer:

Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C.—Catalogue of lead-covered and other cables. Containing tables of standard weights and resistances and general information on conductors. 175 pages, 4½ by 7, boards. Price, 5s.

Wellman-Seaver-Morgan Co., Cleveland, O. — Water power equipment for low heads, 25 pages, 6 by 9.

General Engineering Co., of Ontario, Ltd., Toronto.— The Jones Underfeed Mechanical Stoker, a descriptive booklet, fully illustrated. 90 pages, 9 by 6.

Booth Water Softening Co., 126 Liberty Street, New York.—Hard Water Made Soft, a booklet describing three different types of water-softening machines, giving their respective advantages. 24 pages, 6 by 9.

Diamond Expansion Bolt Co., 9-15 Murray Street, New York.—Catalogue of expansion bolt and shield. 14 pages, 6 by 9.

Worthington Pump Co., Limited, London, E.C.—Air and Gas Compressors, a detailed catalogue of compressors, lifts, hoists, etc. Fully illustrated. 175 pages, 6 by 9.

Cincinnati Electrical Tool Co., Cincinnati, O.—Price list of portable electric drills and grinders.

Hayward Co., 97 Cedar Street, New York.—Digging Machinery, a small booklet showing dredges, buckets, derricks, etc. 32 pages, 6 by 3.

B. Greening Wire Co., Ltd., Hamilton.—Price list of crimped diamond mesh fencing, a new line which this company is now putting on the market.

Penberthy Injector Co., Ltd., Windsor.—Price lists of injectors and glass oilers.

National Electric Co., Milwaukee, Wis.—Cards showing photographs of machinery under construction, and also of electric car equipped with Christensen air brake.

Kellogg Switchboard and Supply Co., Chicago, Ill.— Brownie Bulletin, an illustrated booklet describing in Brownie style the new Kellogg common battery desk telephone set. 16 pages, 7 by 6.

Dodge Manufacturing Co., of Toronto, Ltd.—Condensed price list of power transmission goods, including pulleys, clutches, hangers, rope sheaves, etc. 16 pages, 6 by 9.

Canadian Westinghouse Co., Hamilton.—Bulletin 1109 on the Single Phase Railway System; also Bulletin 1110 on Westinghouse Catenary Line Construction. Also small booklet describing direct current motors, type R.

Westinghouse Electric and Manufacturing Co., Pittsburg.—Bulletin 1102 describing direct current multiple arc lamp for 110 and 220 volts. Also Bulletin 1104 on portable instruments.

MISCELLANEOUS NOTES.

A. C. Leslie & Co., iron and steel merchants, Montreal, have moved to their new building at 560 St. Paul Street.

The Garlock Packing Co., of Hamilton, has removed its Montreal branch into more extensive premises, where a full supply of all packings will be kept on hand. The new address is No. 371 St. James Street.

The friends of John D. Ronald, founder of the fire engine works formerly at Brussels, and latterly of London, will be glad to hear that he is returning from California to Canada, and will take up his residence at Strathroy, Ont.

The American Radiator Company, of Chicago, known as the Radiator Trust, has purchased the old plant of the Cockshutt Plow Company, Brantford, which it will enlarge, and will make hot water boilers and radiators for Canadian trade.

The business heretofore carried on by the firm, "The Polson Iron Works," Toronto, was acquired on May 1st by "Polson Iron Works, Limited." The new company has acquired all the assets of the business and has assumed its liabilities.

The town of Campbellford, Ont., contemplates a considerable development of water power at two points on the River Trent within the control of the municipality, and has asked J. S. Fielding, consulting engineer, Toronto, to make a survey and report upon the power obtainable, and its cost.

Reports from different engineers are now being sent in to the Temiskaming Railway Commission on the question of the operating that road by electricity. These reports are being considered, and Cecil B. Smith, chief of the commission, has visited Pittsburg to enquire into the latest developments in electric haulage.

The Clarkson School of Technology, of Potsdam, N.Y., whose aim is to provide technical education of college grade, will hold a summer session beginning July 6th, and extending for six weeks. The courses include home science, as well as literature and mathematics, and a special course will be instruction in automobiles.

The Cleveland and Elyria factories of the Federal Manufacturing Company have been purchased by the Garford Company, with capital stock of $400,000, and with Arthur L. Garford as its president. The Garford Company will continue to manufacture railway curtains and curtain fixtures and parts for pleasure automobiles and commercial power vehicles.

The Western Machine Co., lately established at 300 Arthur Street, Toronto, by A. Lowndes and George McLachlan, has turned out for J. A. Goddard, Toronto, the first automobile moving van. This vehicle is propelled by an 8 h.p. gasoline motor. The wagon box is 18 feet long by 6 feet wide and 7 feet 6 inches high, and will move at one load the contents of an ordinary eight-roomed house.

The Toronto Furnace and Crematory Company has applied to the Toronto city council for permission to establish a foundry and machine shop on Golden and Silver Avenues, and the Fairbanks-Morse Canadian Manufacturing Company, to erect a foundry on the south side of Bloor Street, west of the G.T.R. The Toronto Railway Company wish also to establish a machine and blacksmith shop at the foot of Sherbourne Street.

The Missisquoi Pulp Co., Sheldon Springs, Vt., have contracted with the Aberthaw Construction Co., of Boston, to build a concrete-steel dam across the Missisquoi river. The dam will be about 300 feet between abutments, and at all heights, from 15 feet to 38 feet. The engineers of the dam are the Ambursen Hydraulic Construction Co., 176 Federal Street, Boston, Mass., and the work is designed to warrant the dam against the heavy ice gorges which have carried out several cribs at that point.

S. C. De Witt has been appointed sales agent for Allis-Chalmers-Bullock, Limited, Montreal, for the Maritime Provinces, with headquarters at Halifax. He is a graduate in electrical engineering of Lehigh University, Pennsylvania, and has had considerable experience in different lines of electrical work. For the past three years he was manager of the De Witt Electric Co., Ltd., with places of business at Sydney, Glace Bay, Pictou, Truro, N.S. and Fredericton, N.B. He is a son of Dr. De Witt, present mayor of Wolfville, N.S., and, being a native of the Province and well acquainted with the business in the East, will no doubt prove a valuable acquisition to the staff of the company.

E. T. Hanna, of Philadelphia, has recently been in Toronto arranging with the Canada Foundry Company, Limited, to manufacture in Canada the Canada water tube boiler, of which he is the patentee. He reports the sales of three boilers, 775 h.p., for the Toronto Water Works, and three boilers, 900 h.p., for the Chatham, Wallaceburg and Lake Erie Railroad Company. This boiler is also made at Indianapolis under the name of the Atlas water tube boiler, and is in use in fifteen States, besides Cuba, Mexico and Japan, the Japanese Government having recently installed twelve of these boilers of 400 h.p. each.

The Western Canada Flour Mills Company, comprising the A. Kelly Milling Company, of Brandon, and the Lake Huron and Manitoba Milling Company, of Goderich, will erect a 4,000-barrel mill in the vicinity of Winnipeg, together with a half million bushel storage elevator and a warehouse to hold 60,000 barrels of flour, with a complete line of new elevators throughout Manitoba, including twenty-six already in operation. The syndicate will have a total milling capacity of 6,500 barrels of flour and two hundred barrels of oatmeal daily, and will also continue the manufacture of salt in Goderich.

Ernest Brown, M.Sc., of Liverpool, Eng., the new assistant professor of applied mechanics at McGill University, graduated from University College, Liverpool, in the Science faculty of the Victoria University with first class honors in engineering, and is also master of engineering in the University of Liverpool. He has held an 1851 exhibition research scholarship. In 1900 he was appointed assistant lecturer in engineering in Liverpool, and two years ago, upon the formation of a faculty of engineering in the University of Liverpool, he was appointed lecturer in applied mechanics in that university, lecturer on strength of materials, theory of structures, hydraulics and dynamics and kinematics.

E. A. James, president of the Engineering Society of the School of Practical Science, Toronto, for 1904-5, has been appointed resident engineer for the Coldwater section of the Toronto-Sudbury branch of the C.P.R. Mr. James graduated from the School of Practical Science in 1904, and this year graduated from Toronto University in applied science, his special subjects being hydraulics and strength of materials. While still a student Mr. James did excellent work on the drainage systems of Manitoba in 1902 as engineer in charge of District No. 6, and in 1903 as assistant engineer of the McLeod district of Alberta, where irrigation works were carried out last year.

The fourteenth annual convention of the Ontario Association of Stationary Engineers was held on May 29th in Engineers' Hall, Toronto. It was the largest meeting ever held, and delegates were present from Hamilton, London, Paris, Brantford, Niagara Falls, Kingston, Brockville, and other Ontario points. The new officers elected were as follows: President, George Fowler, Toronto; vice-president, W. F. Chapman, Brockville; registrar, W. G. Blackgrove, Toronto; treasurer, Chas. Moseley, Toronto. The board of examiners elected were: J. G. Bain, Toronto; Fred. Mitchell, London; W. F. Chapman, Brockville, and F. W. Donaldson, Toronto. A representative number of members were formed into a committee on legislation to follow up the recent efforts to secure a compulsory license law for engineers in this Province, and a sum of money was placed to the credit of the committee. The number of certificates now in force granted by the association is between 1,300 and 1,400, these being of three classes, first, second and third. Members were pleased to see the retiring president, J. G. Bain, present after his recovery from a serious accident, and he and the other retiring officers received a hearty vote of thanks for their work during the past year. The next place of meeting will be Hamilton.

FORMATION OF ANCHOR ICE AND PRECISE TEMPERATURE MEASUREMENTS.*

BY DR. HOWARD T. BARNES, MCGILL UNIVERSITY, MONTREAL.

My attention was first directed to this very important problem by the Harbor Commissioners of Montreal in 1896. The Chief Engineer of the Harbor Commissioners, Mr. Kennedy, was a member of the Flood Commission to investigate the very serious floods that visited the city of Montreal from time to time, and he was appointed with other gentlemen to go into this question with a view of alleviating the disastrous effects. During the investigation of the Flood Commission efforts were made to study the slush ice, which is called in Canada frazil ice, and to connect the formation of this remarkable ice with the temperature changes in the water. A great many results were obtained showing that these temperatures varied a good deal. Calling for observations on this point many independent observers throughout the country took temperature readings during the winter time with instruments at hand and sent their results in to the Commission. The Commission also took a series of measurements of the temperature of the water and they thought they detected small differences of temperature during such times as the ice was most severe. But they were not sure of their results on account of the difficulties encountered in making the measurements. Other observers were not, however, so careful and they sent in results showing apparently that the temperature of the water varied from five to six degrees below the freezing point. Now, it was easy enough for the Commissioners to explain why these very low results were obtained when they received details in regard to the manner in which the measurements were carried out. Usually it was a mercury thermometer thrown in the water and held up in the air to read. Mr. Sproule, the assistant engineer of the Commission, devised a tin case for his thermometer in which he could entrap a small amount of the water and thereby have a longer time to read the thermometer after drawing it out of the water. The thermometers were not delicate enough, and as Mr. Sproule told me, when the question came up in 1896, that during the time of the Commission and later, it was impossible for him to say definitely that any deviations from the freezing point took place, his thermometer being graduated to degreees, and such variations that would occur beyond this point were not recorded. That is why the Commission came to McGill for more refined measurements. They wished, if possible, to connect the temperature of the water with the formation of frazil ice.

We devised then an instrument for doing this which depended on the change in the electrical resistance of platinum wire. Now such instruments have been made before, and have been exceedingly useful for all classes of temperature measurements; but we devised the most delicate differential thermometer that probably has ever been made. This thermometer had a degree which was eight inches long. It was possible to estimate by this means to the ten-thousandth part of a degree. Later I shall speak a little more about the practical details of the measurements.

*A paper presented at the monthly reunion in New York City, in March, 1905, and at the Scranton meeting (June, 1905) of the American Society of Mechanical Engineers.

My first object is to take up the problem of ice formation and so lead on to the measurements, and connect these measurements with the loss of heat from water which governs the formation of ice in the laboratory or in the actual conditions of nature, which problem is not an easy one. The varied conditions in which we meet river ice make it almost impossible to establish a definite set of rules by which we can say how much ice will be formed or what the ice will do. The weather itself varies from year to year and what conditions will hold one year will be entirely different the next. A long and continuous study of each problem of engineering should be made before anything definite can be said in regard to the effects of river ice.

Now I want first to run over the laws of heat, which I shall have to refer to, and I do this for the sake of clearness. I will do this very briefly, somewhat in the form of a review, but if we are to get a connected and scientific knowledge of the subject we must review first of all our elementary physical knowledge of heat transmission, for, after all, the problem is a problem of heat transmission. The extraction of heat from the water causes ice to form. How is this heat abstracted and how does water gain heat again?

Now the three recognized methods of transmission of heat are convection, conduction and radiation. This does not mean that we have three different kinds of heat, that one kind of heat is lost by conduction, one by convection, and one by radiation. It means three processes are operative.

The first method, convection, we may briefly define as the transmission of heat by the movement of matter itself. You have illustrations of this in the ocean currents and trade winds which are so important in tempering the earth's climate. It depends entirely on the fact that matter when heated expands and becomes less dense. Therefore, a heated portion of matter surrounded by cooler matter will be displaced by the cooler matter as a light object is displaced by water. So we have heated matter rising when surrounded by cooler matter. We have one exception to this in water at 4 degrees Cent. As an illustration of this showing the maximum density of water, we have twelve thermometers of equal bulbs containing equal weights of water. One bulb is placed at zero and the others in successive degrees to twelve. At four degrees we have the maximum density or the liquid occupying the least volume. Below that point to zero, water expands. Above that point, as high as we can go, water expands; hence we see that in the case of water the process of convection will cause a current of warmer water to rise until we get to four degrees, and then the reverse process will take place. Below four degrees, as the water becomes cool, the warmer layers sink to the bottom. Now, that has a very important influence, as we shall see presently in ice formation in lakes and quiet water.

The next process of heat transmission is conduction. By conduction we mean the transmission of heat from point to point in the body. Heat is a form of energy; it is a measure of the vibration of the molecules of a body. When the molecules at one point become warm or vibrate more energetically, these vibrations are conveyed to neighboring molecules.

Conduction only affects the ice problem in so far as it causes a thickening of the sheets of ice over a river or lake. We can measure the conduction, and we know it in definite units for ice and for water, and in any problem in which conduction enters we can calculate with a fair degree of exactness the rate at which ice will form; otherwise, conduction plays a very little part in river ice formation.

The next process is that of radiation, or the transmission of heat by ether waves. All bodies radiate energy by ether waves, which travel out in all directions in straight lines with a velocity of 187,000 miles a second. They are in fact merely a continuation of the ether waves which are capable of affecting the optic nerve, and which we call light, and we know some of these light waves possess heating qualities.

These waves extend for a long distance beyond the visible spectrum, and they are being investigated and the limit pushed further and further down. All light waves travel with the same velocity, and hence the length of the waves and the number of vibrations of the waves must vary correspondingly. The longer the wave the slower the vibration. Now we know that this is one fact that distinguishes the heat waves from the light waves. We can extend down for a long distance, almost to connect with the electrical waves which we are able to produce, but we have not yet bridged over a long gap which exists.

When we come to examine the whole spectrum of ether waves, we pass up from the electrical into shorter waves which possess heating qualities. We pass on to shorter waves still light; we pass beyond these into waves which are still shorter, ultra violet; we pass on further, and we come where—perhaps to the X-ray, for the latest ideas in regard to these X-rays are that they are very short waves of ether. We can prove in a wonderful way that the heat waves are similar to light in that they may be reflected, refracted and polarized.

Now the problem of heat transmission by radiation is the most difficult. We know the least about it. A great deal has been done recently in unearthing the laws of radiation from black bodies. And we have in applying our knowledge of radiation to problems, first of all to make a calculation of what it would be if the object were a black body. Then we must make estimates. Every kind of surface depending on its roughness and its temperature will send out or absorb different kinds of waves. In general, the higher temperature of the body the more of the light waves, or shorter waves are sent out and the fewer of the longer waves. The lower the temperature the fewer of the shorter waves will be sent out and the more of the long. Finally we get bodies which are not luminous at all, and then if we take bodies still colder, we find that they emit longer and longer rays the colder they become. Now the difficulty in applying the laws of radiation to practical engineering problems is that we do not know enough about surface conditions or radiation from cold bodies.

Bodies differ a great deal in their power of absorbing rays. Some bodies transmit heat waves; some do not. We have, for example, in colored glasses, very beautiful illustrations of how some bodies transmit light waves and some do not. Some of the rays are absorbed and some can go through. Tyndall has shown us that for heat rays water and ice are very opaque, and he has pointed out that of the longer rays which are emitted from an object heated one hundred degrees above its surroundings, the surroundings being the ordinary temperature of the room, these would be entirely stopped by a mass of water or a mass of ice. Ice is a little more opaque to heat rays than water. From the heat rays that are produced from an Argand burner only 11 per cent. penetrate a small thickness of water. The penetrating rays, however, manage to pass through further and thicker layers of water. The filtering process is very complete, but the rays which penetrate pass on through the water unabsorbed.

This property of selective absorption, which is shown by many substances, is shown particularly for water, and it has only recently been proved experimentally that a large absorption band exists in the case of water for the longer heat rays. An absorption band is a band in the spectrum where the rays have been removed. Now to make the explanation clear, consider some examples. It is an exceedingly important point that I wish to bring out, and one which is to determine whether the long heat rays can penetrate water. Now first of all consider the spectrum. If we can study the light rays in regard to their absorption in bodies, then we can apply our knowledge to heat rays. We find that each vapor or gas has its characteristic spectrum. A good illustration is afforded in the absorption spectrum of iodine or bromine vapor. The light transmitted through the vapor when refracted through a prism shows dark bands together with characteristic colors. These dark bands show where the light at that particular wave has been filtered out and been absorbed in passing through the vapor.

(To be continued.)

DEVELOPMENT AT NIAGARA.

Since the general report of progress made in the Canadian Engineer last year on the power developments at Niagara Falls on the Canadian side, much work has been accomplished on the three great works.

At the Ontario Power Co.'s works little or nothing could be done on the forebay during the winter, but work on the penstock, power house, distribution station and tunnel was carried on all winter, and about 1,000 men are now employed by the company and its contractors. The foundations for the intake piers have been laid, and the forms for the piers, which will be made of reinforced concrete, are being put in. The forebays are being cleaned, and preparations are made to let the water in this month. The type of gate adopted is the "Stoney" gate, made of steel, by Ransomes & Rapier, London, Eng. The gate is now in position. The big steel conduit has been concreted over, and is now being covered with earth to a depth varying from four to twelve feet. The distributing station is being put up, and excavations for the spill weir are being made. The spill weir tunnel is also being driven. The first of the penstocks is in place, and tested, and the first unit of 30,000 h.p. is practically ready, while the second is in course of erection. The power house, which is of concrete, will have temporary ends put in to enclose the units as they are installed. The cable conductors from the power house to the distributing station on the hill are now being laid. It is stated that the first power from these works, which will be ready for transmission about August next, will be used on the United States side, and that Albright & Hays, of Buffalo, who are financially interested, are said to be arranging with a corporation in New York State to take this power.

The Electrical Development Co., of Ontario, has several hundred men at work. The overflow dam, 700 feet long, and with a maximum thickness of 33 feet 3 inches at the base, is now completed. This will have a granite coping to resist the ice. The outer line of ice boom arches is finished. It is built of concrete, the portion of the masonry arches below a line two feet lower than low water mark being of cut stone. Work is being pushed on the head walls and head gates, which will be finished this summer. The excavations for the wheelpit are done, and the masonry lining of the pit is progressing rapidly, two-thirds being already built. The excavation for the tail-race tunnel is completed, and the masonry lining for this is also well advanced. Preparations are well on for the building of the power house, the foundation walls for which are already being laid. The erection of the power house will go on as fast as the foundation walls can be laid up. The opening at the end of the tail-race tunnel under the Falls was made last season, and has been in constant use since for the disposal of material, without any of the trouble that was feared by some, so that this feature may be taken as an accomplished fact. The transformer station, located on the hill, outside the park limits, is well advanced, the erection of the steel work being now in progress. The electrical machinery and some of the hydraulic machinery will soon begin to come. The structural steel and cast iron piping is made by the Canada Foundry Co. It is probable that the first unit of 12,500 h.p. will be ready to transmit current to the industries of the vicinity and to Toronto next autumn.

The Canadian Niagara Power Co. is drawing to the close of construction work for the operation of the units it has in present contemplation. The power house has already a finished appearance, the granolithic floors being laid, and all will be in shape by next month. Three wheels of 10,000 h.p. each are now erected and in working order. One of them is already connected up to the United States side of the river for use in case of an accident to the big power works there with which the Canadian company is financially associated. Two more wheels are being installed, and will be completed during the summer. The power house is heated by natural gas from Welland county, supplied at twenty cents per thousand. The false dam was taken away, and all the forebay finished in March last. The standpipe, 116 feet high and 30 feet diameter, is now finished, and water can be pumped to it either by water power or electricity. The machinery so far installed has stood the tests perfectly. The 60,000 volt switches are nearly finished, and the low-tension bus bar compartment is completed. The transformers are all in place in their building, which was finished last year. Only a few minor details of this building remain to be done, and these will be finished this month. The contract has been let for the second section of the wheelpit, and the excavation is now down 120 feet out of a total of 150 feet. This will be finished in about nine months, and will contain six units of 10,000 h.p. each.

CANADIAN ELECTRICAL ASSOCIATION.

The annual convention of the Canadian Electrical Association will be held on the 21st, 22nd and 23rd of June in the rooms of the Canadian Society of Civil Engineers, 877 Dorchester St., Montreal, and bids fair to be a successful one. Among the items of the programme already arranged for are the following: A paper on "Transformers," by R. T. MacKeen, Canadian General Electric Co., Toronto; "Operation of Transformers at Varying Frequencies and Voltages," by M. A. Fammett, Montreal Light, Heat and Power Co.; "Induction Motors," by Mr. Burson, Allis-Chalmers-Bullock Co., Montreal; "Economy of Isolated Plants," by K. L. Aitken, consulting Electrical Engineer, Toronto; "Carrying Capacity of Enclosed Conductors," by Prof. R. B. Owens, McGill University; "Incandescent Lamps," by A. B. Lambe, of the Canadian General Electric Co., Toronto; "Operation of Alternators in Parallel," by A. L. Mudge, formerly of Montreal, now of Milwaukee; "Selection and Maintenance of Service Meters," by Wm. Bradshaw, of the Canadian Westinghouse Co., Montreal.

Those who remember the valuable information brought out through the "Question Box," instituted through the patient industry of A. A. Dion, will be glad to learn that Mr. Dion has prepared another budget of questions, the answering of which will throw fresh light on many difficulties encountered in practice by members. These questions relate to the management of central stations, to rates for lighting and power, to water wheels, boilers, engines, and steam turbines, generators, motors, transformers, wires, cables, meters, lamps, and miscellaneous.

Among the social features arranged for are a luncheon at the Allis-Chalmers-Bullock Company's works, a smoking concert, and visits to the various sub-stations of the Montreal Light, Heat & Power Co. A trip to Shawinigan is also under consideration. The laboratories of McGill University will be open to inspection by the delegates. The local entertainment committee is composed of: H. D. Bayne, Canadian Westinghouse Co. (chairman); R. E. T. Pringle, Prof. R. B. Owens, H. J. Fuller, The Canadian Fairbanks Co.; C. F. Sise, assistant superintendent, Bell Telephone Co.; Edgar McDougall, Caledonian Iron Works; Ed. F. Sise, manager, Wire and Cable Co.; R. S. Kelsch, consulting engineer; Wallace C. Johnson, Shawinigan Water and Power Co.; W. F. Dean, Canadian General Electric Co.; Alfred Collyer, Allis-Chalmers-Bullock Co. The secretary-treasurer of the Association is C. H. Mortimer, Confederation Building, Toronto.

A NEW OPINION OF THE WEST.

While travelling the other day I shared a seat with a keen-eyed gentleman of middle age. Conversation drifted from one topic to another, and as he had just come from Niagara, we got talking about the power developments there. I ventured to remark that we had unlimited water-powers all through this country, especially in the northern portions, many of the greatest falls being in parts of the country that seem now to be beyond civilization.

"Quite true," remarked my companion, "but we have a great many now being utilized, and quite within the bounds of civilization. Kakabeka Falls, the Soo, Niagara, Shawinigan, Montmorency, and Grand Falls, on the St. John, are all powerful falls, and all well within reach. Within ten years these falls and others will be running our railroads for us. Niagara will carry the trains as far as Detroit, and something else will pick them up there. The Temiskaming Commission are already considering the electrification of the provincial line in the north. Out west the mountains will provide power for a great distance."

My friend was now on his favorite theme—the West. "Within ten or fifteen years," said he, "the whole face of this continent will change. The front will shift from the Atlantic to the Pacific. Go to Winnipeg and you will find a large city being built. Dozens of warehouses are going up, but not one man in five can tell why he is building, except that Henry Smith and John Jones are doing the same thing. People are very much like sheep and they are all following the leader in building up Winnipeg. They have the notion that Winnipeg is the gateway to the West; it is not any such thing, it is only the back door. Within ten years there will be a good many empty warehouses in Winnipeg. No, Vancouver is the city of the future. It has the finest climate in Canada, and it has the best harbor on the coast. San Francisco is land-locked, but Vancouver is mountain-locked. Portland is away up a river, and Seattle is too much exposed. Vancouver is in a position to do an enormous trade with the Orient, and when the present war is over there will be an opening up of China, such as no one at present dreams of. Canadian wheat will go to that country in continually increasing quantities. And, of course, our trade with Japan will expand. Then when the Panama Canal is completed, there will be lines of steamers running from Vancouver to Liverpool, and a great portion of the North-West crop will then find its exit by Vancouver."

The Grand Trunk Pacific was mentioned, and my companion gave it as his opinion that though the line might have a terminal at Port Simpson, it would be compelled to build to Vancouver. Port Simpson, in his estimation, is naturally unfitted to become a great city.

In his enthusiasm, this apostle of the West almost missed the station whither he was bound. As he picked up his grip, he said: "You are a young man; by all means go West, but go far West. I am moving there myself now, and expect to spend the rest of my life in Vancouver. I have property in the East, but I am selling everything east of the Mountains." And with that he was off.

CORNELIUS.

HEATING SYSTEM OF THE ANGUS SHOPS.

The magnitude of the Canadian Pacific Railway Co.'s new Angus shops at Montreal is plainly evident from the fact that no less than thirty-seven miles of steam piping was massed in the Sturtevant heaters, which were installed in connection with the blower heating system. Before a decision was reached a thorough comparative study was made of the different systems of shop heating by direct steam and hot water and by blower methods. The latter was finally adopted as being the most efficient and economical where the requirements are so severe on account of the large spaces to be warmed, the high proportion of window area and the low external temperature. The apparatus was built and installed by the B. F. Sturtevant Co., of Boston. Steam is distributed in tunnels to the different buildings from the central power-house, which is about 2,600 feet from the most distant part of the system. The buildings have a combined volume of about 26,000,000 cubic feet. From quarter to half of the wall surface is glazed, besides which there are skylights aggregating 25 per cent. of the roof surface. The specifications require most of the buildings to be heated to a constant temperature of 65 degs. when the temperature outside is 10 degs. below zero. The radiation for this service is arranged at local points in vertical coils with cast-iron bases, which are coupled up in groups. The fans which draw the air through these heaters are calculated to have an hourly capacity of the enormous volume of about 80,000,000 cubic feet, sufficient to completely change the air in every building once in about every twenty minutes. In very cold weather, however, a closed circulation will be maintained, and the air returned to the heaters without receiving any access of cold air from outside. In the planing mill the fan engine and heaters are located on platforms between the roof trusses. In most of the other buildings they are located in one or more separate lean-to brick annexes. Each set of heaters is supplied with both exhaust and live steam mains. In the locomotive and blacksmith shops the hot air from the heaters is distributed partly underground through brick conduits; but in the other buildings and in parts of these the distribution system consists of cylindrical overhead galvanized iron ducts, supported on the lower chords of the roof trusses, having outlets through the vertical pipes carried down beside each of the interior columns. Practically no valuable floor space is occupied by the heating apparatus. The buffing-room in the brass department at these shops presents an interesting illustration of recent advance in the removal of dust from buffing and grinding wheels. Here a Sturtevant exhaust fan, with a special form of Sturtevant hood enclosing the wheels, insures the withdrawal of all of the dust and fine chips. This system maintains a perfectly clear atmosphere within the room, separates the chips from the dust, and prevents the discharge to the outer atmosphere of dust-laden air, with the attendant disagreeable results.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The sessions of the Canadian Society of Civil Engineers have closed for the season, which has been very successful as to attendance and the quality of the papers read.

On the unanimous recommendation of the council His Excellency Earl Grey has been elected an honorary member of the society.

By an arrangement between the society and the Canadian Mining Institute the institute has had its library and headquarters moved to the society's building in Dorchester Street, Montreal.

The following new members have been elected since the publication of the last list:

Associate Members.

John Bray Cochrane, of Kingston; V. Hector Dupont, of Montreal; Edwin Stanton Fraser, of Bristol, Tenn.; John Ernest Hardman, of Montreal; John Lyle Harrington, of Montreal; Francis Toy Peacock, of Montreal; Francis Ferguson Busteed, of Winnipeg, Man.; John Preston Forde, of Revelstoke, B.C.

Associate Members.

David Williams Burpee, of Fredericton, N.B.; Lorne McDougall Cairnie, of Montreal; Erasmus C. H. Dowson, of Montreal; Alan Travers Fraser, of Pembroke; Arthur John Gayfer, of Winnipeg; Richard Alexander Harry, of Parry Harbor, Ont.; Joseph Paul Leclaire, of Montreal; Mather Byles Almon, Jr., of Kingston, Ont.; James Edward Beatty, of Sarnia, Ont.; Richard M. Charlton, of Montreal; Craven Garnett, of Quebec, P.Q.; St. George James Harvey, of Montreal; James Valence Nimmo, of Paspebiac, P.Q.; Edward Horace Pierce, of Ottawa, Ont.

Transferred from the Class of Associate Member to the Associate Member.

William Duval Baillairge, of Quebec; Walter William Colpitts, of Moncton, N.B.; Thomas Robert Henderson, of Capetown, S.A.; Newton James Ker, of Ottawa; Edmond Antoine Hebert, of Oaxaca, Mexico; Joseph O. A. Laforest, of Levis, P.Q.; Henry Robertson Lordly, of Montreal; Charles Nicholas Monsarrat, of Montreal; Phillips Bathurst Motley, of Montreal; Darcy Weatherbee, of Halifax, N.S.

Transferred from the Class of Student to the Class of Associate Member.

Hugo B. R. Craig, of Kingston, Ont.; Harrie Miles Dibblee, of Victoria Harbor, Ont.; Garnet Burk Hughes, of Parry Sound, Ont.; John Herbert Jackson, of Niagara Falls, Ont.; Yorke de la Cour Kirton, of Durban, Natal, South Africa; Richard Herbert Squire, of Brantford, Ont.; Archibald Sinclair Cook, of St. Catharines, Ont.; William Alexander Duff, of Walkerville, Ont.; John Taylor Farmer, of Montreal; Henry John A. Haffner, of Calgary, Alta.; Henry P. Rust, of Niagara Falls, Ont.

Students.

Frederick William Anderson, of Montreal; Winthrop Pickard Bell, of Montreal; William Godfrey Banks Brown, of Montreal; Archibald Burnett, of Montreal; Ernest Edward Clawson, of Montreal; Lionel Heber Cole, of Montreal; George Edwards Cole, of Montreal; Reginald Percival Cowan, of Montreal; Patrick Davis, of Montreal; John Goodall Dickenson, of New York; Frank George Dunning, of Montreal; Sydney Edward Farley, of Hull, P.Q.; Harry L. Forbes, of Montreal; Paul Roderick Gransaull, of Montreal; Alfred McLean Hamilton, of Montreal; Arthur Elphinstone Hepburn, of Vancouver, B.C.; Laurence Bradley Kingston, of Montreal; Hugh Allan Lumsden, of Montreal; George Eric McCuaig, of Montreal; Clarence Hobart McDougall, of Montreal; George McDonald, of Moose Jaw, Assa.; Albert McMeekin, of Montreal; Thomas Cottrell Mahon, of Calgary, N.W.T.; Edward Newcombe Martin, of Montreal; Wilfred Rowland Motley, of Moose Jaw, Assa.; Jaspar H. H. Nicolls, of Montreal; John F. W. Owen, of Charlottetown, P.E.I.; Norman F. Pedley, of Montreal; John Garnet Reid, of Winnipeg, Man.; Hope Erskine Scott, of Quebec; Joseph Wilfred Simard, of Montreal; Osmond M. Stitt, of Montreal; Roy Alexander Weagant, of Montreal; Francis Graham Wickware, of Montreal; Charles D. G. Booth, of Toronto; Albert Victor Chase, of Toronto; Wiiliam Robert Devenish, of White River, Ont.; Sylvio Antoine DesMeules, of Murray Bay; George W. F. Evans, of Quebec; Edward Oliver Fuce, of Galt, Ont.; Edward S. Holloway, of Montreal; Louis E. H. Lippe, of Joliette; Stuart Stanley McDiarmid, of Ottawa; Arthur Kempston MacCarthy, of Montreal; William Wallace McGregor, of Toronto; Gilbert G. Murdoch, of St. John, N.B.; Edmund Neville Ridley, of Belleville, Ont.; Norman Douglas Wilson, of Toronto, Ont.; Frank Scott Winser, of Montreal.

THE GOVERNMENT TELEPHONE ENQUIRY.

Summary of Evidence.

Since its first meeting on March 20th, there have been almost daily sittings of the Select Committee appointed to enquire into the various telephone systems in operation in Canada and elsewhere. The committee, as has been noted before, is composed of Sir William Mulock (chairman); Mr. Boyce, Mr. Burrows, Mr. Demers, (St. Johns and Iberville); Mr. Grant, Mr. Johnston, (Capt Breton, South); Mr. McLean (York); Mr. Monk, Mr. Roche, (Marquette); Mr. Smith, (Nanaimo), and Mr. Zimmerman.

In outlining the work of the committee, the chairman, Sir William Mulock, stated that information would be presented concerning existing legislation relative to telephones, whether passed by the Dominion Parliament or Provincial Legislatures, also laws of Great Britain and the United States, Australia, and other countries. Grievances there are in thickly settled districts, where companies are now operating, and the operations of these companies will be investigated, but there is also the condition of the rural communities to be considered. The committee will investigate the question whether it is possible to devise a system whereby the people in the sparsely settled districts may have telephone service, not necessarily long distance, but at least local. Sir William submitted for criticism a plan by which telephones should be established for the residents of a municipality by the municipality itself. This he considered more practicable than an attempt to conduct a telephone service throughout the country under the direct management of the Government. Mr. McLean suggested that the telephone system should be centred in the local post office.

F. Dagger, of Toronto, was the first witness called. His evidence showed that the telephone service in Canada is unsatisfactory, principally from the following causes: (1) High rates in large cities; (2) Disproportionately high rates in cities of from 25,000 to 60,000 inhabitants; (3) High long-distance rates; (4) Lack of rural communication. Existing telephone rates were given and shown to be excessive by comparison with records in other countries, notably the United States, Sweden, Denmark, Norway, Switzerland, the State of Guernsey and the municipality of Glasgow. Competition in the United States was shown to be very effective in reducing rates. It was pointed out, however, that the independent companies in the United States are now combining, and there is prospect of the formation of a trust in which stock would be watered and rates increased, with the possibility of the monopoly reverting to the Bell interests. The effect of competition in Great Britain had resulted in the recommendation of the special Parliamentary Committee that licenses should be granted to municipalities desiring to operate telephone systems, with a view of reducing rates by the competition, but that no further licenses should be granted to companies, in view of the possibility of their being bought by the existing monopoly. Municipal telephony was dealt with and reports presented to show the operation of the systems in Glasgow, Tunbridge, Wells, Trondhjeim (Norway), Amsterdam, and St. Petersburg. In small countries, such as Switzerland, Luxemburg, and Guernsey, state ownership and operation of telephones has proved a success, but not in large countries, such as France and Germany, which have both tried the experiment. Mr. Dagger suggested the following policy: Government ownership and control of the long-distance lines; Government control of the local systems. The telephone and telegraph lines of the existing companies could be duplicated for $3,300,000. Regarding local systems, existing companies should be brought under control of a Government department; municipalities should have the power to give or withhold right-of-way privileges; and municipalities so desiring should be granted licenses to operate systems. With regard to rural telephones, Mr. Dagger recommended that co-operation on the part of the farmers themselves should be encouraged, the Government requiring all systems to be built in accordance with uniform specifications, and all such systems to have the right of connection with the nearest local system and with the long-distance system upon payment of proper charges.

Alpheus Hoover, of Green River, Ont., who organized the Markham and Pickering Telephone Co., was the next witness and gave evidence as to the cost and construction of his company's line. The company is operating at Markham, Locust Hill, Green River, Whitevale, and Brougham, and co-operation with similar companies, so as to make connections with Stouffville, Claremont, and Pickering. The company was denied connection with the C.P.R. station by virtue of the agreement between the railway and the Bell Telephone Co., and they have been denied connection with the Bell Company's lines except under conditions which they considered exorbitant.

Angus Cameron, of Beaverton, Ont., told of the Independent Telephone Co., which was established about three years ago in the neighborhood of that town. The company was conducted as a private partnership and had an exchange of 32 telephones. They were handicapped, however, in being refused connection with the Grand Trunk Station, and in being refused connection with the Bell trunk lines, except at an exorbitant price. The result was the system was sold to the Bell Telephone Co., who improved the equipment and raised the subscribers' rates.

John Crawford, M.P., of Neepawa, Man., told of the municipal system on that town and the difficulty of getting connection with the long-distance lines. The Bell Telephone Co. has an office in the town and has about twelve subscribers. Anyone wishing to speak over the long-distance has to pay the regular toll, whether he is a subscriber or not. The municipal system can get no connection with the long-distance lines. The municipal system has been in operation nearly six years, and is giving good satisfaction. It has paid well since its inception, and the business is constantly increasing. The town has not yet made any rural connections but is considering the matter. Connection is had between the municipal system and the C.P.R. Station.

Joshua Dyke, of Fort William, described the system in that town and Port Arthur. The systems are owned separately by the two towns, but there is free connection between them. Installation began in November, 1902, and has been extending ever since. Now there are 500 telephones in Fort William, and 515 in Port Arthur. Rents are $1 per month for domestic and $2 for business. Connection is had with the Canadian Northern Railway, but not with the Canadian Pacific, owing to their agreement with the Bell Co. The agreement between the Bell Co. and the C.P.R. was made in May, 1902, after the municipal telephone debentures had been advertised, and as there had been no talk of anything of the kind before that time, the agreement is regarded locally as a direct effort to destroy municipal ownership of telephones. The efforts of the municipalities to establish a system was antagonized by the Bell Co. by the installation of free telephones and by misrepresentations calculated to injure the municipal credit. The municipal system has been a financial success, and the citizens are perfectly satisfied with the service. The agreement between the Bell Co. and the C.P.R. is generally regarded as a restraint of trade and a great public inconvenience. The matter came up before the Railway Commission last summer, whose decision was that the agreement was binding, but Mr. Blair recommended that it be referred to the Supreme Court. Statements as to equipment of the system and the financial standing were made in detail.

Information relative to the Sprague Telephone Company, of Demorestville, Ont., was given by letter from the manager, John A. Sprague. This company now has two hundred miles of line and two hundred subscribers, being the largest rural telephone company in Canada. Private capital is used by the company, and service is given for $10 per annum. Arrangements are now made for the use of the Bell trunk lines, so that subscribers have a complete system.

The first annual report of the Harrietsville Telephone Association, Limited, of Harrietsville, Ont., shows that this co-operative association has twenty-five miles of metallic circuit composed of four party lines, with forty-eight telephones installed, and the report states that it has been impossible to give service to all who have desired to use the system. One hundred and thirty-five shares at $10 have been sold, and sixty-five more shares are now for sale to allow of extensions.

Alex. D. Bruce wrote from Gormley, Ont., of the company with which he is connected, which now has twenty-five miles of two-wire line with forty telephones installed. The line extends from Stouffville to Markham and the surrounding country in Markham township and Whitechurch. $12 per year gives a subscriber use of the entire system. The company is now considering an extension to Aurora, adding about sixteen miles of line and about thirty telephones.

Alderman Norman Andrews, of Brantford, led the fight against the Bell Telephone Co. in that city last year, and he has examined telephone systems throughout Canada, also in England and Germany, and the system in Amsterdam. He believes the best system for Canada would be Government ownership of long distance lines and municipal or independent ownership of local lines. The Bell Co. paid the city $450 annually for their franchise, and charged $25 for residence phones and $30 for business. The franchise expired last year, and the company offered $700 yearly for a renewal, and ten phones for $200 for the city's use. A renewal was not granted, but the council took up the question of a municipal system. An estimate was prepared for an exchange of 500 phones, showing a yearly expenditure of $7,780 on a capital of $35,000. Rates were to be $12 for residence and $25 for business. A depreciation of 2½ per cent. was allowed, which figure was supported by many authorities. An expert of the Bell company made an estimate, in which he allowed 10 per cent. depreciation, and this, together with the suggestion that in the event of the construction of a municipal plant the Bell would deny connection with long distance lines, and connection with the railway stations would be impossible, constituted the opposition to the municipal scheme. A by-law to provide for the construction of a municipal plant was prepared, and was to be submitted to the people, when the Canadian Machine Telephone Company made an offer for an independent franchise. The by-law was withdrawn, but no agreement has been made with the Machine Company. Meantime a new council has been elected, and the telephone question is still in abeyance. No renewal has been granted to the Bell Co., consequently there is no revenue at present from that quarter. The council is now advertising for an independent system, anl also for a plant to be established by the municipality. Since the agitation the Bell Co. has extended its lines throughout the country surrounding Brantford, party lines have been introduced in the city, thus increasing the number of phones, the long distance equipment is supplied without extra charge, and the charge for extension phones has been reduced from $20 to $12.

The British Columbia Telephone Co., an independent company, owns all the telephone lines in that Province. General rates are: business, individual, $4 per month; business, two party line, $3 per month; residence, individual, $3 per month; residence, two party line, $2 per month. In small places the rates are lower. These rates are nearly fifty per cent. lower than those at Seattle, Tacoma and other places situated similarly to British Columbia as to current rates of wages, etc. Vancouver has more telephones per hundred of population than any other city in the British Empire.

N. D. Neill, president of the American Machine Telephone Co., Brantford, told of the automatic system developed by his company, and now being installed in Peterborough by the subsidiary company, the Canadian Machine Telephone Co., Ltd., of Toronto. Mr. Neill has had an experience as a promoter of telephone companies in this country and the United States for some years. His opinion is that the Government should own the trunk lines; this would encourage the building of independent lines, and facilitate the acquiring of capital for such enterprises, which is now very difficult. By using automatic exchanges it would be possible to give every farmer in the well-settled portions of the country a good telephone service for $12 to $15 a year.

Charles Skinner, general manager of the People's Telephone Co., Sherbrooke, Que., described the operations of that company. (A description of the workings of this system appeared in the Canadian Engineer of February last). The company has now about 900 phones. The capital cost per subscriber is $63. Rates in Sherbrooke are $15 for domestic and $20 for business phones. In small towns the charges are less. Use of toll lines is charged for according to distance, with no time limit. The capital of the company is $100,000, of which about $65,000 is paid up. Dividends are paid on the preferred stock and the remainder of the earnings are used in improving the line. The expenses in fighting the Bell Company has prevented the regular payment of dividends on common stock. Mr. Skinner is opposed to the automatic exchange on account of high initial cost and liability of getting out of order. The demand for rural telephones is very great, but the company considers these a poor investment except as stimulating for subscribers in larger places. Connections are had with the Grand Trunk at Sherbrooke and Windsor, but other than these the company has no connection with the railway stations by reason of the contracts between the Bell Company and the railway companies. The monopoly of the railways seriously prevents the development of the company. Mr. Skinner is inclined to think the Government should own the long distance lines, and is decidedly in favor of municipalities owning the local systems on account of the possibility of their reducing the cost to a minimum.

The Bell Company filed with the committee a number of documents, including a list of 228 patents held by the company, 97 of which have expired; also a number of agreements with various railway companies as to furnishing telephone equipment. It may be mentioned that in ten of these agreements there occurs the clause: "The Telephone Company shall have the exclusive right of placing telephone instruments, apparatus, and wires in the several stations, offices and premises of the railway company." These ten railway companies are: The Bay of Quinte, the Canadian Pacific, the Central Ontario, the Galt, Preston and Hespeler Street Railway, the Grand Trunk, the Hamilton Radial Electric, the St. Lawrence and Adirondack, the Thousand Islands, and the Tillsonburg, Lake Erie and Pacific. This "exclusive" clause, which is the kernel of the railroad monopoly which is so bitterly complained against by the independent telephone companies and others, is in some of the contracts extended so as to read: "The Railway Company agrees to grant and permit forthwith to the Telephone Company the sole and exclusive right, as against any other company, corporation, person or persons carrying on any telephonic business, to enter on such business any office, station, freight shed, building, or other premises of the Railway Company, and there to bring or place telephone instruments, poles, wires or other appliances for the purpose of doing or carrying on therein or thereon any telephonic business or communication; and so that and to the end that no other company, corporation, person or persons shall bring to such office, station, freight shed, building or other premises of the Railway Company or place therein any telephone instrument, pole, wire, or other appliance for the purpose of doing or carrying on thereon or therein any telephonic business or communication."

Dr. J. T. Demers, of La Compagnie de Telephone de Bellechasse, was the next witness. A full description of the system operated by this company will be given next month.

(To be continued.)

WATER PURIFICATION.*

D. J. RUSSELL DUNCAN.

The title of this paper embraces a rather wide subject; one which it is impossible to treat adequately in the short time at the disposal of this meeting. It must, therefore, be confined to brief references to chemical, mechanical, bacteriological, and electrical methods, with suggestions for the application of processes of a practical kind which can be adopted on commercial lines at the least possible capital outlay, and most economical operating and maintenance expenses.

The English system of purifying water by means of open sand bed filtration has many advantages, but these are counteracted by great disadvantages; notably, the large area of land, involving a heavy expenditure of capital; the danger of allowing the filter beds to run for too great a length of time without cleansing; the expense of cleansing; the inefficiency of sand-washing appliances; the excessive growth of Algae in some waters exposed to air and sunshine, especially in the months of May and June; and the failure to eliminate pathogenic germs through the absence of adequate filtering media.

Attempts to form a filtering medium on the surface of sand beds to prevent the passage of bacteria have frequently been made, but are not always successful because of the delicate nature of the film which requires absolute tranquility, a condition impossible of attainment in open beds in which water is liable to surface agitation from time to time, by the action of air currents.

Again the bacterial filtering medium will not withstand the head of pressure of water usually imposed in open filter beds, and whenever broken, allows the free passage of bacteria through the sand, frequently resulting, when the velocities of discharge are not uniform through the whole area of the sand bed, in an accumulation of minute bubbles of air beneath particles of sand, or air locking, which in time impairs the efficiency and rate of filtration.

The rate of filtration in open sand beds, generally about 2,000,000 Imperial gallons per acre per 24 hours, is greatly accelerated by the use of mechanical filters, which can be successfully operated at the rate of 100,000,000 Imperial gallons per acre per 24 hours, and when such filters are used in combination with softening and preliminary sedimentation processes, followed by sterilization, the most perfect results are obtained.

While the English system can be operated with more or less success in Great Britain, and in other countries not subjected to extreme variations of temperature, large open filter beds could be successfully operated in Canada only during spring and autumn, for the local conditions in winter and summer are unfavorable to the adoption of the English system, therefore, purification of water must be conducted within enclosed buildings covering only a small fraction of the ground which the English system requires.

It is also essential that the processes of purification must be absolutely under control, not only throughout each day in the year, but during each hour of every day.

The first principle involved in designing plant for water purification to meet such conditions is that the apparatus employed must be capable of being operated without skilled labor—under the supervision of a workman of ordinary intelligence trained to a system of recording observations—must, in fact, be automatic, or as nearly so as possible; and the final effluent, irrespective of the condition of the raw water supplied, must be up to the highest standard of chemical and biological purity.

The next points are those of control, systematic observation, and regularity in recording the results, as evidenced by analysis, and bacteriological examination of the effluent.

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*A paper read before the Engineers' Club of Toronto, April 27th, 1905.

This control is twofold, first, in regard to quantity of the raw water treated in a given unit of time, and second, in regard to inspection of the effluent.

The former presents no difficulty, and is accomplished by automatic, hydraulic and mechanical appliances; the latter is effected by means of a sampling plant in a room set aside for that purpose, in which samples of purified water are automatically collected during each and every hour throughout the day.

The degrees of hardness, turbidity, alkalinity can be readily observed and recorded, and partial analysis by simple volumetric methods, which intelligent men can easily learn, can be made several times each day, thereby introducing a means of perfect control over all the variations in the condition of the raw water, resulting in the maintenance of the standard of purity of the effluent delivered for domestic supply.

The degrees of turbidity can be observed at any time by means of glass columns suitably mounted in a shaded case so arranged with reflectors that a beam of light from an incandescent electric lamp is at all times, throughout the day and night, projecting a known volume of light through the columns of water contained in the glasses. One column contains pure, preferably distilled water, as a constant standard; the second column, fed by a pipe of small bore, say ⅛-in., has a constant stream of raw water running through it; the sight glasses are about 24-in. long, and that through which the raw water passes is provided with a platinum wire placed diametrically across the tube, adjustable vertically for the whole length of the tube, and provided with an external indicator which moves simultaneously with the observation wire. The observer raises the wire through the column of raw water until it becomes visible and the indicator on the scale shows the degree of turbidity. An hourly examination and record throughout each day is a valuable check upon the subsequent processes of treatment, enabling the experienced observer to regulate and adjust the flow of the precipitation re-agents employed. The third column has a constant stream of purified water flowing through it, and the turbidity, if any, is measured in a similar manner.

The degree of alkalinity, or acidity, can be observed by means of apparatus supplied with small quantities of raw water, which are periodically tested by means of acid or alkaline decinormal standard solutions, and a few drops of a suitable indicator.

The specific gravity of the raw water is also an important matter of observation in treatment for purification. This is observable at all times by a simple apparatus, such as that used in all distilleries, in which a hydrometer floats in a sight glass through which a constant but small stream of the water under treatment flows.

Should it be desired to carry the series of observations further, say, for example, the approximate degrees of hardness, the percentage of chlorides, free ammonia, etc., reasonably accurate and comparative estimates can be quickly ascertained by use of apparatus and chemical solutions designed for intermittent or continuous automatic action in which the observer can see the apparent condition of the raw water, and thereafter adjust the flow through the automatic feed valves of the chemical reagents supplied to the raw water to act upon the dissolved or suspended matters which the purification treatment must eliminate.

The reagents employed for general use, modified in quantity, as analyses of raw water may determine, are:

For softening; lime water, to remove the hardness produced by calcium and magnesium carbonates, known as "temporary hardness." Sodium carbonate; to reduce the permanent hardness, or hardness produced by sulphates.

For coagulation and precipitation of the carbonate of lime, sulphate alumina is employed, the quantity being determined by the degree of alkalinity of the softened water. Commercial sulphate of alumina usually contains 17 per cent. alum, but the less expensive sulph-alumine, containing 14 per cent. alum, serves the purpose equally well.

For the destruction of organic matter, perchloride or iron and chloride of lime in minute quantities are employed with very beneficial results.

The quantities of the above reagents must invariably be dependent upon the composition of the water under treatment, therefore it is unnecessary here to go into further details.

The treatment by any or all of these reagents is not necessarily complete, but must be considered as partial only, if carried in any case to the complete stage, while the complete reduction or elimination of the impurity can no doubt be obtained, the probability of leaving a slight excess of the reagent in the water occurs; this excess, although harmless, might leave traces of color or flavor which would prejudice the public against the treatment.

If, for example, water highly charged with organic matter is treated with iron perchloride and chlorinated lime in sufficient quantity to reduce the organic impurities, analysis of the effluent, while showing a possibly complete reduction of albuminoid ammonia might show a slight excess of chlorides, and chlorides in water are frequently, although not always, attributed to pollution.

It is, therefore, desirable to employ reagents in as small quantities as the circumstances require, and not to attempt the complete purification by any or all of them.

This course accordingly leaves opportunity for other and additional processes being employed. The next stage in the treatment of water, which follows the introduction of each of the reagents is that of sedimentation; it has been customary to conduct this process in large auxiliary reservoirs in which the water is allowed to remain at rest for a given period, but this, of course, has the same objections, or even greater objections than open or slow sand bed filtration, for the reason that large, expensive reservoirs are necessary, and the periodical cleaning of such reservoirs is an item of heavy expense, but the chief disadvantage in these sedimentation basins is the large surface exposed to the action of the wind, which prevents the quiescence essential to complete precipitation of the suspended water.

A continuous flow system of precipitation in enclosed vessels, through which the water under treatment passes at a slow velocity is recommended as more efficient. Any one familiar with the chemist's method of hastening precipitation in test tubes by holding the tubes in a nearly horizontal, instead of in a vertical plane, will readily understand how large cylindrical vessels set on inclined planes are more effective than vertical tanks or reservoirs for this purpose.

The arrangement of these tanks is in a series of inclined planes, connected so that the water entering at the top flows at a velocity of about one inch per second through each cylindrical tank.

Each of the sloping tanks, which may be 20 to 30 ft. in length, and of a diameter about three times greater than the area calculated for the desired volume and velocity, is provided with baffle plates, each of which is 2-3 the area of the cylindrical tank. These baffle plates are fixed alternately from the bottom upwards at an angle of 60 degrees with the axis of the tank, and from the top downwards, the area for passage of water through the tank being alternately above and below these plates. The meandering course of the water through each tank is upwards and downwards, and as the suspended matter in the water impinges upon the plates precipitation is accelerated.

The compartments or pockets formed by the lower baffle plates intercept a large percentage of matter in mechanical suspension and the accumulation of sludge is drawn off through valves and pipes provided for the purpose.

After descending through two or more of these tanks, the water rises through vertical tanks similarly sub-divided with intercepting baffle plates, which form an additional number of traps, and prevent the ascension of impurities.

At the highest elevation calculated to permit of continuous flow, the water next enters the mechanical filters, gravitating downwards through the bacterial filtering film, chemically formed on the surface of the sand, and finally through the sand itself.

The construction of the filters is such that the areas of filtering capacity are gradually reduced from the largest area at the top to the smaller areas suitable for the grades of sand in each layer throughout the filter, so that the velocity of the water through the coarse sand at the bottom of the bed shall be no greater than through the fine sand at the top.

In the common form of gravity filters in which the layers of sand forming the sand bed are uniform in area, and the sand at the upper surface is much finer than that at the bottom, there is greater resistance to the flow of water through the finer sand than through the coarse, consequently the liberation of air bubbles from the water occurs in the zone of least resistence, viz., in the coarse sand. These air bubbles rising upwards are intercepted by the finer sand, cause air-locking and retardation to flow of water.

In the most recent types of mechanical filters the strainers are arranged in tiers so fitted to the channels which carry off the filtered water as to afford passages for escaping air into conduits connected with external pipe carried up to the top of the filter and turned downwards with their exits underneath the surface of the water in the filter; by this means air-locking is prevented, and accumulated air allowed to escape.

The system of mechanical filtration is so arranged that the least possible positive head is imposed on the gelatinous film of filtering material formed on the sand bed and the maximum amount of negative head made available, thereby maintaining the normal efficiency of the film.

After 12, 16 or 24 hours, depending upon the character of the water under treatment, the filter is washed by a reverse current of pure water pumped through it at a head of about twenty feet; this pressure lifts the whole sand bed without carrying over into the waste channel any of the sand, but removing all matters of less density, and while the reverse current is flowing, the sand is thoroughly washed by mechanical agitators. The volume of filtered water used for washing usually averages 3 per cent. of the volume filtered.

After leaving the filters, which, in conjunction with the sedimentation tanks, eliminate the whole of the suspended matter, and effect 95 to 98 per cent. reduction in bacteria, there may still remain a small percentage of bacteria in the filtered water.

An alleged objection to the use of mechanical filters is sometimes raised, viz., that after washing there must be a period of imperfect filtration as the gelatinous film formed partially by chemical means and partially by the slimy matter intercepted takes a long time to form, meanwhile water passing through the sand is liable to carry with it any pathogenic germs which may be in the water.

This objection has had some foundation, for in some American cities, where mechanical filtration has been adopted and where insufficient attention has been given to the preparation of the coagulant and to its proper distribution over the filter, bacteria have been found in the effluent.

This objection is easily overcome and loss of time avoided by the use of an auxiliary chemical feed tank containing solution which quickly forms a gelatinous film over the surface of the sand, while the rewash water is flowing downwards through the filter.

The rewash water is a small percentage of wash water, which, after the upward current has been stopped, the agitators brought to rest, and the sand begins to pack, is the water which finally flows through the filter after washing and which for a few minutes runs to the waste water drain.

The flocculent precipitate formed by the solutions used during this period of rewashing forms a film with great rapidity, and as soon as the rewash valve is closed this film is in its normal condition for delivering pure water.

After filtration the next process to completely purify water is that of sterilization, which can now be practically accomplished by the use of ozone.

Ozone is formed in the atmosphere from oxygen, which the air contains, during the slow oxidation of moist organic matter under the influence of solar light, and also on the passage of lightning through the air.

For industrial purposes, ozone is used in the shape of atmospheric air, which has been partially ozonized by having been passed through a space traversed by silent electrical discharges.

The hourly production of ozone in an apparatus of given size depends upon the tension of the current. Professor Chasey, of Lyons, found that with the ozonizer he experimented upon, no ozone appeared under 9,000 volts; from this point, the production increased irregularly up to 13.000 volts, and then became proportional to the square of the difference in potential; at 41,000 volts the apparatus produced 9.9 times as much ozone as at 13,000.

The temperature of the air, heated by electrification, should be kept at a proper level. Dr. Rideal says that the yield increases with air that is up to 24 degrees C., then declines; other authors, working with oxygen, found that larger quantities of ozone were obtained below than above freezing point.

Prof. Chasey has established that it is uneconomical to try to increase the ozone concentration in ozonized air. To obtain a concentration of 7 per cent., ninety times as much energy was wanted as for a concentration of ½ per cent., so that to produce a given weight of ozone, it is cheaper to enrich feebly a greater volume of air than to enrich considerably a smaller volume of air.

As, in the presence of moisture and powerful bases, ozone has a tendency to oxidize the nitrogen of the air into nitric acid, it is advisable to dessicate the air before electrification begins or to make the ozonizers from unoxidizable materials.

Ozonizers are spaces traversed by silent electrical discharges, through which space passes the air current to be ozonized.

To prevent the silent discharges from turning into sparks, either a dielectric, such as glass, is interposed between the two poles, or the bare metallic electrodes are provided, at the entrance of the current, with regulating devices in the shape of resistances which keep the voltage within the boundary at which the formation of sparks commences, or in that of electrical condensers which limit the intensity of the current.

To ensure the efficiency of the ozone, time and intimacy of contact between the ozonized air and the water are required; intimacy of contact, to ensure the ready absorption of the but slightly soluble ozone, and time for the double process of physical dissolution of the ozone in the water and chemical action of the dissolved and free ozone on the organic matter and the micro-organisms.

The ozonizers are horizontal. There are usually two in the series, each consisting of three groups of three elements.

Each element is made of a horizontal brass half-cylindrical trough, fitted with a plate glass cover and a cast iron water jacket. The trough is earthed and makes one of the poles.

Across the trough, at regular distances, brass half discs with serrated circular edges of platinum about 60 millimeters less diameter than the trough are suspended from the glass lid by means of screws which receive the high tension current from the liquid resistances fitted to each half disc. The resistances are vertical glass tubes sealed at the bottom, in each of which is secured a platinum wire projecting on both sides of the glass. The tubes are filled with a solution of glycerine through which the current is transmitted by a platinum wire dipping in the top of it.

The resistances perform the part of regulators preventing the tension of the portion of currents allowed to each semicircular pole, to rise above the limit at which sparks or voltaic arc are produced.

Silent discharges are produced between the sharp points of the semi-circular poles and the inner surface of the troughs. The troughs are closed at each end and fitted with an air inlet at one end and an air outlet at the other. The current of air circulating between both ends, passes through the succession of half annular discharges which transform part of its oxygen into ozone.

After its passages through each discharge, the air, which becomes heated, is partially cooled down by the surface of the trough. This cooling is completed by means of surface condensers placed between the units of each line of ozonizers.

The ozonizers are placed in a dark room for better observation of the blue-violet color of the rays, which indicate when the apparatus is working in good condition, or otherwise.

In many cases the cost of ozonization combined with rapid filtration is more economical than that of bacteriologically less efficient slow filtration. But even should the reverse be the case, it may occur that even from the standpoint of social economy, the more expensive but safer process deserves the preference.

The practical irregularities to which filtration has been subject appear from a study of the death-rate of typhoid fever in large cities, now generally admitted as an index of quality of water supply.

Fuertes has arranged the statistical data about the typhoid death rate in various localities supplied with different kinds of waters. The typhoid death-rates per 100,000 people, per annum, were as follows for various classes of water: Large normal rivers, 38; impounded waters, 36; ground waters, 32; filtered waters, 20; mountain springs, 10.

Assuming that each death represents the loss to the community of about $3,000, Fuertes calculates that the saving of six lives per year in a city of 100,000 inhabitants would be more than the annual charges necessary to maintain filtering works and to refund the capital. It is evident that a similar conclusion holds true for ozonization, which reduces the typhoid death rate from the level for filtered water at least to that for mountain springs.

In a series of lectures at the Society of Arts, London, some three years ago on the purification and sterilization of water, Dr. Rideal said:

"Ozone has the exceptional advantages of being easily obtained everywhere from atmospheric oxygen, and recent progress in ozone generators and electric supply lead to the belief that this gas may be economically produced. In several directions it has been used for public supply on a large scale, and it promises to be further extended as a "finisher" in the sterilization of water. The chief difference between the action of ozone, O_3, and of atmospheric ordinary oxygen, O_2, is that the latter will not act on most varieties of organic matter without the help of organisms, either direct, in the processes of life, or indirect, through a special class of enzymes, called oxydazes, that some of them produce. In the sterilizing function of ozone, only one-third of the oxygen actually contained in it ranks as "available" oxygen. The gas attacks metal, india rubber, gutta percha, and wood, and is thereby itself destroyed, hence apparatus for its production, storage or conveyance, must be constructed of stoneware or glass, or less advantageously, of protected material."

Very thorough investigations in regard to the efficiency of the ozone treatment have been conducted in France, Germany, Belgium, and Holland.

A communication by Dr. Ohlmuller, of Berlin, to the 37th meeting (Dresden, September 17th, 1903), of the German Association for Public Hygiene may be referred to.

Dr. Ohlmuller's conclusions are:

(1) Ozone destroys, on certain conditions, the bacteria present in water with their spores.

(2) Pathogenic germs, such as those of cholera, typhoid fever, and dysentery are more sensible to the action of ozone than common water bacteria.

(3) The bactericide action of ozone depends upon the proportion of unorganized oxidizable matter present in the water; the number of micro-organisms is of less importance. This is to be duly taken into consideration in choosing a water to be purified by ozone.

(4) Suspended matter should be eliminated by rapid filtration before treating the water by ozone; partly on account of esthetic considerations, partly because the bacteria disseminated in solid matter may escape the action of ozone.

(5) The ozone concentration, i.e., the proportion of ozone present in the ozonized air should be proportional to the amount of oxidizable matter the water contains.

(6) The action of ozone depends entirely upon the intimate contact of the gas with the water.

(7) The ozone concentration may be reduced according to circumstances, by any appropriate extension of the surface of contact and division of the water in finer particles.

(8) Only part of the ozone forced into the water is utilized; it is economical, therefore, to recuperate the waste ozonized air; care should be taken, however, to keep the ozone concentration up to the standard by a supply of fresh air.

(9) Before deciding upon the design for an ozonizing plant, the nature of the water should be carefully determined; the applicability of the process and the technical details of the plant depend upn that nature.

(10) Before being treated the raw water should be examined from a bacteriological, physical, and chemical point of view. This examination should be repeated every time a change occurs in the nature of the water, for instance when an increase has taken place in the proportion of ferruginous compounds present in the water or in its grade of pollution.

Having now called attention to the most modern processes for the treatment of water to render it fit for domestic use, the main facts may be concisely summarized.

Large volumes of water should be treated:

Chemically.—By reagents in solution automatically supplied, which act upon the matters which cause pollution in the water under treatment.

Biologically.—By the formation of a bacterial filter for the elimination of bacteria, and by the sterilization applied to partially purified water from which matter in suspension has been removed, by means of exposure of the water under treatment to the action of ozonized air.

Mechanically.—By apparatus constructed for the rapid precipitation under continuous flow of suspended matter in the raw water, and for the elimination of impurities by filtration.

Treatment by the processes indicated cannot fail to effect the highest degrees of purification within industrial and commercial limitations.

The description of the methods already given may give rise to the idea that the processes are elaborate and complicated, but a further investigation of the subject and examination of the plant employed, such as that recently erected near Paris for purification of the water of the river Seine will demonstrate the fact that for efficiency and economy the processes referred to are all that can be desired.

HELPS FOR ENGINEERS.

The Canadian Casualty and Boiler Insurance Co., which was established in 1903, is able to report that each month of this year its new business has been double that of the same months of last year. Its receipts for the past year were $107,713, and its expenditure $46,501. The expenses were thus less than half the amount of its income for the year. It is not alone in its finances that this company has made rapid progress through the energy of its managing director, Mr. Dinnick, but it appears to be winning the appreciation of steam engineers throughout the country by its efforts to educate the men in charge of steam plants. The company is now sending out to all engineers, whose addresses are obtainable, a series of bulletins, prepared by its chief engineer, A. M. Wickens, on the care of boilers and engines. The company has also just issued a very instructive pamphlet of thirty-two pages containing three papers reprinted from the Canadian Engineer. One is on "Boiler Feed-water," by Mr. Wickens; another on "Purifying Water for Engines," by G. M. Davidson, engineer and chemist of the Chicago and North-Western Railroad, and the third on "Boiler Scale and Boiler Feed," by Harry Spurrier, analytical chemist, of Davenport, Toronto. The pamphlet is sold at ten cents, but those issued by the company are sent free while they last to engineers or owners of steam plants. The papers contain much information in a condensed form. The head office of the Canadian Casualty and Boiler Insurance Co. is corner of Adelaide and Victoria Streets, Toronto, with branches in Montreal and several other cities.

NEW CHEMISTRY AND MINING BUILDING.

Ontario School of Practical Science.

The accompanying photograph shows the new building of the School of Practical Science as it appeared a couple of months ago before it was quite completed, and while the snow was still on the ground. This building is situated on College Street, Toronto, the photograph being taken from the south-west corner. The work of the school will now be carried on in two buildings, the old one being the Engineering Building, devoted to civil and mechanical engineering, architecture, and kindred subjects, while the new building shown herewith will be used for analytical and applied chemistry, electrochemistry, metallurgy, assaying, mineralogy and geology. The administration offices are also in the new building.

The lowest floor of the building contains the electrochemical laboratories, which are admitted to be the finest on the continent. They are very commodious and well equipped, including electric furnaces, crucible and other furnaces, and several general laboratories for electrochemical work. The floors are of cement, and the electrical cables are carried in tunnels, which are covered with removable slabs, so that all connections are readily accessible.

A large part of the two lowest floors is set aside for a museum.

The chemical lecture-room is well fitted up for the purposes of demonstration. The lecture table is provided with water, gas and electric connections and down-draft fume ducts. Immediately behind the lecture-table communication is had through the wall with the preparation room in the rear. Blackboards throughout the building are constructed of ground glass, mounted over a black background, with vertical and horizontal strings just behind the glass, which divide the surface into square decimeters—a device which is found useful in plotting curves, etc.

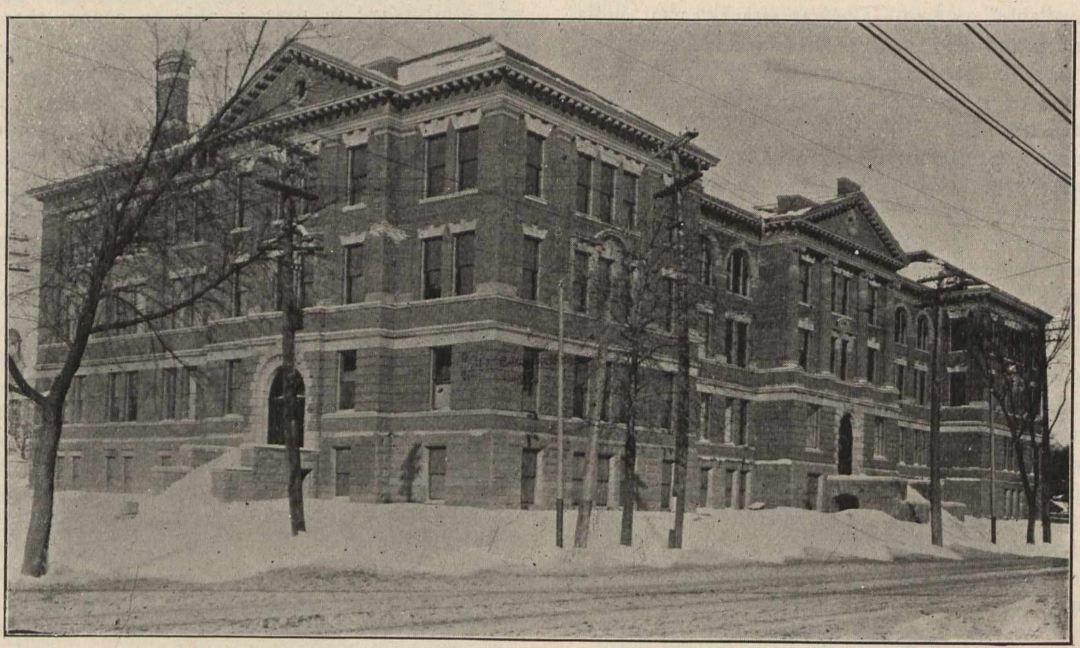
The building contains several chemical laboratories, all of which are equipped with fume cupboards, fume ducts and all the best appliances. The individual cupboards in the tables are neatly arranged so as to accommodate all kinds of apparatus in the simplest manner. Among the various laboratories may be mentioned the gas analysis room, the polariscope and spectroscope room, and the photographic dark-room, besides rooms equipped for the study of the chemistry of combustion, lighting, explosives, and various lines of applied chemistry.

The upper floors are devoted to mineralogy and geology, and contain workrooms and laboratories, besides collections of various kinds.

The mineralogy and geology departments of the school have been occupying the new building all winter, the assaying department moved in at Christmas, and the other departments will move into their quarters this month; so that when the fall term opens the chemistry and mining departments will be installed in one of the finest buildings ever put up for that purpose, and the engineering departments will have the advantage of more room in the old building.

ELECTRICAL EQUIPMENT, SCHOOL OF SCIENCE NEW BUILDING.

The new building, known as the "School of Mining and Chemistry," in connection with the School of Practical Science of the Toronto University, marks a decided step in advance in the teaching of scientific subjects to the coming generations of this Province. It is equipped with most up-to-date appliances for demonstrating modern methods, as well as for experimental and research operations. It may be inferred that an institution of this character, which is sending out as its graduates the future engineers, who will take a prominent part in the development of the mining and power resources of our country, should teach thoroughly the latest methods of production and application of the power of the future, electricity. With that end in view, the "powers that be" decided to instal a plant that would produce a current for light and power in the building, and would also allow the students to obtain a practical knowledge of the construction of the machinery, and the production, handling and distributing of power.



New Chemistry and Mining Building, School of Practical Science.

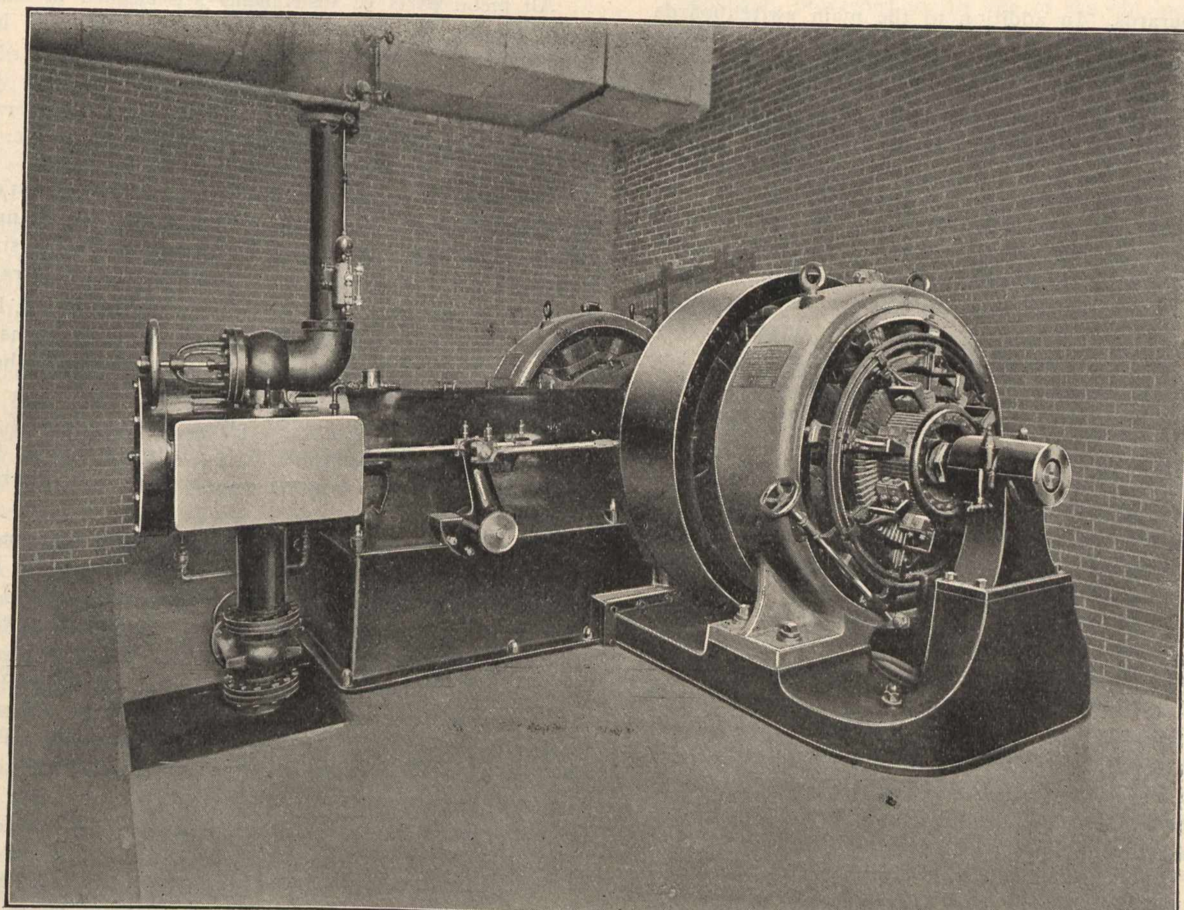
The mining department is located in a wing of the building, and this is now being equipped with practical working machinery. The mill-room is 53 feet by 72 in area, and the equipment already installed consists of a 15 h.p. motor, a five-stamp battery, Challenge ore feeder, amalgamating plates, a Wifley table for concentration, a clean-up pan, steel settling tanks, a steel tank suspended from the roof girders to furnish a constant supply of water, and a track with travelling crawl to transport ore. The machinery was supplied by the Wm. Hamilton Manufacturing Co., of Peterboro. In the next room there is an equipment for preparing the ore for the milling-room, this including a gyrating crusher of Hadfields' make, and a set of Hamilton rolls 16 inches by 12 inches, besides platform scales, jib crane, buckets, etc. Two other rooms will be used for future additions.

The power and heating plant is located in the rear of the building. The electrical features of this plant will be found described elsewhere in this issue. The building is ventilated by a vacuum system operated by fans in the top story, and the principal ventilation of the laboratories will be accomplished through the fume cupboards. Steam and compressed air will be supplied to the laboratories, and electricity is supplied to all the senior laboratories.

The contract for this installation was given to the Electrical Construction Company, of London, Limited, one of the younger companies manufacturing electrical machinery, but one which is rapidly making a reputation in their line. It seems appropriate that this company should have supplied the machinery, as the managing director, E. I. Sifton, is one of the earlier graduates of the School of Practical Science in Electrical Engineering.

The contract was completed to the satisfaction of the engineers in charge—Messrs. Ross & Holgate—which shows that the experience obtained by the students of the School of Practical Science is of a high order when it enables a student to design and manufacture apparatus of this kind in such a manner as to obtain this contract in competition with the largest and best manufacturers in Canada and the United States.

The entire plant upon completion was subject to a severe test under the supervision of consulting engineers, Messrs. Ross & Holgate, of Montreal, in conjunction with the professors in



Engine and Two Dynamos.

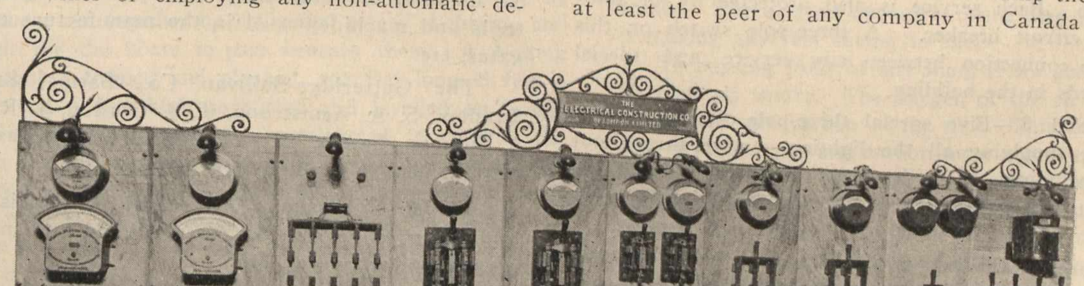
the electrical and mechanical branches of the School of Practical Science. The test comprised thorough inspection of all mechanical details and materials together with operating the plant at various percentages of load ranging from friction load to nearly 50 per cent. overload, taking readings and making calculations to show the efficiency, temperatures, regulation, overload capacity, and general capability of the plant to perform the various duties which may be required of it.

It was further tested to a full load run of ten hours immediately followed by two hours' run at 25 per cent. overload, ing an eighteen hour run at full load.

The generators showed during this test that they could be operated from "no load" to 25 per cent. overload without shifting off the brushes or employing any non-automatic device for any purpose whatever, thus showing the care which had been used in designing the generators so they would regulate themselves under varying conditions to which they will be subjected. Notwithstanding the severe test, there were absolutely no changes required or improvements suggested.

The plant itself is unique, consisting of two dynamos each of 75 kilowatts' capacity connected direct to one engine having a capacity of 300-h.p.

The main switchboard, consisting of ten marble panels, each with its recording instruments, is spoken of by the engineers in charge as the most complicated board they have ever installed, and the successful carrying out of the specifications of this board is sufficient to stamp the contractors as at least the peer of any company in Canada manufacturing



Switchboard.

electrical apparatus. In addition to the main switchboards there are three panels, each one controlling a motor operating an exhaust fan in connection with the ventilating system.

Four additional panels are used, fitted with instruments to automatically control the temperature of each room throughout the building.

The reproduction of photos of engine, dynamos, and main switchboard, together with a description of the use of each panel, will show how completely the plant is designed to obtain the results required of it. Panels 1 and 2 control and indicate the total output of each machine, respectively, and consist, for each dynamo, of: Voltmeter, illuminated dial, ammeter, rheostat, main switch, 600 amp. capacity, to connect dynamo service lines to their respective bus bars; 600 amp. switch, to connect the bus bars to the five-pole switch, described under panel No. 3.

Panel 3.—Ground Detector.—To test and ascertain if at any time any of the conducting wires either of the dynamo or lighting or power distribution services should become defective in insulation showing contact with piping, or other conducting material giving connection to the ground.

Five-pole, double-throw, six hundred ampere switch, which, when thrown in one position connects the two dynamos in parallel, and when thrown in the other direction connects the dynamos in series for the operation of three-wire service. Two other three-pole, double-throw switches, on this panel supply to the lighting distribution bus bars from either series or parallel connection, and also allow connection with the city lighting service.

Panels 4 and 5 control each a 600 ampere service and deliver the current to the Mining Department of the School, where it is used in electrical furnaces and other experimental work.

Each panel is provided with an ammeter, a circuit breaker which automatically breaks the circuit if at any time carrying more current than the capacity for which it is set, also double throw switches allowing either panel to take the current from either dynamo or from both. One switch on this panel controls current to pilot lamps illuminating each panel of the board, and another connects motors through the building to the power service supplied from either the dynamos or the city circuit.

Panel 6 controls distribution of two services of three hundred amp. each to panel No. 10. Two ammeters indicate amount of current from each service, and six switches (interlocking), allow each service to be supplied from either or both dynamos or from city service. The interlocking device protects either service from being supplied by more than one service at any time. Each service is also protected by an automatic overload circuit breaker. A three-pole switch on this panel forms the connection between city service and special distribution boards in the building.

Panels 7 and 8.—Five special three-pole, fusible, single-throw switches, supplying all the lighting service throughout the building, including the milling and engineering buildings. An ammeter on each panel indicates the amount of light being used.

Panel 9 controls, through two double-pole, fused switches, two special service lines to the engineering building, the current used being indicated by two ammeters. A three-pole, fusible switch controls a three-wire service for the engineering building.

Panel 10 consists of eight fusible 300 amp., single-throw, double-pole switches, connected to various departments for special treating, demonstrating and laboratory work. These switches are supplied with current through a system of interchangeable, flexible, lead-plug switches from three different courses through two service lines from the interlocking switches (panel No. 6), thus making a most flexible service capable of being obtained from many different sources through different channels.

A glass case, recording wattmeter on this panel registers the amount of current which has been consumed from source of supply other than the generating plant.

Three other panels control the operation of motors in the building, each panel having thereon an ammeter, automatic overload circuit breaker, and automatic speed controller.

All metal parts of instruments are finished in black oxidized copper, the board itself being polished and bevelled, "blue Vermont" marble, 2-in. in thickness.

NEW INCORPORATIONS.

Dominion.—Canadian White Co., Montreal, $1,000,000; W. G. Ross, R. C. Smith, R. C. Grant, W. W. Skinner and W. F. Chipman, Montreal. To carry on the business of electrical, mechanical and civil engineers and contractors.

The Duncan Electrical Co., Montreal, $90,000; C. Duncan, W. P. Baird, W. King, F. Loomis and M. T. Williams, Montreal. To deal in electric supplies for traction, telephone and telegraph purposes.

The J. W. Harris Co., Montreal, $150,000; J. W. Harris, W. B. Powell, F. D. Monk, F. X. Durand and C. G. Martineau, Montreal. To carry on business as general contractors.

The Kensington Brandon Land and Development Co., Montreal, $100,000; G. A. Forbes, G. H. Bisset, P. F. Richardson, Montreal, W. H. Olive, Westmount and J. Curry, Toronto. To deal in land, and act as construction engineers and to supply light, heat and power.

The Canadian Manufacturing Co., Montreal, $40,000; L. Rubenstein, E. Goodwill, H. Ward, H. J. Elliot, Montreal, and A. D. Gall, Westmount. To carry on business as machinists and engineers, manufacturing electric motors, dynamos, steam turbines, etc.

Ontario.—The Imperial Cement Co. has increased its capital from $250,000 to $300,000.

The Maple Leaf Automobile and Electrical Manufacturing Co., London, $50,000; J. O. Weldon, G. H. Rapson, D. Ferguson, H. S. Albertson and W. Barton, London.

The Empire Gas and Oil Co., Windsor, $40,000; V. C. Fry, A. G. Gulden, G. W. Videau, C. A. Buhrer, F. D. Andrus, E. Bond and T. J. Quinn, Detroit.

The New Liskeard and Northern Ontario Mining and Developing Co., New Liskeard, $25,000; J. Cox, J. H. O'Brien, J. O. Margueratt, J. C. Moss, F. W. Haynes, H. Thompson and E. Monaghan, New Liskeard.

Blackford Oil and Gas Co., Windsor, $30,000; F. B. Preston, W. F. McCorkle, W. A. Spitzley, J. H. Brogan and E. D. Preston, Detroit, Mich.

Canadian Fence Manufacturing Co., Woodstock, $250,000; C. A. Brink, N. Stickney, G. Bragg, Township West Oxford; J. B. Murray, West Zorra; T. H. Blatchford, East Oxford. To manufacture stationary and portable fences; also the tools and machiney used in the manufacture of wire, posts, gates, etc.

The Gutteridge-Sullivan Co., Sarnia, $40,000; T. P. Bradley. S. A. Armstrong, T. J. Gordon, J. R. Pierdon and J. Sullivan, Sarnia. To manufacture brick machinery, dies; also to deal in earthenware, pottery, etc.

British Columbia.—The British Columbia Construction and Distributing Co., $25,000; to build and mantain electric works, power houses, etc.

Braim Patent Switch Co., $50,000; to manufacture the device for operating street railway switches from an approaching car.

Col. W. P. Anderson, of Ottawa, chief engineer of the Department of Marine and Fisheries, ex-president of the Canadian Society of Civil Engineers, has been elected a member of the Council of the Institution of Civil Engineers of Great Britain. He is the only Canadian on the council of that institution.

Herbert J. Armstrong has this month opened business as consulting mechanical engineer in Toronto, with offices at 43 Victoria Street. Mr. Armstrong, who has been for several years with the John Inglis Co., of Toronto, will make a specialty of designing and laying out steam plants, and in planning structural work and power distribution systems.

THE FIRST SOO CANAL.

In view of the fact that next month there will be a ceremony at Sault Ste. Marie, Mich., in celebration of the fiftieth anniversary of the opening of the canal there, it is interesting to recall the fact that the first canal lock on the continent was that constructed on the Canadian side of the same river about the year 1798.

The following extract from a recently published history, The Annals of Sault Ste. Marie, by Edward Capp, gives the particulars of this early canal of the north.

"In 1670 Prince Rupert of England had been granted by King Charles II. a charter for a new company which called itself the Company of Merchant Adventurers trading into Hudson's Bay. To this association was given the control of all that vast territory whose lakes and rivers drain eventually into Hudson's Bay and to the posts which they established at various points did the natives bring their packs of furs for barter.

For nearly a century the work of the company's agents was uninterrupted from the interior save for a raid at long intervals by the French, but with the establishment of peace in 1763, the country became a field of operations for great numbers of independent barterers. For eleven years little notice was taken of these, but their traffic grew to such an extent that, in 1774, the Hudson's Bay Company found it necessary to establish outposts in its own defense.

This movement, however, was not sufficient, for the "independents" continued to grow in strength, until 1783 three of them, Peter Pond and Thomas and Joseph Frobisher, formed themselves into a rival organization, which has come down to us under the name of the North-West Company.

The new institution was peculiarly Canadian, and with its 5,000 agents throughout the country, most of whom were in some measure identified with the natives, it gradually assumed the control of the great district.

The North-West Company erected a post at Sault Ste. Marie, at the foot of the Rapids, on the north shore, where were the house of the bourgeois, or chief factor, the men's house, a magazine, and a number of stores for the reception of merchandise, and here came all the furs bound from the west to Montreal and all goods en route from Montreal to the interior.

To facilitate the traffic, a canal was cut for the passage of bateaux and canoes between the islands and the mainland, and a lock, the first in the West, the forerunner of the present wonderful engineering triumphs, was constructed, having a lift of nine feet.

The lock was 38 feet long and 8 feet 9 inches wide, the lower gate letting down by a windlass and the upper folding gates working with a sluice. The sides were held in place by vertical timbers tied together by horizontal pieces at the top and high enough for the boats to pass beneath them. A leading trough of timber framed and planked, 300 feet long, 8 feet 9 inches wide and 6 feet high supported and levelled on beams of cedar through the swamp was constructed to conduct the water from the canal to the lock. The canal itself was 2,580 feet long, and along the whole length of lock, trough and canal a roadway was cut 45 feet wide, and there was also laid a log towpath the full way, 12 feet wide for oxen to track the boats.

In the construction of the work 20,000 feet—board measure —of 2-inch plank were used as well as 5,000 feet—running measure—of hewn timber.

Whatever year after 1783 it was begun, it was completed by 1798.

No record exists of the lock ever having been used, and as a saw-mill was built at the foot of the canal used as a raceway, it may have proved unsuccessful for its original purpose because of the great fall of water which it was necessary to overcome. However that may be, it is not mentioned later than 1803 and at the time of the American occupation of the Sault it seems to have been completely forgotten.*

Impressed with the governmental report of Captain Bruyeres referring to the lock and adjoining land, which report is reproduced by the Canadian Archivist, three gentlemen, His Honor Judge Steere, Mr. Joseph Cozens, D.L.S., and Mr. A. S. Wheeler, General Superintendent of St. Mary's Falls Canal, Michigan, proceeded to the site of the old lock and were successful in unearthing it.

The measurement and details exactly corresponded with those of the report of 1802, and the lock, through the generous patriotism of Mr. Clergue, was restored in form, if not in material, and may be seen to-day to the north of the Lake Superior Power Company's offices."

*Canadian Archives, 1886 and 1889.

A SMOKELESS CITY.

At the regular meeting of the Engineers' Club of Toronto, on May 11th, A. M. Wickens read a paper under the title, "A Smokeless City," which was followed by some discussion. Below is a summary of the paper and discussion:

If a city is to grow, it must become a manufacturing centre. A purely commercial city is an impossibility in a young country. Even our business blocks become in a measure factories—they must have their power plant for the operation of elevators, the supply of heat, etc. To make the city smokeless is a desirable and laudable end toward which to strive. As we are situated, it seems that we must burn soft coal, on account of first cost, and soft coal is proverbially smoky. As soon as our city by-law came into force, we had a number of men, all profoundly versed in combustion and fuels, and all supplied with perfect apparatus for overcoming the smoke nuisance. Some discharge a jet of steam over the coal; others have air ducts to supply heated air to the fire; while others introduce fuel oil and other oils with the steam jets. All these so-called new ideas have been experimented with, and some discarded, years ago—some as early as 1837. Most of them mimimize the smoke to some extent, but usually at the expense of some extra coal. In the test which I conducted, the arrangement was such that the steam jets blew for about six minutes after each fire was put on. There were 15 jets, ⅛-in. in diameter. After a six hours' run we found that the amount of steam we used for improving the combustion was 7 per cent. of all the steam made. The apparatus was guaranteed to cure 90 per cent. of the smoke and save 10 per cent. of the fuel. The first thing it had to do was to save 7 per cent. to make up for the steam used, consequently it would have to save 17 per cent. to make a net saving of 10 per cent. Again, during 70 per cent. of the time, the fire was normal, so that during the 30 per cent. of the time, when this apparatus was on, it would have to make the total saving, which would be nearly 55 per cent. during that time, to make up for the time it was not on. The result was, when we came to sum up the test, the apparatus was 5.6 per cent. behind. But it killed 90 per cent. of the smoke. There is no apparatus using live steam for a jet that is making any real saving in fuel.

In burning fuels of any kind, if we get perfect combustion, we have no smoke. The oxygen of the air must be thoroughly mixed with the carbon of the fuel. This may be demonstrated with a lamp. Air and carbon meet and there is no smoke; but turn up the wick, and you have smoke for lack of air; the same result would follow if you close the air ducts at the bottom of the chimney. It is the carbon in the coal that burns; two atoms of oxygen combine with one atom of carbon, forming carbonic acid, which burns perfectly and represents 14,800 British thermal units per pound. Let the quantity of air be reduced until one-half the quantity of oxygen that is required is supplied to the furnace, and then one atom of oxygen combines with one atom of carbon and the result is carbonic oxide. The heat value of one pound of carbon converted into carbonic oxide is only 7,800 heat units, and it is a very smoky substance; so when we supply only half the quantity of air we lose nearly half the heat units in the fuel. The air must be thoroughly mixed with the coal and the furnace heat must be kept at a high temperature. If we put in too much air we carry away too much heat. Theoretically coal requires 12 pounds of air per pound for consumption, but practically we use from 18 to 24 pounds. The reason is that we cannot get the air and coal to mix properly and thoroughly. When the minimum amount of air is used, the stack losses per pound of coal are 1,400 heat units, if the temperature of the escaping gases is about 400 deg. F. If we use twice the quantity of air without reducing the stack temperature, the loss increases to

2,300 heat units per pound. The problem of balancing the amount of air consumed and the temperature of the fire appears to be very simple, but in practice it does not work out easily. The reasons are: The difficulty of mixing the carbon with the oxygen; boilers are often poorly designed; they are poorly set and badly connected with the smokestack; flues are not large enough and the average ability of the fireman or stoker is seldom more than the muscular ability to shovel.

A first-class boiler well set and using the best soft coal can be made to smoke like a volcano by an ignorant fireman; neither is there any apparatus in existence that will prevent smoke if fires are managed ignorantly. The only way to have a smokeless city is to consult the best engineers, have everything of the highest class, and engage first-class men to manage the plant.

In reply to a question, Mr. Wickens explained the action of the steam jet in smoke consumption. The jets are usually put in front of a furnace, set at an angle, so that the direction of the flow of steam will strike the bridge wall just above the coal, and the idea is that the jet holds the smoke over the incandescent fire just as the volatile parts are released, and gives it an opportunity to light and burn. Some tell of the steam becoming a hydrocarbon and contributing to combustion, but it really does not do that because at the time fresh coal is put on the fire the fire is cooled and there is not heat enough to convert the steam into a hydrocarbon.

R. W. King: The attainment of the proper mixture of carbon and oxygen is very easy in the lamp, because arrangements are made there for a steady and proper flow of oil, and a steady and proper flow of air which is heated around the burner and impinged on the flame. The same thing can be done in the burning of any fuel, but it requires nice adjustment, and the average fireman has not intelligence enough to keep up that adjustment. Then fires are not always run at the same rate, whereas the lamp is always burning at the same rate. With the fireman, conditions are constantly changing, and it is difficult to keep the adjustment correct. It is generally conceded that if you want a clean city you must burn hard coal. In New York, as the result of a smoke by-law, everyone is now burning hard coal. There is a dust nuisance with hard coal, which is overcome in the plant of the New York Steam Heating Co. by discharging the smoke into a settling chamber where the dust is thrown down. As to steam jets, I have seen these for thirty or forty years. They will give quite a little assistance at the expense of the steam. The later forms have a jet above the fire and a jet at the back pointing down, and the effect is that they form a whirlwind and hold the smoke and give a thorough mixture.

Mr. Wickens: There was a test the other day between two boilers, one fitted with a fuel economizer device and the other without. The man who ran the boiler without the device was used to the coal, and knew the boiler, and knew when extra steam would be wanted, and he made a splendid eight hours' run. The next day the proprietor of the device made a run. The device was a pretty fair arrangement; it did not use steam, but air was heated and discharged through the furnace. He lost steam when called upon suddenly, and his coal clinkered. He made a saving of a little over two per cent., while if he had fired the apparatus as well as the old fireman he would have saved twelve per cent. The test was practically a test between the two men. . . In comparing a furnace with a lamp, there is one condition in the lamp that does not obtain in the furnace. If you let too much air go through the lamp it is not a waste, but if you do that in the furnace you carry heat out of the stack which you cannot get back.

The discussion was carried on for some time, coming to the general conclusion that there are times when hand firing is better than any kind of stoker, more especially where the loads are variable, but where there is a reasonably steady load, a properly arranged automatic stoker would be better than hand firing.

* * *

Windsor proposes to buy a new lighting plant.

Vancouver will establish the first municipally owned and operated electric light and power plant in British Columbia.

By a unanimous vote Lethbridge, Man., carried a by-law to grant the C.P.R. certain exemptions in return for building a new station and making that town a divisional point.

ESSENTIAL ELEMENTS IN THE DESIGN OF DAMS.

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

(Continued.)

Comparison of Vertical with Inclined Pressure Face of Dam.

The inclined face is shown in Fig. 5 in January issue, and a brief reference is there made to it, without discussion. In investigating this, we will take Fig. 24 and assume the water upon vertical face b-c, and will find the centre of gravity at g^1, and the centre of pressure on sub-base at p^2.

In Fig. 25 assume the water pressure on inclined face a-c, the centre of gravity at g^2, and the centre of pressure on sub-base from weight of mass at p^3.

The horizontal pressure of the water in either case will equal $(b\ c)^2\ 31.25$, and the weight will be $\frac{bc \times ab}{2} \times 140$.

(140 lbs. being the weight of 1 cub. ft. of mass.)

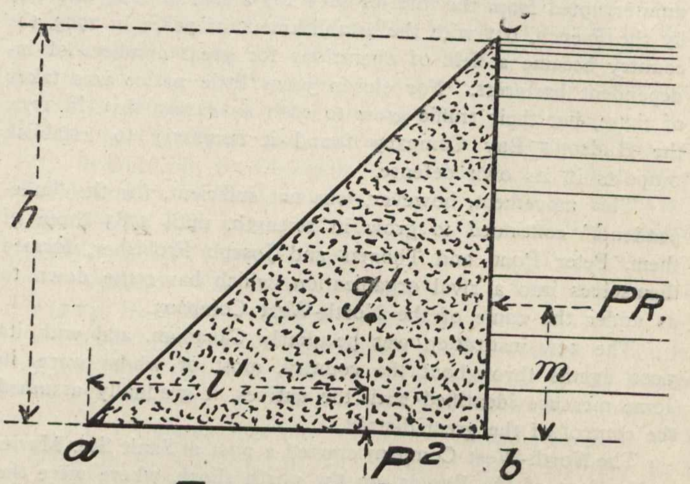


FIG. 24

If ab were equal to bc = h, then we would have $\frac{h^2\ 62.5}{2}$ and $\frac{h^2\ 140}{2}$.

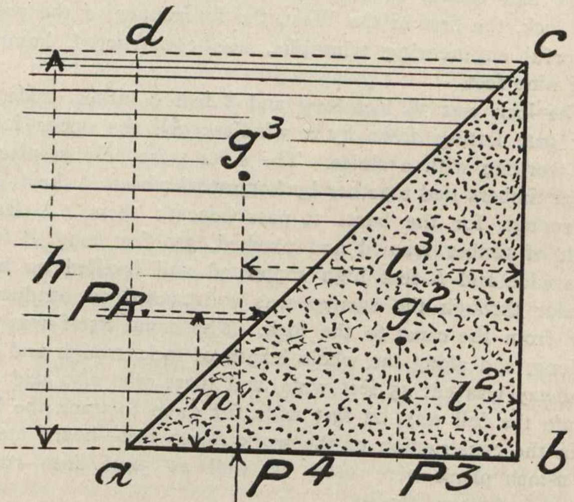


FIG. 25

The S. S. F. with co-efficient of friction of .65 on sub-base would then be $\frac{140 \times 65}{62.5 \times 100} = 1.456$ in each case.

When the vertical component of the water is not considered in Fig. 25, the overturning moment will be for each case = p m.

The O. S. F. for Fig. 24 would be with fulcrum at "a," $\frac{\text{weight} \times l^1}{\text{p m}}$.

The O. S. F. for Fig. 25 would be with fulcrum at "b," $\frac{\text{weight} \times l^2}{\text{p m}}$.

E	D	F	G	E	D	F	G	E	D	F	G	E	D	F	G
62 5	1	31.25		1625 0	26	1593.75	21125 0	3187 5	51	3156 25	81281	4750.0	76	4718 75	180500
125.0	2	93.75	1250	1687.5	27	1656 25	22781 25	3250 0	52	3218 75	84500	4812 5	77	4781 25	185281
187.5	3	156.25	281.25	1750 0	28	1718.75	24500.0	3312 5	53	3281.25	87781	4875.0	78	4843 75	190125
250 0	4	218.75	500 0	1812 5	29	1781.25	26281.25	3375 0	54	3343 75	91125	4937 5	79	4906.25	195031
312.5	5	281 25	781.25	1875 0	30	1843 75	28125 0	3437 5	55	3406.25	94531	5000.0	80	4968 75	200000
375 0	6	343.75	1125.0	1937 5	31	1906.25	30031 25	3500 0	56	3468 75	98000	5062 5	81	5031.25	205031
437 5	7	406.25	1531 25	2000 0	32	1968.75	32000.0	3562 5	57	3531.25	101531	5125 0	82	5093 75	210125
500.0	8	468 75	2000.0	2062.5	33	2031 25	34031.25	3625.0	58	3593.75	105125	5187 5	83	5156 25	215281
562 5	9	531.25	2531 25	2125 0	34	2093.75	36125 0	3687.5	59	3656.25	108781	5250 0	84	5218 75	220500
625 0	10	593.75	3125.0	2187 5	35	2156.25	38281 25	3750.0	60	3718.75	112500	5312.5	85	5281 25	225781
687 5	11	656 25	3781 25	2250 0	36	2218 75	40500 0	3812 5	61	3781 25	116281	5375 0	86	5343.75	231125
750 0	12	718.75	4500.0	2312 5	37	2281 25	42781 25	3875.0	62	3843.75	120125	5437 5	87	5406.25	236531
812 5	13	781 25	5281 25	2375 0	38	2343 75	45125 0	3937 5	63	3906.25	124031	5500.0	88	5468.75	242000
875 0	14	843.75	6125 0	2437 5	39	2406 25	47531 25	4000 0	64	3968 75	128000	5562.5	89	5531.25	247531
937.5	15	906 25	7031 25	2500 0	40	2468.75	50000 0	4062 5	65	4031 25	132031	5625.0	90	5593 75	253125
1000 0	16	968.75	8000.0	2562 5	41	2531.25	52531 25	4125.0	66	4093.75	136125	5687 5	91	5656 25	258781
1062 5	17	1031 25	9031.25	2625 0	42	2593 75	55125 0	4187 5	67	4156.25	140281	5750.0	92	5718.75	264500
1125 0	18	1093.75	10125 0	2687 5	43	2656 25	57781.25	4250 0	68	4218.75	144500	5812 5	93	5781 25	270281
1187 5	19	1156 25	11281.25	2750 0	44	2718 75	60500 0	4312 5	69	4281 25	148781	5875 0	94	5843.75	276125
1250 0	20	1218.75	12500 0	2812 5	45	2781 25	63281 25	4375.0	70	4343.75	153125	5937 5	95	5906 25	282031
1312.5	21	1281 25	13781.25	2875 0	46	2843 75	66125 0	4437 5	71	4406.25	157531	6000.0	96	5968.75	288000
1375 0	22	1343.75	15125 0	2937 5	47	2906 25	69031 25	4500 0	72	4468.75	162000	6062.5	97	6031.25	294031
1437 5	23	1406 25	16531 25	3000 0	48	2968 75	72000 0	4562 5	73	4531 25	166531	6125.0	98	6093.75	300125
1500 0	24	1468.75	18000.0	3062 5	49	3031 25	75031.25	4625.0	74	4593 75	171125	6187.5	99	6156.25	306281
1562 5	25	1531 25	19531 25	3125 0	50	3093 75	78125 0	4687 5	75	4656.25	175781	6250.0	100	6218 75	312500

J.S.F.

Water Pressure upon Vertical Face of a Dam—per lin. foot. Column E gives intensities of pressure at given depths; column D gives depths; column F gives average pressure at given depths; column G gives total pressure over total surface.

Since l^1 is greater than l^2, the Fig. 24 will be the more stable.

But the water pressure is on "a c" in Fig. 25, and it will equal $\frac{h^2}{2} \times 62.5$, with centres of pressure g^3 and p^4.

The adhesion will then equal:

$$\frac{65}{100}\left\{\left(\frac{h^2}{2} \times \frac{140}{1}\right) + \left(\frac{h^2}{2} \times \frac{62.5}{1}\right)\right\}$$

and pr $= \frac{h^2 \times 62.5}{2}$, giving S. S. F. for Fig. 25 of 2.105, as compared with 1.456 for Fig. 24.

The stability mom. will also be increased by $h^2 \times 62.5 \times \frac{l^3}{2}$.

Since $l^1 = \frac{2\,ab}{3}$, $l^2 = \frac{ab}{3}$ and $l^3 = l^1$, then the total stability value of Fig. 24 $= \frac{2ab}{3} \times \frac{ab \times bc \times 140}{2}$.

And of Fig. 25 =

$$\left\{\frac{ab}{3}\left(\frac{ab \times bc \times 140}{2}\right)\right\} + \left\{\frac{2ab}{3}\left(\frac{ad \times dc \times 62.5}{2}\right)\right\}$$

eliminating equivalent factors, and we have:

$$= \text{as } \frac{2 \times 140}{3} \text{ is to } \left\{\frac{1 \times 140}{3} + \frac{2 \times 62.5}{3}\right\}$$

$= 93.3$ is to $[46.6 + 41.6] = 93.3$ to 88.2.

Taking the overturning mom. as equalling

$$\frac{bc}{3}\left(\frac{bc \times bc \times 62.5}{2}\right) = \frac{62.5}{3} = 20.83 \text{ in equivalent ratios.}$$

$$\text{O. S. F. will} = \frac{93.33}{20.83} = 4.48 \text{ for Fig. 24.}$$

$$\text{O. S. F. will} = \frac{88.2}{20.83} = 4.23 \text{ for Fig. 25.}$$

This shows the advantage in regard to overturning, to be with Fig. 24, having the vertical face to the water pressure, as 4.48 is to 4.23, but we have found that Fig. 25 has the advantage in S. S. F., as 2.105 is to 1.456, and as the S. S. F. is nearer to the limit of strength and the factor most in need of being bettered, we must decide upon Fig. 25 as being able to maintain its position with the greater degree of security.

(The table of pressures given this month will be found useful for reference in connection with this series of articles.)

RADIUM AND ITS CONNECTION WITH CHEMICAL AND PHYSICAL PROBLEMS.

By JOHN WADDELL, B.A., D.Sc., SCHOOL OF MINING, KINGSTON.

In 1895, Roentgen's discovery that rays emitted by an electric discharge, through a highly rarefied gas in a closed tube or bulb, was capable of affecting a photographic plate and of producing fluorescence in a number of substances, drew the attention of the world to investigations made by previous investigators, which were, however, not so startling in character. The so-called X-rays were thereupon experimented with not only by numerous amateurs, but also by a number of scientific investigators.

Twenty years before Roentgen's discovery, Crookes had expressed the opinion that in the case of electric discharge in a bulb containing gas in a very rarefied condition, the negative pole or cathode sends out material particles which proceed at right angles to the surface of the cathode. If the cathode forms a portion of a spherical surface, the rays converge towards a single point or focus.

The energy of the particles projected from the cathode shows itself in various ways. Small fans properly placed in the exhausted bulb can be driven by the rays. They produce fluorescence in many substances, such as mica, gypsum, and glass. They produce heat, and when the rays are focused upon a thin piece of platinum foil it may become even red hot.

Wherever the cathode rays are stopped, another phenomenon occurs. The point at which the rays are stopped becomes a centre from which new rays proceed. These rays are probably not material, but like light rays, undulations of the ether. They are not shot out at right angles to the surface merely, but in all directions. They are not entirely like light rays, however, because they are not reflected or refracted, and substances opaque to light may be permeable by these rays, while other substances, transparent to light, may be impermeable by these the X or Roentgen rays.

A very important characteristic of the X-rays is that when they pass through air it becomes a conductor of electricity. The air is said to be ionized. The molecules of the air are to a certain extent (a very small extent only), grouped into clusters some charged positively some negatively. In dry air the negative clusters are probably smaller than the positive. The clusters of molecules are called ions because they carry electricity.

In ionized air an electrified body is discharged. If the body is positively charged, its change is taken away by the negative ions, if it is negatively charged, its charge is taken away by the positive ions. An electrified body, therefore, when brought within the influence of a bulb in which Roentgen rays are being produced, is discharged.

The character of the Roentgen or X-rays was, as the latter name indicates, unknown, and many researches were started for the purpose of elucidating the matter. It was found that the exhausted bulbs in which the X-rays were produced always fluoresced and it was thought for a time that the fluorescence was the origin of the X-rays. Becquerel, on this assumption endeavored to find out whether fluorescent substances produced an effect on a photographic plate. For this purpose he made use, among other substances, of some fluorescent compounds of uranium and found that they affected the plate. But he discovered further that these uranium compounds even in the dark, under which circumstances they do not fluoresce, as well as those uranium compounds that do not fluoresce at all, produce the same effect on the plate.

Working under Becquerel's direction, Mme. Curie found that some ores of uranium, especially some pitchblendes, were more radioactive than pure uranium or pure uranium salts, and she separated from large quantities of ore small quantities of material very much more radioactive than the original pitchblende. She considered that she had obtained an element like bismuth (a radioactive bismuth), to which in honor of her country she gave the name polonium. It is doubtful whether polonium is really an element in the usual sense. Later, Mme. Curie obtained salts like those of barium, but with very great radioactivity, and she was able to determine the atomic weight of the new element to which the name radium was given. The quantity of radium in the most radioactive pitchblende is very small, only a very few grains to the ton.

Radium and its compounds have three very conspicuous properties; they act on the photographic plate so that sciographs, or shadow pictures, may be taken; they cause fluorescence in a number of substances, and they ionize air and other gases. This last effect is the most readily observed, and is so delicate that a few grains of inactive material containing $\frac{1}{10,000,000,000}$ of its weight of radium shows the presence of the latter by its power to discharge an electrified body. This quantity is about a millionth of what can be weighed on an ordinary good chemical balance. That the electrified body is not discharged by particles sent out by the radium is proved by the fact that both positive and negative bodies are discharged.

One of the most remarkable features about radium is that it sends out several kinds of rays. Newton considered that light consisted of particles sent out from the luminous body. This theory proved to be incorrect, but now we have a case in which the evidence is almost, if not quite, decisive, that material is shot out from the body. Three kinds of radiations from radium have been detected, called, respectively, alpha, beta, and gamma. The alpha radiations consist of particles whose mass is approximately double that of the hydrogen atom, the beta radiations consist of particles about one-thousandth the mass of the hydrogen atom, and the gamma radiations are most probably ethereal waves.

The proof that alpha and beta radiations consist of particles with electrical charges sent out with immense rapidity lies in the fact that the radiations may be deflected by the influence of a magnet. It is well known that if a current of electricity is passing through a wire which is free to move, the wire may be moved by the influence of a magnet and the magnitude of the motion will depend upon the strength of the current and also upon the strength of the magnetic influence. This principle is made use of in some forms of telegraphic instruments. If a number of electrified particles are moving in one direction, they form a current of electricity which is practically the same as a current in a wire, and just as a wire with a current flowing through it is deflected by a magnet, so the electrified particles would be deflected. The amount of deflection will depend upon the quantity of electricity on each particle, upon the mass or weight of the particles, upon their velocity, and upon the strength of the magnetic influence. If the particles are charged with negative electricity, they would be deflected to one side of the natural path, if charged with positive electricity, they would be deflected to the other side. The beta radiations are found to be deflected to the side which shows that the particles are negatively charged; the alpha radiations are deflected to the other side and consist therefore of positive particles. The amount of deflection of the beta rays is much greater than that of the alpha rays, and from a comparison of the amount of deflection, it is found that while the alpha rays consist of particles of about twice the mass of the hydrogen atom moving with a velocity about one-tenth that of light, the beta rays consist of particles approximately one-thousandth the mass of the hydrogen atom moving with a velocity between one-third and nine-tenths that of light. Some of the particles move faster than the others, the limits being approximately those given above.

The energy of the alpha radiations is much greater than that of the beta radiations, because though the velocity is less the mass is much greater. Moreover, in a given time about four times as many alpha particles, as beta particles, escape from radium. But though the alpha particles have more energy than the beta, they are more easily stopped, just as a person might stop a cricket ball thrown from the hand, but would not care to stop fine shot from a gun. A very thin metal foil, even a sheet of paper or a very few inches of air, stop by far the greater number of alpha particles. The beta particles are much more penetrative. The gamma rays have so far not been deflected by a magnet, and are, therefore, probably not material. They are the most penetrative of all. The penetrating power is pretty nearly in ratio: 1:100:10,000.

I have said that air is ionized by these radiations being formed into positive and negative groups of molecules, but it will be seen that these are not to be confused with the positive and negative particles emitted by radium, the alpha and beta radiations. For one thing we know from other considerations that the groups of molecules of air are very much larger in size, than the particles emitted by radium, and for another thing, the charges of electricity carried by the particles sent out from radium, are much less than can be carried by ionized air. Hence, though radium is sending out more positive particles than negative, the radium does not become negatively charged since ionized air in the neighborhood carries away all the charge. For the same reason, a conductor placed in the neighborhood of a radium compound is not ordinarily made positive by the alpha rays or negative by the beta rays. But a special experiment has been devised in which a conductor was made negative by the beta radiations. The radium compound was enclosed in a metal box thin enough to allow beta radiations to go through, but impermeable to alpha radiations. The beta radiations were allowed to fall upon a conductor surrounded by a non-conductor such as a coating of wax. Hence though the air was ionized, electricity could not escape from the conductor, and it became charged negatively. It is said that the metal box containing the radium became charged positively owing to its having retained the alpha radiations.

The ionization of the air is mainly due to the alpha rays, the ratio of the ionizing powers being nearly the inverse of the penetrating powers, namely, 100,000:100:1. On the other hand, the photographic effect is chiefly due to the beta rays, though the alpha rays are also effective. Fluorescence is in some substances due to beta rays, in other cases to alpha rays.

(To be continued.)

DECIMAL COINAGE IN AUSTRALIA.

The Daily Mail of Sydney, N.S.W., for April 19th, contains the following item:

In the forthcoming session of the Federal Parliament, the Government will introduce a bill for the establishment of the Metric System of Weights and Measures in Australia. The bill provides that the Metric System shall be legalized immediately, while the Governor-General will be empowered to make it compulsory at any time. The bill would include the establishment of decimal coinage as well, were it not for the difficulty which would be experienced in getting rid of the existing currency. The Imperial Government is willing to take £100,000 worth annually, but the Federal Treasurer declares that it would be necessary to export double that amount.

DIRECT ROLLING PROCESS FOR COPPER.

In the Canadian Engineer for November, 1902, was given a description by H. J. Martin, of Swansea, England, of his Direct Rolling Copper Process, by which the heat contained in copper cakes or wire bars, immediately after they are ladled in the refinery, is utilized for the rolling of the metal direct, thus doing away with reheating, as now practised. A recent number of the Iron and Coal Trades Review, of London, contained a detailed description of the process, with drawings for a copper refinery equipped for this method of handling.

The writer claims for his process the following advantages:

1. Great reduction of time in casting all the larger masses of copper, through doing away with hand-ladling of same by tapping from the furnace and pouring from a big ladle, at the same time enabling either means to be carried out, as found desirable, for any particular product.

2. Prevention of chilling and setting of copper in the ladle by the continuous flow of molten metal in same at a high temperature, without interfering with the proper control necessary for starting and stopping the pouring into the moulds.

3. The amelioration to a large extent of the present trying conditions for the workmen in carrying out the tedious, laborious and hot work now necessary.

4. The moulds being all self-contained, thus obviating the present trouble of putting together and taking apart after casting.

5. Freedom and independence of movement between the different stages of the casting operation, through providing storage room, etc., between each.

6. The furnace charge of cakes, plates and bars being available on the same day, instead of the next, as at present.

7. Prevention of cold sets, etc., through pouring in a larger body and so filling the mould more rapidly.

8. The moulds being so constructed as to be suitable for immediately tipping the hot cakes therefrom and thus enabling direct rolling, with its further advantages, to be adopted or not, as found desirable.

THE PRESENT POSITION OF THE METRIC SYSTEM.

A paper read by the late Arthur Harvey, a few weeks ago, before the Engineers' Club, of Toronto, dealt very fully with the present situation in England, the United States and Canada with reference to the Metric System. In view of the general adoption of metrics in all countries except the Anglo-Saxon strongholds, and the consequent isolation of such non-metric countries becoming yearly more complete, Mr. Harvey took the position that Canada should be prepared for eventualities. Canada, in his opinion, cannot prudently make metric weights and measures compulsory until either the United States or England, which divide most of our foreign trade between them, had taken that step, but in the meantime we ought to familiarize ourselves with the question.

Dealing with the position in England, Mr. Harvey summarized the debate in the House of Lords, February 23rd, 1904, on the second reading of the bill to render compulsory the use of the Metric System. In this debate, the following facts were referred to:

The Colonial Conference of 1902 passed a resolution advising the adoption of the Metric System throughout the Empire and urging the Governments to give consideration to the question of its early adoption.

The House of Representatives for Australia has passed a strong resolution in favor of the system.

New Zealand has passed a Weights and Measures Act by which the Governor is empowered to enforce by proclamation the compulsory adoption of the system. This proclamation is not to be issued prior to January 1st, 1906, and it is not intended to have it issued before the adoption of the system by Great Britain.

Three hundred and thirty-three members of the British House of Commons have signified their intention to support the metric bill when presented.

The Chambers of Commerce of the Empire, meeting in Montreal in 1903, passed a resolution in favor of the system.

The Cape of Good Hope House of Assembly has addressed the Imperial Government on the subject of the adoption of the Metric System.

The Transvaal Chamber of Mines have signified their cordial approval of the proposal.

The Governors of Malta and Bermuda have intimated the desire of the inhabitants of those islands for the adoption of the system.

All civilized nations, with the exception of Great Britain and her dependencies, the United States, and Russia, have adopted the Metric System. In the United States there is a bill before Congress providing for the adoption of the system, and in Russia a little is being done in this direction as the Government has instructed iron and steel works to alter their machinery so as to produce rods, rails and sheets on a metric scale.

The Metric System, worked out in France, originated in England. In a letter dated November 14th, 1783, James Watt laid down a plan which was in all respects the system adopted by the French philosophers seven years later.

The bill, after a lengthy discussion, was given a second reading in the Lords and referred to a select committee. It might be noted that a select committee, presided over by Sir Henry Roscoe, made a very full report of this subject in 1895.

Mr. Harvey gave a few letters from British consuls, samples of many which have been received, all pointing out the loss to British trade through the persistence of British weights and measures, and all favorable to an immediate change to the Metric System. The letters read were from Brazil, Sweden, Argentina, Germany, Bulgaria, Algeria, Spain, and the Netherlands.

The change to meters and kilos in England is likely to be sudden, as a wave of opinion speedily overwhelms a democratic country, such as England now is. The trades and labor councils are already advocates of the Metric System, and the Trades Union Congress, at Leeds, September, 1904, representing 5,000,000 workingmen, unanimously resolved to petition the House of Commons in favor of Lord Belhaven's bill, which had just passed the Lords.

Mr. Harvey then described the situation in the United States. Here the foreign trade is still insignificant in its ratio to internal trade, and questions of domestic convenience are likely to outweigh those of the profit of external commerce in the consideration of the Metric System. The Metric System was made legal in the United States in 1866. Every year for the past fifteen years bills have been introduced to make the system compulsory in Government transactions, and these have been referred to the Committee on Coinage, Weights and Measures. This is not a permanent committee, its members being appointed by the Speaker at the beginning of every new Congress, but as a general thing those who show an interest in weights and measures are reappointed to the committee if re-elected to the House. Thus, James H. Southard, the present chairman, has occupied the seat for three Congresses. None of the bills have become law, though in every case they have received strong commendation from the committee. Last year's session was the one preceding a presidential election, and the present session is a short one, where there is little time for anything beyond the regular appropriation bills. Knowing this, the committee planned to hear the opponents of the Metric System last year, and those in favor of it this session. "I confidently look for another favorable recommendation."

said Mr. Harvey, "which will in due course have to await the meeting of the Congress next year."

"In Canada, we must probably remain inactive, but we should be watchful. Sometimes opportunities may arise of assimilating our local measures to metric standards. For instance, in the bill now being made law establishing a minimum size for packages of apples, it might be useful to have the packages sized to half a cubic meter, for use in other countries beside Britain. In any event, as both systems are legal, the equivalents might be given in the accounts. I for one am firmly convinced that Britain and the States should fall into line with the other forty countries, which have tried and proved the practical convenience of the Metric System, and there would ensue such a development of trade, especially on the engineering side, as has not yet been seen in the history of the world."

FIREPROOF CONSTRUCTION.

F. W. Barrett, manager of the Expanded Metal Fireproofing Co., Toronto, recently addressed the Canadian Manufacturers' Association on "Modern Types of Factory Construction," and his remarks were enthusiastically received. A summary is given below.

Our grandfathers built their factories of wood, largely because it was most convenient, and it was cheap, but there are very few such buildings left. They did not succumb to the winds, nor did they rot away; the great majority of them have gone up in smoke. The modern engineer has evolved various types of buildings for manufacturing purposes, a few of which I will undertake to describe:

For metal workers, and for other lines of manufacture, where both machines and products are heavy, the single story building, from 40 to 80 feet in length, and width as may be desired, is very generally adopted. This type of building is essentially adapted for moving weights, by means of travelling cranes. The framework for such a building is of steel, both columns and roof trusses. For ventilation and light, especially if the building is broad, a monitor top to the roof is advisable. The walls of such a building are not over twenty-five feet high as a rule, often less, and they can be built in different ways. Very commonly a light brick wall is adopted, forming piers around the walls columns, the spaces between made lighter. In localities where cement, sand and gravel are easily obtained, concrete walls are rapidly supplanting brickwork. For the brick and for the concrete it is necessary to excavate and build heavy foundations to carry the walls. A very considerable economy can often be effected by adopting a light form of wall enclosure sustained entirely by the steel frame. It may be in the shape of metal siding, but this is subject to corrosion, and requires, therefore, to be frequently painted. Another light wall enclosure is made by attaching light steel studding, on which expanded metal lath is wired; cement plaster is applied on both sides, forming a wall two inches thick, which protects all the metal work in it from corrosion, and withstands the weather perfectly. With a wall of this description no foundation is required beyond a pier under each wall column, which may be spaced 18 feet or 20 feet apart.

The roof of this class of building is ordinarily supported by light steel trusses. If not too wide, it is often desirable to have the truss in one span, leaving the whole floor clean of intermediate columns. Where the columns are introduced, it is usually wise to put in two rows, to which a travelling crane can be attached, to travel the full length of the building. This same section can be raised to make a monitor top.

The roof plate is the next point to be considered. Undoubtedly wood is the cheapest, and on that account very often used. That is where the building fails to be first-class. If it is worth while to pay the cost of a steel frame instead of wood and brick, or cement walls instead of wood, surely it is just as much an improvement to have the roof built of incombustible materials. If the roof is flat, or nearly flat, no better roof has been devised than reinforced concrete. If a pitched roof, then the same form of expanded metal and two-inch cementine is available, as I described for the walls.

To show that these wooden roofs are a menace to the building and to machinery and contents, I know of a case of a cement factory at Durham, where a fire started at one end of a 200 or 300 foot building, and in a few moments swept the full length of the building. The lesson was a sudden one, and they got a couple of fire curtains built to cut the roof into sections. These fire curtains are made by covering a steel truss all around with expanded metal, carrying it two feet above the roof, and plastering it on both sides with cement plaster.

In buildings in which the contents are not particularly inflammable, the structural steel work is exposed. In dealing with buildings where the stock and contents are in themselves combustible, it becomes necessary to protect the structural steel, for a fire may cause great damage by warping and bending the steel work. To protect steel columns and beams there is nothing equal to cement concrete judiciously applied. It preserves the steel from corrosion, it expands and contracts under extremes of heat and cold in the same ratio as the steel, and at the same time is an excellent insulator.

The relative merits of concrete and terra cotta have often been discussed. Professor Norton, of the Massachusetts School of Technology, at Boston, in his report on the Baltimore fire, says:

"When brick or terra cotta are heated, no chemical action occurs, but when concrete is carried up to about 1,000 degrees Fahrenheit its surface becomes decomposed, dehydration occurs, and water is driven off. This process takes a relatively great amount of heat. It would take as much heat to drive the water out of this outer quarter inch of concrete partition as it would to raise that quarter inch to 1,000 degrees Fahrenheit. Now a second action begins. After dehydration the concrete is much improved as a non-conductor, and yet through this layer of non-conducting material must pass all the heat to dehydrate and raise the temperature of the layers below, a process which cannot proceed with great speed. Much has been said about the uncertainty of concrete. The value of concrete in theory is often admitted by those who consider it unwise to use it, because of the difficulty of getting the materials properly proportioned, mixed and placed in position. I have never been able to see the force of this. It is quite as easy to lay sound concrete as it is to put somewhat irregular and confessedly brittle brick of terra cotta into place with proper bonding."

There is another type of factory building where for various reasons a building three or four or more stories in height is desirable.

The worst kind of a factory building is probably the most common one, having steel or iron columns, and steel girders, the joists and flooring being of wood, and without protection on the columns and girders. To make bad worse, the stairways are left open on each floor, also the elevators, so that if a fire starts in the lower part of the building, it can in a few moments spread from top to bottom through these openings. A fire under such conditions will soon distort the columns and girders, and fairly tear the building into ruins in a very short time.

About twenty years ago, Edward Atkinson, of Boston, president of the Boston Manufacturers' Mutual Fire Insurance Company, recognized the dangerous character of this mixture of wood and iron, and he recommended that factory buildings should be limited to one or two stories in height, and that the structural frame work should be in heavy wood columns and beams and flooring eliminating the iron columns, and the light joists and flooring. He described this type of building as the "slow-burning mill construction." Undoubtedly this was an improvement on the mixture of iron and kindling wood type, but wood will burn. Experience has shown beyond question that mill construction buildings will burn very fast, especially if built with resinous southern pine.

The improvement of twenty years ago is out of date now. The men that were burnt out of "mill construction" buildings demanded something better and safer. Hence the development of the most modern type of factory building, which I will describe:

The walls may be of brick or concrete; in many cases the walls are little more than a series of piers or columns with the intervening spaces filled with glass windows and a belt course at each course up to the window sills. The columns and beams to carry the floors may be in steel covered or protected with concrete or the columns and beams may be built of reinforced concrete throughout.

To do this wooden forms or centering is constructed and on these the concrete is laid. Steel rods are introduced in the concrete beams and columns by way of reinforcing them. Concrete structural work of this kind can be made just as strong as steel work of approximately the same sizes when protected. The floor slab should in my opinion be of concrete reinforced with expanded metal finished on the top surface with cement trowelled smooth or a hardwood surface flooring laid on the concrete.

The roof should be built on the same princip'e as the floors, but a weather-proof surfacing of metal, asphaltum or felt should be added, the skylight curbs and pent-houses should be constructed in concrete or porous brick.

To make this building completely typical, the stairs should be of concrete and completely enclosed at each floor, and there should be an automatic self-closing fire door at every entrance. The elevators should also be enclosed with brick walls or with expanded metal and cementine walls with a self-closing fire door at each opening.

The window frames and sash should be of sheet metal with rivetted or lapped joints and the glazing of all windows exposed to an adjoining building should be in wire glass or luxfer prisms in copper glazing.

Of course this is not the cheapest style of building you can erect, but it is not so very costly. I have found that compared with first-class heavy mill construction, all of wood, the cost is the same or approximately so. Compared with the cheaper forms of mill construction, there is an addition of from 5 to 10 per cent. to the total cost of the building. To offset this the insurance of the cheaper building is two or three or even five times as much as on the fireproof building I have described. On a valuable building and contents this becomes an immense economy, and would pay the interest on a much greater increase of outlay.

If it is better to have incombustible brick walls than wooden ones, it is equally advisable to have incombustible floors and partitions, rather than three by twelve joists and inch flooring. The law compels you to build safe walls, prudence should cause you to adopt equally safe construction for the floors and roof.

We are doing very well in Canada in building this modern type of factory building. In the recent developments of hydraulic and electric power almost all the power houses are fireproof after one or other of the types I have described. The great feature of the really modern factory building is immunity from destruction by fire. The sooner this is generally recognized and acted upon the sooner the business community will be relieved from the enormous drain on their resources from fire losses.

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MACHINE SHOP NOTES FROM THE STATES.

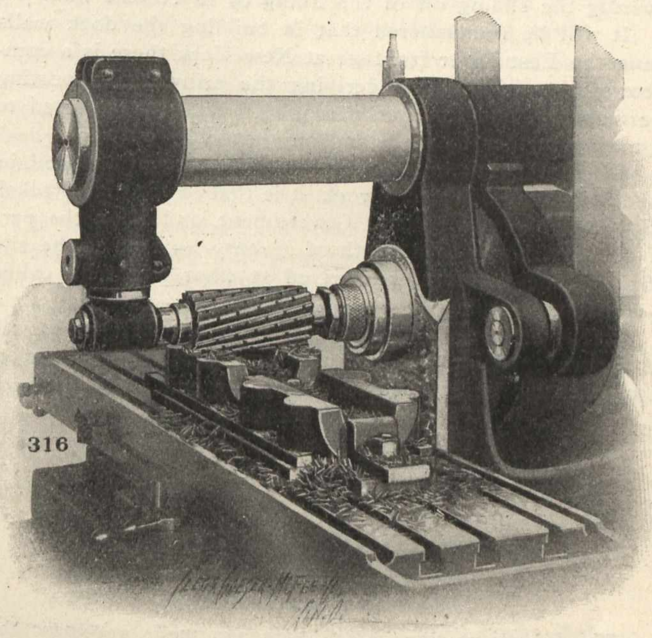
By CHARLES S. GINGRICH, M.E.

XVI.

Those of us who have at some time in our lives been connected with general machine shops, will remember having made special efforts to so arrange the design of machines that castings could be used without any machining; or, if this could not be easily accomplished, with as little machining as possible. The writer certainly recalls such cases in his own experience, and has a distinct recollection of instances of a vast amount of time having been spent to accomplish this result, beginning with the drafting-room and carrying the effort through the pattern shop, only to find that the foundry could spoil it all by careless moulding.

For the most ordinary work, as for instance, bearing caps such as are used on most wood-working machinery, laundry machinery, and in fact, all machinery of that class, even the best castings seldom come from the foundry with the under sides perfectly flat, these invariably requiring some chipping and filing to make them lie flat, and while this may have been all right in the old days, it certainly is getting to be a very expensive process in the light of recent developments of machine tools.

As proof of this assertion, I submit an illustration of a milling machine facing off bearing caps which are 6" wide over all, at a table travel of more than 14" per minute. The milling cutter is of high speed steel, and this cut is taken across two caps as shown, in less than one minute's time.



The finished caps are perfectly flat, and a great deal better than a rough cast cap could possibly be. The miller is not a large one, either, it being a No. 2 Plain "Cincinnati." This certainly is a great deal cheaper than chipping and filing, gives very much better results, and also cuts down the expense in the foundry.

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THE REVETMENT WALL AT THE QUEBEC DOCKS.

Editor Canadian Engineer:—

Sir,—Some few years ago I read before the Society of Civil Engineers of Canada, at Montreal, a paper on the "Instructiveness of Failure," the fact of a structure remaining secure or intact, being proof only that it is strong enough, while at the same time it may be 10 or 20 times as strong as it need be.

Here is another and glaring example of the "Instructiveness of Failure." It will have been noticed by engineers, and in fact by almost any one visiting the Quebec docks, that, from the moment of their termination, they began to lose their straightness of outline. The walls have not only lost their original batter, but have gone on leaning over towards the open until they have had to be tied in by iron rods at intervals, and have actually burst and fallen in great masses into the basins, and those which have not as yet parted company with the structure, are bound sooner or later to follow the same fate.

Hble. Mr. Laliberte, Chairman of the Harbor Commission, Que., is credited with the idea of immediately rebuilding the broken or fallen portions. I have, therefore, written him recommending that he do nothing of the kind, except temporarily, but on the contrary, remove the masonry, reinforce the foundation, and then rebuild the revetment wall. The reinforcement of foundation would consist in underpinning the present cribwork by a row of piling, which, as it cannot be so placed that the cribwork may rest directly upon it, must be driven outside the cribwork, with shouldering pieces thereto, and the whole thoroughly bolted. The piles should be driven to some 15 or 20 feet, or until stopped by the resistence of the soil.

It will be remembered that at Assouan, on the Nile, Sir Benjamin Baker, after making a foundation of concrete to a thickness of fifteen feet, then caused a row of iron sheet piling to be driven on both faces, penetrating to a further depth of thirteen feet into the sandy substratum of the river.

The toe timber of the cribs having nothing to "butt" against but sand, the cribs have all settled at the toe, thus leaving the supporting timber-work into an incline, and favoring the sliding off of the lining or revetment wall.

It will be remembered that in building the dock walls along the East River frontage at New York there is a complete system of piling underlying the cribwork supporting the masonry, and that inclined piles have been resorted to in a way further to withstand any tendency outward.

When I speak of the unresisting nature of the soil or sand at the toe of the cribwork, it is that in 1876 M. Steckel, on the part of the Federal Government, and I, on the part of the city, bored to a depth of seventy-six feet at the site of these docks before we arrived at what might be called a resisting stratum.

Let it be hoped that this case of failure at Quebec will be a cure once for all for such omissions or mistakes, as it may cost over $150,000 to rectify the evil.

Yours truly,

Charles Baillairge.

PORTLAND CEMENT.

Article I.—Historical.

The Egyptians some 4,000 years ago made a cement that has withstood the decay of ages. The binder used was quick lime, CaO, which was used without any attempt at improvement up to the rise of the Roman Empire. In fact, as long as man confined his building enterprises to structures in the air, it left little to be desired. It was when the Roman began his magnificent enterprises in sanitary and hydraulic engineering, that lime was found to be useless to sub-aqueous structures. After some experimentation, the Roman hit upon a material, which, when added to slacked lime imparted to it the peculiar quality of hardening under water. Pliny and Vitruvius both mention this material as a volcanic ash occurring at Puzzuolani, from which they named it Puzzolane. Pliny gives a formula for its use: Twelve parts Puzzolane, six parts quartzose sand, nine parts rich slacked lime (well dried). Mortar made from this cement was used in the famous aqueducts in and about Rome.

Up to the middle of the eighteenth century, Puzzolane seemed to meet all the requirements of a hydraulic cement. It was the common belief that the hardest hydraulic limes were made from the hardest and purest limestones. In 1756 the fallacy of this belief was proved by John Smeaton, who was entrusted with the task of constructing the Eddystone Lighthouse. For this purpose he sought a material of local occurrence to displace the expensive Puzzolane, and discovered that septaria noduli, found along the Thames, gave, when calcined and pulverized to a very fine powder, a cement which possessed very energetic properties. He demonstrated that a mixture of carbonate of lime and clay was what gave hydraulicity, and it has been remarked that the Eddystone Lighthouse stands not only as a beacon to "ships that pass in the night," but as a monument to mark the starting point of all that we know concerning hydraulic cements. This cement of Smeaton's for no well-defined reason became known as Roman cement, and rapidly displaced all other as a binder.

Many years afterwards, Joseph Aspdin, a bricklayer of Leeds, attempted to make an artificial cement which should equal, if not surpass, the natural or Roman cement. Realizing that the hardness and hydraulicity of the natural cement was in proportion to the clay present in the limestone, he made several experiments in mixing clay and limestone. Finally, in 1824, he hit upon a mixture which produced a cement harder than anything yet known. On account of its resemblance in color and texture to the oolitic limestone on the island of Portland, which was in great favor as a building stone, he named his product Portland cement.

In his first patent, which was issued October 21st, 1824, for "An improvement in the modes of producing an artificial stone," Aspdin thus describes his process:

"My method of making a cement or artificial stone for stuccoing buildings, waterworks, cisterns, or any other purpose to which it may be applicable (and which I call Portland cement), is as follows: I take a specific quantity of limestone, such as that generally used for making or repairing roads, after it is reduced to powder or puddle, but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself, and I cause the puddle or powder, or the limestone itself, as the case may be, to be calcined. I then take a specific quantity of argillaceous earth or clay and mix them with water to a state approaching impalpability, either by manual labor or machinery. After this proceeding, I put the above mixture into a slip-pan for evaporation, either by the heat of the sun or by submitting it to the action of fire until the water is entirely evaporated. Then I break the said mixture into lumps and calcine them in a furnace similar to a lime kiln, until the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beaten or rolled to a fine powder, and then it is in a fine state for making cement or artificial stone. The powder is to be mixed with a sufficient quantity of water to bring it to the consistency of mortar, and thus applied to the purpose wanted."

Aspdin failed to point out the exact amount of clay needed, and he omits to state that the calcining must be carried on to the point of incipient vitrification. These omissions may be regarded as casting some doubt upon the authenticity of his discovery of Portland cement in 1824, but it is a well-known fact that in 1825 he established a factory at Wakefield, which is still in existence. His son, William Aspdin, also established a cement factory in the Thames district.

In the early days a great deal of mystery surrounded the manufacture of cement. I. C. Johnson, a veteran cement manufacturer, published, in 1880, the following description of Aspdin's precautions: "Although Aspdin had works, there was no possibility of finding out what he was doing, because the place was closely built in with walls twenty feet high, and with no way into the works except through the office. Even if I had gained access to the works, I probably would have learned but little, for the process was so mystified that even the workmen knew nothing about it, and considered that the virtue consisted of something Aspdin did with his own hands. He had a kind of tray with several compartments, and in these he had powdered sulphate of copper, powdered limestone, and other materials. When a layer of dried slurry and coke had been put into the kiln, he would go in and scatter some handfuls of these powders from time to time, as the loading proceeded, so as to surround the whole process with as much mystery as possible. I had a laboratory of my own, and I worked night and day to find out how the cement was made. Finally, I tried quicklime, powdered, and mixed with clay and calcined, by which means I got something nearer. After that I used chalk and clay, but too much chalk in proportion, and the resulting compound being highly burned, swelled and cracked. By mere accident, however, some of the burned stuff was clinkered, and, as I thought, useless. However, I pulverized some of the clinkers and gauged it. It did not seem as though it would harden at all, and no warmth was produced. On examining it some days later, I found it much harder than any of my other samples, and moreover the color was a nice gray. Supposing that at last I had the right clue, I went in on a larger scale, using five of chalk to one of clay. This was well burnt and finely ground, but it was a failure on account of excess of lime. The whole of this material was tossed away as useless, and remained in a corner for some months, after which I had the curiosity to test it, and gauged it as before, when, to my astonishment, it gauged smoothly and did not crack and blow as before, but became solid and increased in hardness with time. Cogitating as to the cause, it occurred to me that there had been an excess of lime, and that the exposure in a damp place had caused the lime to slack. This was another step in advance, and I went on experimenting till I came to five of chalk and two of clay, and this gave results so satisfactory that this cement was soon set up as a standard by the French Government Works, to which all subsequent purveyors had to conform."

Since the days of Aspdin the use of cement has expanded in a rapidly increasing ratio. In 1850, six pounds of cement was used per capita in the United States, while in 1902 the consumption was 119 pounds per capita. In a period of eight years, ending with 1902, the consumption of cement in that country increased 2,600 per cent. In the course of his history man has passed through the stone age, the bronze age, the iron age, and the steel age, and now it appears that we are entering what may be called the plastic age, in which asphalt, plaster and cement play large parts.

In Canada the use of cement has increased in almost the same degree. The production of cement in this country has increased from 70,000 barrels, in 1887, to 720,000 barrels, in 1903, while the imports during the year ending June, 1903, were the equivalent of 735,000 barrels. These imports came from the following countries in the order named: Belgium, Great Britain, United States, Germany, Japan, Holland.

In the preparation of this article extracts have been made from a paper by F. W. Huber, of the United States Geological Survey, which appeared in the California Journal of Technology, and also from a publication of the Canadian Portland Cement Co., Limited.

NOTES ON CONCRETE.

(Concluded.)

From the above it appears that pit sands (rounded and made up of different sized grains), are more desirable than crushed granite or quartz (sharp); that a little clay is probably not detrimental; that coarse sand or crushed stone gives a higher tensile strength than fine sand, and that the rounded pit sand or the crushed limestone gives better results when subjected to abrasion than clean, sharp granite sand.

Stone.

Specifications generally require that stone for concrete should be broken to pass a 2-inch ring and screened, and it has been considered as essential that the edges should be sharp to secure a bond. Now it is common practice to use gravel in place of broken stone, and the superiority of coarse pit sand over crushed quartz indicates that the practice is good. Gravel and sand pumped from river beds or taken from pits is frequently used and mixed directly with cement to form the concrete. Such concrete possesses the advantage of making a more dense mass with less labor than when using broken stone.

General.

The above considerations indicate that the old style of specification of 1 to 2 to 4 and 1 to 3 to 5, etc., where each ingredient was specified with rigid exactness, must be modified if we are to secure the best results for the least money. It is obvious that each locality and enterprise, where concrete is to be used, offers a separate problem which must be studied in detail by an experienced competent engineer. It is not difficult to point to the waste of very large sums of money in engineering works—where large masses of concrete of rich proportions have been used—where at least one-fourth the cost per cubic yard might have been saved without the slightest detriment to the work.

The provision of strongly braced, very substantial forms is very necessary where concrete is laid above ground, and—if a smooth face is desired—dressed two-inch lumber should be used, the face concrete put in wet and carefully worked with a spade against the form to get the mortar face homogeneous. It is difficult to brace forms to allow of a greater height than three or four feet of concrete being laid in one day, and the surface of this lift should be well wetted down next morning and covered with a little mortar before depositing the regular mixture.

Concrete is especially applicable to mining on account of the facility of handling and placing it underground in confined spaces for such purposes as tunnel linings, supporting columns, machinery foundations, shaft linings, dams, stoppings, and fireproof structures above and below ground.

Reinforced Concrete.

The reinforcing of concrete with steel, which has recently come into such general use, where lightness and strength are desired in a permanent structure, makes it practicable to use concrete for many purposes for which a short time ago lumber would be exclusively used. The expense of a building constructed of a steel or timber frame with concrete floors, walls and roofs is in most localities very moderate considering the advantages in durability and fire risks secured.

There are many systems of reinforcing concrete advertised extensively, and they probably all possess considerable merit either in strength or convenience in use; but it is questionable if plain, round steel bars, properly proportioned and located to take the strains, are not as good, considering the cost.

Experiments show that clean, straight, round steel bars have an adhesive strength when embedded in cement mortar of about 250 lbs. per square inch of surface; that steel or iron bars are perfectly preserved from corrosion when embedded in good wet laid cement concrete, and that rust—unless in form of scale—does not damage the metal for such use.

The writer conducted tests with two concrete floors, one, (A), 2⅞-in. thick by 4-ft. 7-in. span, reinforced with 3-16-in. round steel rods laid 8-in. C to C, across and lengthwise, and tied with wire at intersections; and (B) 4-in. thick by 4-ft. 1-in. span, reinforced with expanded metal No. 10 gauge. (A) was composed of National cement 1 part, coarse pit sand 1½, and limestone ¾-in., mesh and under 2½; (B) was Atlas cement 1 part, pit sand 2, and pit graved 5. A 28-day test showed deflections as follows:

(A).

Lbs.	Ft.	
1,500	0.002	
3,620	0.006	
4,220	0.008	No cracks showing.
4,220	0.012	One-half hour later. No cracks showing.
000	0.006	

=2,110 lbs. per sq. ft. without sign of failure.

(B).

Lbs.	Ft.	
3,000	0.001	
6,000	0.004	
7,500	0.006	
10,500	0.013	
13,250	0.014	
14,000	0.017	Showed hair cracks on under side.
000	0.005	

=3,500 per sq. ft.

By comparing the loads carried by the two floors per square foot, the span, and thickness of the floors tested, it will be seen that—though the concrete is richer in the thinner floor—it compares very favorably with the more expensive one.

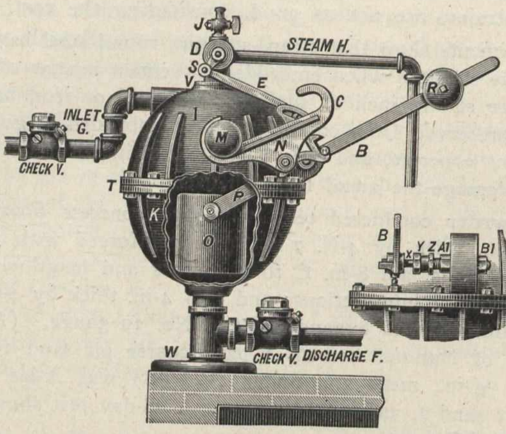
A great advantage of using concrete is that with competent supervision unskilled workmen can very quickly be trained to do the work, and the employer is thus freed from the difficulty and expense of using skilled union labor.

It is a common statement that concrete cannot be made water tight. The writer can show an eight-inch reinforced concrete wall (cement, sand and gravel), which—under a head of seven feet of water—shows a dampness in spots only on the lower side, and no precaution was taken to make it water-tight other than good, honest workmanship. He can also show concrete retaining dams that show not even a dampness on the outside when subjected to a head of fifteen feet of water, and has built a three-foot concrete wall on an old concrete foundation five feet under water which, when retaining a head of seven feet of water against it, showed a very few small trickles of water leaking through it.

THE PRATT RETURN STEAM TRAP.

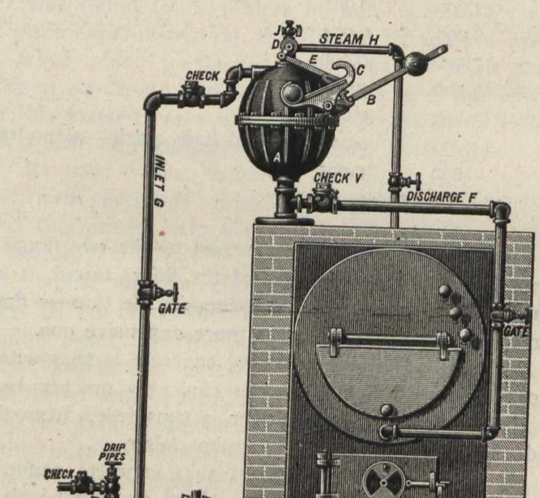
The accompanying cut shows the latest style of high pressure trap now on the market, known as the Pratt Return Steam Trap, and which is handled by The Canadian Fairbanks Company, Limited, for Canada.

The most careful managers of steam plants aim to secure the greatest saving in coal and water possible and are constantly watching the market for new devices which will bring about these results. The whole question of economy in a steam plant consists principally in the saving of heat. Every pound of water warmed from 50 degrees to 212 degrees, Fahrenheit, is known to have absorbed a certain amount of heat, and as other quantities are measured in units, such as feet, pounds, minutes, horse-powers, etc., heat is measured in units called heat-units. A heat-unit is equal to the amount of heat required to raise the temperature of one pound of pure water one degree Fahrenheit, at the temperature of its maximum



density; so that in order to raise the temperature of one pound of water from 50 degrees to 212 degrees Fahrenheit, about 163 heat-units would be required.

The amount of coal that would have to be consumed under the average boiler to produce this quantity of heat would be about .0142 pounds. It is evident, then, that for every pound of water at a temperature of 212 degrees Fahrenheit allowed to go to waste, .0142 pounds of coal are also sacrificed. The No. 1 Pratt Return Steam Trap will return to the boilers about 200 gallons or 1,668 pounds of water per hour. If the normal temperature of the feed water is 50 degrees Fahrenheit, using the information given above, we would save by using this trap, $1,668 \times .0142 = 23.68$ pounds of coal per hour. With



coal costing $4 per ton delivered, the total amount of money saved would be 43c. per day of ten hours. This does not include the value of the water saved, which would average for 2,000 gallons not less than 7c., making the total saving per day about 50c. This applies to the smallest trap, and the amount saved will, of course, increase proportionately with the number of gallons of water returned to the boiler, and the difference between the normal temperature of the feed water and the final temperature when entering the boiler. The use of the Pratt Return Steam Trap has effected a saving in many instances of from 10 to 25 per cent. In comparing this Trap with a pump for returning condensed water, it will be apparent to all that the pump requires live steam to perform its work, and unless the exhaust is condensed and passes through an oil filter into the receiver, a considerable heat will be wasted. In the matter of cost for repairs, the trap would also be found the most economical, as many cases are on record where the Pratt Return Traps at the end of ten or fifteen years' constant use have been repaired and made absolutely as good as new at an expense of from $15 to $20. Steam fitters will experience no trouble in connecting, as there are no fine adjustments to be made.

The second cut shows the manner in which the Pratt Return Steam Trap is connected to a boiler or boilers for return automatically condensation direct the steam.

If any interested readers of this paper should be in need of any device of this nature, The Canadian Fairbanks Company, Limited, will be very pleased to give advice from experts who have made and are constantly making studies of this question to suit different requirements.

INDUSTRIAL NOTES.

Winnipeg is to have a 6,000,000-gallon reservoir.

Ingersoll passed a by-law to loan $20,000 to the Ingersoll Nut Co.

Work on the development of Kakabeka Falls will begin this month.

Mackenzie & Mann will establish a copper smelter at Port Arthur this summer.

A valuable sandstone quarry has been discovered about fifteen miles from Prince Albert.

The McLachlan Gasolene Engine Works Co., Toronto, will build new shops at Swansea.

Fire did $20,000 damage at the Palmer Piano Co., Toronto, recently. Loss covered by insurance.

The Burrow, Stewart & Milne Co., Hamilton, are enlarging their stove foundry at a cost of $15,000.

Whitby voted a bonus of $25,000 to the Keystone Beet Sugar Co. for the establishment of a beet sugar factory.

The National Cream Separator Co. is considering removal from Guelph to Niagara Falls, N.Y., owing to trade difficulties.

W. Langford has been awarded the contract for the erection of a 100-foot extension to be made to the Peterboro Shovel and Tool Co.

The Peterborough Lock Manufacturing Co. will spend $40,000 on new buildings and equipment. Wm. Langford has been given the contract.

The contract for the erection of the power house for the new water-works plant at Portage la Prairie was awarded to Chas. Jeffrey, a local contractor.

The Neptune Meter and Brass Works, of New York, intend to establish a branch in Canada. About eighty hands would be employed in the new factory.

The Imperial authorities contemplate the restoration of the military establishment at Esquimalt. An appropriation of $1,500,000 has been voted as a beginning.

The Henderson Roller Bearing Co., of Toronto, are contemplating the building of a branch at Port Arthur, which will manufacture for the western market.

The Ogilvie Milling Company have let a contract at Fort William to a local firm for one million feet of lumber, to be used in the construction of the proposed flour mill.

The C.P.R. depot at Cranbrook, B.C., collapsed while undergoing certain changes, and eleven men were injured, of whom it is reported four will die, and five others are in a serious condition. The depot is having another story added to it, and the supposition is that the new part was not sufficiently braced.

The International Harvester Co., Hamilton, is installing a 36-inch intake pipe, which will extend 700 feet into the bay. This will be separate from the regular water supply, and will be useful in many ways, especially in case of fire. The company's large wharf will probably be completed this year. This will give the company the finest wharf frontage on the bay. The slips will be dredged, and there will be a depth of twenty feet at the wharves.

A large brick structure in Owen Sound, owned by R. P. Butchart & Bros., and used as an iron warehouse, was recently destroyed by fire. Loss is estimated at $10,000.

The Dymond Gas and Engine Co., with a capital of one million dollars, will locate in Port Arthur, if satisfactory arrangements can be made with the town. They will employ 200 men the first year.

The Massey-Harris Company, Toronto, will build a new factory. It will be four stories and a basement, and will have a surface area of 404 feet by 123 feet. The estimated cost will be $125,000.

The D. Conboy Carriage Company have secured 150,000 square feet of property, at Riverdale, Toronto, for $15,000, cash, and will erect a $75,000 factory, to employ 200 hands in the manufacture of carriage tops.

The American Radiator Company has purchased the old plant and buildings from the Cockshutt Plough Company, of Brantford, Ont., and will establish a branch there on an extensive scale for its Canadian trade.

Joseph Forques and Joseph Dufort were instantly killed and Francis Chartrand seriously injured as a result of the bursting of one of the ovens of the Laprairie Pressed Brick and Terra Cotta Company, Laprairie, Que.

The ratepayers of Portage La Prairie will vote on a by-law to give the Henderson Roller Bearing Co., of Toronto, a free site and exemption from taxes for twenty years; the company to erect a $25,000 building and install a $50,000 plant.

The Alberta Railway and Irrigation Company, of Lethbridge, has ordered a 175-h.p. Robb-Mumford boiler from the Robb Engineering Company. This makes eight boilers of this type that this company has purchased during the past few years.

The Vanderbilt plans for constructing an international railway tunnel under the Detroit river have been completed, and work will begin very soon. The undertaking will cost from $10,000,000 to $20,000,000, and require two years to complete.

A modern pipe foundry of large capacity is to be erected by the Canada Foundry Company in connection with its extensive Toronto works. Before drawing up the plans, the company had the leading pipe foundries of the United States examined.

A Toronto firm engaged in the manufacture of builders' hardware have bought the factory of the Brantford pottery, and will commence the manufacture of their line. The present pottery company will probably take some $6,000 stock in the new concern.

Boring night and day at the base of the big dam at Fennspoint, Conn., situated on a hill, the work of muskrats caused the dam to give way, and the water, which covered four acres of land, rushed down the hill and settled through the main streets of the town, flooding many cellars.

After two years and four months' work, and right up to contract time, the tunnel to connect the waters of Lake Coquitlam and Lake Beautiful, in connection with the electrical power scheme of the Vancouver Power Company has been completed. The tunnel is 12,775 feet long.

The Robb Engineering Co., Limited, has received an order from the Windsor and Tecumseh Electric Railway Company, of Walkerville, Ont., for a 450-h.p. Robb-Armstrong Corliss engine and two 200-h.p. Robb-Mumford boilers, also for a large steel smokestack, condenser, and all piping complete.

The Cape Breton Coal, Iron and Railway Company have awarded contracts aggregating $30,000 for the erection of buildings at their collieries at Broughton, Cape Breton. The buildings include a hotel, private residence and general offices. The company will spend $250,000 there this summer.

It is rumored that several of the leading rubber interests of the Dominion are about to form a combine, with a capital of $10,000,000. The Commercial Rubber Co., of Canada, the Granby Rubber Co., the Gutta Percha and Rubber Co. of Toronto, and the Maple Leaf Rubber Co., of Port Dalhousie, are among the companies mentioned.

Winnipeg council will submit a by-law to the ratepayers fixing the assessment of the Canada Furniture Manufacturers' property at $25,000, for a period of ten years, for which the company will erect, in addition to the union factory, a three-story building, 64 by 70 feet, with basement, and double the number of hands at present employed.

At Staples, Ont., a boiler in one of the mills of the Nieber-gall Stave and Lumber Co. exploded. One employee, Ralph Welsh, was instantly killed, and six others injured. At the inquest the jury decided that the accident was due to a defective boiler, and attached negligence on the part of the company for not providing adequate protection for the safety of its employees.

A fire broke out in the Dyment, Baker Co.'s planing mill and box factory, London, Ont., and consumed the factory, together with a part of the London Machine Tool Co.'s plant; over a million feet of lumber belonging to the Dyment, Baker Co.; three M.C.R. cars, containing $8,000 worth of machinery, and $3,000 worth of hardwood lumber, owned by Tambling & Jones, builders. The loss will be fully $75 000, with about $50,-000 insurance. Of the loss, $12,000 is sustained by the Machine Tool Company, and from $30,000 to $35,000 by the Dyment, Baker Co. The fire is supposed to have been caused by a sky rocket.

J. Wesley Allison and G. H. Meldrum, of New York, have secured control of the Canadian Tin Plate and Sheet Steel Company, organized some time ago, in Toronto, and have interested Montreal and Toronto capitalists, with the result that the manufacture of tin and sheet steel will be begun in Morrisburg. The capital stock will be $1,500,000. Sheet steel and tin plate are imported into the Dominion at the rate of $5,000,-000 a year, and it is this home market that the company has undertaken to capture. It will require twenty-eight mills to turn out all the sheet steel and tin plates required in Canada, and when completed they will give employment to 3,000 men.

Among recent contracts awarded to Allis-Chalmers-Bullock, Limited, Montreal, were three 450-h.p. induction motors, one 100-h.p. induction motor, rope driven, for use in the Royal and Glenora Mills of the Ogilvie Milling Co.; six type E-24 Ingersoll-Sergeant rock drills for the British Columbia Copper Co.; two Ingersoll-Sergeant submarine drills for the Montreal Harbor Commissioners; one Gates K. crusher with engine and other equipment to Michael Connolly for his contract at St. Raymond, Que.

Work has already commenced on the new factories of the Canadian Rubber Company of Montreal, Papineau Ave. and Notre Dame St. When completed, this latest addition to their already fine plant will be a distinct ornament to Papineau Ave., as several old buildings will be pulled down, to make room for the new factories, which are laid out on the most modern plans. A new roof and many other marked improvements are being added to the existing plant. All the contemplated improvements, it is anticipated, will be completed within eighteen months, and as the present management have a reputation for doing big things quickly and thoroughly, no doubt this time limit will not be exceeded. The extension of the manufacturing facilities will make it possible to add very largely to the present large force of work people employed.

The Abner Doble Company, of San Francisco, announces that arrangements have been made with the John McDougall Caledonian Iron Works Company, Limited, of Montreal, whereby the latter become sole licensees for the manufacture of the Doble system of water-wheels in Canada. The tangential water-wheels and needle-regulating nozzles, manufactured by the Abner Doble Company, are well known for their excellence of design and workmanship, and considerable engineering interest has recently been shown in relation to the four 8,000-h.p. wheels, which that company has built for operation in California power plants. The McDougall Company have a most extensive machine works, their plant including machine shops, pattern shop, foundry, forging works, and structural material shop. Their plant is, therefore, well equipped for the manufacture of water wheels and other hydraulic machinery. They already have in hand the building of a 100-h.p. wheel to operate under 170 ft. head taking water through a 3½ in. jet and having a speed of 130 revolutions per minute. The Canadian licensees are prepared to furnish the steel pipe, structural work and all machinery necessary for complete power plant, and the Doble Company requests that all engineers or parties interested in water power developments in Canada, address the McDougall Company direct. They have retained the Abner Doble Company as their consulting engineers.

The American Cereal Company will close their mills at Peterboro and transfer the export business to their Ohio mills. They claim that excessive freight rates have compelled this move,

The plan for a sanitary sewage system in the Woodbine neighborhood, Toronto, provides for a septic tank and bacteria beds, and will cost $80,000.

RAILWAY NOTES.

Work on the new C.P.R. station at Port Arthur, Ont., will be begun shortly.

The Winnipeg electric railway has started work on a new $100,000 power house.

The Pere Marquette will spend $90,000 in improving its terminal yards at Sarnia, Ont.

The Montreal Street Railway will lay twenty miles of new track during the coming summer.

The C.P.R. are constructing a new steel bridge over the Rosseau river, at Dominion City, Man.

The work of double tracking the I.C.R. between Stellarton and New Glasgow will be begun at once.

Word has been received that the Island of Kaiwan, near Port Simpson, B.C., has been selected as the terminal of the G.T.P.

Fort William carried the by-law giving a bonus of $300,000 to the Grand Trunk Pacific, by a vote of 777 for to 55 against.

Smith & Sherbourne, of Victoria, B.C., have been awarded the contract for the C.P.R.'s new station at Revelstoke, the price being $25,000.

The G.T.R. will build a short line from Ottawa to Kingston. It will probably be built under an old charter and handed over to the G.T.R. when completed.

The I.C.R. will shortly invite tenders for two new structures at Moncton, one to be used for workshops, the other for the stores and mechanical offices, the present quarters being insufficient.

Assiniboia will have a second "Soo" line branch within a year, the management having decided to push its Thief River Falls branch, to be constructed this year, northward into Canadian territory.

Dominion Day will be celebrated in Fort William by the turning of the first sod of the Grand Trunk Pacific branch, which is to connect with the main line at a distance of 200 miles.

Orillia has reached an agreement with the James Bay Railway Company whereby the latter undertakes to run its main line through the town in return for a bonus of $30,000 and a right of way over the corporation property.

Angus Sinclair, contractor, Port Arthur, has been awarded the contract for the building of arch and top-rail culverts between Fort William and Rat Portage, on the C.P.R. The culverts will be mostly built of concrete.

The C.P.R. have placed a contract for the construction of 45 miles of road from Spencer's Bridge, on the main line, 180 miles east of Vancouver, to the Nicola coal mines, following up the Nicola river. This road is the commencement of the proposed road to Midway, some 200 miles from the Nicola mines.

Rhodes, Curry & Co. have received the contract from the Canadian Northern Railway for the building of nineteen cars, viz., four first class cars, ten mail and express cars and five baggage cars. The company have also received an order for one hundred flat cars for Contractor A. R. McDonald, to be used on the Temiskaming and Northern Railway.

The C.P.R. have awarded a contract for the construction of a line from Bolton to Parry Sound to George S. Deeks & Co, The distance is 128 miles, and it is assured now that the James Bay Railway is to have a rival. The Toronto-Owen Sound line will be used as far as Bolton. This road will also make the C.P.R. a competitor with the G.T.R. for Muskoka tourist traffic.

MUNICIPAL WORKS, ETC.

At Galt a $5,000 by-law for water-works extension carried.

Strathcona, Alta., is calling for tenders for the installation of a water and sewer system.

Westmount has adopted a by-law authorizing the borrowing of a quarter of a million for public works.

Wingham will submit a by-law to its ratepayers to raise $12,000 for the extension of the waterworks system.

By-laws to spend thirty-five thousand dollars for street and water-works improvements were defeated at St. Mary's.

At Ottawa, the civic by-law to give the city power to purchase the Consumers' Electric Light Company for $200,000, was carried.

At Regina a by-law to raise $160,000 for the completion of the water-works, sewer and electric light systems was passed by an overwhelming majority, only four electors voting against it.

At Medicine Hat four by-laws, involving an expenditure of $54,600, were carried almost unanimously. The by-laws provided for $12,000 for sinking another municipal gas well, $2,600 for municipal improvements, $10,000 for extending the water-works system, and $30,000 for the erection of a new municipal building.

A septic tank and bacteria bed system of sewage disposal will be established at the foot of Woodbine Ave., Toronto. for the benefit of the residents in the Kew Beach district. There has been much opposition to this method of dealing with the sewage disposal problem, and the residents petitioned against the City Engineer's recommendations for the installation of the system there. Dr. Sheard, the Medical Health Officer, has, however, recommended the change on sanitary grounds, and this cannot be petitioned against. The cost of the work will be $80,000, of which amount the city will contribute $24,000, and the residents the remainder.

MINING MATTERS.

After losing nearly $15,000 wages the strikers in the Acadia mine at Westville, N.S., have gone back to work on the company's terms.

Word has been received from the Yukon of a rich strike of placer gold on Highet Creek, a tributary of the Mayo river, about 250 miles from Dawson.

Heyland Patterson, Pittsburg, has been awarded the contract for the steel tipple of the C.N.R. Coal Co. at Fernie, B.C. The tipple will cost $170,000.

It is said that statuary marble, the equal of any in the Carrara quarries of Italy, has been discovered in Hastings County, Ont., near Bancroft, and quarries are now being worked.

A testing plant for reducing magnetite iron by electrothermic process is to be installed at Ottawa. Dr. Heroult, one of the original investigators in this branch of metallurgy will conduct the experiments.

The contract has been awarded the Canadian General Electric Company for furnishing two 30-kilowatt generators with switchboard and general supplies for the Western Fuel Company of Nanaimo, B.C.

The third year students in mining engineering of McGill University have left for their annual field operations in mining. They will spend a month visiting some of the principal mines and industries in the Eastern States.

It is said that several of the large mines of the Rossland camp are about to amalgamate. The probable list of the properties included in the merger, with their respective values, is as follows: Le Roi mine, and Northport smelter, $5,000,000; Centre Star mine, $3,500,000; War Eagle, and associate mines, $2,000,000; the Trail smelter, $1,250,000; East Kootenay Coal lands, $1,000,000; Rossland Power Co., $300,000; Snowshoe mine, $500,000. Total $13,500,000.

One of the great expenses of mining in a mountainous country is fuel for power to operate the necessary plant. The Ellwood Tinworkers Gold Mining Co., of Lardo, B.C., near Cambourne, were fortunate enough to secure control of a mountain stream affording a constant supply at a minimum cost. In order to develop the power, Allis-Chalmers-Bullock, Limited, Montreal, who had the contract, built at their works, in Montreal, a compound, duplex, power-driven Ingersoll-Sergeant Air Compressor with piston inlet valves. The cylinders are 12¼ and 20¼ by 14-in. stroke, the machine travelling at 130 revolutions per minute. Mounted directly on the shaft of the compressor is a double water wheel, designed by the Doble Engineering Co., of San Francisco, which will develop 90-h.p. under the head of 170 ft. afforded by this stream. The wheel is equipped with a patent needle nozzle fitted with hand control. The compressor will deliver 625 cub. ft. of free air per minute. This system of mounting a water-wheel directly on the compressor is an ideal way of generating power, as the loss by friction is very slight and all gearing, shafting, etc., is rendered unnecessary. In addition to the compressor, Allis-Chalmers-Bullock, Limited, supplied a complete outfit of drills, air receivers, columns, tripods, hose and mining sundries.

MARINE NEWS.

At Port Arthur, while workmen were putting carbide into one of the buoys to be placed in the harbor, the buoy exploded, injuring two men.

R. J. Leslie, Halifax, has been awarded the contract for a new steamship service between Maritime Provinces and Newfoundland. The steamship employed will be the Amelia.

The Great Lakes Dredging Company has been awarded the contract for dredging in the Port Arthur harbor. It is understood it will be given a contract for dredging in the Fort William harbor also.

The Dominion Government steamer Aberdeen, light-house supply boat in the Gulf of St. Lawrence, is at the Polson Iron Works being equipped with new boilers. It is expected she will be in the yards two months.

The Marine Department has decided to rebuild the steamer Scout, and plans will soon be ready. The hull and up to the deck will be rebuilt at Kingston, and the remainder of the vessel by the Government marine gang at Prescott.

An Englishman has invented a boat with fin-shaped propellers on its sides to make it rise and sink at the will of the commander. It is said to have been a great success, and will probably be adapted to the use of some of the naval submarines.

Preliminary reports of the engineers and surveyors of the Georgian Bay Canal, made to the Department of Public Works, indicate that much more advantageous routes than those previously surveyed have been located, which will greatly decrease the cost of the work.

The Bertram Engine Works Co., Toronto, has just finished replacing the port cylinder and a new frame in the steamer Chicora of the Niagara Navigation Co.'s fleet. The engines were tested under steam by J. J. Weinert, the mechanical engineer at the yard, and everything was satisfactory.

It is understood that negotiations are going on with a well-known firm in England with a view of constructing another powerful icebreaker for the St. Lawrence. The proposed vessel will be 160 feet between perpendiculars, 30 feet beam. Speed, about 14 knots, and its total cost about a quarter of a million dollars.

The old Anchor Line steamer, China, recently purchased by the Merchants' Montreal Line, has been towed to Toronto to receive new boilers, have her engine compounded, and to receive a thorough overhauling before going on the route between Montreal, Cleveland, Toledo, Detroit and Windsor. Her owners claim she will be able to make 12 miles an hour.

The changes and improvements in the Northern Navigation Co.'s steamer Saronic (formerly the United Empire) are now completed. The company have expended about $30,000 in overhauling the steamer, and now she is first-class in every particular. The new name is in honor of Sarnia, the headquarters of the Lake Huron and Lake Superior division of the company's business.

LIGHT, HEAT, POWER, ETC.

Galt council is discussing the installation of an independent lighting scheme for municipal purposes.

The Power, Light and Heat Co., of Sherbrooke, Que., has sold its entire gas plant to the city for $233,000.

Valleyfield, Que., will build an electric light plant, and has retained the services of Charles Brandeis, consulting engineer, of Montreal, in connection with same. Work will be started immediately.

The Sherbrooke Power, Light and Heat Company intend shortly to instal two large dynamos and water wheels, and will soon call for tenders for making these and other improvements to their plant.

Collingwood is considering the advisability of building an entirely new electric plant, adding to the supply of light and furnishing power for sale, involving a cost of from $30,000 to $35,000.

A syndicate is being formed to develop electric power at Lyndhurst, Leeds county, with excellent water power, for the purpose of supplying light, heat, etc., to adjoining villages. There is ample power at Lyndhurst to drive a big dynamo.

The Grand River and Western Power Company are applying for a charter to construct a water course and feeder at Dunnville and a raceway northerly from the Grand river to Jordan, on Lake Ontario, for the purpose of developing electrical and hydraulic energy. It is also proposed to construct lines of wire, poles, tunnels and conduits for the transmission of light, heat and power

The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 29th, 30th, and 31st, 1905. Subjects for papers have been selected and assigned as follows: "Local Distributing Centres for Fire Telegraph Systems," "Underground Construction," "Best Methods of Overcoming Induction on Police Telegraph Circuits," "Advisability of Fusing Fire and Police Telegraph Boxes," "The Necessity of a Rigid Inspection by the Municipality," "Electric Light Engineering," "Electric Light Plants." Frank P. Foster, Corning, N.Y., is secretary of the association.

In the matter of electric lighting, the towns in the North-West are showing the enterprise which characterizes them in everything else. The town of Calgary has just awarded to Allis-Chalmers-Bullock, Limited, Montreal, the contract for a complete civic lighting plant. The current will be generated by a 260-K.W. alternating current generator of the Bullock engine type, of slow speed. The contract includes, besides the generator, a switchboard, three 35-light, 6-6/10 ampere arc light circuits, and all the wiring necessary for the commercial circuits, thirty lighting transformers, pole line, etc., etc. The work will be begun at once.

Bernard Heaton, principal of the Shilarpur Engineering College, Calcutta, arrived in Toronto on an important mission, being commissioned by the India Government to investigate into technical education and mining development in Canada, and to make a report to the India Government. Mr. Heaton is also collecting trade prospectuses of interest for Shilarpur College library. He has already visited England and the United States, in connection with the work he has undertaken.

PERSONAL.

Mr. Clement, assistant city engineer of Toronto, has been appointed city engineer at Vancouver, B.C.

Henry Frampton, Moncton, an I.C.R. carpenter, while at work on the roof of the car shops, fell a distance of twenty-three feet and sustained fatal injuries.

Anson H. Campbell has been appointed general agent, at Montreal, of the Canadian Casualty and Boiler Insurance Co., with offices in the Liverpool & London & Globe Building (Room 65), No. 112 St. James Street.

George H. Webster, assistant agent of the Canada Atlantic Railway, has been appointed secretary of the recently formed Eastern Canadian Passenger Association. Mr. Webster's headquarters will be in Montreal.

George Dale, of Foxboro, while working at the Canadian Portland Cement Company's works at Marlbank, was caught in the machinery and instantly killed. He was thirty-five years of age, and leaves a widow and four children.

George A. McCarthy, assistant engineer of the Temiskaming and Northern Ontario Railway, has been appointed to the position of chief engineer in succession to W. B. Russell. Mr. McCarthy was for ten years in the employ of the Intercolonial Railway.

M. J. Butler, assistant chief engineer of the National Transcontinental Railway Commission, has resigned. He will take an important engineering post with the Grand Trunk Pacific Railway Company. Mr. Butler is known throughout Canada as a first-class engineer, and has been engaged on many important works.

C. J. Crowley, C.E., who was resident engineer for some years on the Grand Trunk Railway, at Toronto, and later resident engineer on the Pennsylvania North River tunnels, has been placed in full charge of the construction of the projected tunnel under the Hudson river from the Pennsylvania depot, in Jersey City, to Cortlandt St., New York.

Mrs. Frances A. W. McIntosh, formerly advertising manager of the Standard Tool Co., Cleveland, is now with the Hill Publishing Co., New York, having charge of the make-up of Power. Mrs. McIntosh was one of the organizers of the Manufacturers' Advertising Club, of Cleveland, which is a flourishing organization now fifteen months' old. She is now a prominent member of the Woman's Advertising Club in New York, which is a small but promising association.

H. H. Henshaw has been appointed general manager of Allis-Chalmers-Bullock, Limited, Montreal. Born in St. Hyacinthe, in 1865, he first entered the office of Mr. Walker, chief accountant of the Grand Trunk in 1880. He remained there until 1886, when he was appointed secretary-treasurer of the Royal Electric Co. During the next four years when that company carried on its manufacturing department Mr. Henshaw came into contact with manufacturers, electricians, and engineers all over the country, and after it disposed of its manufacturing interests he not only retained his relations with them, but made many new acquaintances in the business world. He remained as secretary-treasurer of the company until its absorption in the Montreal Light, Heat and Power Co., of which he also became secretary-treasurer, and remained in that position until the present appointment.

R. S. Lea, Freeman C. Coffin, and H. S. Ferguson, civil engineers, have formed a partnership under the style of Lea & Coffin and H. S. Ferguson, as consulting engineers, making a specialty of pulp and paper mills and power developments. The offices of the new firm are in the Coristine Building, Montreal. Mr. Lea, the resident member of the firm, is well known in connection with McGill University, having been an honor graduate of that university, and being for several years assistant professor of civil engineering, during which time he contributed valuable papers to the Canadian Society of Civil Engineers, dealing with sanitary subjects and the question of the flow of streams in relation to water power and water supply. Mr. Coffin has had extended experience as engineer of waterworks and sewage disposal systems, having been employed as consulting engineer or engineer in charge of works in over eighty places in the United States and Canada. He is the author of a work on hydraulics, and of several papers on the construction and maintenance of water-works, sewage systems, etc. He has also been frequently called in as an expert in the valuation of such works. He is a member of the American Society of Civil Engineers, as well as of the Canadian Society of Civil Engineers, and of other technical societies. Mr. Ferguson is chief consulting engineer of the Great Northern Paper Co., one of the largest paper and pulp mill corporations of the United States, several of whose largest pulp and paper mills he has designed. Among these is the plant, at Millinocket, Maine, one of the largest in the world. He is also a member of the Canadian and American Societies of Civil Engineers, and of the American Society of Mechanical Engineers.

TELEGRAPH AND TELEPHONE

The Bell Telephone Co. will build a new office at Brantford to cost $40,000.

The Marconi Wireless Telegraph Co. will erect a station at Winnipeg. It is the intention to erect stations at different points until the continent is bridged.

The Bell Telephone Co. are preparing to lay their wires underground in the business portions of some Canadian cities. Work is now going on in Ottawa, Montreal and London.

The Bell Telephone Company will place its wires underground in the main business portion of Stratford. The company estimates that the necessary expenditure to complete the work will be in the neighborhood of $11,000.

The Bell Telephone Company has completed two additional lines between Ottawa and Montreal, and will shortly build a direct line to Quyon, crossing the Ottawa by means of a submarine cable near Fitzroy Harbor. A line is also to be built up the Gatineau as far as Wakefield.

The Dominion Government have decided to install a wireless station in the Quebec Postoffice building, and the Superintendent of Public Works in Quebec, P. Beland, has received instruction to begin immediately the work of preparation of two offices for the employees of the department, which will have charge of the station.

NEW INCORPORATIONS.

Dominion.—The Canadian Scale Co., Montreal, $20,000; C. A. Backer, R. Osgood, Boston, Mass.; L. A. Wheeler, G. D. Fyfe and J. A. Ewing, Montreal.

The St. Lawrence Floating and Wrecking Co., Montreal, $200,000; J. W. Harris, F. X. Durand, T. Lessard, P. G. Martineau and J. Durand, Montreal. To build, repair and deal in navigable vessels of all descriptions, to build and operate dry docks, and to sell machinery for repairing vessels.

The Montreal Cement Co., Montreal, $500,000; J. Morgan, T. M. Morgan, C. D. Morgan, J. W. Cook, and A. Falconer, Montreal.

The Atikokan Iron Co., Toronto, $1,000,000; J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, R. Richardson and others, Toronto. To carry on the business of a mining, milling and development company.

The Colonial Construction Co., Montreal, $2,000,000; F. S. Maclennan, Westmount; J. J. Meagher, F. Robertson, J. C. Macdiarmid, and J. T. Mitchell, Montreal. To carry on the business of a general construction company and contractor, also of an electric light, heat and power company.

New Brunswick.—The Campobello Island Telephone Co., Wilson's Beach, county Charlotte, $2,000; W. E. Ludlow, A. Matthews, J. L. Savege, J. Brown, J. W. Matthews, M. Calder, W. Osborne, and J. M. Johnston, Campobello, Charlotte, N.B.

The following companies have been granted charters in Ontario:

Ontario.—The Smith Stacker and Feeder Co., of Hamilton, $40,000; H. W. Smith, M. F. Smith, Township Glanford; E. O. Smith, W. V. Edwards, and J. P. Stanton, Hamilton. To manufacture agricultural implements, threshing machines, straw stackers, etc.

Dominion Gold Mining and Reducing Co. and the Cedar Island Gold Mining Co., incorporated under the laws of the Imperial Parliaments of Great Britain and Ireland.

The Boston Canada Oil Co., incorporated in South Dakota, U.S.

The Eagle Lake Gold Mining Co., incorporated in Arizona, U.S.

Breitung Iron Co., incorporated in Michigan, U.S., to use not more than $1,000,000 capital.

The Calumet and Algoma Mining Co., Sault Ste. Marie, $1,000,000; J. Herman, J. Vertin, H. E. Lean, H. Bibber, C. Sclenk, L. Cæsar, and F. Roehm, Calumet, Mich.

The Cain Brick Co., Ottawa, $15,000; E. E. McMullin, M. J. Stevenson, Montreal; J. P. Cain, C. E. Cain, Ottawa, and W. E. Cain, Quebec.

Standard Inspection Bureau, Toronto, $40,000; J. Galt, A. L. Reading, T. C. Irving, and H. E. Redman, Toronto. To carry on the business of civil, mechanical and electrical engineers, analysts, surveyors, examiners and inspectors.

The Fort William Dredging and Harbor Improvement Co., Fort William, $150,000; E. R. Wayland, G. Morton, E. S. Rutledge, C. H. Jackson, F. R. Morris, T. E. Dean, L. L. Peltier, and W. Stevenson, Fort William. To erect docks and breakwaters and carry on a general dredging business.

The Selkirk Gas and Oil Co., Selkirk, $10,000; R. J. Winyard, N. Overholt, W. C. Holmes, J. W. Holmes, M. Miller, W. H. Smelser, D. Jepson, and A. Aldrich, Selkirk.

The Burgessville Telephone Co. of Ontario, Burgessville, $40,000; M. Emigh, J. G. Corless, Township North Norwich; H. E. Service, H. Sneath, Burgessville; A. E. Wilson, E. F. Park, Township East Oxford, and W. T. Nutt, Township Dereham. To carry on the business of a telephone company within the County of Oxford.

The Fidelity Oil and Gas Co., Leamington, $100,000; J. W. Rosendale, J. W. McKay, J. Leyden, T. H. Rockford, Buffalo, N.Y., and A. S. Holmes, Leamington, Ont.

Guelph Windmill and Manufacturing Co., Guelph, $50,000; G. A. Black, F. X. Frank, W. Fielding, A. McKinnon, Guelph; and F. C. Cockerton, Plattsville. To manufacture and deal in windmills and farm implements.

The Canada Fire Protection Co., Toronto, $100,000; H. F. White, A. D. Crooks, A. C. Bedford-Jones, G. W. Marsh, and J. A. C. McCuaig, Toronto. To manufacture fire-proofing materials, fire-prevention and fire-extinguishing appliances, including automatic sprinklers, automatic alarms, etc.

Lake Huron Copper Mining Co., Thessalon, $500,000; J. A. McEachern, Thessalon; B. B. Danziger, J. Danziger, S. C. Yeomans and C. S. Brown, Chicago, Ill.

The Galt Down-draft Furnace Co. has changed its name to the Down-draft Furnace Co.

Michigan and Ontario Oil Co., of Arizona, have been granted a charter to operate in Ontario, to use not more than $40,000 capital; A. R. Bartlet, Windsor, attorney.

The Crucible Steel Casting Co., Hamilton, $50,000; G. E. Husband, T. H. Husband, B. K. Husband and J. Scott, Hamilton.

The Leamington-Comber Oil Co., incorporated in Michigan, has been granted a charter in Ontario to use $40,000 capital; A. R. Bartlet, Windsor, attorney.

Murphy Iron Works, incorporated in Michigan, have been granted a charter to operate in Ontario to the extent of $40,000; M. C. Huyatt, Toronto, attorney.

Peterborough Boiler and Radiator Co., Peterborough, $40,000; E. F. Mason, A. Parker, R. G. Sturgeon, W. S. Davidson and S. V. Sturgeon, Peterborough.

The International Oil and Gas Co., Ingersoll, $200,000; A. Campbell, R. L. Aldrich, A. MacLaren, Detroit; J. B. MacLaren, Ingersoll, and W. T. McMullen, Woodstock.

Simplex Engine Co., Toronto, $150,000; V. L. Rice, H. L Rodgers, G. C. Edwards, A. Allan and A. H. Edwards, Toronto.

Hagersville Light and Fuel Co., Hagersville, $40,000; D. J. Almas, S. W. Howard, C. Stringfellow, J. C. Ingles and W. Swanzie, Hagersville. To deal in petroleum oil.

The Stratford Brick Tile and Lumber Co., Stratford, $40,000; C. S. Keller, J. Keller, J. D. Monteith, C. H. Davies, F. B. Deacon, Stratford.

Ontario Dock Co., Toronto, $100,000; J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill and R. Richardson, Toronto. To construct wharves, elevators, ships, vessels, etc.

The Buster Brown Gas and Oil Co., Windsor, $500,000; G. S. Smith, I. E. Brown, J. L. Wentz, E. W. Leh, Detroit, and J. W. Hanna, Windsor.

Temiskaming Telephone Co., New Liskeard, $25,000; T. McCamus, F. S. Brickenden, W. J. Middleton, W. Hugh, J. J. Sparling, D. Stewart and D. T. K. McEwen, New Liskeard.

Quebec. — Franco-American Automobile Co., $20,000; T. Craig, S. Page, H. B. Rainville, T. N. Patenaude, and G. Husson, Montreal.

New Brunswick.— The Provincial Telephone Co., $9,000; D. Fraser, Fredericton; H. S. Giberson, J. Fletcher, Gordon; H. W. Beveridge, A. Straton, Gordon, and J. Burgess, Grand Falls. To erect telephone lines throughout the County of Victoria.

Manitoba.—The People's Peat Fuel Co., Winnipeg, $750,000; H. W. Hollis, J. W. Stewart, A. H. Middleton, R. E. Ollerenshaw and P. C. Locke, Winnipeg.

The Dominion Pressed Brick Co., Winnipeg, $60,000; R. P. Roblin, J. H. Agnew, G. H. Clark, Carman.

Haug Bros. and Nellermoe Co., Winnipeg, $100,000; I. J. Haug, N. A. Nellermoe, Fargo, U.S.; L. J. Haug, E. E. Sharpe, T. L. Metcalfe and A. L. Stackpoole, Winnipeg. To manufacture and repair machinery.

British Columbia.—Edward Baillie Syndicate; $40,000. To carry on a general mining business.

The McKinley Mines, $2,000,000.
The West Coast Power and Light Co., $50,000.
The Continental Power Co., $50,000.
The North Pacific Steamship Co., $50,000.
The Interior Power Co., $25,000.
Greenwood-Fremont Mines, $250,000.
Surf Inlet Power Co., $50,000.
Bulkley and Telkwa Valley Coal Co., $1,000,000.
The Ladysmith Hardware Co., $25,000.

A HIGHLAND LAMENT.

Oh, waesome oor that saw the birrth
Of turbine thochts in Pairson's heid!
I weesh that I wes aff the airth,
Or else the turbine men was deid.

I'm a receeprocatin' mon,
I luve tae hear the bearin's boomp;
I coont the piston's put upon
That's relegated tae a poomp.

This whirrligiging thing I hate,
For whatna gude is it ta dae?
Tae see the fearsome thing gyrate
Gars ma puir stommick gang agley.

I widna greet gin it hed ocht
Tae need a feetter's tender haund,
But it hes rin sin' it was bocht—
I haena had tae slack a glaund.

I've hed eneuch! I winna bide
Tae watch a high-speed coffee-mill;
An' bid my weary hert be still.
I'll droon me in ma native Clyde

—Simplex, in The Electrical Engineer.

LITERARY NOTES.

The annual report of the Queen Victoria Niagara Falls Park Commissioners has just been issued. As it is now twenty years since the organization of the commission, the report contains a summary of its history, which forms very interesting reading. It is twenty-six years since Lord Dufferin brought his influence to bear on the authorities of Canada and the United States to secure and hold for the benefit of the public lands about the Falls, so that the people of all nations might enjoy this natural wonder for all time. In 1880 the Ontario Government surrendered its rights to the Dominion Government, in order that the project might be carried out as an international undertaking, but as the Dominion Government did not take action in the matter, a provincial commission was appointed in 1885, the original members being Sir Casimir Gzowski, John W. Langmuir, and J. Grant McDonald, the second of whom is still a member of the Commission. By purchase of private lands and grants of Crown lands, the commission obtained a reservation in the park proper of 196 acres. Besides this there is the Chain Reserve along the river from the park to Queenston Heights, and from Chippawa to Fort Erie, which together with lands at Queenston and Fort Erie leased from the Dominion Government, make an aggregate area of 787 acres under the control of the commission. Improvements have been carried on, in the way of the installation of elevators down the face of the cliff, the construction of shelters, the removal of objectionable buildings, the placing of protections to prevent erosion at exposed points, and a great deal of work in draining, levelling, and decorating. Among the first franchises granted by the commission was that given the electric railway connecting Queenston and Chippawa. Right of way through the park and the use of water for power development is granted by the commission, for which $10,000 per annum is received. Concessions for refreshment and photograph stands and the privilege of taking visitors behind the Falls produce a revenue almost as large. In 1892 the first franchise for commercial power development was granted to the Canadian Niagara Power Co. This franchise lapsed by reason of default in construction of works, and a new one was subsequently granted. The works have now been pushed vigorously so that 20,000 electrical horse-power is now ready for transmission. The northerly half of the power-house is completed, and the work of restoring the park grounds disturbed is well under way. The Ontario Power Company entered into agreement with the Commission in 1902 for the development of water-power by leading water from the Welland Canal through the park to the river. The company later changed their plans and obtained the right to take water from the river at Dufferin Islands. The intake at Dufferin Islands, the pipe line through the park, and the power-house at the foot of the cliff below the falls are now approaching completion. In 1903 a franchise was granted to the Electrical Development Co., of Ontario, for a power-house to be situated between the intake of the Ontario Power Co., and the power-house of The Canadian Niagara Power Co. The forebay, wheelpit and tailrace tunnel have been constructed in record time, and are being rapidly completed. From franchises granted the Commission has received $620,000 up to the present, about $365,000 being from the three power companies. When all these companies are developing power to the full extent of their rights, the yearly income to the province from these rentals will be about $275,000.

The Popular Science Monthly for May has an article, entitled "Present Problems in Radioactivity," in which Prof. Rutherford, of McGill University, deals with the present status of investigations in this realm, where he is a recognized authority. He treats at length of alpha, beta and gamma rays as exhibited in the elements uranium, thorium, actinium and radium. As to the source of energy emitted by radioactive bodies, he combats the theory of borrowed or external energy, and supports the alternative theory that the energy is derived from the radio-atoms themselves, and released in consequence of their disintegration. Alpha and beta rays consist of particles projected at great speed; it is calculated that in order for the alpha particle to acquire the velocity with which it is expelled it would be necessary for it to move freely between two points differing in potential by five million volts. It is supposed that these particles were originally in rapid motion in the atom, and for some reason escaped from the atomic system with the velocity they possessed at the instant of their release. The expulsion of these particles results in the disintegration of the radioactive substance and the formation of new substances; thus, radium produces an emanation, which on further disintegration results in a series of substances known as radium A, radium B, radium C, etc. In the case of uranium and thorium the disintegration proceeds at such a slow rate that about 1,000,000,000 years would be required before half the matter present is transformed. In the case of radium, however, the process takes place at over a million times this rate. In a gram of radium about half a milligram is transformed in a year. There is no evidence that the process is ever reversed, and in order to account for the presence of any radium on the earth to-day it is necessary to assume that radium is continuously produced from some other substance or substances. Investigations are now in progress, the results of which strongly support the view that radium is the product of the disintegration of uranium, or possibly of thorium. "The great problem at present in the study of radioactive minerals," says Prof. Rutherford, "is not the attempt to discover and isolate new radioactive substances, but to correlate those already discovered." As to the radioactivity of ordinary matter, experiments to date have shown that this exists, but it is possible that it may be accounted for by the presence of minute quantities of known radioactive substances.

MOTOR BOATS.

Editor Canadian Engineer:

Referring to paragraph in issue of the "Canadian Engineer" of February, 1905, stating that our firm were the sole builders of complete motor boats in Canada, and to letters from Georgian Bay Engineering Works, and from Hamilton Motor Works, Limited, appearing in the issues of March and April, 1905, I should like to clear what apparently is a misunderstanding. Our claim that we are the sole builders of complete motor boats in commercial quantities in Canada under one management is, I believe, entirely correct, no other firm, to my knowledge, going into the manufacture of motor boats to the same extent as ourselves. When we started four years ago, we manufactured only hulls and purchased our engines. This season we have put in a machine shop, and now manufacture engines. Our output of complete motor-boats this year will be in the neighborhood of seventy-five. Yours truly,

THE CANADA LAUNCH & ENGINE WORKS, LIMITED.
M. M. Whitaker, Manager.

Toronto, May 29th, 1905.