PAGES

MISSING

The Canadian Engineer

Vol. XI.—No. 5. TORONTO AND MONTREAL, MAY, 1904. PRICE 10 CENTS / $1.00 Per Year.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

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

Subscription—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

Offices—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, Limited, Publishers,

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

CONTENTS OF THIS NUMBER :

THE TORONTO FIRE AND ITS LESSONS.

The night of April 19th, 1904, will long be remembered for the most disastrous fire from which Toronto ever suffered, a conflagration which far exceeds that which has ever visited any Canadian city in the value of property destroyed. By it a large part of the wholesale district of the city was wiped out. The fire broke out at 8 o'clock in the evening, and before it was got under control, in about 9 hours, 14 acres had been burned over and property to the value of nearly $15,000,000 destroyed, with about $10,000,000 of insurance. The fire had its useful lessons, to which all concerned would do well to take heed.

As to the origin of the fire, it is attributed to electric wires. Formerly all fires, the origin of which was obscure, were attributed to incendiarism. Now the electric wire has to bear the blame. Whether it was the cause of the Toronto conflagration or not will probably never be known. There is no doubt that electricity is a prolific cause of fires, and that many such disasters may be attributed to defective and unskilful wiring. There is danger also from short circuiting, the gnawing of insulating material by rats, and other causes which appear to be almost beyond control. It behooves property owners, electric contractors, insurance companies, and all others who have to do with such matters to see that the utmost care is exercised in installing electrical apparatus, in order that the danger may be reduced to the minimum.

Though Toronto has an efficient fire brigade, which is fairly well equipped, it is evident that something is still wanting if they are to cope successfully with an extensive fire. After the Baltimore conflagration, which the Toronto one resembles in many respects, some of the business and insurance men who visited the scene were impressed with the desirability of having, in cities with a water front, a water service for fire purposes alone, and entirely separate from the ordinary waterworks. Had Toronto possessed such there is little doubt much property could have been saved on the night of the 19th. One of the chief difficulties the fire brigade had to contend with was poor pressure, and it stands to reason that if a large number of streams are being drawn from the mains the pressure must be greatly reduced. The proposition is that fire mains should be laid in the business part, with stationary steam or gasoline pumping engines on the water front, to be used for fire purposes only. The city council has asked for a report on the subject from the chief of the fire brigade, and there is little doubt what it will be, and that such a system will be installed in Toronto before long, as it has been in some cities in the United States.

Another suggestion is that all high buildings should be equipped with stand pipes and hose on every flat. With high buildings catching fire at the top, as most of those in the Toronto fire did, it is almost impossible to reach the fire with ordinary hose. Water towers are of some service, but even they fail to accomplish their object after buildings reach a certain height; and even then, as is the case with hose, the stream is scattered in the face of a high wind, snch as prevailed in the Toronto fire. The automatic sprinkling system serves a useful purpose, and it was the means of saving the Kilgour factory and preventing the spread of the fire to Yonge Street. We expect to see this system more extensively introduced as a result of this lesson.

A fire tug would be a good thing to have in Toronto harbor. This was evident at the time of the fires at the west end of the island last year, and probably some of the property along the Esplanade which was burned in the recent fire might have been saved by such an appliance.

A dead wall is sometimes an efficient protection. The J. D. Ivey Co., at whose premises the fire stopped on Wellington Street West, attributed their escape largely to the fact that there were no window or door openings on the east side of their building. It must be remembered, however, that the direction of the wind was away from them. Where there are openings iron shutters are a great protection. They are of no use, however, unless they are in place and closed, and this was the case with some buildings at the Toronto fire.

Iron window frames, with iron sash, glazed with wire glass, should be more employed in large buildings. Wire glass has not come into general use, and is not looked upon with favor by many. Ordinary glass may answer where iron shutters are used.

A. A. Allan & Co., wholesale furriers, saved a large quantity of valuable goods by storing them in what are usually coal areas under the sidewalk. These had been converted into fire-proof vaults by means of iron doors. The less valuable coal is likely to give way to the more valuable goods in such places in the future.

Many of the burnt-out firms lost their books and papers, which were supposed to be safe from fire in their vaults. This is, of course, the result of faulty construction, for stone, brick and iron vaults are fire-proof under almost any circumstances, if proper precautions are taken in their construction. The ordinary fire-proof safe seems to have done its work well in the midst of what was a very hot fire.

As has been demonstrated before, iron construction of buildings does not prevent their destruction by fire. Instead of being consumed the material becomes warped and twisted out of all shape. Only when fire-proofed by the use of terra cotta or concrete will iron stand the intense heat without injury.

On the question of general construction the remarks of Foster Warner, architect of the Granite Building, Rochester, may be quoted. He says: "I believe that the only fire-proof building is the one that has been constructed of material that has been created by fire. In other words, brick and terra cotta are made by fire. Consequently it stands to reason that these materials will better stand an extreme degree of heat than stone or concrete, which have never been subjected to a high temperature." The cement men dispute this opinion, and claim that concrete should be included among efficient fire-proof materials.

It would be a great protection if elevator shafts and stairways were inclosed in fire-proof walls. How often do we hear of flames running up elevator shafts, which serve as great draft tubes. The Toronto fire spread in the building where it broke out in this manner.

The Toronto fire spread with remarkable rapidity. Notwithstanding the substantial character of most of the buildings in the fire-swept area the flames leaped from one to another with irresistible fury, being driven along by a high north-west wind, which at times approached almost to the velocity of a gale. Almost nothing was saved. Buildings, machinery, stocks, all were swept away. But the sufferers are facing the situation bravely. Under the direction of the city engineer the walls of the burned buildings are being blown down with dynamite, and preparations for rebuilding are going on rapidly. A better and more substantial city will rise from the ruins of Toronto's great fire.

ELECTRICAL SMELTING.

If Canadians as a nation had the education in chemistry which the Germans have they would in a single generation lead the world in electro-chemical industries. Canada has the water powers, thousands of which are running to waste as yet. Combine this great natural asset with the German aptitude for chemistry, and industrial miracles would be wrought all over the country. Cheap water power brings within the range of commercial success hundreds of products which without such cheap power would forever remain curiosities of the laboratory or the lecture-room. A glimpse of the industries now carried on at Niagara Falls in the electro-chemical field opens up a vista of enormous possibilities wherever large water powers exist with raw materials near at hand. The large and steady increase in the production of carbide of calcium for the manufacture of acetylene gas is one example among others of the successful developments that have already taken place in Canada in this branch of science as applied to industry.

The smelting of ores by electricity is another application of the cheap electrical power which this country possesses in unique abundance; and the foresight which prompted the Dominion Government to send a commission to Europe to investigate the electro-thermic processes in development there is likely soon to be demonstrated in a practical way. The commission, consisting of Dr. Haanel, of the Geological Survey, C. E. Brown, electrical engineer, and a secretary were joined in England by Prof. F. W. Harbord, of Cooper's Hill, Surrey, metallurgist to the Government of India, and proceeded to Sweden, where the electric smelting of iron is carried out upon a commercial scale. They also visited Germany and France, where smelting by electricity is carried on. The experiments at Livet, in the Pyrennes, were considered the most important. A sample lot of ninety tons of Spanish ore was put through for the benefit of the Canadian Commissioners, who brought away samples of the pig iron, which was smelted, it is said, at a cost of $8 a ton. It was demonstrated here that both pig iron and steel could be made by the electrical process alone. The commission will report on the cost of these processes, and upon this will depend the applicability of the method to those portions of Canada where coal is not to be had cheaply for smelting. Dr. Stansfield, of Montreal, in a recent lecture before the Canadian Society of Civil Engineers, expressed his doubts as to the commercial advantages of the processes he had examined, except in cases where water power was very cheap, and where both the raw material and the market for the finished product were close at hand. Dr. Haanel, however, appears to be much more hopeful of the processes he investigated, and if the electrician's report is equally favorable, we may soon see in various parts of Canada the reduction of other metals besides iron by electricity.

—At the meeting in Montreal, last month, of the wire nail manufacturers of Canada to consider the question of renewing their contracts with the United States Steel Trust for wire rod for the year's supply, several features of interest developed. One was that the Dominion Iron and Steel Co. expected to be in a position to manufacture steel rods within the month, and the American Steel and Wire Co., one of the branches of the United States Steel Trust, had not, it was claimed, lived up to their agreement during the past year, as they had not sold rods as cheaply to Canadians as they could be imported by Canadian firms from Great Britain, Germany or Sweden. It is claimed that the difference in price was between $4 and $5 per ton. The United States Company were anxious to have their agreement renewed at this meeting, and succeeded in obtaining contracts from some of the Canadian manufacturers for six to twelve months' terms. It is said that one of the arguments used was a threat to enter the Canadian market with manufactured wire nails and compete with the Canadian manufacturer if he did not agree to the terms they imposed for the purchase of wire rod. Another meeting was held later in Toronto; and it is understood that one prominent manufacturer in the East refused to be coerced, and that his example would be followed by some Western manufacturers, who, in that case, will have to look to the Dominion Iron and Steel Co. or to Europe for their supplies, and face probable competition from the United States. Some of the other firms, however, succumbed to the threat, and have placed their orders for the year. The competition referred to will, however, hardly materialize, as the duty on wire nails is 60c. per 100 lbs., with a further duty on the kegs or boxes, and the United States Steel Trust in order to secure trade would be obliged to sell the manufactured article as low, if not lower, than the price charged Canadian manufacturers for the rods. This agreement between Canadian wire nail manufacturers on the one hand and the American Steel and Wire Co. on the other, has been in force since 1899, with the exception of 1900, and included all wire nail manufacturers in Canada. The American Steel and Wire Co., in return for these Canadian companies purchasing wire rod supplies from the Trust kept their manufactured product out of the Canadian market, on the same plan, if not by the identical means, taken by the makers of shovels to divide the Canadian and United States markets between them, as far as such monopolies are able to do. In both cases the monopoly may end, as we learn that a new company is now quietly installing a plant to make shovels in Canada on a scale which will certainly affect the market price of those commodities.

* * *

—A communication in this issue corrects an error into which we fell last month as to the position of the American Machinist on the question of metric weights and measures. We were informed by a United States manufacturer of machine tools—who, while opposed to the introduction of the system on the ground of cost, yet believes it inevitable—that Mr. Miller was personally a believer in the advantages of the metric system. Mr. Miller does not state his own personal convictions, but if his friend is wrong, the misconception probably arises from the fact, mentioned in the letter, that nearly all who have written in the American Machinist are advocates of the introduction of metric weights and measures. To those who are regular readers of our able contemporary, and have marked the high average of intelligence and practical knowledge of machinery shown by its contributors and correspondents, this fact alone will bring conviction that the metric system is bound to be adopted by the Anglo-Saxon world. The chief difficulty in the engineering trades is the fear that the change will be very costly. We believe this cost is much over-estimated.

* * *

THE METRIC SYSTEM IN PRACTICE.

Editor, Canadian Engineer:—

Sir,—Much discussion of a speculative nature has been indulged in, in regard to the Metric System, as to whether its application in commerce would, or would not, be fraught with much benefit.

Unquestionably the change from any one system of measurement, to any other, will occasion temporary inconvenience, irrespective of whether the system changed to is either better or worse than that changed from. Experience has shown that the public adheres tenaciously to a practice once adopted, and a long continuance of almost any practice creates a bias, and will more or less mask the ability to see an innovation in its true relation to the end desired—the knowledge of what is—being much more complete, than the knowledge of what might be.

Much favor is lavished upon the so-called duo-decimal system, because 12 can be divided by 2, 3, 4, and 6, the dividend being a whole number in each case. The late Herbert Spencer urged this point, and it is unquestionably one of much moment, but the decimal notation offers a much greater advantage in that it is easy to work out quite large arithmetical problems mentally by this notation, whereas the introduction of 12's would inevitably involve confusion or at least much increase the difficulty.

Moreover, the commercial world is so continually using the percentage method of expressing relative and absolute values, that in the nature of things, it is highly appropriate to combine a centessimal system of coinage and gravimetric and volumetric measurements.

As one who has used the Metric System for years, side by side with our feet and inches, pounds, and gallons, I most emphatically favor the Metric System, and I can confidently assert that any one who essays to become as familiar with this system as they have been with the duo-decimal, will never want to return to the latter.

No analysts use septems, minims, and grains now; even when results must be expressed per gallon, the so-called "miniature gallon" is used being 70 cubic centimeters, which volume of water contains as many milligrams as there are grains in a gallon, and so by transposition of terms each milligram counts as one grain per gallon; this miniature gallon is largely used in water analysis. Assayers appreciating the ease of the Metric Sytem have adopted a weight known as the "assay ton" (approximately 35.8 grams), which contains as many milligrams as a ton does ounces, and so one milligram pound represents 1 oz. per ton of precious metal. Another instance of the convenience of the Metric System is afforded when the barometer is used for ascertaining heights, where a decrease of one millimeter represents an ascent of 10 meters. or, as one can see at a glance, the ascent is ten thousand times the diminution in the barometric column; this is by no means so easy to perceive when the statements are made in feet and inches, e.g., a reduction of the column by one-tenth inch equals an ascent of about 87 feet. Again, in computing the weight of liquids from the measurements of the containing tanks, the superiority of the Metric System becomes apparent; up to the point where the cubical contents are ascertained there is not much difference, but having obtained the number of cubic feet we must now multiply by 6.23 for gallonage, and 62.3 for pounds; whereas, having ascertained the number of cubic decimeters you may either call it kilos for weight or litres for volume; this point saves an enormous amount of work and time where much liquid measurement is necessary, as in breweries, distilleries, soap works, and chemical works generally.

It is unfortunate, but not inconvenient, that the meter exceeds the 10-millionth part of the meridional arc of the earth (by one part in 6,400 or .0155 per cent., as stated by Sir John Herschel), which it was intended to be, nevertheless this does not impair its usefulness. In conclusion,, I would say to those who oppose the Metric System, use it till you are thoroughly familiar with it, and you will fall in love with it.

Yours truly,

HARRY SPURRIER.

Davenport, April 23rd, 1904.

* * *

THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—As some further evidences of the extended desire, through all classes in this country, for the adoption of the Metric Weights and Measures, I may inform you that the petition—of which a copy is attached—is being signed by all trade unions, by all the chambers of commerce, by all the teachers' associations, by all the retail trade societies, and by most of the town and county councils, hundreds of thousands of individuals, merchants, school-masters, ministers of religion, shopkeepers and retailers, manufacturers, engineers and workmen.

In all, several millions of persons will be represented by the signatures of officials of the various organizations.

Moreover, there are 315 M.P.'s pledged to vote for our Metric Bill, and it is certain that these promises could not have been secured had the Parliamentary representatives not felt that their constituents were anxious for the change.

I am, Sir, your obedient servant,

E. JOHNSON,

Sec., Decimal Association, Cannon St., London, Eng.

Extracts from the petition referred to: That in the opinion of your petitioners the adoption of the Metric Weights and Measures by this country is highly necessary: 1st. Because it has already been adopted by nearly all the civilized countries. 2nd. Because it would materially assist education by facilitating the teaching of arithmetic, and setting free a considerable amount of time which would be devoted to more useful subjects than the learning and practising of our complicated and confused Tables of Weights and Measures. 3rd. Because, as our Consuls frequently reiterate, we lose trade in consequence of our Weights and Measures not being understood in other countries, and because the adoption of the Metric Weights and Measures would obviate the present necessity for manufacturing on one basis for export trade and on another for home trade. 4th. Because the colonies desire the change, but feel that the lead must, on account of intercolonial trade, be taken by the Mother Country. 5th. Because it would lead to the abolition of a large number of anomalous, customary, or local, but illegal, Weights and Measures, still largely used in various parts of the country. These irregular Weights and Measures are chiefly objectionable because they give facilities to dishonest traders to take advantage of purchasers who are not acquainted with them.

That numerous demonstrations of the desire for the change have been made by resolutions and petitions of public bodies, institutions, chambers of commerce, trades unions, retail trade organizations, manufacturers, engineers, and teachers.

That a Select Committee of the House of Commons in 1895 reported in favor of the compulsory adoption of the Metric Weights and Measures within two years.

That your petitioners are much disappointed that, although eight years have elapsed since then, no steps have been taken to give effect to this recommendation of the committee.

That by reason of the fierce competition for foreign trade, the need for the change is even more serious now than in 1895.

That there are indications that the Metric Weights and Measures will before long be adopted by the United States, one of the main arguments likely to influence that result being the facility it would give for successful competition with this country in trading with countries using the Metric System, especially in the Republic of South America.

That the Colonial Premiers at the Coronation Conference resolved: "That it is advisable to adopt the Metric System of Weights and Measures for use within the Empire, and the Prime Ministers urge the Governments represented at this Conference to give consideration to its early adoption."

* * *

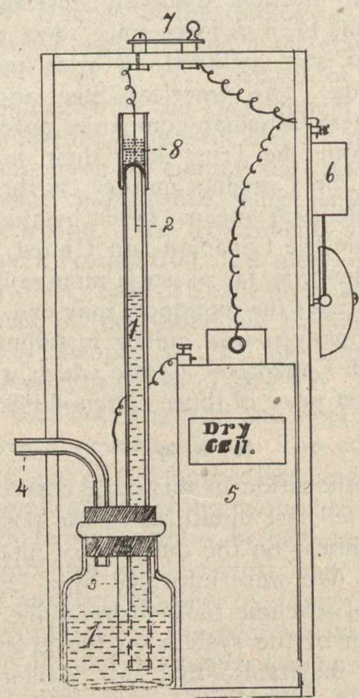
A NEW VACUUM GAUGE AND ALARM.

Harry G. Spurrier, of Davenport, Toronto, has invented a vacuum gauge and alarm, for which a patent has been issued.

The instrument was devised primarily to meet the necessities of vacuum pan practice, where even small variations of vacuity seriously affect industrial results. The instrument consists of a rather short mercury column (1) which by its variations of altitude will make or break electrical contact with a bell and battery circuit, resulting in an audible as well as visible announcement to the engineer.

A small bottle or reservoir containing mercury is tightly fitted with a rubber stopper (S) through which passes the tube containing the mercury column, and bearing a platinum wire fused through its upper end. The lower end of this tube passes nearly to the bottom of the reservoir, and is well immersed in the mercury.

Through the rubber stopper also passes a bent tube (4) terminating immediately beneath the stopper, and also a wire (3) which passes into the metal in the reservoir. The necessary bell and battery wiring completes the arrangement. In practice the connection is made by stout India rubber tube between the bent glass tube and a small metal tube tapped into any convenient portion of the pipe or pan to be exhausted. As the vacuity increases in the condenser-chamber or pan, the mercury in the upright tube descends to a point correspondingly low. At a predetermined point, say 25 inches, or 635 millimeters of vacuum, the mercury in the column falls below the lower extremity of the platinum wire and the electrical circuit is broken at this point,—but, should the vacuum fall below 25 inches, or 635 millimeters, the mercury will rise, touch the wire, and the bell will ring, and continue ringing until the switch (7) is opened or the vacuum increases.



Vacuum Gauge and Alarm.

1—Mercury. 2—Plat Wire. 3—Copper Wire. 4—Tube to Vacuum Pipe. 5—Battery. 6—Bell. 7—Switch. 8—Mercury Cup.

The obvious use of such an alarm in a condensing plant scarcely needs comment, as the engineer is at once warned of approaching danger, and the cost of the instrument would be more than repaid in a single instance when flooded cylinders were avoided. The instrument may be piped up by ¼-inch pipe to any desired point, or the bell alone may be wired to the chief's office.

The alarm is also an absolute check for accuracy to ordinary spring gauges. By measuring the column of mercury from the level in the reservoir to top of column—the "deficiency," or how far short of perfect vacuity the realized vacuum falls, may at once be ascertained, this measurement being absolute, which is not the case when the vacuum "realized" is gauged in the ordinary way, because this implies a constant barometer which we do not actually have. A model as the cut has been in actual operation for two years, and on dozens of occasions has rung out a valuable warning, and has never failed in a single instance to report itself at the right moment.

This instrument will at once appeal to all who operate condensers, whether attached to engine or pan systems. Its use, for example, on the big engine of the Street Railway power house in Montreal would have saved the disastrous accident which happened there two or three years ago.

* * *

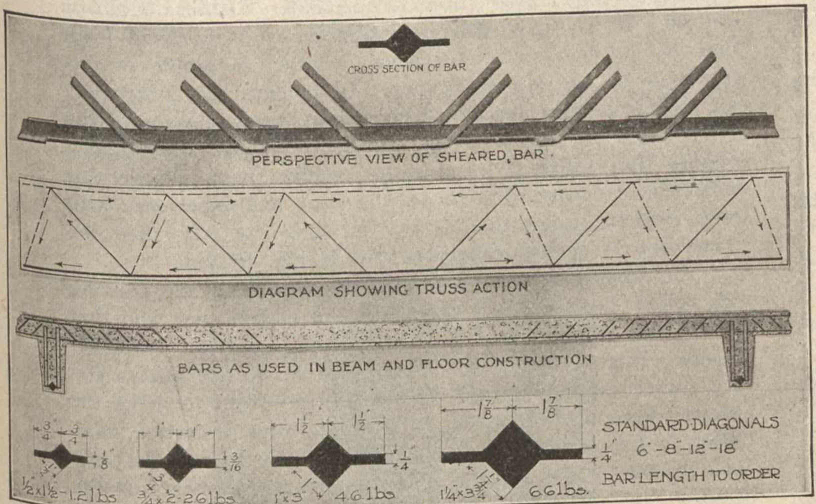
—Two spans of the C.P.R. bridge, near Saskatoon, have been washed away by the high water in the South Saskatchewan.

* * *

—The E. S. Harrison Co., Winnipeg, have been awarded the contract for the machinery in the new power house for Regina, N.W.T., to be constructed from plans by John Galt, C.E., of Toronto.

THE KAHN TRUSSED BAR IN REINFORCED CONCRETE.

As thoughtful architects and engineers are giving the subject of reinforced concrete a great deal of attention, a description of the Kahn system of reinforced concrete will be of interest. Julius Kahn, a civil engineer of Detroit, Michigan, realizing that the forms of reinforcement used did not provide for all possible loads, has invented a trussed bar, patents for which have been turned over to the Trussed Concrete Steel Company, of Detroit, Michigan. The Kahn trussed bar consists of a half truss struck up from a single rolled section, providing the tensional members of a truss. Concrete is an excellent material for compression, but is comparatively weak in tension. When the Kahn bar is imbedded in a mass of concrete, forming an independent, self-contained beam or truss, the concrete supplies the missing compression members of the truss. A beam when built in this manner, when tested to destruction, invariably fails at the point of greatest bending moment by pulling in two the



steel reinforcement which is imbedded within the concrete. The Kahn trussed bar, not only provides horizontal reinforcement, but also vertical reinforcement, which European engineers have found so necessary to provide for shear at the ends of the beams. These engineers endeavored to overcome the shearing strains by using U-shaped stirrups of iron around the horizontal rods, which have been used largely for reinforcement heretofore. The advantage of the Kahn trussed bar lies in the fact that the sheared up members are rigidly attached to the main horizontal bar, being, in fact, a part of the bar, and they therefore carry all strains directly into the main tensional member. It has been found by tests where twisted or deformed rods were used for reinforcement, that when tested to destruction, they failed by shear either at the ends or along the main horizontal member, and the concrete would open up at an angle of about 45 per cent. with the horizontal. The inclined members of the Kahn bar cross these lines of rupture at practically a right angle, and they therefore hold the material together. Another advantage claimed for this bar is that at the centre of the beam, where bending moment is greatest, the full cross-section is left unsheared, whereas, at the ends where maximum shear occurs, and bending moment is the least, the members are struck up to provide for shearing stresses.

An illustration of this form of construction can be seen in Toronto, where the roof of a fur vault for the Gillespie Estate has been designed in accordance with the Kahn system by Gordon & Helliwell, architects, and is now under construction. The Trussed Concrete Steel Co. has offices in the leading cities in the United States, and has now extended its business to Canada, having appointed A. J. Stevens, C.E., Canada Permanent Bldg., Toronto, as general agent for the Dominion.

* * *

The Eugene F. Phillips Co. will build their large new factory, at St. Louis du Mile End, a suburb of Montreal.

THE TORONTO FIRE.

The following industries were burned out in the great Toronto fire of April 19th: M. McLaughlin & Co., Dominion Flour Mill, Toronto Coffee and Spice Mills, Henderson Roller Bearing Mfg. Co., Dominion Fence Co., A. Dunlop, elevator manufacturer, Pugsley, Dingman & Co., soap and blue manufacturers, Eckardt Casket and Eckardt Silver Plate Co., Wm. Jessop & Sons, dealers in steel; W. A. Rogers, Limited, silver plate manufacturers. The wholesale stationers, who suffered heavily, nearly all carried on manufacturing or printing on their premises and many of the wholesale dry goods dealers had manufacturing departments.

When it was seen that the fire would reach large dimensions, outside aid was asked by telephone, and Hamilton, Brantford, London, Peterboro and Buffalo sent detachments of their fire brigades, which rendered efficient help.

* * *

R. G. Black, chief electrical engineer Toronto Electric Light Company, gave an interesting talk to the Canadian Asssociation of Stationary Engineers, in the Engineers' Hall, Toronto, April 20th, on "Alternating Current and How to Handle It."

* * *

—E. H. McHenry, chief engineer of the Canadian Pacific Railway, has resigned the position which he assumed two years ago, succeeding P. A. Peterson. For some time he has not been in the best of health. The name of a prominent engineer, understood to be W. F. Fye, assistant chief engineer of the C.P.R.. is mentioned as Mr. McHenry's successor, but nothing has been decided. Mr. McHenry was at one time receiver of the Northern Pacific, and is reported to be a man of means. It is rumoured that he will join the staff of the Grand Trunk Pacific.

* * *

The first of twenty new locomotives, which are being built for the C.P.R. at the Saxon Engine Works, Chemnitz, Germany, is being tested at Montreal. They are made to a design furnished by the C.P.R. The diameter of the cylinders is 23 inches; diameter of driving wheels, 63 inches; total wheel base, 25 feet 2 inches; weight, 168,335 pounds; water capacity, 5,000 gallons; coal, 10 tons; weight of tender, 127,000 pounds; total wheel base of engine and tender, 53 feet; total weight of engine and tender, 295,355 pounds. They are ten-wheeler compound, and will haul large trains with freight cars of sixty tons each—the solution, in fact, of the problem, how to make profits at present rates. They will cost about $20,000 each. While twenty will complete this particular order, the C.P.R. really need something like one hundred and fifty new locomotives, which are being supplied as fast as the local shops and foreign firms can turn them out. As far as tested the German engine gives satisfaction.

* * *

NEW CATALOGUES.

Copies of the following catalogues and bulletins received may be had on writing to any of the firms named, mentioning The Canadian Engineer:

The Westinghouse Electrical Manufacturing Co., Pittsburg, Pa., "Westinghouse Auxiliary Apparatus for Railway Equipments"; "Electric Locomotives for Surface Haulage"; "Westinghouse Automobile Charging Outfits"; "Type Motors"; and "Westinghouse No. 91 Single-Phase Railway Motor and Car Equipment."

The Brown & Sharpe Manufacturing Co., Providence, R.I.: Milling and grinding machines, automatic gear-cutting machines, screw machines, cutters, accurate test-tools, and machinists' tools, gauges, etc.

The Trussed Concrete Steel Co., Detroit, Mich.: "The Kahn System of Reinforced Concrete."

The Bullock Electric Manufacturing Co., Cincinnati, Ohio: "Methods of Speed Control," a treatise on the electrical control of speeds.

J. H. Williams & Co., Brooklyn, N.Y.: Automobile and general forgings in iron, steel, copper, bronze and aluminum, drop-forged wrenches and "Vulcan" patent drop-forged chain pipe wrenches.

Arthur Koppel, New York: "Narrow Gauge Railway Materials." (Supplement to Catalogue No. 77.)

The Hisey-Wolf Machine Co., Cincinnati, Ohio: "The Hisey Portable Electrically-driven Grinders and Drills."

The Keystone Manufacturing Co., Buffalo, N.Y.: Machinists' tools, ratchets, wrenches, steel sockets, centre punches, etc.

The Railway and Electric Equipment Co., Buffalo, N.Y.: "List No. 2": electrical machinery and railway equipment.

The Joseph Dixon Crucible Co., Jersey City, N.J.: Graphite pipe joint compound.

The American Steam Packing Co., Boston, Mass.; "American" steam packings and beltings.

The Canada Foundry Co., Toronto: The "Beaver Posthole Digger."

North Bros. Manufacturing Co., Philadelphia: "Yankee Tools."

The Moran Flexible Steam Joint Co., Louisville, Ky.: "The Moran Flexible Joint."

The Knowles Steam Pump Works, New York: "Pumping Machinery for Beet Sugar Factories."

The Standard Pressed Steel Co., Philadelphia: "The American Pioneer Pressed Steel Shaft Hanger."

The Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio: "The Improved Cincinnati Air Compressor."

The Pittsburg Meter Co., East Pittsburg, Pa.: "The Keystone Water Meter."

The France Packing Co., Tacony, Philadelphia: Steam stopper packings.

The National Electric Co., Milwaukee, U.S.A.: Catalogue No. 60, "Alternators."

Thos. H. Dallett Co., Philadelphia: Pneumatic tools.

The Colburn Machine Tool Co., Franklin, Pa.: The New Colburn Universal Saw-table.

The Geo. White & Sons Co., London, Ont.: Threshers, traction engines, locomotive boilers, stationary engines and boilers, steam saw mills, etc.

The Jenckes Machine Co., Sherbrooke, Que.: "The Farrel Patent Crusher."

Fairbanks, Morse & Co., New York and Chicago: Hoists and mining machinery, operated on gasoline, naphtha, distillate, kerosene and crude oil.

W. R. Perrin & Co., Toronto: Catalogue No. 8: machinery for abattoirs and packing houses.

The Crandall Packing Co., Palmyra, N.Y.: Steam, ammonia and hydraulic packings.

Johnson & Phillips, London, Eng.: Arc lamps, brackets, electric fans, etc.

The Mason Regulator Co., 156 Sumner Street, Boston, Mass.: "The Mason Pump Governor."

National Electric Co., Milwaukee, Wis.; Direct Current Generators and Motors.

Kellogg Switchboard and Supply Co., Chicago; Magneto Switchboards.

Westinghouse Machine Co., East Pittsburg, Pa.; Westinghouse-Parsons Steam Turbine.

A. Leschen & Sons Rope Co., St. Louis, Mo.; Long Distance Transportation of Ores by Aerial Wire Rope Tramways.

Sheldon & Sheldon, Galt, Ont. Steel Plate Planing Mill Exhausters; also Friends—Heating and Ventilating Systems.

The Garvin Machine Co., New York; Metal Working Machine Tools.

Joseph Dixon Crucible Co., Jersey City, N.J.; Proper Care of Driving Chains.

Armstrong Bros. Tool Co., Chicago; Tool Holders.

The Lunkenheimer Co., Cincinnati; Tin Hanger illustrating valve.

Penberthy Injector Co., Windsor, Ont.; Oilers, Injectors, etc.

The Unbreakable Pulley and Mill Gearing Co., Manchester, England; Card showing Self-Oiling, Swivel Bearings in New Type Hangers.

Chicago Pneumatic Tool Co.; "Something Pneumatic;" a monthly magazine to be issued by them, the character of which is indicated by the title.

THE AMERICAN MACHINIST AND THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—I note your article in the issue for April, entitled "Metric Measures and Weights," and that in it you state that the American Machinist strongly advocates the Metric System. In this you are mistaken. The American Machinist has not advocated the Metric System and does not advocate it. It has opened its columns to contributions from such men as have had experience with both the English and Metric Systems in the construction of machinery either here or abroad. It has published all communications received from men having had such experience, whether favorable or unfavorable to the Metric System. It happens that practically all the communications so received have been in favor of the system, but we should be as willing to publish those which oppose the system if we were to receive them. While this indicates, of course, that those who have had experience with both systems prefer the Metric, it does not say that the American Machinist advocates the Metric System.

We have, however, attempted to show that the pending bill before Congress is a moderate and proper one, and that it will not impose any hardship upon American manufacturers. This we believe to be true, and we do not believe you are correct when you say that this bill proposes to make the Metric System compulsory in America after a certain date. What it does propose is to make the Metric System the only one in use by the several administrative departments of the United States Government after a certain date. This, we believe, will simply have a tendency to facilitate the general introduction of the system, but do not believe that it will compel its introduction.

Truly yours.

FRED. J. MILLER,

Editor, American Machinist.

New York, April 12th, 1904.

YOU HAVE ONLY TO ASK.

A. A. Dion, Ottawa, editor of the "Question Box" department of the Canadian Electrical Association, has issued circular No. 3, the suggestions in which are reproduced below.

Mr. Dion has evidently spent much time on his department, and it is satisfactory to learn that the responses have been fairly plentiful. Answers to questions will in the main be deferred till the next convention, but where answers are urgently required, he will send them personally on receipt of a stamped, self-addressed envelope. The following are the questions asked:

A. The C.E.A. having decided, at the convention of 1903, in Toronto, to recommend to the members the system of accounting previously adopted by the N.E.L. Association, do you recommend printing and distributing the booklet, containing a description of the system, at a cost not to exceed $50?

B. Do you believe the interests of this Association would be better served by the election of a larger Executive Committee, which would make it possible to give a chance to more of those who are desirous of working actively for the society's welfare?

C. Would the appointment of assistant or local secretaries in large centres of population be conducive to the progress of the Association and the interest of the members individually?

D. (a) Would you recommend the appointment of a strong and active committee to collect data of interest to members; such data to be distributed from time to time during recess between conventions? (b) What data should be collected?

E. Should this Association be mainly an electric light association with company membership as the N.E.L. Association?

F. Is there too much time spent at conventions, in attending excursions and entertainments, and should more time be devoted to business?

G. What would you suggest as the best means of bringing into our Association the many operating companies not now represented?

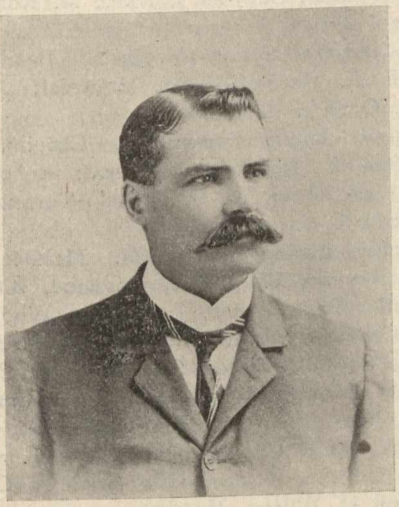
H. Can you suggest any improvement in the manner of conducting meetings, discussions, etc.?

I. Have you any other suggestions to offer?

So far, 76 questions have been submitted for answer at the forthcoming convention.

L'ASSOCIATION PROVINCIALE DES INGENIEURS-MECANICIENS.

The annual meeting of the L'Association Provinciale des Ingénieurs-Mécaniciens (Provincial Association of Stationary Engineers), Court Cartier, was held last month in Montreal, when the following officers were elected: Richard Marchand,



Richard Marchand.

president; Ephrem Brisebois, 1st vice-president; Alcibial Leprohon, 2nd vice-president; Etienne Leroyer, treasurer; Alexandre Bélair, recording secretary; Johnny Joly, financial secretary; Télesphore Leclaire, introducer; Omer Fontaine,

Ephrem F. Valiquet.

door-keeper, Rosario Drouin, Alphonse Collin and Charles Coulombe, auditors; Louis Thibault, caretaker; Richard Marchand, Rosario Drouin and Ephrem F. Valiquet, delegates to executive council; Ephrem F. Valiquet, instructor.

This Association exists for the education and mutual improvement of its members, and is not a trades union. The new president is Inspector of Boilers for the City of Montreal, and is widely and favorably known in that capacity. Mr. Valiquet, who ably fills the post of instructor, now has charge of the machinery in the new grain elevator of the Harbor Commission.

CANADIAN ELECTRICAL ASSOCIATION.

At a meeting of the Executive Committee of the Canadian Electrical Association, held on the 21st April, it was decided to hold the next annual convention in Hamilton on Wednesday, Thursday and Friday, June 15th, 16th, and 17th. Committees were appointed to make the necessary arrangements, and interesting papers will be read.

The Committee on Papers, of which R. G. Black is chairman, have succeeded in securing a very valuable and instructive series of papers by well known authors.

Much interest is being taken by the members in the Question Box, which, under the able direction of A. A. Dion, of Ottawa, promises to become a source of much valuable information to the members.

There is much of interest to electrical men to be seen in and about Hamilton. Many changes and improvements have been made to the Hamilton Electric Light and Cataract Power Company's system since the Association last met there. There is also the new works of the Westinghouse Electric and Manufacturing Company. Probably a day will be spent in visiting the great power development works in process of construction at Niagara Falls.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting of the above society, on the 14th ult., a ballot for new members and transfers of members from one class to another was opened with the following result:

ASSOCIATE MEMBERS.

Charles Burnby Bell, of Montreal; Thomas Edward Lamb, of Montreal; Miles Penner Cotton, of Winnipeg; Lauritz Nicolai Jenssen, of Quebec; John Bell McRae, of Ottawa; Joseph Ovila Montreuil, of Quebec; Edward Godfrey Poole, of Halifax, N.S.; Hendry James Durie Ross, of Ottawa; Karl Weatherbe, of Windsor, N.S.

TRANSFERRED FROM THE CLASS OF ASSOCIATE MEMBER TO THE CLASS OF MEMBER.

John George Gale Kerry, of Montreal.

TRANSFERRED FROM THE CLASS OF STUDENT TO THE CLASS OF ASSOCIATE MEMBER.

Raoul de B. Corriveau, of Ottawa; Casimer Stanislaus Gzowski, Jr., of Toronto; Frederick T. Kaelin, of Montreal; John Herbert Larmonth, of Peterboro, Ont.; Julian C. Smith, of Montreal; John Abbet Walls, of Montreal.

ASSOCIATES.

Noulan J. E. Cauchon, of Montreal; Robert Edmund Pringle, of Montreal; Harry Wilson, of Montreal.

STUDENTS.

Edmund Joseph Bolger, of Kingston; Edgar Thomas J. Brandon, of Niagara Falls, Ont.; John A. Brundige, of Niagara Falls, Ont.; James Henry Burd, of Smith's Falls, Ont.; Frederick Fieldhouse Clarke, of Smith's Falls, Ont.; Henry J. Crudge, of Montreal; Camille Arnauld D'Abbadie, of Winnipeg, Man.; Victor A. G. Dey, of Montreal; Arthur Stewart Eve, of Montreal; Gordon B. Glassco, of Montreal; Lionel Edward Howard Grant, of Toronto; John Buicke Harvey, of Lyndhurst, Ont.; Thomas H. Hogg, of Chippewa, Ont.; William Dawson Lawrence, of Maitland, N.S.; Jason F. Mack, of Moncton, N.B.; Alister Maclean, of Montreal; Allan Getchell McAvity, of Toronto; Fred. Gordon McPherson, of Halifax, N.S.; Michael J. Murphy, of Halifax, N.S.;

Frank Peden, of Montreal; Herbert Lawrence Price, of Montreal; William Redpath, of Montreal; Max Veitch Sauer, of Niagara Falls, Ont.; Alexander Gibson Tapley, of Moncton, N.B.; Stuart Mills Thorne, of Niagara Falls, Ont.; Geo. Boyd Webster, of Montreal; John S. M. Wynn, of Niagara Falls, Ont.

THE ORILLIA DAM FAILS.

A break occurred at the base of the concrete dam of the municipal plant of Orillia, at Ragged Rapids, on the Severn, on April 7th, allowing the water to escape to such an extent as to lower it below the flume inlet, closing the plant and leaving the town without power or light. Some of the factories had steam plants on which they could fall back; others have been forced to put it in. The water supply can be kept up to some extent by one of the old engines. For light, coal oil has to be used. The accident is doubtless due to faulty construction, and the council has resolved, after a thorough examination, to abandon the dam and blast a tunnel through the rock from the head of the rapids to the power house. The tunnel will be 8 by 12, and 1,500 feet long. A shaft will have to be sunk at the head of the rapids, and a bulkhead built at the power-house. The plan is that the water will run through the tunnel, and rise in the bulkhead to the level of the river above. This will give five feet more head than at present, and there will be a proportionate increase in the amount of power available. It is roughly estimated that this plan can be carried out for $21,000. The cost of building a coffer dam, to keep the water away while repairs were made to the concrete dam, was estimated at $26,000. This would be a mere preliminary, and the repairs would have to come afterwards. It is doubtful if a good job could be made. The dam is very faulty in construction, and has been the cause of much litigation between the town and the contractor. Another section threatens to give way.

The town council has also decided to install a complete auxiliary steam plant in the old electric light station, and supply power during the day as well as light at night. The total cost of the auxiliary plant will be about $7,000, against which can be set $2,200 obtained for the old engines. The plant will supply about 3,500 lamps at night and over 300-h.p. during the day. An engine has been secured at Hamilton, with a capacity of 350-h.p. Negotiations are proceeding for a new generator, on the two-phase system, the same as the Ragged Rapids plant. It will cost about $2,500. It is also proposed to put in a new boiler. The auxiliary plant is expected to be in working order within four weeks.

STEAMBOAT ENGINEERS.

The following have been appointed engineers on the boats named for the coming season:

Richelieu and Ontario Line: Kingston, A. R. Milne; Toronto, W. A. Black; Bohemian, G. Gendron; Spartan, R. G. Marshall; Corsican, W. S. Parker; Hamilton, A. Demartigny; Algerian, C. Gendron.

Hamilton Steamboat Co.: Macassa, Oscar Flumerfeldt; assistant, A. Tompkins.

Montreal and Lake Superior Transportation Co.'s Line: J. H. Plummer, R. Chalmers; H. M. Pellatt, J. Byers; A. E. Ames, S. Gillespie.

Algoma Transit Co.: King Edward, S. Beattie; Minnie M., J. Grimes; Polaki, James Greig; Leafield, A. Foote; Theano, J. L. Smith.

Other appointments are: Wexford, D. McLeod; Strathcona, F. Smeaton; W. D. Matthews, E. J. Odell; Newmount, J. W. Aston; Donnacona, C. Dugold; Westmount, H. Young; Turret Crown, W. Robinson.

MCGILL DEGREES AND HONORS.

The degree of M.Sc. has been granted by McGill University to J. Lester W. Gill, B.Sc., professor in the Mining School, Kingston; J. E. Egleson, Charles M. McKergow, and John F. Robertson, lecturers in the mining faculty of McGill.

The following students of the Faculty of Applied Science have been awarded prizes for work done last summer: Prize for summer thesis in civil engineering course, John B. Harvey. Prize for best summer thesis in electrical engineering course, George K. Macdougall. Prize for the best summer thesis in mechanical engineering course, William F. Drysdale. McCarthy prizes for surveying field work: First prize, Thomas M. Fyshe; second prize, Douglas C. Livingston.

The following have passed for the degree of Bachelor of Science. (In order of merit):

Chemistry—Frederick M. G. Johnson, Montreal; Arthur Gordon Spencer, B.A., Truro, N.S.; F. J. Le Maistre, Westmount; William Gilbert MacNaughton, B.A., Huntingdon.

Civil Engineering—Samuel Blumenthal, Montreal; William D. Lawrence, Maitland, N.S.; John B. Harvey, Lyndhurst, Ont.; Aubrey A. Blanchard, Charlottetown, P.E.I.; F. T. Lucas, Hamilton; Stratton H. Osler, Cobourg; H. F. J. Lambart, New Edinburgh; Henry J. A. Haffner, Winnipeg; Gordon T. Jennings, Toronto.

Electrical Engineering—George K. McDougall, Montreal; George Herbert Cole, Ottawa; John H. Cardew, South Beach, Ont.; George W. Scott, B.A., Montreal; Frederick W. McCloskey, Boiestown, N.B.; John A. Wenger, Ayton, Ont.; Alexander S. L. Peaslee, Denance, Ohio; Howard K. Dutcher, Charlottetown, P.E.I.; Louis H. Marotte, Westmount; J. S. H. Wurtele, Actonvale; Harry E. Blatch, St. John's, Nfld.; Herbert F. Rodger, St. John's, Nfld.; M. Roffey, Braintree, Essex, Eng.

Post Graduate Course—Frederick B. Brown, B.Sc., Montreal; F. A. MacKay, B.Sc., Montreal; George Gordon Gale, B.Sc., Quebec.

Mechanical Engineering—C. J. Chaplin, Westmount, Que.; William F. Drysdale, Montreal; Robert A. Kemp, Beamsville, Ont.; John W. G. Grecy, Toronto; F. C. D. Wilks, Brantford.

Mining Engineering—James M. McPhee, Loch Katine, N.S.; Norman W. Parlee, Rossland, B.C.; James H. Grice, Bootle, Eng.; Ernest J. Carlyle, Woodstock, Ont.; Robert A. Chambers Truro, N.S.; Reginald F. Taylor, Gananoque; Charles C. Richards, Charlottetown, P.E.I.; Gordon O. McMurtry, Montreal; Colin St. George Campbell, Aldershott, Ont.; Geo. Boyd Webster, Montreal; Patrick Moy Davis, Windsor, Ont.; Harold J. Doyell, Port Hope; Michael H. Sullivan, Ottawa, Ont.; John A. Cameron, Toronto; William D. Wilson, Hamilton.

Ernest George Gnaedinger, Montreal.

The Grand Trunk Railway may install an electric plant in their new machine shops at Barrie.

LITERARY NOTES.

Statics by Algebraic and Graphic Methods. By Lewis J. Johnson, C.E. 8vo. 133 pages, 42 figures and six double page plates. Price, $2. Published by John Wiley & Sons, New York, and Chapman & Hall, London.

This book is intended chiefly for students of engineering and architecture, and the author, who is assistant professor of civil engineering in Harvard University, aims to give the starting points of the science so as to make clear the deductions. Other purposes are to show the mathematical limitations of pure statics; to develop the analytical and graphic methods of solution side by side. The problems are so graded as to give a progressive illustration of principles, and to show how they are used in engineering practice. The advantages of the graphic method are shown in problems involving complicated geometric relations. Among other sources, Rankin's "Applied Mechanics" and Hoskins' "Graphic Statics" are drawn on to a considerable extent.

Metallurgical Laboratory Notes. By Henry M. Howe, professor of metallurgy in Columbia University. Published by the Boston Testing Laboratories, Boston, Mass.

The author's purpose is to teach, by the analytical method, not individual processes, but the underlying principles applied to each case. This is done by a series of distinct experiments, and the author seeks to concentrate the student's attention upon the leading principle, illustrated in each experiment. "It seems clear," the author contends, "that instruction in general should as far as possible deal with principles rather than with the details of practice," hence his departure from the beaten track by showing a principle in each experiment. There are, in the 128 pages, 91 experiments set forth, with occasional illustrations, and an appendix containing tables of atomic weights, of molecular weights, melting and boiling points, of various metals and compounds.

Entropy; or Thermo-dynamics from an engineer's standpoint. By James Swinburne. Small 8vo., 137 pages Diagrams. Price,, 4s. 6d.. Published by Archibald Constable & Co., Limited, 2 Whitehall Gardens, London, Eng.

The author seeks to correct the inaccurate definitions used in treatises on thermo-dynamics, and gives the student a clearer notion of the physical meaning of entropy. He recalls his own difficulties as a student, and now endeavors to make meanings clearer.

Roads and Pavements. By Ira Osborn Baker, C.E., professor of civil engineering in University of Illinois. 8vo. 655 pages; 171 cuts, and 68 tables. Price, $5. Published by John Wiley & Sons, New York, and Chapman & Hall, London.

This is a comprehensive treatise on road making and street building, and confirms the good opinion expressed by engineers who have used his earlier work on "Masonry Construction," as a guide who aims to provide for every contingency that may arise, and states all the essential facts that require to be known on the subject. While the treatment is concise, the whole scope of the work is confined to roads proper; bridging, tunneling, retaining walls, etc., being left to other works treating on those topics. The headings of some of the chapters convey some idea of the book. After showing the financial value of good roads and street paving, he deals with location, earth roads, gravel roads, macadamized roads, race tracks and miscellaneous roads. In the department of city streets he deals with street design, street drainage, curbs and gutters, pavement foundations; asphalt, brick, cobble stone, stone block, wood block, and other pavements; comparison of cost, etc., and a chapter each goes into sidewalks and bicycle and race tracks. Materials and their cost are, of course, chiefly based on conditions and prices in the United States.

Other publications received are:

"Electric Coal Cutting," a reprint of a paper read before the Institution of Mining Engineers of Great Britain (London and Newcastle-on-Tyne) at the last annual meeting. The writer describes various types of machines, and indicates the class of coal and situation of mines where coal cutting machines may be profitable.

"Subject-Matter Index of Mining, Mechanical and Metallurgical Literature for 1901." Published by the North of England Institute of Mining and Mechanical Engineers (Newcastle-on-Tyne, England); 151 pages in paper covers; price, 42s. The issue for 1902 is in preparation. An earlier publication would add much to the value of the work.

The April number of Mines and Minerals, Scranton, Pa., is a special number on wire ropes used in mining operations. It contains a mass of useful information on the subject, much of which has never been collected in one publication.

Taking the lives of Senator Wark and Prof. Goldwin Smith, as a text, the editor of the Canadian Magazine preaches a timely sermon on the health of the Canadian people. Self-denial, he urges as the first need, and he cites the Japanese as an example of a people noted for their self-restraint. He concludes: "If Canadians are to be physically strong, they must eat less pastry, they must breathe more fresh air, they must encourage still more athletic sports and physical culture, they must realize that the reckless pursuit of "the dollar," is not a reasonable ambition for either an individual or a nation, but that strong bodies and sound "minds are the marks of a vigorous race."

"The Patternmaker" is a new monthly, issued at Cleveland, O., by the Iron and Steel Press Co., at $1 a year. It contains 38 pages of reading matter, size of page, 7 by 10 in., is well printed, and contains many valuable hints for the pattern shop man. A sample copy will, no doubt, be sent on application.

THE GREAT WEST.

H. J. Fuller, general manager of the Fairbanks Co., for Canada, has returned from a trip to the Pacific Coast. In conversation with a representative of the Canadian Engineer, Mr. Fuller says of affairs in the West: I believe that British Columbia is going ahead as rapidly, if not more so, than any province in the Dominion to-day. The lumber mills are complaining of low prices which they are receiving, at the same time new mills are constantly going up, and the C.P.R. has reduced the freight rates on lumber in British Columbia to Winnipeg and Manitoba points, which should help largely to increase the output.

As regards the fisheries, they are not expecting a large run of salmon this year; the year after next the salmon are expected to run in large quantities. The north trade is largely in the hands of commercial companies, who have business in the United States and very little trade, proportionately, is going to Canada, although they purchase in Montreal certain goods. At the same time the expense of travelling in that district prevents manufacturers from doing missionary work and introducing their specialties in that country, as they would elsewhere.

There are a large number of coal mines constantly being opened upon the Crow's Nest Pass line, and anthracite mines on the main line of the Canadian Pacific, near Banff. The latter-named road controls large mines, and is, at present, putting in an extensive plant for operating it.

The severe winter has affected the cattle trade very much; it is impossible, however, to get an accurate estimate as to how many cattle were lost, but dead cattle could be seen all along the way through the ranching country.

The expectation is that an equally large number of settlers will go into Manitoba and the North-West Territories the coming season as went in last year. The fact remains, however, that the crop last year was very small and disappointing, and a great many chattel mortgages were placed on property of merchants in the smaller towns, and jobbers are carrying a large amount of paper which is, of course, an unhealthy condition and one sure to exist in any country depending upon one crop. Every effort is being made to get the farmers to diversify their crops and ensure more steady returns.

INDUSTRIAL NOTES.

The Newington, Ont., peat works are to be enlarged and more machinery added.

Collingwood still hopes to get the tin plate industry of which Mr. Lewis is the promoter.

The capital of the Montreal Pipe Foundry Co. has been increased from $150,000 to $250,000.

Frothingham & Workman, wholesale hardware dealers, of Montreal, have been incorporated as a joint stock company.

The Leroy Automobile Co. talk of leaving Berlin. They want more room and the town council declines to grant exemption.

F. A. Wegner, president of the Frontenac Cereal Company, of Kingston, is asking what encouragement Medicine Hat will give for similar works there.

Chris. Kloepfer, of Guelph, has had plans drawn, at Galt, for a large wood-working plant, to cost $12,000. The factory will produce woodwork for buggies, wagons and cutters.

The Frost Fence Co. is about to move from Welland to Hamilton, where a two-story brick factory, about 150 by 50 feet will be erected at once. The company employs about forty hands.

The alabastine works, at Paris, Ont., have been burned.

A by-law is to be submitted at Sherbrooke, Que., to give a bonus of $10,000 to a smelter.

The contracts have been let for a large tannery at Ottawa, to cost $75,000.

The Northern Elevator Co. will erect a flour mill at Winnipeg, with a capacity of 2,500 barrels.

J. Butchart, of Owen Sound, according to the Victoria Times, is about to start cement works at Tod Creek, B.C. He will commence with about 200 barrels a day, but hopes soon to manufacture daily 800 or 1,000 barrels.

The rod mill of the Dominion Iron and Steel Co., at Sydney, C.B., is about completed. The Morgan Construction Co., which built it, is about to erect similar works in several places in Germany and France.

A new carriage factory, at Stratford, Ont., will make a vehicle with a patent attachment by which, when turning, back and front wheels turn simultaneously, so that but a small space is needed, and there is no danger of an upset.

The town of Niagara-on-the-Lake has voted a bonus of $15,000 and exemption for twenty years to the Niagara, Queenston and St. Catharines Railway to build an electric railway from St. Catharines to Niagara-on-the-Lake, thence along the bank of the Niagara river to Queenston.

The Toronto branch of the Fairbanks Co., described in our March issue, was destroyed in the great fire, but this will not interfere with their business, as they have secured temporary quarters at 124 Bay St. As a complete line of goods is kept in stock by the Montreal headquarters, they can promise to fill all orders as usual. They will, just as soon as possible, rebuild.

The Dodge Manufacturing Co., of Toronto, Limited, who in January last opened a branch office and wareroom at 419 St. James St., Montreal, report very gratifying results from that quarter. The Montreal office is in charge of Frank F. Young, formerly of the sales department, Toronto. Mr. Young says most of the mills prefer taking their requirements from the maker when it is made convenient to do so, and as Montreal is the distributing centre for the eastern part of the province, he finds a ready welcome for Dodge products.

The Grand Trunk elevator, at Midland, was recently struck by lightning, resulting in its total destruction by fire. It was built in 1882, and enlarged ten years ago, having a capacity of 500,000 bushels. It was rented by E. R. Bacon, of Chicago, and a large business was anticipated the coming season. Four large grain steamers, frozen in near the elevator, had a narrow escape. When the lightning struck the elevator it shattered it from top to bottom, lifting whole sections of the roof and throwing down some of the large timbers.

The Locomotive and Machine Co.'s works, at Longue Pointe, near Montreal, recently taken over by the American Locomotive Co., has received orders for 13 new engines from the Grand Trunk, Canadian Pacific, Toronto and Buffalo, and Cape Breton railways. They have on hand nearly 3,000 tons of iron purchased in Germany and more is on its way to this country. They intend to procure all their iron from Germany or England, as it can be purchased there at better prices than at Pittsburg. All the other supplies will be bought in Canada.

A company, known as the Cape Breton Iron and Steel Co., has been formed to establish new iron works at Sydney. Two steel buildings will be erected having expanded metal sides, roofing fireproof, each 100 feet wide by 150 feet long, one of the buildings to be used as a steel and iron foundry, the other for a machine and forge shop. Another building 40 feet wide by 50 feet long will be used as a clipping room for castings, etc.; pattern and carpenter shop 35 feet wide by 60 feet long; power station, containing boiler, engine, electric generator, air compressor, etc.; office building; storage building; gas producer, etc. It is the intention to erect the plant in sections putting each into active operation and on a dividend-paying basis as soon as it is completed. It is estimated that about $100,000 will be expended on construction work this year.

Baird Bros. will rebuild their furniture factory at Plattsville, Ont.

As will be seen in a card elsewhere, a member of the Institute of Mechanical Engineers of Great Britain, having had practice in India and in British Columbia, is open for an engagement as consulting engineer or to take charge of works.

In consequence partly of labor difficulties, common to the bookbinding and printing trades in Toronto, the Barber & Ellis Co., manufacturing stationers, who were burned out in the Toronto fire, will rebuild in Brantford, Ont.

The Mansfield Glass Works, of New York, with a capital of $200,000, and employing about 150 men, have decided to establish a Canadian branch in Hamilton, and the Petrie Machine Co., manufacturers of cream separators, recently burnt out at Guelph, have also decided to rebuild at Hamilton.

H. and W. H. Bunker, of Lisle, Ont., are said to be the inventors of a unique machine for converting straw into wood or fuel. The machine rolls the straw so tightly that it is as tough as a stick of timber. The product, used as fuel, is much cheaper than either coal or wood, and gives an intense heat. A number of machines are to be built.

The Goldie & McCulloch Company, Limited, Galt, have decided to erect large new boiler shops on the property they bought a year or so ago at Hunter's Corners, on Preston road, between the lines of the Grand Trunk and the Galt, Preston and Hespeler Street Railway. Contracts have been awarded. The shops will be over 300 ft. long, will be built largely of steel, and will be equipped with the most modern machinery in the world for boiler manufacture. The company's capacity in this branch will be greatly increased. The change has been made necessary for two reasons, first, their growing trade, and second, the necessity of having railway switches to expedite shipping.—Galt Reporter.

The Keewatin Flour Mills Co. has been incorporated, with a capital of $2,000,000, to build a large flour mill at Keewatin, on the main line of the C.P.R., 129 miles east of Winnipeg, where the Winnipeg river water power is available to the extent of about 5,000-h.p. The mill will have a capacity of 3,000 barrels a day, and will be so designed as to be capable of enlargement when required. The provisional directors are: John Mather, Ottawa; Angus W. Fraser, K.C., Ottawa; Robert M. Cox, Ottawa and London, Eng.; Edwin C. Whitney, Whitney; David L. Mather, Rat Portage; Hon. James D. McGregor, New Glasgow, N.S.; R. L. Borden, K.C., Halifax; George Burn, Ottawa; Hon. E. H. Bronson, Ottawa, and John Coates, London, Eng., and Melbourne, Australia.

A new company has been formed to consolidate several of the oil companies doing business in Canada. It is called the Canadian Oil Co., Limited, with head office in Toronto and capital $1,500,000. The companies absorbed by the new company are: The Union Petroleum Co., Limited, the Grant-Hamilton Oil Co., of Toronto; the Sun Oil Co., Limited, Hamilton, Ont.; the McCord Oil Co., Petrolia; Canadian Oil Refining Co., Petrolia; Sterling Oil Works, Marietta, Ohio; Walker Oil Co., Winnipeg; Gall-Schneider Oil Co., Montreal; Canadian Oil Refining Co., Petrolia. The officers and directors are: William Irwin, Peterboro, president; James Playfair, Midland; E. R. Clarkson, Hamilton; John J. Main and D. B. Hanna, of Toronto, vice-presidents; W. W. Cummings, treasurer; W. J. Shephard, Waubaushene; W. J. Lovering, Toronto; R. R. Hall, Peterboro; W. D. Lummis, Toronto; Joseph Wright, Toronto; John J. Kerr, Petrolia; Thos. Ramsay, Hamilton; Leopold Bauer, Hamilton; W. P. Bull, Toronto, directors. Thos. H. Hamilton is general manager of the new company, which will have a meeting the first or second week in May by which time the organization will have been completed.

* * *

S. H. Colburn, general manager of the Colburn Machine Tool Co., Franklin, Pa., returned from the Continent last month. During his trip he successfully secured representation for his firm's products in Great Britain and the Continent.

LIGHT, HEAT, POWER, ETC.

The Water Commissioners of Windsor, Ont., will ask for tenders for an electric plant at the pumping station.

Chesterville is to be lighted with acetylene gas. The Continental Light and Heat Co. has been given a ten years' franchise.

The Consumers' Electric Co., Ottawa, will spend $30,000 on conduits for their wires between their generating plant and their former station.

The Shawinigan Water and Power Company will construct a second transmission line from Shawinigan Falls to Montreal, to transmit 10,000-h.p.

The Barrie Gas Co. has reduced the price of gas, with a special reduction to those who consume at least 3,000 ft. per quarter and use gas for fuel the entire year.

The Mayor of Kingston favors getting power from the Mississippi. The city would erect its own transmission line, and could supply power at from $10 to $12 per horse-power per annum.

The Privy Council has given judgment in favor of Kingston in its suit with the Light, Heat and Power Co. The effect is that the city is not required to pay the company anything for its franchise.

The windmill lighthouse at Prescott will hereafter be lighted with acetylene gas, as will nearly all the Canadian lighthouses along the St. Lawrence. By the use of acetylene great economy will be effected.

The St. Thomas Gas and Electric Light Company, St. Thomas, Ont., propose to increase their capital for the purpose of extending their plant. The city council, however, is taking steps with a view of buying them out.

The Chambly dam of the Montreal Heat, Light and Power Co., which was swept away last year, has had a pretty severe test this season. Five out of seven spans of an iron bridge were carried away and lodged against the dam.

The Department of Railways and Canals have let the contract for the electric lighting of the Welland Canal from Port Colborne to Port Dalhousie, to the Canadian Westinghouse Co., Hamilton. Between 600 and 700 lights will be required. The power will be obtained from De Cew falls.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery.

G. A. Powell, sales manager of the Packard Electric Co., Limited, of St. Catharines, leaves in a few days for Winnipeg to open a branch office of his company there. Mr. Powell will remain in charge of the Winnipeg office until the organization is perfected. With a branch office in the east at Montreal, and in the middle west at Winnipeg, the company is in a good position to care for the demands of their rapidly increasing business.

The Volta Electric Repair Works has been established at 86 Adelaide street West, Toronto, under the proprietorship and management of D. McGregor Johnston. The Volta works will be devoted exclusively to the repairing of electrical apparatus of all kinds. Mr. Johnston understands thoroughly the construction of electrical machinery both for direct and alternating current systems. He has had over twelve years' experience, and, being a graduate of the School of Practical Science, of Toronto, has technical knowledge as well as shop practice.

The engineers of the Mexican Light and Power Co., a Canadian company that is installing the great water power and electric transmission plant in the State of Pueblo, ninety miles from Mexico, found that the town of Necaxa, with a population of about 1,000, occupied a site particularly suitable for the necessary reservoir, and the company forthwith purchased the entire town and moved it to a new location. All the buildings, including the Catholic Cathedral, were razed and reconstructed on the new site. The new town bears the name of Canadita. The initial capacity of the company's plant will be 45,000-h.p., and this will be increased to 80,000.

The Perth town council has taken over the arc light plant of the Perth Electric Light Co., and is now running it as a municipal concern.

The Crocker-Wheeler Company, of Ampere, N.J., manufacturers of electrical machinery, has increased its capital from $1,000,000 to $2,000,000.

Stave River Falls, about 35 miles from Vancouver, where there is a 20,000-h.p., is being developed. C. A. Stoess, the Stave Lake Power Co.'s engineer, has a number of men at work cutting a canal.

The Canadian General Electric Co. is moving from its Montreal shops to Peterboro the machine tools and equipment required for direct current machinery. This will involve the transfer of about 100 hands to Peterboro, but about 200 will be retained at the Montreal works, where manufacturing and repair work will still be carried on.

The Montreal Light, Heat and Power Co. has given notice to electrical contractors in Montreal that they will in future refuse to make connections with 50 and 104 volt systems. All connections must now be made at 110 volts. Connections will be made only at the front of buildings to avoid actions for damages from carrying wires over roofs.

Mr. Jenison has, by an act passed at the late session of the Ontario Legislature, secured the control of the Kaministiquia water power near Fort William. It was formerly under his control but he failed to utilize it, and it passed to F. H. Clergue. Jenison wished to get it again, and there was a big fight between the two men during the late session. Finally, it was given to Jenison, who is bound under the terms of his agreement to develop it without delay, and under stringent conditions.

RAILWAY NOTES.

There are in Italy 1,600 miles of railway run by electric power.

The Central Vermont Railway bridge over the Richelieu was swept away by the spring freshets.

The American Car and Foundry Company, New York, is filling a contract for eighty-six ballast cars for the city of Winnipeg.

On United States railways, during the three months ending 31st December last, 1,166 people were killed and 13,319 injured.

The Guelph Herald says the construction of the railway from that city to Goderich is to be proceeded with at once. Wm. Davis, C.E., has completed the preliminary survey.

Application is being made for a charter for the Nipissing, Ottawa and Montreal Railway, to run from Lake Nipissing to Montreal and from the former along French river to the Georgian Bay.

The Stratford Radial Railway Co., which already has a charter to connect Stratford with Mitchell and St. Mary's and Mitchell, will extend its electric road to Goderich. Work is expected to commence in May or June.

A blinding snowstorm was the cause of a head-on collision on the Grand Trunk Railway, near Simcoe, on the 15th of April, when considerable damage to rolling stock was done. A storm of such proportions in April is a rare occurrence.

Napanee will submit a by-law for a bonus of $20,000 for the proposed electric railway from Toronto to Cornwall. Trenton has agreed to take $10,000 worth of bonds. Belleville will be asked to take $50,000. The road will cost about $4,760,000.

The Berlin, Waterloo, Wellesley and Lake Huron Railway Co. asks for an amendment to its charter so that it may build from Wellesley to Stratford, St. Mary's, Clinton and Bayfield. The company also seeks power to enter into an agreement with the Galt, Preston and Hespeler Railway Co., the Preston and Berlin Railway Co., or any other railway company.

Angus Sinclair, superintendent for Mackenzie & Mann in the construction of the Halifax and Southwestern Railway, promises to have a train into Halifax by June 1st.

An engineer has been instructed, on behalf of the various railways, to make a report upon an international bridge between Windsor and Detroit. The main points to be considered are the advantages and drawbacks, respectively, of a high bridge and a drawbridge.

M. P. Davis, contractor for the Quebec bridge, hopes the present season to grade the line connecting the southern end with Chaudiere Junction. Next season the erection will begin of the steel superstructure. This will take two years, and the contractor thinks that by 1907 the work will be complete.

President Ledyard, of the Michigan Central Railway, and President Newman, of the New York Central, have just made the trip from New York to Chicago on a special train of one baggage and three passenger cars. Over the M.C.R., in Canada, they made the world's record time for part of the distance—over 75 miles an hour.

Joseph E. Duval, recently appointed to the new position of inspector of railway accidents, will act under the recently organized railway commission. He comes of a family of railway men, his father having seen nearly forty years' service with the G.T.R., and he has three brothers in railway positions. He himself began when 14 as a G.T.R. telegrapher and for 18 years was chief despatcher for the Canada Atlantic, being promoted three years ago to car service agent. His first investigation in his new office was into the collision at Guelph.

MARINE NEWS.

A new ice-crushing ferry steamer, to run between Windsor and Detroit, is being built at a cost of $300,000.

The Dominion Marine Association recommends an enlargement of the Welland Canal to accommodate vessels of 6,000 tons.

The steamer A. B. Wolvin, the largest ever built on the Great Lakes, and the largest on any water for freight carriage, has been launched at Lorain, Ohio. She cost $500,000.

The St. Catharines Board of Trade advocates the construction of four miles of canal, from Lock 2 on the old canal to Marlatt's Pond, to relieve congestion on the Welland Canal.

The Canada Atlantic Transit Co. has withdrawn its line of steamers between Parry Sound and Duluth. It will continue to operate the line between the former port and Milwaukee and Chicago.

Steps are being taken at Victoria, B.C., to provide a steam life boat. A life-saving association has been formed, and equipment will be provided, the cost being defrayed by a special collection of funds, preferably on Victoria Day.

Bowring Bros., of St. John's, Newfoundland, will build two steamers for coast service, 200 ft. long, 31 ft. deep to main deck, with a speed of 12 knots, and specially designed for winter navigation. Meantime they will charter vessels.

The average length of ocean ships has increased some 50 to 60 per cent. within the last 25 years. The beam has increased still more rapidly. The draft has not increased in the same ratio, the depth of water in many harbors not permitting it.

A. B. Polson and J. B. Miller, of the Polson Iron Works, Toronto, have been in Great Britain and on the Continent looking over the shipyards for ideas in connection with marine architecture. Mr. Polson expresses the hope that Canada will in future build her own turbines.

Nap. Payette, of Penetang, has launched a big scow which he built for Clark & Pratt, of Parry Sound, to carry bark from Parry Sound to Penetang. It is 85 ft. long, 24 ft. wide, and has a hold depth of 6 ft. The deck and bottom are of 8-inch stuff bolted with inch iron bolts at intervals of 2 ft. It is said to be one of the best on the Georgian Bay.

The Reid Wrecking Company, of Sarnia, has been awarded the contract for the removal of the wreck of a burned steamer in the St. Clair river at Russell Island.

The Anticosti, the second of the light-ships ordered from the Polson Co. by the Dominion Government, was launched April 9th. She is in all respects like the Lurcher, launched last fall, and sent to Nova Scotia. The Anticosti will be stationed off the island after which she is named.

The hull of a new stern wheel steamer for the Hudson's Bay Co. will be built at Fort Vermillion, on Peace River, and it is probable that others will be built there subsequently. A. Watson, of Victoria, B.C., who will have charge of construction, has already superintended the construction of a number of similar steamers for the company on the Pacific coast.

The Scottish Hero, the first vessel to arrive at Sydney this season, and one of those chartered by the Dominion Iron and Steel Co., brought 370 tons of rails, manufactured in England from steel made at Sydney. They are to be sent to different parts of Canada to be tested. The Scottish Hero also brought 800 tons of firebrick and 9,980 barrels of cement, though cement is made largely in Canada.

A curious accident is reported from Winnipeg. The Gertie H., a small steamer, came in contact with the C.N.R. Railway bridge and lodged there. A stove was upset which set the steamer and bridge on fire. The burning vessel drifted off and next struck the Louise traffic bridge, setting it on fire. Finally it drifted ashore, and was burned to the water's edge. Both bridges were considerably damaged. The crew escaped by climbing on the bridge.

Two iron steamers are being built at the Bertram works, in Toronto, a grain carrier for builders' account, and a ferry boat for St. John, N.B. The former is 256 feet long, 42 feet beam, and 18 feet deep. She will be fitted with triple expansion engines, 15, 25, and 42 in. by 30 in., and two return tubular Scotch boilers, 10 ft. by 11 ft. The hull only of the ferry boat is being built in Toronto. She will be fitted up at St. John.

Plans for the big marine railway and dry dock of the Victoria Machinery Depot Co. have been completed by the H. I. Crandall Co., of Boston. This dock will be 65 feet wide and over 270 feet long, and have a carrying capacity of nearly 3,000 tons. The plans show very heavy class of construction, both in wood and steel. The steel has already been ordered from the mills, and the inspection of it placed with the De Lano-Osborn Engineering Co., of Toronto. It is intended to have the dock fully completed and ready for service by the middle of the shipping season, and it will add materially to the facilities of the port for handling large vessels.

MINING MATTERS.

The British Columbia lead producers are advocating a change in the lead bounties granted last session.

J. J. Rutledge estimates the output of gold from the Canadian Klondyke, since its discovery, as $125,000,000.

Geo. Weese, of Bancroft, Ont., has sold a corundum property in that locality to United States capitalists for $11,000.

It is reported that oil has been struck in paying quantities at Swift Current, about 40 miles south of Cardston, N.W.T.

A carload of cobalt from the recently discovered deposits on the Temiskaming Railway has been sent to St. Louis to the World's Exposition.

The Dominion Iron and Steel Co. will operate largely on the Bell Island iron deposits, Newfoundland, this season. A number of men have already gone, and the working force will be increased to about 2,000.

The A. Leschen & Sons Rope Co., of St. Louis, are sending to their friends and others interested, a useful souvenir in the shape of a celluloid wire rope gauge, which will gauge the standard sizes of wire ropes from ¼-in. up to 1¼-in.

The councils of St. Catharines and Merritton have petitioned Parliament for the imposition of an export duty of twelve cents a thousand feet on natural gas. The Provincial Natural Gas Company, with headquarters in Buffalo, is piping all its supply from the Niagara peninsula, while local residents cannot get any.

A rich strike in high-grade copper ore is reported from Oyster Harbor, just north of Ladysmith, B.C., close to the Tyee Copper Company's smelter. The discoverer is Robert Herd, a prospector. Samples treated at Victoria give $80 a ton in copper, $3 in gold, and $1.50 in silver. James Dunsmuir and Clermont Livingston, general manager of the Tyee Copper Company, have been negotiating with a view to purchase.

The British-American Company, of Victoria, which had a gigantic dredge built last year for recovering gold on Pine Creek, have let a contract in San Francisco for a larger one. The present dredge is capable of handling 3,000 yards of grale a day. The new one will have 5,000 yards' capacity, and will work on the Spruce Creek electric plant from the falls on Pine Creek, which will give power to both. Philadelphia capital is interested.

At a recent meeting of the executive council of the Canadian Mining Institute, the president, Eugene Coste, was requested to act as secretary of the Institute, in succession to the late B. T. A. Bell, till the next annual meeting. Mr. Coste's address is 18 Toronto St., Toronto. We understand that J. E. Hardman, mining engineer of Montreal, will for the present conduct Mr. Bell's paper, the Canadian Mining Review, the publication office of which will be moved to Montreal.

PERSONAL.

James M. Sinclair, manager of the Eureka Mineral Wool and Asbestos Co., Toronto, returned a few days ago from a trip to New York, Philadelphia, and other cities, in the interests of his firm.

John L. Weeks, treasurer and general manager of the American Steam Gauge and Mfg. Co., Boston, died on the 2nd ult. He had been connected with the company for over thirteen years, and the loss of his faithful services is keenly felt, not only by the board of directors and stockholders, but by a large circle of business acquaintances.

The following graduates of the School of Practical Science, at Toronto, have secured contracts for surveys in the North-West this coming summer, and will take out in their parties a number of students of the school: Messrs. C. Harvey, H. H. Moore, H. J. Bowman, C. C. Fairchild, H. S. Holcroft, R. H. Knight, J. W. Tyrrell, M. B. Weeks.

A. F. Brown has been appointed manager of the Machine Tool Department of the Fairbanks Co.'s Toronto branch. Mr. Brown was formerly connected with the Packard Machinery Co., Chicago, and has a record as a successful machinery salesman, and will, no doubt, owing to his practical knowledge, make his firm first in the territory over which he has been placed.

George Dawson, senior partner of Dawson & Riley, the contractors for sinking the large wheel pit for the Canadian Niagara Power Company, died suddenly in his office at the works, Niagara Falls, on the 21st April. Heart failure is supposed to have been the cause of death. Mr. Dawson was 76 years of age, and was widely known in both Canada and the United States, having constructed many large works throughout the country.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have recently engaged C. C. Starr, who was formerly connected with the firm of John Starr, Son & Company, to act as their representative in the Maritime Provinces, with headquarters at 134 Granville street, Halifax, Nova Scotia. The Maritime Provinces are included in the district of the Canadian Westinghouse Company's Montreal office, and Mr. Starr will be consequently an attache of that office.

R. C. Trott, late engineer at the Reformatory, at Penetanguishene, Ont., died last month at Brentwood, aged 66. In a private note to the Canadian Engineer last year, Mr. Trott expressed his belief that his time here would be short, and took occasion to put on record in this journal some interesting facts concerning the fitting out and repairs of the Great Eastern, on which he worked.

The following have obtained the degree of Bachelor of Science at Queen's University: Thomas Brown, Hawkesbury (in mining); T. Wm. Cavers, Carleton Place (in mining); E. T. Corkill, Sydenham (in mining); E. M. Dennis, Woodstock (in mining); M. V. Ferguson, Kingston (civil engineering); J. V. Gleeson, Kingston (chemistry and mineralogy); E. V. Malone, Toronto (in mining); R. B. McKay, Cornwall (in mining); K. R. McLennan, Lindsay (civil engineering); F. R. Reid, Kingston (chemistry and mineralogy); R. L. Squire, Kingston (civil engineering); H. Walker, B.A., Morewood (civil engineering); A. R. Webster, Gananoque (electrical); J. K. Workman, Kingston (mineralogy and geology).

TELEPHONE AND TELEGRAPH.

The Dominion Government has just completed a telephone line to Ganges' Harbor, Salt Spring Island, B.C.

The Bell Telephone Company will not accept the offer of the Ottawa city council of five years' exclusive franchise, provided the company put in house 'phones at $23, instead of $25, and charge only $5 additional for a desk extension where a wall 'phone is installed.

The Huntsville Lumber Company is having installed a telephone service at Moose Lake, two miles in length, connecting the driving camps with the stations along a tributary of the Big East, down which logs are driven. Notice can thus be sent back in case of a jam of logs instead of a messenger, as heretofore, saving much time.

The International Telephone Company will connect Victoria and other places on Vancouver Island with points on the mainland as far south as Portland, Oregon. The company will lay a four-ply cable by way of San Juan, Orca and Lummi island to Whatcom. It is understood that a rate of 50 cents will be charged for a one-minute conversation with Vancouver and 60 cents with Seattle.

A section of country ten miles north of Guelph is largely provided with rural phones. Especially are they used in connecting the farm dwelling with the barn and remote sections of the farm. The phones cost but $2.50 each, and the wire and other connections in the same proportion. It is possible for a farmer with an outlay of ten dollars to have three phones on his place connecting his various buildings. The cost of maintenance is said to be but one dollar a year for the entire system. In many instances farmers are having the individual phones installed, and later connected in the form of a neighborhood system.

MUNICIPAL WORKS, ETC.

Carleton Place town council is asking for $10,000 for perment sidewalks.

The floating bridge, at Pigeon Creek, near Peterboro, has been damaged by ice. The bridge is 4,400 feet long.

The by-law to raise $10,000 for electric light and waterworks improvements, at Mitchell, Ont., has been carried.

A rubber pavement, laid under the archway of Buckingham Palace and on several other private roads in London, is such a success that it is proposed that London should be made a city of silence by paving the roads with India rubber, The only difficulty is the cost, as the rubber paving costs $15 a square yard.

The dam on the Rideau, at Poonomale, above Smith's Falls, was carried away and let the Rideau Lakes' water out, doing much damage. It will be some time before repairs can be made by the Government. Temporary repairs to retain the water were, however, made within eight days. Making the repairs was a work requiring brains and skill. Just after the accident, nothing could be done owing to the large blocks of ice which were coming down. But as soon as the ice cleared, work was started. Large elm trees, which grew on the banks, were felled and converted into open cribs. By means of ropes these cribs were steered into place just above the break in the dam, and then held by tying the ropes to trees. Then stone was brought down on rafts and the cribs filled to the height of a couple of feet above the woodwork, thus holding the cribs in place without the ropes. The cribs were put into place in sections and when all were in formed a coffer dam just above the break, conserving the water as well as the old dam. This coffer dam keeps the water off the broken part sufficiently to allow the old dam to be rebuilt.

INTERNALLY FIRED VS. EXTERNALLY FIRED BOILERS.

The following is a contribution by D. W. Robb, of the Robb Engineering Co., Amherst, in the Engineering Magazine:—

It is generally admitted that theoretically the internally fired boiler should have a lower efficiency than any form which gives better space for combustion, and less close proximity of the fire to the cooling surfaces. It is not often that the two types of setting have been accurately and impartially compared, and hence data and results of trials, made by independent authorities upon boilers of nearly the same capacity, with practically the same coal, and under closely similar conditions, demand unbiased presentation. It must be clearly understood that the following article is not a comparison between two different makes of boilers, but between two different types of furnaces, types which are open to the entire engineering profession for use, both on land and at sea, the whole forming a valuable contribution to practical steam engineering.—The Editors.

Probably most engineers who are interested in steam-boiler construction and economy, have the opinion that a highly heated brick furnace is more favorable to the complete combustion of the volatile hydrocarbons contained in bituminous coal than the cool surface of an internal furnace surrounded by water; but I think it is at least open to discussion whether the more direct utilization of the heat in an internal furnace, by which radiation and air leakage are avoided, does not more than offset the other advantages of the brick furnace. With either arrangement of furnace, it is necessary to admit the proper proportion of air, and the air must be heated to a high temperature, say 1,400 degrees F., in order to produce combustion of the volatile gases. This air is more easily and more naturally heated by passing through the bed of fuel on the grate than in any other way. If cold air is admitted above the fire, combustion will be checked, even with a brick arch; or if a large amount of coal is thrown upon the fire at once, the air supply will be checked and cooled so that the volatile gases, which are being rapidly set free, will, to a large extent, pass off unconsumed for want of sufficient heated air. Therefore, the question of obtaining perfect combustion with either kind of furnace is largely dependent upon the skill and care of the firemen in having the fire of such thickness that the air supply will be properly regulated and in carefully spreading the fuel in small quantities over the fire.

This result may be obtained mechancially either by the system of underfeed stoking, or by down draft on the Hawley plan, by which the volatile gases are forced to pass through the bed of incandescent fuel, thus receiving the heat and air necessary for complete combustion. Either of these systems of stoking may be carried out in a steel furnace surrounded by water as well as in a brick furnace. It is necessary, however, to have the internal furnace large enough to permit complete mingling of the burning gases before them come in actual contact with the cooling surfaces, and in this respect furnaces of small diameter, such as are used in the Scotch or Lancashire types of boilers, are at fault.

In order to make a comparison of the actual economy of the two methods of burning soft coal for steam generation, a table is given, comprising four trials of steam boilers —two of a water-tube boiler, set in brick, fitted with Dutch oven in front, and two of a boiler of the internal furnace type. These trials were made at technical schools under the direction of careful and experienced men, and the results very fully and exactly recorded; they correspond closely in conditions, the boilers have about the same amount of heating and grate surface, the coal for three of the trials being from the same mine, and for the other trial of nearly the same calorific value.

The trials of the water-tube boiler with Dutch oven (A and C) are taken from a paper by Professor E. A. Hitchcock, of the Ohio State University, presented at the Saratoga meeting, June, 1903, of the American Society of Mechanical Engineers.

The trials of the internally fired boiler at McGill University (B and D) are taken from a report by Professor John T. Nicolson, D.Sc., formerly of McGill University, now director of mechanical engineering at the Municipal Technical School, Manchester, England, and Professor R. J. Durley, B.Sc., of McGill University.

Description of Boilers.—The equipment at the Ohio State University, especially constructed for the purpose of boiler and fuel testing, (referred to in trials A and C of the table annexed) consists of a water-tube boiler, a Green's fuel economizer, an air heater, induced and forced-draft fans. The boiler (of the Babcock & Wilcox type) has 56 4-inch by 16-foot tubes, and a 42-inch diameter drum, giving a heating surface of 1,070 square feet. The furnace is of the Dutch-oven or fire-brick-arch type with stationary grates, having an area of 25 square feet. The furnace projects in front, so that the front of the bridge wall is on a line with the front of the boiler, the arch extending 1 foot 6 inches beyond the end of the grate bars. The boiler is arranged so that it may be operated with or without the fuel economizer or the air heater, and with natural draft, induced draft, or forced draft.

The McGill University boiler, (referred to in trials B and D of the table annexed), is of the Robb-Mumford internally fired type, consisting of upper and lower water and steam drums connected by circulating necks. In the lower drum, the axis of which is inclined upwards about 1½ inches per foot of length, is a cylindrical firebox, from which the tubes lead to the rear head of the boiler. On leaving the tubes, the hot gases are passed over the external surfaces of the boiler between the lower and upper drums and inside a steel casing covered with brick. The inclination of the lower shell and a baffle plate around the upper half of the furnace assist in the natural circulation which appears to be unusually brisk. The grate is fitted with rocking bars. The principal dimensions of the boiler are as follows: Lower drum, 68 inches diameter by 15 feet 6 inches long; upper steam drum, 38 inches diameter by 17 feet 9 inches long; furnace, 49 inches diameter by 8 feet 3 inches long; tubes, 2¾ inches internal diameter, by 7 feet 1 inch long, 148 in number; total heating surface (not including the lower surface of the lower shell, which although enclosed is not effective), 1,074 square feet; grate surface, 24½ square feet. The boiler is in regular use in the MacDonald Engineering building at McGill University, and is part of the installation which supplies steam for light, power, and heating purposes. It can be worked either under natural draft or with forced draft on the closed-ash-pit system.

Apparatus Employed.—For both sets of trials at the Ohio and McGill Universities, draft gauges were used to measure the draft and thermometers and pyrometers to take the temperature of the air on entering the ash-pits and the gases leaving the boilers, also for the feed water.

Pressure gauges were used to get the steam pressure, and for the Ohio trials a barrus calorimeter was used to determine the quality of steam. For the McGill trials the steam was taken as dry. For all trials weighing tanks were used for weighing the water, the weighing tanks opening into a collecting tank below from which the water was pumped to the boilers. All steam and hot-water piping was covered with non-conducting material; all fittings were made tight or blanked off to avoid leakage. The fuel was weighed, the time and weight of each barrow load being noted. Samples were taken with each barrow load for the determination of moisture and for calorimetric tests by a Mahler

Calorimeter, for the Ohio trials, and by a Donkin calorimeter for the McGill trials.

Methods Employed in Carrying on the Trials.—For the Ohio University trials (A and C) with brick furnace and setting, the boiler was fired continuously from thirty-six to forty-eight hours before the trial, in order that the brick work should be thoroughly heated. About two hours previous to the commencing of the test proper, the fire was drawn, the damper being closed, grate bars and ash-pit cleaned, and a new fire immediately kindled with the coal to be used. This new fire was converted as quickly as possible to the condition to be maintained throughout the trial, the draft being regulated to give the desired fuel consumption and depth of fire fixed to secure the best consumption with the least amount of air excess. The tubes were blown free of soot after starting the fire. About ten minutes before starting the test proper, the exact time being noted, the last fresh coal was thrown on, and five minutes later, the fire was levelled with a rake and the thickness determined by resting a bar on the bed of fire and levelling it by sighting on the level gauge and then noting the thickness by graduations on the fire door, which was open just enough to allow the rod to pass into the furnace. At the time for starting, the height of water in the boiler drum was noted on a scale reading in one-tenth inches, fastened to the gauge glass, and a string was also put on the glass at the same point, as a guide for the person controlling the feed water to the boilers. All readings were taken at regular intervals of one-half hour, commencing fifteen minutes after the test started. The firing was done at regular intervals of three to five minutes, depending upon the rate of combustion, and the amount fired was usually two shovelfuls. At the end of the trial, the same methods were employed as regards firing, the thickness of fire, etc., as at the beginning, and if the water in the boiler was not the same height by the scale, the necessary correction was made for this, based on the calibration of the boiler drum. The fire was then allowed to burn out, when all refuse was cleaned from the grates and the pit. The trials were conducted by A. J. Boehme, G. R. Bott, and J. S. Wilson, members of the senior class of mechanical engineering for graduation thesis, carried on under the direction of Professor Hitchcock.

For the McGill University trials, (B and D) at the commencement of a trial the fire was allowed to burn down until only just enough was left to light up a fresh fire, the stop valves being manipulated so as to keep the steam pressure constant. At the time of commencing, a known weight of wood (allowed for as half its weight of coal) was fired and firing then began with weighed coal. The fire was opened up as the production of steam increased. The end of the trial was taken to be the time when evaporation ceased, as the last of the weighed coal died down on the grate. Just enough fire was left to light up again. In this way, any uncertainty as to the depth of the fire at the beginning and end of the trial was avoided. The level in the water gauge was the same at the commencement and end in each trial. The trials formed a portion of the regular instruction course in the department of mechanical engineering at McGill College, and were carried out with the boiler at ordinary work, the remaining boilers in the room being steamed so as to take the fluctuations of the load so far as was possible. In no case was special preparation made for the trial, except that the tubes were swept just before the trial began.

Trials of Boilers.

(A and C with brick furnace—B and D internal furnace).

Desig'n of trial.	A	B	C	D
No. of trial (original report)	101 B.E,H.	2	160	3
Date of trial	Feb. 2, '01	Nov. 11, '98	Feb. 12, '02	Nov. 18, '98
Type of boiler	Water-tube	Int'l-furn.	Water-tube	Int'l-furn.
Duration of trial —hours	10	8h. 5m.	9	8h. 22m.
Heating surface —sq. ft.	1,070	1,074	1,070	1,074
Grate surface— —sq. ft.	25	24.5	20	24.5

Average Pressures and Temperatures:—

Steam pressure by gauge, lbs. per sq. in.	134	102.5	98	111.5
Steam temperature, deg. F.	358	339.2	337	344.6
Draft at damper, ins. water	.16	.375	.552	.25
Draft in ash pit, ins. water	+.08	.0	—.02	+.46
Feed water, deg. F.	166	141	53.2	146
Escaping gases, deg. F.	490	427	556	454
Air entering ash pit, deg. F.	158.5	39	57.9	70
Air used per lb. coal, lbs.	19.41	17.5	18.6	18.9

Fuel and water:—

Kind of coal,	George's Creek R. M.	George's Creek, R. M.	Hackers Run (lump)	George's Creek, R. M.
Coal consumed per hr.—lbs.	375	324.1	581.4	523
Moisture in coal, per cent.	1.08	1.7	.85	2.2
Ash and refuse in coal, per cent.*	8.9	6.6	10.48	6.8
Coal per sq. ft. grate per hour	14.8	13.23	29.07	21.35
Water evaporated per hour, lbs.	3,262	2,832	4,011	4,234
Factor of evaporation	1.094	1.115	1.203	1.112
Evaporation per hr. from and at 212°	3,569	3,157	4,826	4,708
Evaporation per lb. coal, lbs.	8.69	8.75	6.889	8.09
Equivalent evaporation from and at 212° per lb. of coal—lbs.	9.518	9.75	8.30	9.00

Heat Value of Coal and Efficiency of Boiler and Furnace:

A—Heat used in evaporation, B.T.U.	9,192	9,580	8,016	8,480
B—Calorific value of coal, B.T.U.	14,240	13,900	13,647	13,900
C—Efficiency boiler and furnace, $A \div B = C =$ per cent.	64.54	69	58.74	61

Ash and refuse in Coal:

*The percentage of ash and refuse for trials B and D would have been higher if they had been taken from the analysis as they were for trials A and C instead of by weight. (See Prof. Hitchcock's paper, sec. 20), and for this reason the evaporation per pound of combustible is omitted.

Comparison of trials.—Trials A of the external brick-furnace boiler and B of the internal furnace boiler were made under natural or low-pressure draft, and trials C and D of the same boilers under forced draft. All of the trials show the evaporation per pound of coal to be in favor of the internal furnace boiler, and the total efficiency of the two types of boilers and furnaces based on the heat value of the coal, which forms the true test, shows 4.5 per cent. in favor of the internal furnace boiler for natural draft, and 2.25 per cent. for forced draft. It will be noted, however, that the brick-set boiler and furnace was given the following advantages in the trials:—In trial A for the brick furnace with natural draft the air entering the ash pit was preheated to 158.5 degrees F., as compared with cold air at 39 degrees for the internal furnace boiler, trial B. Professor Hitchcock's trials (Numbers 116 and 117) show that preheating the air to about the same extent gives a direct advantage of 2.4 per cent., and an indirect advantage, as indicated by less CO in the escaping gases, of 1.3 per cent. So, it would appear that if the air had been preheated for trial B of the internal furnace boiler it would have shown a total efficiency of 8.2 per cent. better than the brick-set boiler and external furnace.

In the forced-draft trials (C and D) the grate surface was reduced to 20 square feet for the brick furnace and not for the internal furnace. Professor Hitchcock's paper (Sec. 26) shows that the reduced grate surface would give an advantage to the brick furnace through less excess of air.

Loss of Heat of Brick Work When Running Intermittently.—In the trials of the brick-set boilers with external furnace at the Ohio University, it will be noted that the boiler was fired continuously from 36 to 48 hours before the trials, in order that the brick work should be thoroughly heated, and Prof. Hitchcock states in his paper (Sec. 20) that as a result of a series of trials made especially to determine that point, cold brick walls continued to absorb heat for 72 hours, and increased the loss during the trial 8.5 per cent., and he also states that brick-set boilers should be preheated not less than 30 hours before the commencement of a trial in order to give their best results. This shows clearly the advantage of an internally fired boiler in cases where

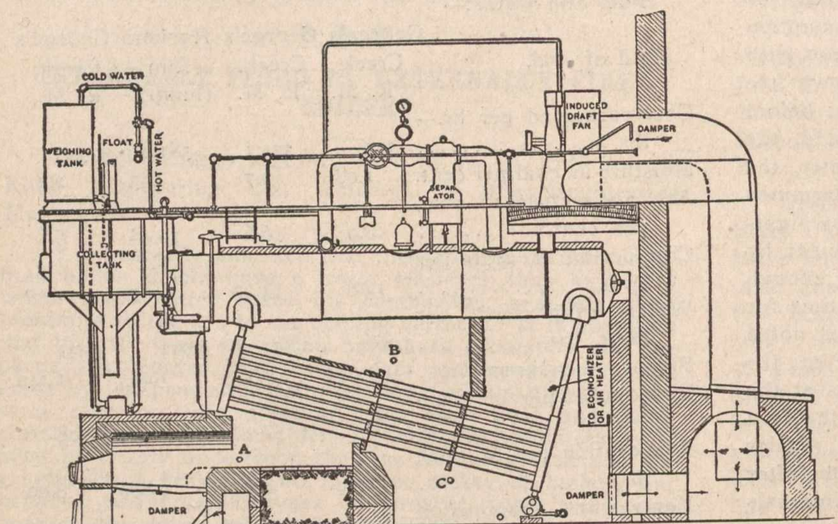


Diagram of Externally Fired Boiler with Dutch Oven Used in Professor Hitchcock's Tests.

steam is used only during the day time or at intermittent periods, because the internal furnace will give as good efficiency during the first hour of steaming as at any subsequent period. The exact amount of loss in running a brick-set boiler during the day time only is not shown by these trials, but from Professor Hitchcock's results I think it fair to assume it would not be less than 4 to 6 per cent. in favor of the internal furnace.

It will be noticed in comparing the methods of starting and stopping that Professor Hitchcock used the running start, whereas in the McGill trials, the fire was burned down to the lowest possible point before starting, and also at the end of the trial. While these methods probably give about the same results, Professor Hitchcock's method would be in favor of the boiler, because the condition of his fire would be at its best from start to finish. It would also seem probable that a fire built up even two hours before the start, as

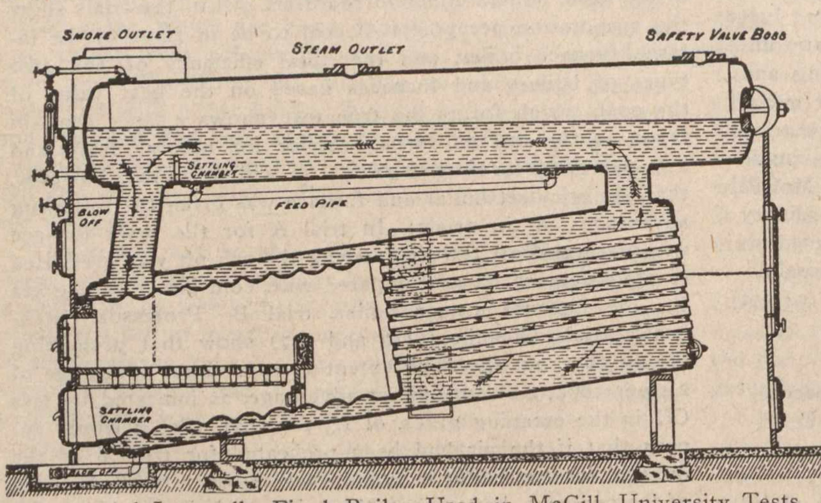


Diagram of Internally Fired Boiler Used in McGill University Tests.

was done in the Ohio University trials, might contain a greater amount of combustible matter at the beginning of the trial than at the end, when there would reasonably be a larger accumulation of clinker and incombustible material on the grate.

The McGill trials do not show any allowance for moisture in the steam; if we assume that the steam from the boiler contained the same amount of moisture as from the brick-set boiler, we should have to deduct 0.8 per cent. for trial A and 1.7 per cent. for trial C from the results of the internal furnace boiler trials.

To sum up the comparison:—The comparative efficiency of the two types of boilers and furnaces as shown by the trials with the additions for preheated air in trial A, deducting the moisture in the steam, is 7.4 per cent. in favor of the internally fired boiler when the brick setting and furnace is preheated or run continuously; or if run in day time only, say 11 to 13 per cent. in favor of the internal furnace. Under forced draft and continuous running, the difference shown is slightly in favor of the internal furnace boiler, although perhaps not outside the limit of error of testing; but under intermittent running the difference would be considerably in its favor.

It may be said that the differences shown by these trials in favor of the internally fired boiler are within the limits of error of boiler trials conducted by different operators; but taking into account that the firing of the Ohio boiler was done by skilled men, and conducted with a view to getting the best results for the apparatus, while the McGill trials, although carefully conducted, were made with the regular firemen to show the students the methods of testing and the results under ordinary conditions of running; and considering further that the method of starting and stopping the trials at the Ohio University was rather more favorable to the boiler than at McGill—I think the comparison a safe one. But even if the internal boiler did not give any better results than the brick furnace and setting, it would show that the expense in first cost and repairs of a Dutch oven and brick setting are unnecessary; and especially considering the rapid deterioration and increase of air leakage incident to brick work, when subject to the intense heat of combustion, they are objectionable as compared with the internally fired self-contained boiler, which should hold its maximum efficiency in continued service and require much less repairs than the the brick furnace and setting.

* * *

—A very interesting lecture on Sewage was given before the Engineers' Club of Toronto, on April 7th, by A. E. Mercer, who has had extended practice in town engineering in the South of England. At the meeting on the 19th, Stanislas Gagne described in an instructive way the process of mechanical pulp manufacturing.

—Achille Michaud, chief engineer of the Government steamer Druid, died suddenly at Quebec.

—The Bruce Carruthers scholarships in mining, at Queen's University, Kingston, were won by D. D. Cairns, Grand Falls, and C. C. Bateman, Kingston.

—May 1st was the sixtieth anniversary of the sending of the first despatch over a telegraph wire by the Morse system. It was sent from Baltimore to Washington. That short stretch of line was the beginning of a system that now comprises 245,000 miles over which last year 91,391,433 messages were sent.

—The amalgamation of the interests of the New Ontario Steamship Company, the Canadian Lakes and Ocean Company, and Captain Fairgrieve, into the Montreal and Lake Superior Line, has been completed. The six steamers, J. H. Plummer, A. E. Ames, H. M. Pellatt, Arabian, Wahcondah and Neepawa, will call at Toronto, Hamilton and Cleveland, two steamers a week, on the trips between Montreal and Fort William.

John and Daniel Kilgore propose to establish a brick and tile factory at Douglas, in the County of Renfrew, where good clay is to be found in large quantities.

MACHINE SHOP NOTES FROM THE UNITED STATES.

By Chas. S. Gingrich, M.E.

V.

Since sending in my last communication I have had occasion to spend some little time in the machine shop connected with a large printing establishment in Chicago, and was shown a job which I believe will be of special interest in this column, because it is an excellent example of the adaptability of the milling machine, showing, as it does, a case of work done by milling that could not be done economically on shaping or planing machines. It happens that this printing house uses a special metallic backing for electrotypes instead of mounting them on wood, as is usually done. An idea of the nature of these blocks may be gained from the pieces shown at the extreme left of Fig. 3. These pieces are shown with their faces down, and it will be seen that they are cored out so as to make them as light as possible. Whatever may be the advantages to the printer from such an arrangement, it is interesting to us to know that these blocks, which are 4 3-16 in. x 6½ in. long and ¾ in. thick, must be, and are, finished all over, with edges dead square, and the two faces parallel within .001 in., and it is the method by which this is done that I am about to describe. Credit for devising this process is due the Cincinnati Milling Machine Co., who claimed at the outset that the work could be done successfully on one of their No. 3 plain geared-feed millers.

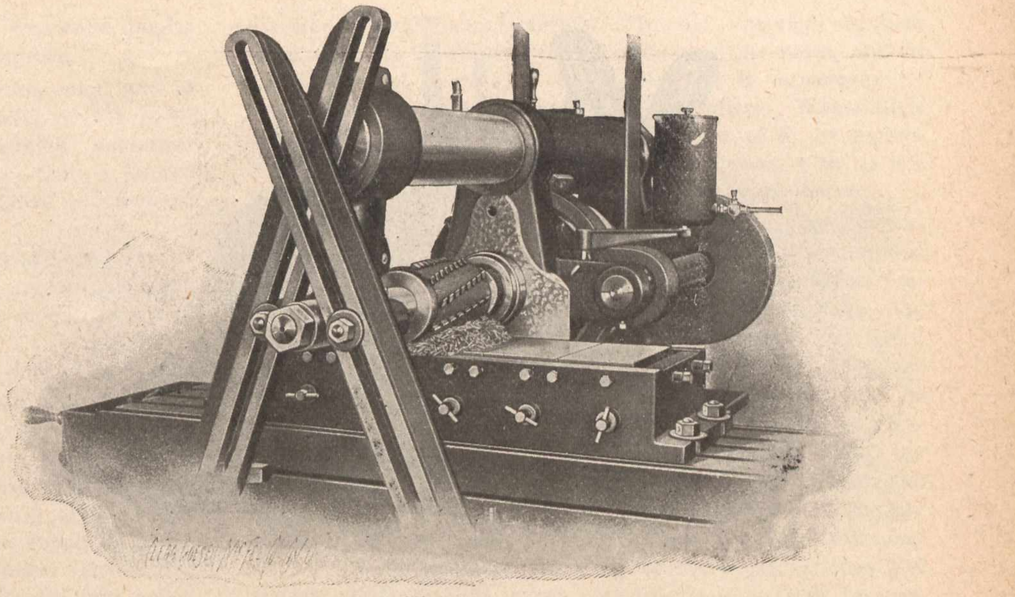


Fig. 1.

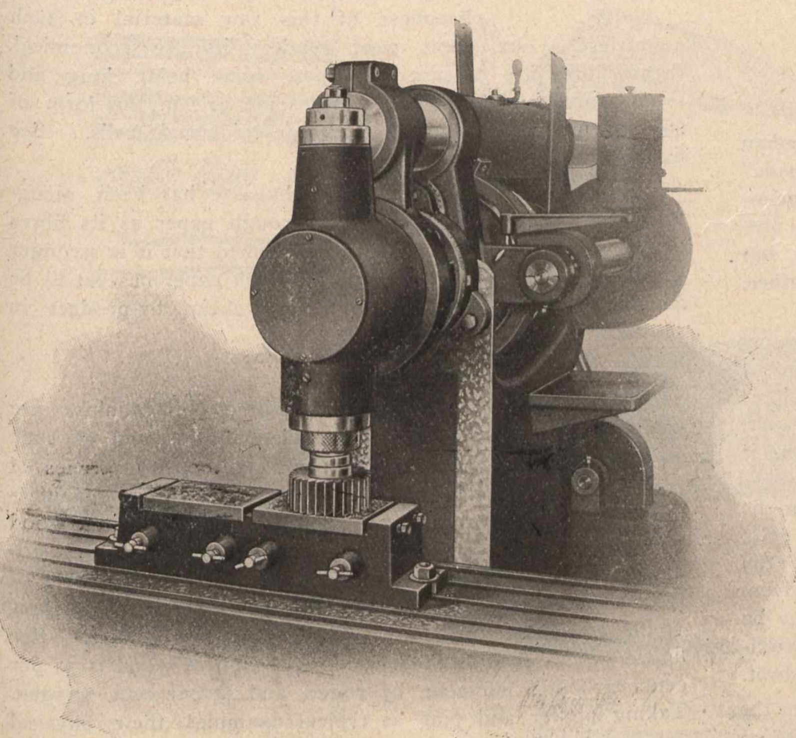


Fig. 2.

Fig. 1 shows the miller taking a roughing cut off the pieces, which removes the scale and gives an approximately flat surface, so that the pieces can be held in a more accurate fixture, and milled to within a few thousandths of correct size by using the vertical attachment on the miller as shown in Fig. 2. For the third operation, shown in Fig. 3, they are held on a magnetic chuck, and finished to exact size by using a mill having but one cutting edge. And they are finally finished by being again held in a fixture, shown in Fig. 4, in such a manner that two edges are finished at one cut, using side milling cutters in a gang.

The remarkable part of the whole process is that these pieces are finished by the method shown above with a maximum variation of less than .001 in. in the short space of time of 27½ minutes each. The pieces are made in large lots at one time, and each operation is made on all the pieces before a change is made in the cutters and the fixtures on the machine.

It is only when we carefully weigh and consider results like the foregoing that we thoroughly appreciate the revolutionizing influence that the milling machine is having in machine shops. It is now a generally recognized fact that no large machine shop can get along without a miller, and to judge by the rate at which the field of the machine is increasing, it is safe to say that it is only a matter of a few years' time until the manufacturing miller will be considered as indispensable as the manufacturing lathe in every shop.

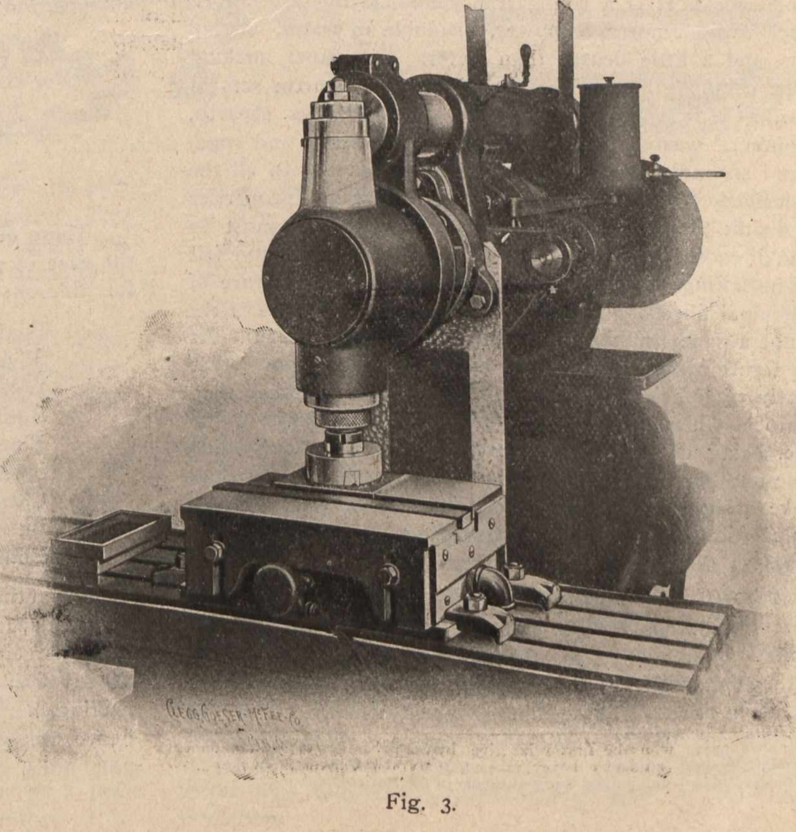


Fig. 3.

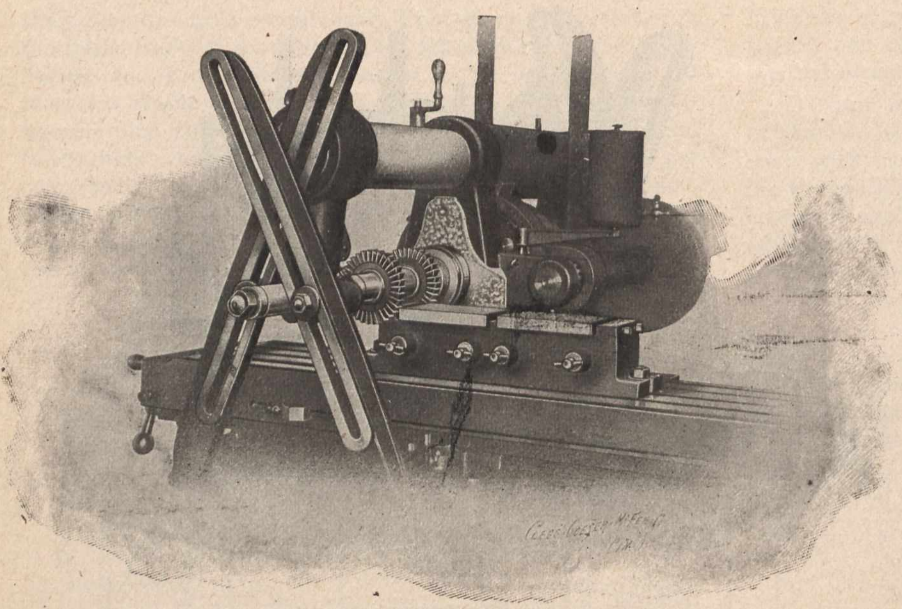


Fig. 4.

MECHANICAL WOOD PULP.*

BY STANISLAS GAGNE, B.A.SC.

At a time when so much emphasis is laid upon Canadian industry and Canadian manufactures, when "Made in Canada" is used as a sign to catch the market of the world, a review of mechanical wood pulp, an industry which not only at present constitutes an important asset in Canadian wealth, but which promises to become almost a monopoly in the future, should be opportune and interesting.

It was the discovery of ground wood pulp as a paper making material in 1845 that first afforded an opening for the growth of this industry in Canada. Mechanical wood pulp is adapted to many other uses besides that of producing paper, but it is as a paper producer that its future is assured, and it is chiefly in this connection that the process will be considered in this paper. Before entering into details, however, upon the process involved in the manufacture of mechanical wood pulp, a sketch of the essential components of paper and of the different materials employed in its manufacture will be given that the efficacy and utility of the mechanical process may be judged by comparison. Typical paper consists of approximately pure cellulose so matted together as to form a sheet.

CELLULOSE.—Cellulose is termed the material basis for the vegetable world. It is a white, translucent, tasteless, odorless substance without nutritive power, insoluble in water, alcohol and oils, and a little denser than water. For paper making purposes, cellulose fibres are derived from two main sets of sources, in the first place, from cotton and linen rags, esparto, flax (spinners' waste), hemp (old rope), jute, straw and sugar cane; and secondly, from different kinds of wood. In all the fibres derived from these sources the following properties are requisite; they must have a certain length, they must be small in breadth or thickness, they must be flexible and felt well. The felting power depends specially on the structure of the individual fibre. An example of a good felting fibre is the wool (not a paper making fibre, being of animal nature). As seen in figure 1, the wool fibre is discontinuous, consisting apparently of imbricated scales; these brought together tend to interlock, whereas silk fibres (also of animal nature), for example, being dual cylinders, perfectly smooth, simply slide over one another when rubbed or pressed together. We shall now take a short glance at some of the commonest sources of cellulose fibres as enumerated above, and see in what degree they possess these different properties.

COTTON.—Cotton fibres are the purest cellulose available in a natural state. They are long, thin, and rather rough, and when dry tend to roll themselves around their axis, hence they felt well. Figure 2 shows the form and structure of a cotton fibre. These fibres, which usually reach the paper-maker in the form of rags and waste, form the basis of most high grade book papers, and also enter, in different degrees, into the composition of nearly all grades.

FLAX.—The fibres of the flax are long, strong and flexible; they are often jointed and cut up, and are capable of lengthening without breaking. They are used by the paper-makers also in the form of rags and spinners' waste, and produce a very strong paper, (linen paper), which, however, is not so compact as that manufactured from cotton. See figure 3.

HEMP.—Hemp fibres resemble very much those of flax, but are coarser and stronger; especially is the pure fibre of Manila hemp which constitutes the basis of the real Manila paper. These fibres usually reach the paper mill in the form of old ropes and rags.

STRAW.—The fibres of the straw are little adapted to paper making, but the cheapness of this raw material in such countries as our great west renders its use economical. Straw fibres are of several shapes, some being long and slender and fairly uniform, while some are in the form of smooth pith cells, and of serrated epidermal cells. See figure 4.

SUGAR CANE.—Cane thrash or bagasse has been recognized as a good raw material for rough paper as its fibres possess great strength. It has been claimed that it is stronger than Manila hemp, but its value for book paper has yet to be demonstrated. As straw it is a very cheap by-product in southern countries.

WOOD.

Most of the above-mentioned sources of cellulose are available only in comparatively small quantities, and as such the paper-makers use them merely to get special grades of paper. On the other hand the great bulk of our manufactured paper is derived from wood. Roughly speaking, wood may be said to be composed of cellulose fibres cemented together. These bundles of cellulose fibres are in the form of long cells which are usually parallel to the longitudinal axis of the tree which cells are also cemented together. See figure 5. The general chemical composition of wood is 50 per cent. carbon, 6 per cent. hydrogen, and 44 per cent. oxygen. Taking poplar and pine as typical examples their physical composition is as follows:

	Pine.	Poplar.
Per cent. of cellulose	53.3	62.8
" " resin	2.0	1.3
" " aqueous ext.	1.2	2.9
" " water	14.5	12.1
" " lignin	30.0	20.9

These quantities vary with different qualities, especially in the case of pine. The following is the percentage of cellulose for different woods:

Poplar	62.8
Silver fir	56.9
Willow	55.7
Birch	55.5
Pine	53.3
Spruce	53.0
Chestnut	52.6
Beech	45.5
Ebony	30.0

The fitness of these different kinds of wood as pulp producers depends somewhat more on other properties than on their percentage of cellulose as will be seen later. Nearly all our Canadian species of wood may be employed for pulp making, but in actual practice the number of kinds is limited; hence we shall consider only those used in our Canadian pulp mills, and more especially those employed by mechani-

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

cal wood pulp manufacturers, namely, birch, basswood, poplar or aspen, hemlock, pine, fir or balsam and spruce.

Birch.—The fibres of the birch are white, long, and in breadth and thickness vary in different parts of the same fibre; they are, as a rule, pointed and exhibit numerous markings in the form of slits. See figure 6. Only a limited quantity of it is used in Canada, and mostly all by chemical process. It makes a fine grade of paper.

Basswood.—The fibres of the basswood are very similar to those of the birch. They are employed more than birch as a paper producer, and give a fine grade of paper, strong and soft.

Poplar or aspen.—The fibres of the poplar or aspen are among the best wood fibres for paper making. They are white, long, thin, and pliable, and resemble closely, in appearance, the birch fibres; some show joints and extend in the form of a rail, see figure 7, but they are used for fine book paper, as they are capable of acquiring a fine gloss. They are pulped extensively where a large supply is available, but the difficulty in securing sound wood renders the operation sometimes rather expensive. Poplar and aspen apparently sound to the eye are very frequently, through certain districts, discolored and rotten at the heart. This "black heart" must be removed, as its presence renders the pulp very inferior in quality in proportion to the quantity of the discolored and rotten part.

Hemlock.—The hemlock furnishes a coarse and rather brittle fibre of dark color, and suitable only for cheap paper. Generally speaking, it is used only where the supply of other woods becomes short.

Pine.—Pine fibres are brown in color, long, flat and broad, their ends are tapered and are characterized by oblong openings which penetrate through them. This wood is used but in few places, and pulped by chemical process. It produces a brown paper specially well adapted for boxes for sugar confections.

Fir and balsam.—The fibres of the fir or balsam resemble those of the spruce described below, and are, like it, white, long, thin, and strong. As found in different parts of Canada, this species contains varying quantities of resin, a fact of much consequence in its value as a pulp producer. Where it contains little resin it ranks near spruce as a raw material, but where resin is present in large quantities, it is detested by the manufacturers. In the chemical process much difficulty is experienced in removing the resin, and in the mechanical process no end of trouble is occasioned by the resin in the various parts of the machinery. Where little resin exists, as much as 25 to 40 per cent. of fir or balsam is used with spruce, and when largely resinous, 5 to 10 per cent. is considered plenty, and none at all much better.

Spruce.—The physical composition of spruce, as given at the beginning of the article on wood, shows that it contains 53 per cent. of cellulose fibres, its other constituents resembling those of pine. Its fibres are white, long (from 1-20 to 1-5 of an inch), thin (from 1-500 to 1-2000 of an inch), broad and flat, rough, strong and often twisted. They are characterized by the presence of numerous pitted cells or cups, circular and elliptical; see figures 5, 8 and 9. In Canada we have mainly three kinds of spruce; the black, the white, and the red or grey; these colors refer chiefly to the bark and not necessarily to the wood fibre. The black variety is that which stands in most favor with all pulp manufacturers. Its fibres are the toughest of the three varieties and are fine and white. It grows very thickly in swampy regions, such as the Laurentian areas, where it is easily recognized by its dark bark and long stem, with only a bunch of leaves at the top. The white variety grows specially on dry ground and its fibre is a little weaker than that of black spruce, but somewhat whiter. It also makes a fine grade of pulp. The name grey spruce refers to the color of the bark, and red spruce to the color of the wood. The fibres of red spruce resemble those of the white variety, but have a pinkish color. These three varieties of spruce form the basis of the wood pulp industry of Canada, and in the majority of the mills spruce is employed exclusively, especially for mechanical pulp. They furnish the best wood fibres for paper making, and our immense available supply renders them a most economical raw material. It may be added that trees of slower growth produce the longest and toughest fibres; for example, spruce grown on poor soil or in rocky places, or again in cool climate give better fibres than that grown in richer soil and warmer climate. For these reasons, spruce grown in Newfoundland or near the Labrador Coast gives a better grade of pulp than that grown farther inland and south. For climatic reasons also, Canadian spruce furnishes better pulp than that grown on the soil of our southern neighbors.

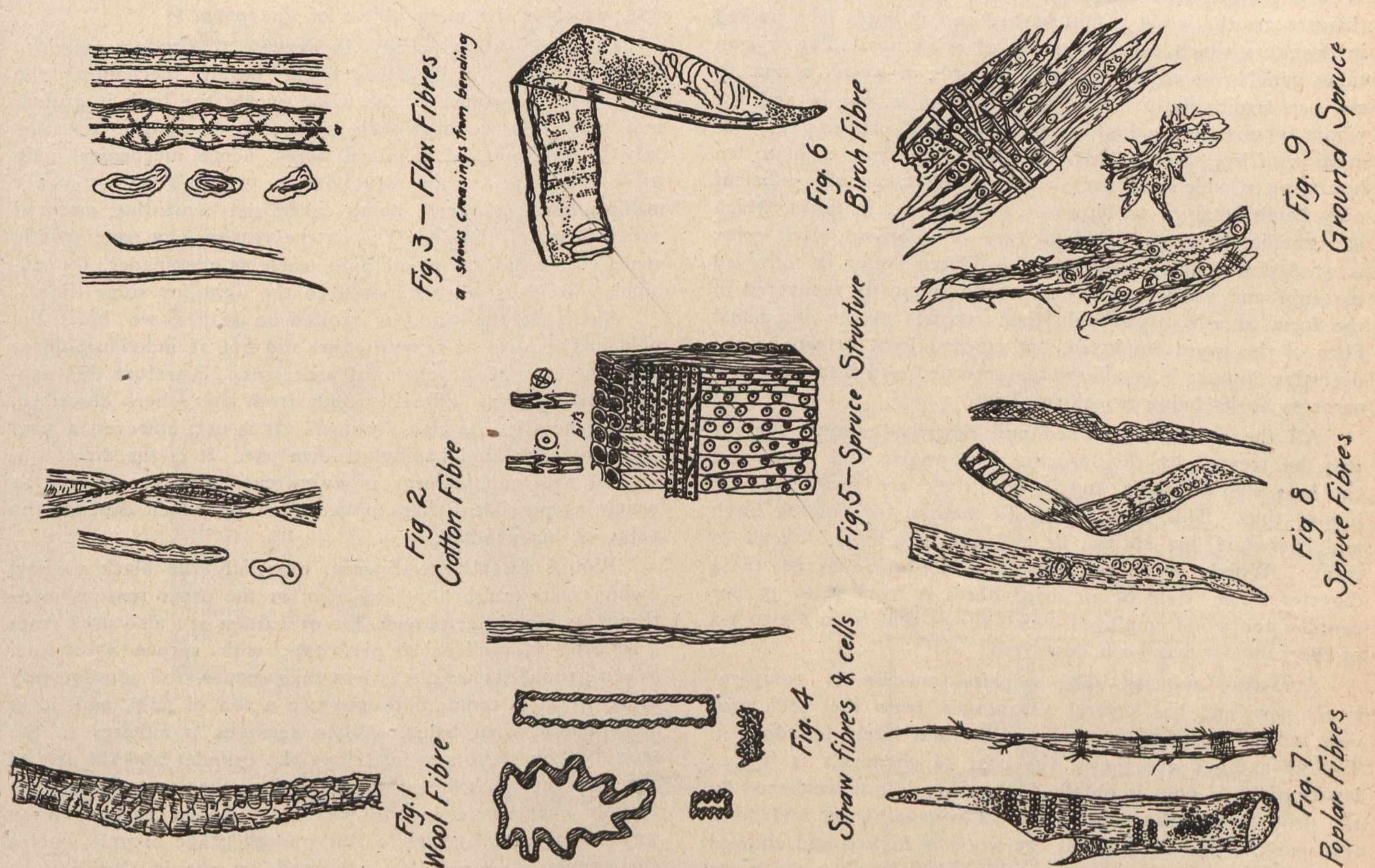


Fig. 1 Wool Fibre

Fig. 2 Cotton Fibre

Fig. 3 – Flax Fibres

Fig. 4 Straw fibres & cells

Fig. 5—Spruce Structure

Fig. 6 Birch Fibre

Fig. 7 Poplar Fibres

Fig. 8 Spruce Fibres

Fig. 9 Ground Spruce

PROCESSES.

The following is an outline of some of the different processes for obtaining fibrous material or pulp from the above mentioned sources. In all processes, except perhaps the mechanical, the direct aim is to obtain the cellulose fibres pure and individual. Cotton, flax, and hemp are used, as said before, in the form of rags or waste, which are first boiled to cleanse them, then beaten to separate the fibres and bleached. Straw and bagasse are treated by chemical process suited to their composition; they are not pulped in Canada. Wood is treated by two different processes, namely, the chemical and the mechanical. In Canada we have mainly two distinct chemical processes; the alkaline or soda process, and the acid or sulphite process. The action of the chemicals in both cases is to dissolve the non-cellulose constituents or the cementing material of the wood, thus leaving the individual fibres.

Soda process.—Twenty-five years ago the soda process was considered the most economical of the different chemical processes. It was first developed in America in 1853 by Watt and Burgess; and in 1867, by Angus, Logan & Co., of Windsor, Que., who made soda pulp out of basswood. In this process the wood is first barked and chipped, then packed in digesters which usually consist of cylindrical steel or iron tubes capable of containing 2 to 3 cords of wood; a nine to ten per cent. solution of sodium hydrate is put in and the whole is raised to a high temperature and pressure by admission of live steam. This "cooking" lasts from eight to ten hours, after which the pressure is partly taken off, sufficient only being retained to blow the mixture out in tanks, which is immediately done. This mixture of a brown black color is washed with hot water, and the diluted liquor is conveyed to tanks and washers where the soda is mostly recovered in the form of ash. The pulp then consists of the individual fibre of the wood employed, but colored light brown by the digesting liquor; it is afterwards screened and bleached, preparatory to its being transformed into paper.

All the woods mentioned and described above are or may be treated by this process, but poplar and aspen are the best adapted to it, and in fact they are nearly always pulped thus. This is also a good method for pulping birch and basswood, but spruce, fir and pine are more difficult to treat. Woods are never mixed in the same charge of a digester. The yield of air dried fibres is from 30 to 35 per cent. of the wood employed which shows that from 1-3 to 1-2 of the cellulose has been destroyed.

Sulphite process.—The sulphite process is comparatively new, and has several advantages over the soda process which caused most of the mills built lately to adopt it. The advantages are these: the cost of chemicals is less, a larger yield of pulp is obtained, the fibre is not weakened by the process, and the paper made from it is harder and more transparent. In this process the wood is barked and chipped as in the soda process; some manufacturers remove the knots and other impurities which are but little acted upon by the chemicals, while others claim that it is more economical to remove them afterwards in the screens. The chips are dumped into the digester which is an iron clad cylinder, vertical or horizontal, or perhaps also rotary, lined with some material not acted upon by the acid; in the past lead was employed for this purpose, but in later practice, a layer of 4 or 5 inches of portland cement has been found to work well. In a digester of a capacity of 2 cords, 2,500 gallons of a 3½ per cent. solution of an acid sulphite is put in and live steam is turned in thus raising the temperature and pressure. The constitution of the wood tends itself to the formation of certain organic sulphur acid (sulphonates), which greatly facilitate the process. After 10 to 12 hours of "working," the pulp is blown out into the tanks where it is washed; the liquor in this case, however, being usually dumped into the nearest stream, the gases only being preserved. In this case also the pulp consists of the individual fibres, which, after being washed, screened and bleached, are ready for the paper machines. As in the case of the soda process all the woods above described may be "pulped" by this method, but spruce is the best adapted and the most employed. The yield by this process is usually from 40 to 50 per cent. of the wood employed, which is quite an excess over that of the soda process. There are many other so-called chemical processes for isolating cellulose from wood, but as they are not used in Canada, and not likely to be for some time at least, they are of little importance to us.

The mechanical process.—In the mechanical process the wood is first cut into 1½ to 2 feet lengths and barked. These blocks are then pressed against revolving sandstones which grind the wood to a pulp. This, again, after being screened and bleached is ready for the paper machines, but as our mechanical pulp is nearly all made for exportation, it has to be transformed into a convenient shape for shipment. For this reason, the mechanical process as usually understood also means the use of "wet machines" to put the pulp into the form of sheets, and also of hydraulic presses to extract the water from these sheets, and of packing presses to put them into proper shape for shipment. The above description of materials and processes has been given to convey a full understanding of the aim and object of pulp making, and to furnish a basis of comparison. We shall now turn our attention to a fuller description of the mechanical process, which is the main object of this paper.

The aim of this process is likewise to produce cellulose fibres for paper making, but being purely mechanical the whole solid substance of the wood except the bark is ground into pulp. As we have seen, spruce for example, contains only 53 per cent. of cellulose fibres, hence mechanical pulp made from spruce can only contain 53 per cent. of paper making fibres, the rest being called the cementing material which is mainly lignin. This is the reason why paper partly made of mechanical wood pulp, such as newspaper, for example, discolors when exposed to the light for some time.

Again, as the wood is ground on stones, we have the pulp in the form of minute chips and not as individual fibres as in the case of the chemical processes. Therefore this process gives a very different result from the others described, which places it in a class by itself. It is not, however, a rival to them; each kind having its own use. It is the direct object of the manufacturer in every case however to get as nearly as possible a fibre pulp, a fact on which depends the value of his product.

Woods employed.—Spruce, especially the black variety, owing to its tough fibre and also for the other reasons mentioned, is mainly employed. Fir or balsam are also used from 5 to even as high as 40 per cent., with spruce as stated. When ground its weight is less than spruce, and consequently more wood is required to produce a ton of pulp, and it is more bulky when baled. When resinous it adheres to the stones, chokes the screens, clogs the cylinder and the felt of the wet machines, causing irregular sheets and general trouble everywhere in the process. Poplar (aspen) when ground makes a fine white and smooth grade of pulp, but as the supply is nearly always limited, its use is also limited. Spruce and poplar or aspen make a good combination, spruce lending its strength and poplar its firmness to the pulp. The methods of cutting and bringing wood to the pulp mills are the same as in the case of ordinary sawmills, the only exception being that all the wood of a tree is utilized save the branches; in some cases logs as small as three inches in diameter are brought to the mill as the size of the blocks is really of not much importance. Figure 10 illustrates the general principles adhered to in the building of a pulp mill. No definite rule is offered for the arrangement of the machines, each individual site having its own peculiarities.

Power.—All mechanical wood pulp mills in Canada are situated on some water course or stream from which the necessary power is derived, and in most cases, on which the wood is floated to the mills. As a rule steam power cannot be used for this purpose on account of the large amount required as a consequence of the great variations of the load, and its cost. A water fall, natural or artificial, is the only source of power that can be utilized for a pulp mill. An ordinary grinding machine producing 5 tons of pulp (dry) per 24 hours, requires about 350-h.p., and an additional 25 will drive the rest of the machinery for those 5 tons, therefore 75-h.p. are necessary to produce one ton of pulp (dry) in a day. As it is not the purpose of this paper to discuss the methods of utilizing a water-power, and the means of getting the highest power from a given fall, a few remarks concerning the requirements of the process will be sufficient. A dam or canal, or perhaps both, are built, and from there a penstock, flume or pipe line conveys the water to the turbines or water-wheels. The types of these wheels are governed by the height

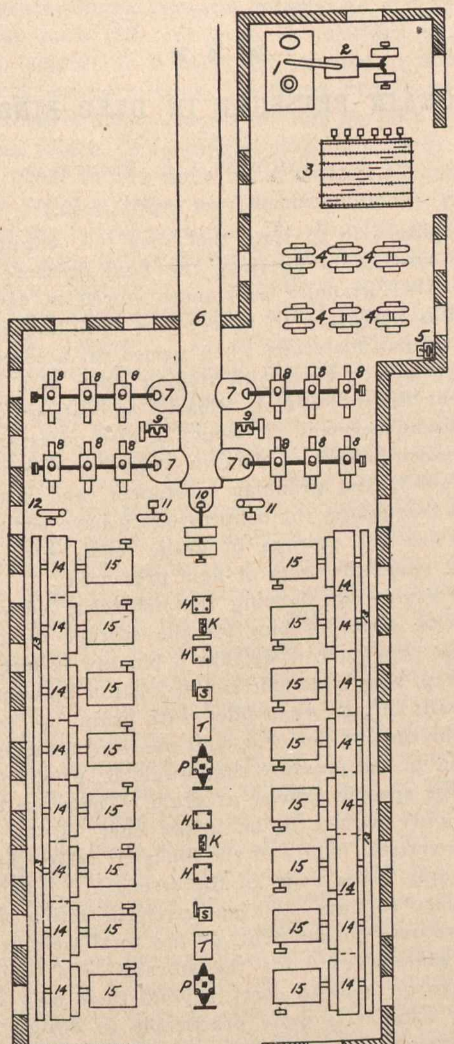


Fig. 10—General Plan of a Mechanical Wood Pulp Mill.

Explanation: 1—Steam Boiler. 2—Steam Engine. 3—Sawing Machine. 4—Barking Machine (in pairs). 5—Splitting Machine. 6—Water Flume. 7—Turbines and Casings for same. 8—Grinding Machines. 9—Pressure Pumps. 11—Casing and Turbine for general work. 11—Stuff Pumps. 12—Low Pressure Pump. 13—Troughs. 14—Screens (vibrating type). 15—Wet Machines. H—Hydraulic Presses. K—High Pressure Pumps. S.—Scales. T—Tables. P—Packing Presses.

of the fall (the usual practice being to use reaction turbines for low heads and impulse turbines for high heads) by the variations in the volume of water available and by the work that is expected of them. As will be seen later, some such speed as 175 to 250 R.P.M. is required, and this ought not to vary when part of the load is taken off, as when pockets of the grinders are being filled, thus relieving the pressure on the stone. To attain this result, governors are sometimes employed, especially when wheels drive only one or two grinders each, for then, one pocket opened means 1-3 or 1-6 of the load suddenly taken off, and in such cases the turbine will increase in speed according to its construction if no governor is attached to it; but the cost, great wear, frequency of repairs and losses of time, occasioned by these causes most manufacturers to do without them if they possibly can. As will also be seen later, pumps are sometimes used to act as governors, but as their use, as such, means a different grade of pulp at different times they are unsatisfactory for this purpose. The best means of getting over the difficulty seems to be to couple on one pair of turbines, turning both in the same direction relative to their common shaft, as many grinders as possible. If a pair of turbines are thus attached to each other, as in the case of Fig. 10, the friction on the end bearings will be eliminated, thus increasing the efficiency, and if these are made of the largest possible power several grinders are coupled to that pair, and in that case the variation of the load is smaller. In some cases turbines may be built so that variation of speed will be small compared with certain variations of load, thus dispensing with governors. Again turbines may be designed for a given speed when some of the pockets of the grinders are idle, and in operation, when the pressure is relieved from one pocket, the same pressure is automatically applied on another one, thus keeping the load, and thereby the speed constant. Therefore the problem is this: Given a certain head and volume of water, to get a turbine that will give a good efficiency at a given speed, and that speed not to vary much with certain variations of the load. To fulfil these requirements, it does not do to get any turbine whatsoever because of its low prices or other such considerations.

Handling logs.—To maintain proper order in this description of the mechanical process, we shall start with the wood as it arrives near the mill, i.e., where lumbering operations proper end, and follow it through the different parts and machinery of the process. If logs are floated down the river, they are kept in a boom above the mill dam from which they are taken to the cutters by means of a slide, chain conveyor, and log jack, or a similar arrangement depending on the nature of the ground relative to the mill. If brought by cars they are dumped near the mill where some arrangement such as an endless chain distributes them to the cutters. A similar device is used if the logs are brought from the river below the mill or taken from the piles of the winter supply which have been laid on skidways at the fall before the river was frozen. One of the rules that should be observed in handling logs is to keep them out of contact with the ground as much as possible, because sand and dirt will occasion trouble when they are sawn and barked. The wood should also be employed as green and wet as possible, because the grinding operation is thus facilitated and the pulp is of a higher grade as the fibres are more flexible and not so hard to detach from each other.

Sawing.—The logs are cut into lengths regulated by the size of the pockets of the grinders, usually 24 inches, though some use as small as 16-inch lengths. For mills of a small capacity, say up to 30 tons per day, a swing saw is generally

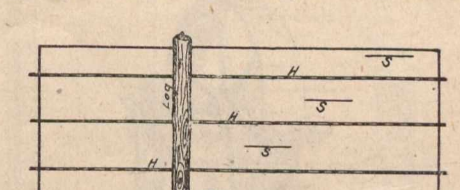


Fig. 11—Principle of a Pulpwood Sawing Machine.

Explanation: A—Driving Pulley. B—Driving Belt. C—Saw Pulleys. D—Tightening Pulleys. E—Tightening Pulleys. F—Conveyor. K—Frame. H—Chain Conveyors. S—Saws.

considered a good arrangement, especially when logs are from 10 to 14 feet long. If the logs are brought to the mill in 4-foot lengths (cord length), a cradle saw is sometimes used, where logs are put on a cradle which is swung to the fixed revolving saw. One of the best machines for sawing these blocks, when the mill has a large capacity and output, is that represented by Figure 11. In that case each saw is on a separate shaft and all these saw shafts are driven by the same pulley and belt. Logs are driven across the table by endless chain conveyors, and in this way only one saw is cutting a log at a time. If more than one saw is made to cut a log at one time, that log is liable to jam beween the saws, damage them and fly out, especially if three saws or more are used. By this method, illustrated in Figure 11, when a log has passed across the whole table, it is all cut up into the required lengths which fall near by, or are conveyed to the barkers.

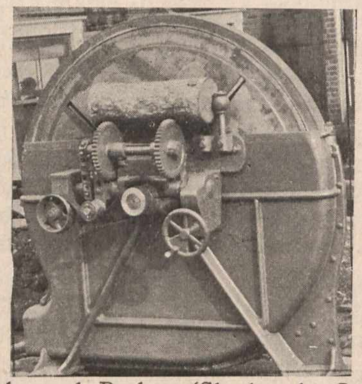


Fig. 14—Pulpwood Barker (Sherbrooke Iron Works.)

BARKING.—The type of barker most frequently employed is that represented by Figure 14. In consists of a disk about 52 inches in diameter in which four knives are so set as to cut a thin slice off the wood stick at a time. That disk is surrounded by a cast iron frame open to give access to the knives, and a table to support the wood is attached to it. The bolt or stick is pressed against the revolving knives and the bark and chips, falling behind the disk, are blown by fans acting like a centrifugal pump, through a pipe to a convenient place, usually to the boiler to be utilized in steam generation. The wood is usually pressed and revolved against the cutting knives, by hand. Various arrangements (such as the one represented in cut), have been invented to revolve the wood automatically against the knives, but the writer is doubtful if such a plan is useful and economical. The speed of revolution of the stick, in these automatic revolving appliances, depending as it does on that of the knives, they ought to do good work and save labor if the bark is of uniform thickness, but in cases where logs are brought long distances by water and through rapids, the

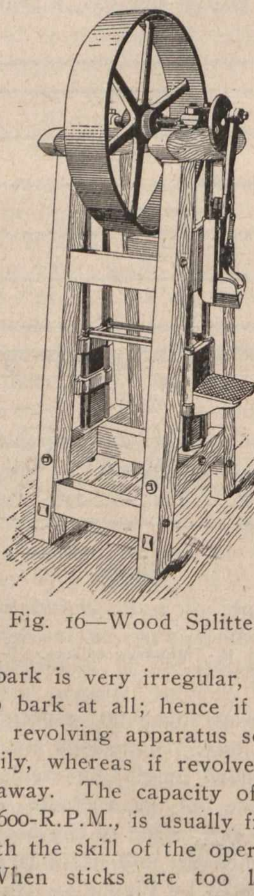


Fig. 16—Wood Splitter.

thickness of the bark is very irregular, and in fact, parts of the stick have no bark at all; hence if these sticks are put into an automatic revolving apparatus some good wood will be cut unnecessarily, whereas if revolved by hand the bark only will be cut away. The capacity of an ordinary barker running at about 600-R.P.M., is usually from six to ten cords a day, varying with the skill of the operator.

SPLITTING.—When sticks are too large to enter conveniently into the pockets of the grinders they are split by hand or by a machine, such as represented in Fig. 16. In these cases, which frequently occur where pulp mills are provided with a carriage and saw for turning large logs into lumber for the market instead of utilizing them to produce pulp, little splitting is required after barking. It is usually found convenient to have the sawing, barking and splitting operations all performed in a separate building, as shown in general plan, Fig. 10. Power for this purpose may be derived from one of the turbines or from a steam engine, the bark and small butts being used as fuel. From the barkers the wood is conveyed to the grinders.

(To be continued.)

GRAIN-PRESSURE IN DEEP BINS.*

By J. A. JAMIESON, C.E., MONTREAL.

(Continued from April issue.)

It is quite safe to state that very few engineers would make the mistake of applying the fluid pressure theory to grain or other granular substances stored in deep bins. To do this it is necessary to ignore the well-known fact that strictly granular materials when placed on a level floor, will form a pyramid or cone with sloping sides, at a considerable angle from the horizontal, clearly indicating considerable friction within the mass. It would be also necessary to ignore all the known published data in regard to friction between different solids and granular substances, and also the many structures throughout the country which have been safely used for years for the storage of grain, coal, etc., but which would not stand the tests of fluid pressures.

With a view to showing the difference between designing a bin or series of bins for the storage of grain or for the storage of a fluid, if we take a bin say 12 feet square and 72 feet deep, with a co-efficient of friction between grain and the bin walls of .468 when filled with grain, the vertical pressure will be only 15 per cent. and the horizontal pressure only 9 per cent. of the pressure that would be produced by a fluid of the same specific gravity as grain. Therefore the bin bottom will only require to be 15 per cent. of the strength to carry the vertical load and the walls to resist the horizontal pressure only 9 per cent. of the strength. The walls, however, require to have sufficient strength acting as a column to support over 86 per cent. of the total weight of grain in the bin, while if used for the storage of a fluid, the walls would have no load to carry beyond their own weight. On the other hand it is quite practicable to design and build a tank or standpipe that will have an ample margin of safety when filled with water, and that would undoubtedly fail when used for the storage of grain.

In order to show the importance of the question from a financial standpoint, it may be stated that if the bin structure of the Montreal Harbor Commissioners' elevator was designed and built to safely withstand fluid pressure and at the same time safely carry the grain loads, the cost would be at least $200,000 greater than if designed for the storage of grain with a factor of safety of 4. It would, therefore, seem that in cases where so much money was involved, and when the question of the proper design to meet the requirement of an important link in the transportation problem was at stake, the question would have been worthy of careful investigation. We, therefore, have as the two extremes, tanks apparently designed to hold chaff, and those of the expert fluid pressure theorist, who would have grain storage bins designed to hold water.

In view of the wide divergence of opinion and the lack of accurate published data on which to base calculations for the strength of grain storage bins, the serious losses that have occurred and the consequent lack of confidence caused thereby, the author believes that all engineers and owners interested in grain elevators and the storage and handling of grain, will agree that a full investigation and systematic series of tests to ascertain the manner in which grain loads are carried and the pressures produced by grain, are very urgently required. The author, therefore, proposes to present as clearly and briefly as possible the information gained by con-

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

ducting a systematic series of tests, calculations, and investigations, to ascertain all possible information on this subject and in order to confirm the tests and deductions therefrom, and will illustrate some of the weaknesses that have developed in different forms of construction. He will also endeavor to show the cause for certain failures, and describe the problems to be met in the safe and economical design of grain bins, and will in connection therewith, illustrate and describe a number of designs of grain bin constructions.

Before proceeding to describe these tests, the author will briefly outline such different tests, calculations and discussions on this subject as it has been possible to obtain from any hitherto published records. In Great Britain in the year 1882, Isaac Roberts made a series of tests on both model and full-sized bins, which demonstrated that in a grain bin having a depth equal to 4½ times the diameter, the proportion of the grain weight resting on the bin bottom was very small, as also the lateral pressure. Mr. Roberts read a paper describing his tests before "The British Association for the Advancement of Science." The author, however, regrets that he has been unable to obtain a full copy of this paper. In 1895, H. A. Janssen, C.E., Bremen, Germany, made a number of experiments on small rectangular bins with a view to obtaining the proportion of weight of the grain contained in a bin that would rest on the bottom, and that would be carried by the bin walls. His bins were all of approximately the same depth but of varying horizontal areas. Briefly, his system of tests consisted in supporting bin walls on four jackscrews while in the bottom of the bin was placed a loosely-fitting board resting on a platform scale. By filling the bin with grain the proportion of weight resting on the bottom was recorded on the scale. When the weight previously placed on the beam balanced the weight of grain resting on the bottom, a record was taken of both the weight of grain in the bin and the proportion of said weight that was resting on the bottom. The bin was then slightly raised by means of the jackscrews, and owing to the friction of the grain on the bin sides this also relieved part of the bottom pressure and allowed the beam to drop; added weights were then placed on the beam and the filling of the bin proceeded with, the same procedure being followed until the bin was filled. Janssen's tests were thus carried out in four different sizes of bins, but were to obtain the bottom pressure only, as he found that having obtained the bottom pressures, it was quite simple to calculate the lateral pressure. By conducting a series of tests to obtain the co-efficient of friction between grain and the bin wall materials, he was enabled with the information thus gained to calculate pressures in different sized bins. His experiments seem to have been very carefully and scientifically carried out, and his apparatus well adapted for the purpose. The results which he obtained are almost identically the same as those obtained by the author.

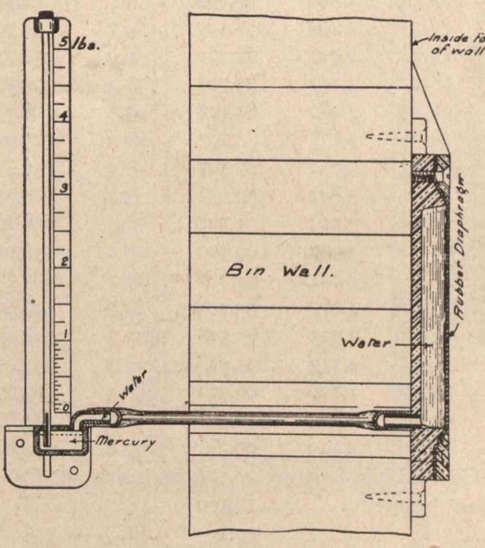
[The author then relates the investigation of Prante, at Bernberg, and of Airy in England, the latter being upon theory only.]

In 1897 the failure of a coal bin in Paterson, N.J., started a discussion in "Engineering News" on the pressures produced by coal and other granular materials stored in shallow bins. This discussion was started by the Editor, and a number of engineers contributed more or less valuable letters on the subject, but no records of actual tests were given, and since the discussion was confined almost entirely to shallow bins there is very little of it applicable to the deep bin problem.

About two years ago, or at the time of the controversy regarding the Montreal Harbor Commissioners' elevator, Dr. H. T. Bovey, C.E., Dean of Applied Science, McGill University, and John Kennedy, C.E., Chief Engineer, Montreal Harbor Commissioners, made a series of tests in the bins of the Canadian Pacific elevator, Montreal, and the Great Northern, Quebec.

At the beginning of the year 1900, it became apparent that wooden elevator construction must soon be replaced by buildings less liable to destruction by fire, and since this would involve entirely different materials of construction, the author realized that more accurate data was required to permit of intelligent and economical design of new construction. He therefore determined to conduct a series of tests with a view to gaining such information. There being no known appliance for making tests, the first and most difficult problem to be met was the design of the testing appliance to make the tests in a full-sized bin which would meet all requirements as to accuracy, decrease as well as increase of pressure due to the movement of the grain, and would record the pressures in different parts of a bin under all working conditions. Several styles of weight scale-levers and beams were first designed, all of which were open to serious objection and the difficulty seemed unsurmountable until the author conceived the idea of using a hydraulic diaphragm and a mercury or water column gauge, the first of which could be placed inside the bin at any given point either on the sides or bottom, with a tube leading through a small hole in the wall to the gauge, and therefore ascertain the pressure per square inch either vertically or laterally at any point of the bin. This appliance was immediately designed, care being taken to get the pressure face of the diaphragm, which was made of pure sheet rubber as large as practical, so that there would be no receding of the face by displacement of the water, owing to the pressure raising the mercury in the small gauge glass. When this appliance was manufactured and tested, it was found to be an accurate and sensitive weighing machine, and it is believed that no more suitable or accurate testing gauge can be found for the purpose. (See illustration.)

On the 10th of April, 1900, and following days the tests were carried out in the full-sized bins of the Canadian Pacific Elevator, at West St. John, N.B., the inside dimensions of the bin being 12-ft. by 13-ft. and depth above the hopper bottom 67-ft. 6-in.; the grain being used was Manitoba wheat, weighing 49.4 pounds per cubic foot. The hopper bottom of the bin was first filled with grain and levelled off. To obtain the lateral pressure the diaphragms were then placed in position against the walls a short distance above the hopper bottom, with the face vertical, and on top of a small platform attached to the hopper bottom with face horizontal, to obtain the vertical pressure. The gauges were set up in an adjoining bin, a small rubber tube forming the



Grain Pressure Tests—Hydraulic Pressure Diaphragm and Mercury Pressure Gauge.

connection between the diaphragm and the mercury cup of the gauge, the diaphragm and tube being completely filled with water. The grain was then weighed and run into the bin in the usual manner, the first draft having a clear drop of 70 ft. Each draft weighed 30,000 pounds and gave a depth of 3-ft. 9-in. in the bin. The gauge was closely observed as the grain was running in, and the maximum readings taken and recorded as each draft was complete, until the bin was filled. The gauges and the grain were then allowed to remain for about eighteen hours, at the expiration of which time there was practically no change in the reading of the gauge. The grain was then drawn out of the bin and the gauge closely observed and the readings recorded as each 30,000 pounds were weighed out, the maximum readings during the draft being taken. The grain was drawn off at the rate of 9,000 bushels per hour. The pressures fluctuated considerably as the grain was being drawn out with a maximum increase of 4 per cent. over that obtained when filling the bin or when the grain was at rest. The position of the diaphragm was then changed to near the corner of the bin and the above procedure repeated with practically the same readings as in the first test. During the running out test, the valve was suddenly closed several times, stopping the downward movement of the grain; this gave a slight increase of pressure, and when the valve was again opened a corresponding decrease of pressure. The pressures obtained both vertical and lateral were then plotted, the maximum readings of the different tests being used. The plottings and curves obtained are shown in the accompanying diagram, plate No. 5, and the pressure per square inch both on the bin bottom and against the walls are given in the accompanying tables, which also show the total side pressure, the relative vertical and lateral pressures and the co-efficient of friction between grain and walls. The column of "Equivalent Fluid Pressure" shows the pressure that would be produced by a fluid of the same specific gravity as the grain due to the different heads, or in other words, the pressures which would exist if there was no friction between the grain and the bin walls.

GRAIN PRESSURE TESTS.

Wheat.—Cribbed Wooden Bin.—Bottom Pressure Tests, Canadian Pacific Railway Elevator, St. John, N.B.

Inside dimensions of bin 12 ft. by 13 ft. 6 in. = 23,328 sq. inches. Depth of bin, 67 ft. 6 in. Each draft weighed into bin = 30,000 lbs. = 3 ft. 9 in. high. Wheat used for test, No. 1 hard Manitoba, weighing 49.4 lbs. per cub. ft. Total grain above diaphragm, 540,000 lbs. To fill hopper bottom, 16,500 lbs. = 556,500 lbs. = Total weight of grain weighed into bin.

Grain weighed into bin.	Height of grain column.	Pressure of grain on diaphragm.	Grain carried on bottom. Weight	% total weight. grain.	Grain carried on bin sides. Weight.	% total weight graint
lbs.	ft. in.	lbs.	lbs.		lbs.	
30,000	3 9	1.118	26,081	86.9	3,919	13.1
60,000	7 6	1.948	45,443	75.7	14,557	24.3
90,000	11 3	2.499	58,297	64.7	31,704	35.3
120,000	15 0	2,927	68,291	56.9	51,719	43.1
150,000	18 9	3,247	75.746	50.4	74,254	49.6
180,000	22 6	3.482	81,228	45.1	98,772	54.9
210,000	26 3	3.635	84,797	40.3	125,203	59.7
240,000	30 0	3,752	87,527	36.4	152,473	63.6
270,000	33 9	3.843	89,650	33.2	180,350	66.8
300,000	37 6	3,924	91,539	30.5	208,461	69.5
330,000	41 3	3.987	93,009	28.1	236,991	71.9
360,000	45 0	4.041	94,268	26.1	265,732	73.9
390,000	48 9	4.077	95,108	24.3	294,892	75.7
420,000	52 6	4.095	95.528	22.7	324,472	77.3
450,000	56 3	4.113	95,948	21.3	354,052	78.7
480,000	60 0	4,129	96,321	20.1	383,679	79.9
510,000	63 9	4,129	96,321	18.8	413,679	81.2
540,000	67 6	4.129	96,321	17.8	443,679	82.2

Carried on bottom 96,321 on sides 443,679 lbs.
In hopper 16,500

Total carried by bottom = 112,821 lbs.
Total carried by sides = 443,679 lbs.

Total grain in bins = 556,500 lbs.

GRAIN PRESSURE TESTS.

Wheat.—Cribbed Wooden Bin.—Side Pressure Tests.

Inside dimensions of bin 12 ft. by 13 ft. 6 in. = 23,328 sq. inches. Depth of bin 67 ft. 6 in. = 18 sections = 3 ft. 9 in. high. Wheat weighing 49.4 lbs. per bushel. Each section of grain column in bin = 3 ft. 9 in. high, weighing 30,000 lbs. Combined area of four sides of bin = 27,540 sq. inches.

Grain weighed into bin.	Height of grain column.	Equivalent fluid pressure.	Side pressure of grain on diaphragm.	Side pressure per section.
lbs.	ft. in.	lbs.	lbs. per sq. inch.	lbs.
30,000	3 9	1.286	0.343	9,446,220
60,000	7 6	2.573	0.938	25,832,520
90,000	11 3	3.859	1,317	36,270,180
120,000	15 0	5.145	1.615	44,477,100
150,000	18 9	6.431	1.804	48,682,160
180,000	22 6	7,718	2.011	55,382,940
210,000	26 3	9.004	2.111	58.136,940
240,000	30 0	10.290	2.201	60,615,540
270,000	33 9	11.576	2.278	62,736.120
300,000	37 6	12,863	2.345	63,581.300
330,000	41 3	14.149	2.381	65,672.740
360,000	45 0	15.435	2.417	66,564.180
390,000	48 9	16.721	2.435	67,059.900
420,000	52 6	18,008	2.453	67,555.620
450,000	56 3	19.294	2.453	67,555.620
480,000	60 0	20.580	2.453	67,555,620
510,000	63 9	21.866	2.462	67,803.480
540,000	67 6	23.153	2.462	67,803.480

Total side pressure 1,004,631.660

RELATIVE VERTICAL AND LATERAL PRESSURE.

(See bottom Pressure Table). Pressure on bottom due to 67′ 6″ grain = 4.129 lbs. per sq. inch × area of bottom, 23,328 sq. ins. = 96,321 lbs.

Maximum pressure on side of bin due to 67′ 6″ grain = 2.462 lbs. per sq. in.

Vertical pressure = 4.129
Lateral pressure = 2.362 ——— = 59.6% of vertical pressure, or vertical pressure = 1.66% of lateral pressure.

Co-effic. of friction between Grain and sides bin = W. carried by sides = 443,679 lbs. / Total side pressure = 1,004,632 lbs. = .441

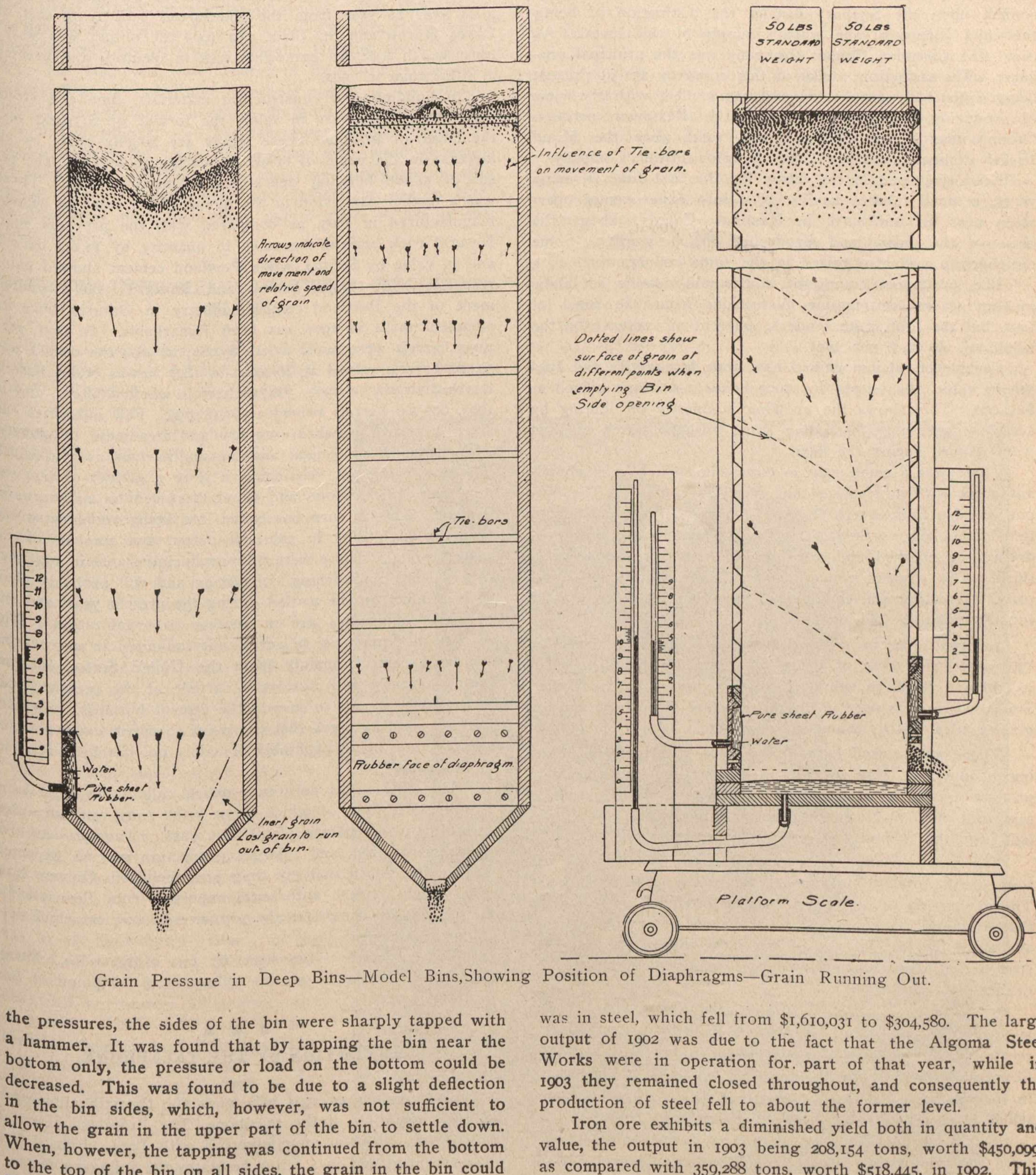
To get further data the author conducted a series of tests in model bins, in the winter of 1902-3. Of the several bins one had sides made of corrugated or trough plate steel, the corrugations running horizontally and attached to corner columns; one was made of smooth wood boards; one of the same dimensions as the last with the boards roughened on the inside of the bin, to imitate a bin of ordinary wooden cribbed construction; one was also lined with flat steel plates to imitate a square steel bin. These were each 12 inches square and 6 feet 6 inches deep. Two were round steel bins, each 6 inches diameter, and 6 feet 6 inches deep. There were six hydraulic diaphragms: One being 12 inches square, one 12 inches in diameter, one 6 inches square, one 6 inches in diameter, one rectangular 3 x 12 inches, and one 2 inches square.

In testing for bottom pressure the diaphragms were the full size of the different bins, forming a complete bottom for them. The total weight of grain coming on the bottom therefore rested directly upon a thin sheet of pure rubber, which in turn rested on the water contained in the diaphragm, while the bin itself rested upon the frame of the diaphragm. Connection as made between the diaphragm and the glass gauge column by a rubber tube, which was set vertically alongside of a measuring scale. To obtain the lateral pressure the diaphragm was made to form part of the bin wall, the face being set vertical and in line with the inside face of the bin. The whole apparatus was set on a platform scale so that the weight of grain could be accurately taken as the bin was filled. The measuring scale was then adjusted accurately to the height of water in the gauge glass. Grain was then poured into the top of the bin in drafts varying from 25 to 6¼ pounds each, according to the size of the bin used, and readings of the height of water column in the gauges taken and recorded at each draft as the bin was filled. Tests for bottom or vertical pressure were made in all the different bins, and for lateral pressure in a majority of the bins. In the square trough plate, or corrugated steel bin, tests were made with the following varieties of grain, viz.:—Wheat, peas, corn or maize, and flax-seed; and in the cylindrical bin, tests were made with thoroughly dry, clean river sand. The grain used was the highest grade that could be procured and was thoroughly clean and commercially dry. The wheat was No. 1 Manitoba Hard, weighing 50 lbs. per cubic foot; peas weighed 50 lbs.;

corn 45 lbs., and flax-seed 41.5 lbs. The sand weighed 100 lbs. per cubic foot. The weights as above were all carefully ascertained by means of the Grain Testers' Balance. Wheat was used to conduct the full series of tests, while the other grains were only tested in two of the bins, with a view to establishing the comparative pressures with wheat, over 50 separate tests being made in full. The tests were all carried out in duplicate. After the first series were completed, the readings plotted and calculations extended, the second series were undertaken with a view to checking the first, and to gain such additional information as was found to be desirable. In the first series the grain was poured into the bin from a pail, while in the second series of tests a funnel with a large opening was used. This did not make any difference in the maximum pressures obtained, but the latter mode of filling the bin gave very accurate curves when plotting the diagrams, while the plottings from the first series were in some instances somewhat erratic. With a view to ascertaining the effect of vibrations or shocks on the pressures, the sides of the bin were sharply tapped with a hammer. It was found that by tapping the bin near the bottom only, the pressure or load on the bottom could be decreased. This was found to be due to a slight deflection in the bin sides, which, however, was not sufficient to allow the grain in the upper part of the bin to settle down. When, however, the tapping was continued from the bottom to the top of the bin on all sides, the grain in the bin could be settled from 2 to 3 inches, giving a slightly increased pressure on the bottom.

In test No. 1A, the full records of which are here given, it will be noted that the settling of the grain amounted to 2¼ inches, giving a maximum reading of 10½ inches of water, or an increase due to the shock of 1¾ inches of water, equal to total increased weight on bottom of approximately 9 lbs. or less than 3 per cent. It may be stated that this shock was proportionately very much greater than could be procured under ordinary conditions in large elevator bins.

(To be continued.)



Grain Pressure in Deep Bins—Model Bins, Showing Position of Diaphragms—Grain Running Out.

MINERAL PRODUCTION OF ONTARIO.

The following figures of the mineral production of Ontario for 1903 are from the report of T. W. Gibson, director of the Bureau of Mines.

The values of all the items in the metallic list are lower except nickel, copper and zinc ore, but the chief reduction was in steel, which fell from $1,610,031 to $304,580. The large output of 1902 was due to the fact that the Algoma Steel Works were in operation for part of that year, while in 1903 they remained closed throughout, and consequently the production of steel fell to about the former level.

Iron ore exhibits a diminished yield both in quantity and value, the output in 1903 being 208,154 tons, worth $450,099, as compared with 359,288 tons, worth $518,445, in 1902. This reduction was also one effect of the paralysis which fell upon the great industries at Sault Ste. Marie, and which led to the closing of the Helen iron mine before the shipping season was over.

The blast furnaces of the province turned out 87,004 tons, or 25,683 tons of pig iron less in 1903 than in 1902. Of the iron ore smelted into pig iron, 32 per cent. came from Ontario mines and 68 per cent. was imported from the United States.

The yield of gold was $188,036, or a decrease of $41,792.

The production of copper (in ore and matte), was valued at $716,726, which was greater in 1902 by 471 tons, the increase in value being $36,643. The chief source of copper remains the nickel-copper mines of Sudbury, but the purely copper ores of the Massey Station mine are now being smelted, and ore is also being raised at the Superior and Tip-top mines.

The output of nickel was larger last year than ever before, exceeding that for 1902 by 1,053 tons in quantity and $288,107 in value. The production of 6,998 tons of nickel, valued at $2,499,068, constitutes a record, and undoubtedly confers upon the Sudbury district the distinction of being the chief source of the world's supply of this metal. As usual, the Canadian Copper Company was the principal producer. The reduction works of this company are at present being extensively overhauled and remodelled, with the view of producing high-grade matte by the Bessemer process. Other concerns contributing to the total were the Mond Nickel Company and the Lake Superior Power Company.

Lead reappears in the tables for the first time in many years, a small furnace having gone into experimental operation near Bannockburn, in Hastings County, about the close of the year, and producing $1,500 worth. Some molybdenite was also raised in the same county.

The substances comprised in the non-metallic list show in some cases considerable fluctuations from the level of 1902, but the footing-up renders apparent an increase on the whole of about 7 per cent.

Carbide of calcium gained 1,105 tons in quantity and $54,580 in value, the output for 1903 being 2,507 tons valued at $144,000. This shows the growing popularity of lighting by acetylene gas, notwithstanding some mishaps which resulted from its use during the year.

There was a small gain in corundum, which is of abundant occurrence in Hastings and Renfrew counties. The output was 849 tons, worth $84,900, of grain corundum, and 270 tons of cobbed worth $2,700. Two companies are now producing the crushed and sized article, with prospects of a third. The pioneer concern, the Canada Corundum Company, is erecting and equipping a new plant of much greater capacity than its old one.

Feldspar was in good demand, and the shipments for 1903 were in excess of those for 1902 by 6,520 tons in weight and $7,171 in value. It is all exported to the United States, where it is used in the manufacture of pottery, and for glazing tiles, baths, enamelled ware, etc.

There were raised 7,469 tons pyrites, principally in Hastings County, or 3,098 more than in 1902, and the aggregate production was greater in value by $6,700. The output is sent to United States markets, principally Buffalo and Cleveland, for the manufacture of sulphuric acid.

The yield of mica, as returned to the Bureau, was 948 tons worth $102,205, or almost exactly the same as in 1902. The production of this article is now confined, more largely than formerly, to companies working on an extensive scale; and since the introduction of micanite, in which the smaller sizes are utilized, the demand is not so much for size as for quality.

The value of natural gas produced last year was valued at $196,535, very little less than in 1902. Much the larger portion now comes from the Welland field, that in Essex County being practically abandoned. A pool at Dunnville, in Haldimand, is being exploited, and gas is also now being taken from the White Medina formation at Brantford.

Petroleum, of which the Lambton County oil fields remain the chief source, is steadily declining in point of yield. Compared with 1902, the production of crude for 1903 was 1,545,254 imperial gallons less, while compared with 1893 it was 17,414,662 gallons less. In ten years, therefore, the quantity of crude product has fallen off over 50 per cent. The higher prices which prevailed last year, however, prevented the value falling with the production; indeed, there was a marked increase, taking as a basis petroleum products and crude petroleum used for gas and fuel, amounting to $155,620. It is a legitimate subject of enquiry whether there are not yet undiscovered reservoirs of both petroleum and gas in this province. The supply of the former has, heretofore, been taken wholly from the limestones of the Corniferous formation, in which it is found at a depth of about 470 feet from the surface. Borings have been made to the Trenton, but without much success; recently, however, oil has been found in considerable quantity in the southwest corner of Kent County at a depth of 1,290 or 1,300 feet, in what is believed to be the Guelph formation, and more recently still at Brantford, oil has been struck in the White Medina, between 500 and 600 feet below the surface.

Salt continues to be raised in about the same quantity from year to year from the widespread beds lying east of Lakes Huron and St. Clair. In 1903 the output was 58,272 tons, worth $388,097, somewhat less in quantity and greater in value than in 1902.

In building and construction materials, lime and stone both show a decrease in value, the former of $175,000 and the latter of $97,000. These losses are largely offset by an increase in the value of brick amounting to $175,000, the result of active building operations in many centres. There was a further expansion in the quantity and value of cement manufactured in 1903, as compared with the previous year. Natural rock cement increased in quantity by 12,249 barrels and in value by $18,524, while Portland cement showed gains respectively of 172,361 barrels and $266,578. The development of the Portland cement industry in Ontario since its commencement in 1901 has been remarkable. In that year 2,033 barrels were made worth $5,082; in 1894 the output was 30,580 barrels valued at $61,060; in 1897 it was 96,825 barrels worth $170,302; in 1900, 306,726 barrels worth $598,021, and in 1903, 695,260 barrels valued at $1,182,799. Few industries can show a record equal in rapidity and steadiness of growth. The cheapness of cement and the multifarious uses to which it is now being put, ousting as it is to a greater or less extent, lime, brick, stone and wood, have led to an enormous demand. This in turn has called into being an industry fast attaining high rank in value of output and amount of invested capital. There were nine producing plants in 1903, five others were approaching completion and will probably place their product on the market during the present year, and one or more companies are in process of organization. The market in Canada is, however, not unlimited in extent, and imported cement, mainly from the United States, is competing severely with the native article at the present time. It would be a pity to overdo the cement business, and there are not wanting signs that the point to which expansion can for the time being profitably or safely go, has been reached, if not passed.

The only other substance which calls for special mention is peat fuel, of which some 1,100 tons were manufactured by two separate plants last year. The product has given satisfaction, and a larger production may be expected. It is to be hoped that ere long peat fuel from Ontario bogs will largely replace anthracite, imported from Pennsylvania, in the kitchen ranges of the province—a use for which it is eminently fitted.

The ton used is the statutory ton of 2,000 lbs. Values have been computed at the selling price at point of production.

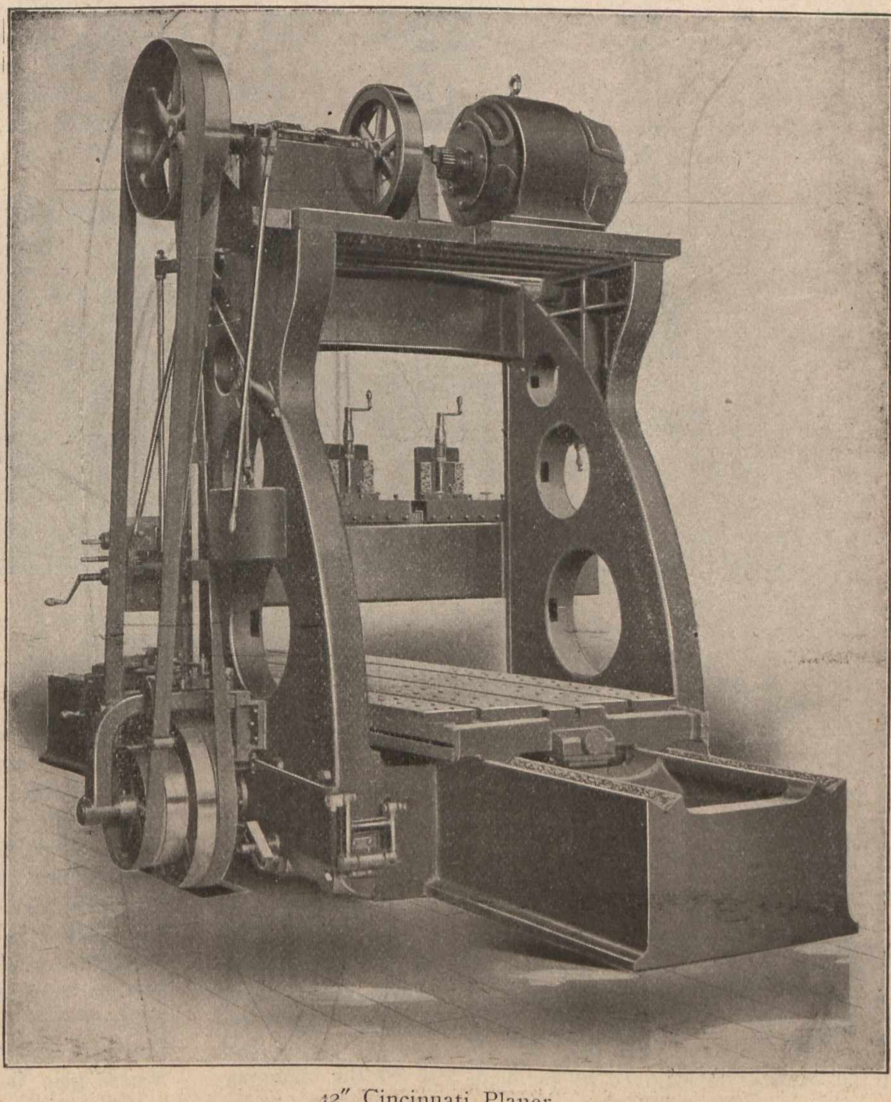
INVENTION OF THE TELEPHONE.

The summer of 1904 will mark the thirtieth anniversary of the invention of the telephone. The Brantford Board of Trade has been in communication with Prof. Graham Bell, the inventor, and in a letter he states the following facts:

"Now it so happens that the telephone was invented in Brantford during my visit to my father and my mother in 1874. Up to June, 1876, only laboratory experiments had been made with the instruments, and the transmission of speech was from one room to another in the same building. The first transmission of speech over a real telegraph line was effected in Brantford in the autumn of 1876, on the lines of the Dominion Telegraph Company, by means of instruments which I had brought from Boston. In one experiment speech was transmitted from Brantford to Mt. Pleasant, in another from Brantford to Paris, and in a third from Brantford to my father's house on Tutela Heights, where the results were witnessed by a large company of Brantford people. These experiments were made August 10th, 11th, and 12th, 1876, according to an account published in the Toronto Globe and quoted by the Scientific American of September 9th, 1876. In these experiments the transmission was effected only in one direction, the instruments employed not being well adapted for reciprocal communication. As to citizenship, I was born in Edinburgh, Scotland, and was, therefore, a British subject by birth. I landed in Canada from Great Britain on the 1st of August, 1870, and after a few days spent in Paris, Ont., I removed to Brantford, where I resided with my parents at Tutela Heights until March, 1871. The telephone was invented in Brantford in the summer of 1874. . . During the whole period of the development of the telephone, therefore, my political status was that of a British subject, who had taken out his first papers of naturalization in the United States, and who, although not a full citizen, was entitled to the rights and privileges of citizenship. The telephone went into commercial use in 1877. We now have more than three million miles in use in the United States."

FORTY-TWO-INCH HEAVY PATTERN CINCINNATI PLANER.

The accompanying illustration shows a new 42-in. heavy pattern planer, made by the Cincinnati Planer Co., Cincinnati, O. The bed is of the modern deep pattern, resting direct upon the foundation, and is thoroughly braced throughout by the box girders. The V's are wide, and fitted with automatic roller oiling devices. The table has their dirt-proof feature, and is so designed that the rack is extended at each end permitting of a longer piece being planed than the stated capacity of the machine. Complete shafting mechanism is furnished on both sides. The housings are of the popular box form, securely bolted to the sides of the bed and are of such proportion as to insure the greatest stiffness. The cross rail is accurately fitted to the housings, and strengthened by an arch-shaped brace on the back. It is made of sufficient length to admit of an extra head being attached at any time, allowing either head to have full traverse across the table. Provisions are made for raising and lowering it by power. The heads are carefully fitted to the rail, and are graduated for swiveling and provided with automatic feeds in all directions. They can be operated from either end of the cross rail. The down feed screws are provided with micrometer adjustment and ball bearings. Side heads can be furnished on one or both housings, with independent power and hand vertical feed, and can be run below the top of table when not in use. The handles, which control the feeds, travel up and down with the heads, always convenient to the operator. The combination friction is a new feature in planers, insuring positive feed when heads are taking their heaviest cuts. The shifter is so constructed that the table reverses without shock or jar and all disagreeable noise of the belts is obviated. It is also provided with a safety locking device, preventing the table from starting except at the will of the operator. The rear dog is fitted with a latch, so the table can be run from under the cutting tool when desired. The driving shafts are made of special crucible steel, accurately ground, and run in long boxes fitted into bored holes in the bed. This construction provides the best facilities for lubrication, and makes it possible to remove any shaft with gears intact. The gearing is very powerful, cut from solid stock and all placed on the inside of the bed. The rack is also cut from the solid, is of extra width, and is bolted and pinned to the table in short sections. The countershaft is fitted with self-oiling patent adjustable hangers.

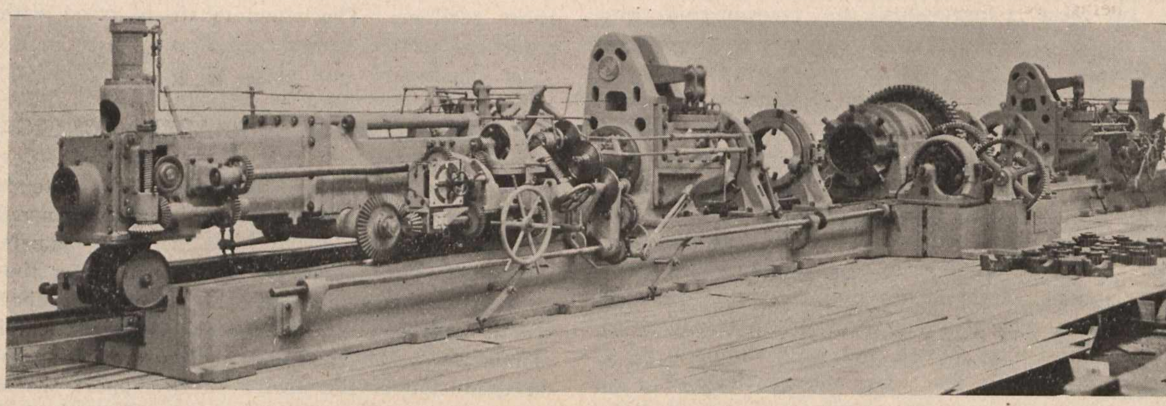


42" Cincinnati Planer.

FOURTEEN-INCH HYDRAULIC BORING LATHE.

The machine illustrated herewith is intended to bore gun forgings, marine shafts and ingots generally. It will take in a shaft 60 feet long, 30 inches in diameter, and bore a hole out of the solid 12 inches in diameter the full length, or 14 inches for short length. Two boring bars are used, one at each end, while the work is being held in a hollow spindle or revolving chuck. Two revolving steady rests on each side of the centre chuck support the work. The feed pressure required to do such extremely heavy work is so great that it becomes impractical to feed by rack and pinion or screws. For this reason the boring-bars are fed in by hydraulic pressure. The boring-bar itself is clamped in a head by means of hydraulic pressure, in addition to lever and toggle joint. The hydraulic pressure against the piston is 720 lbs. per square inch, giving a total pressure of 200,000 lbs. against the piston. It is obvious that an arrangement like this would allow the tool to gouge into the work should the metal be soft, and, generally speaking, would not offer any means of control of the feed. In order to provide for this control, the rear end of the piston, that is, the end projecting backward from the cylinder, is cut as a very steep screw. A nut revolving on this screw has a worm-wheel with very steep pitch cut on its outer circumference. The angles of the screw and the worm are so chosen that the pressure against the piston will be able to revolve the nut, and the movement of the nut will be able to revolve the worm, but a relatively small amount of resistance on the worm will entirely check this movement. This amount of resistance is provided by ordinary feed mechanism taken from friction discs, which have the necessary change-gears, etc., to enable the operator to get any feed desired. It will be seen, therefore, that the hydraulic cylinder furnishes the pressure and the feed mechanism furnishes the amount of feed, but that the feed mechanism is never subjected to the heavy strains due to the exceedingly heavy work to be done on this machine.

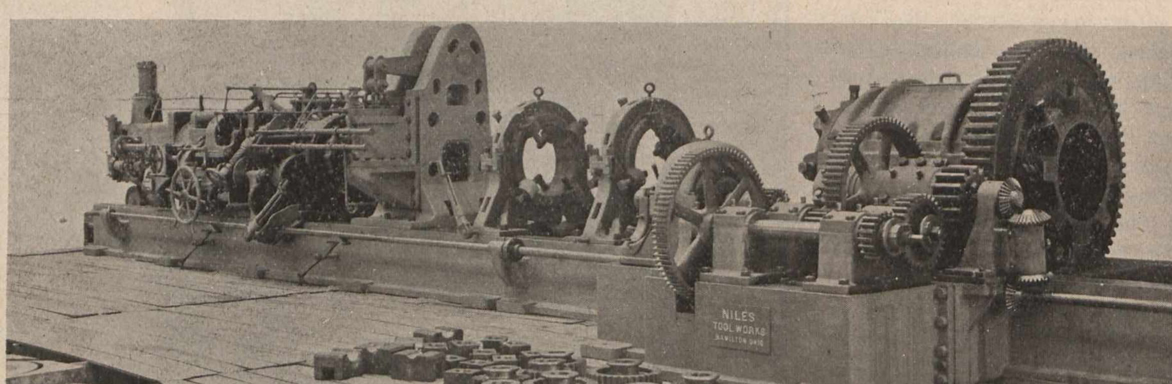
The illustration clearly shows the drive of this machine. It is driven by a 100-h.p. Westinghouse motor, 220 volts. A motor of this make and size always allows of some speed variation by means of field control. The range of speed is increased by change-gears, which are also clearly visible in the illustration. The main driving gear, which is bolted on to the hollow spindle or chuck, has 75 teeth, 4 inches pitch, 10 inches face. It is a steel casting, as is also the spindle. The piece to be bored is chucked by means of set-screws, shown in the illustration. There are eight set-screws, 3½ in. in diameter on each side of the machine. The feed is taken from the last driving-shaft, and is transmitted to the two cylinders by means of the long shaft running alongside and in front of the bed. This shaft is supported by drop-bearings and is made in three pieces coupled together. Change-gears and friction discs give a wide range of feeds. A hand feed is provided for by means of hand wheel. Before using this hand wheel, friction discs and feed driving-shaft are disconnected by means of hand wheel. A 5-h.p. motor gives a fast motion to a train of gearing, whereas the feed mechanism gives a slow motion to this train. Clutch lever throws in either one or the other, and thus gives either a slow feed or a quick traverse of 10 feet per minute to the piston, and, if the cylinder is clamped to the bed, also to the clamping-head, or, if the clamping-head is clamped to the bed, it gives this quick traverse to the cylinder. This quick traverse is really gotten by means of hydraulic pressure in the cylinder, and the small motor only regulates the speed. A hand wheel gives adjustment to the piston and clamping-head, or to the cylinder should this latter be clamped to the bed.



Niles-Bement-Pond Co.'s Hydraulic Boring Lathe.

The parts to be moved being very heavy, it is natural that a great amount of movement of the hand wheel is required in order to produce a small amount of motion of either the clamping-head or cylinder, and, consequently, if the cylinder is travelling at a rate of 10 feet a minute by power, this hand wheel would race at a terrific speed, which would be dangerous to the operator. For this reason, the arrangement of the hand wheel is made in such a way that this hand wheel is loose on its shaft or stud if either the quick traverse or feed is thrown in, and is only connected to the mechanism which moves the cylinder when both feed and quick traverse are out of action, thus avoiding all possibilities of danger.

The train of gearing moved by the motor can be connected to the cylinder mechanism, or it can be connected to the shaft, which, by means of suitable gearing, drives a grooved roll, which is not visible in the illustration, but which is held in a floating frame inside of the rear part of the cylinder casting. This floating frame carries the hydraulic cylinder, the piston of which is connected to this grooved roll while the cylinder casting is connected to two other rollers under the bar. By admitting water in this cylinder the inner boring-bar is clamped between the rollers, and by moving the grooved roll in a quick traverse, motion is imparted to this inner bar.

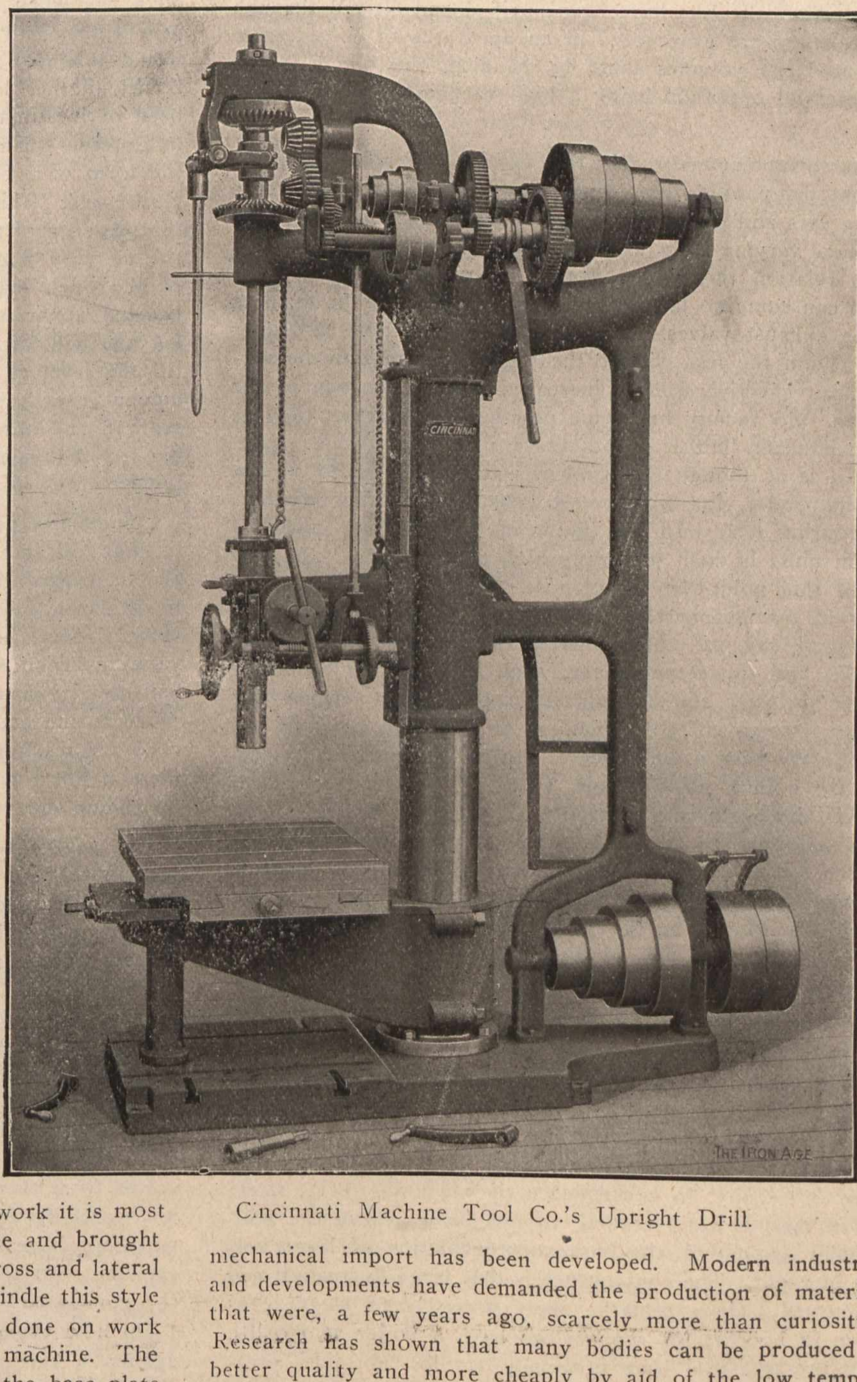


Niles-Bement-Pond Co.'s Hydraulic Boring Lathe—Back View.

The mode of operating this machine is to force 4 feet of the boring-bar into the work. By that time the clamping head is up to the work and 4 feet distant from the cylinder. The quick traverse is then brought into play and the clamping head is pulled back until it comes up to the cylinder. The inner boring-bar is then pushed 4 feet further forward and the boring-bar is once more forced into the work another 4 feet. This alternate action of forcing the bar into the work and drawing the clamping head back so as to take a new grip is repeated until the centre of the work is reached. Before setting up new work, whereby, of course, the position of the clamping head and cylinder may have to be relocated, the following mode of operation is adopted: Supposing the cylinder and clamping head are near the centre of machine and are wanted at the extreme end of the machine; then first clamp the clamping head to the bed and by means of the quick traverse push the cylinder back 4 ft.; then clamp the cylinder to the bed, unclamp the clamping head, and run it back 4 feet. Repeat this cycle of operation as many times as necessary. The inner boring-bar can, of course, be withdrawn in one operation. The piping for the different cylinders is at the rear of the machine supported in brackets or rollers where the piping is sliding. There are handles for operating the various valves both on the front and rear sides of the machine.

CINCINNATI HEAVY PATTERN UPRIGHT DRILLS.

The latest upright drill made by the Cincinnati Machine Tool Co. is here shown, this particular machine being fitted with patent geared tapping attachment on spindle with quick return motion, and also with compound table. The tapping attachment, as illustrated, is applied to machines from 24 inches up, and the manufacturers claim that this attachment makes the drills the most efficient on the market for drilling and tapping work, such as generally done on high-priced machines. These drills fitted with this attachment are but little higher in price than a machine fitted with friction clutch pulleys, when the additional belting and line shaft pulleys are taken into consideration. By the use of this attachment drilling and tapping can be done very much quicker than on machines arranged with friction clutch pulleys, or tight and loose pulleys, as the operator has full control to stop, start and reverse the spindle instantly, thereby being enabled to do a greater amount of work owing to the reduced time in making changes of drills, chucks and sockets. By using this attachment either right or left-hand tapping is done equally well, a forward motion of the lever, shown at the left, starts the tap, and after the required depth has been reached, a movement of the lever in the opposite direction reverses the spindle and returns the tap twice as fast as it went forward. The attachment can be disengaged when no tapping is to be done, thus saving all the parts from wear, leaving the machine a Standard Drill, with the advantage of being able to stop the spindle instantly for making changes of chucks, sockets and drills without stopping the machine at the shifter. The success of this attachment has been so satisfactory that over 50 per cent. of all drills made by the company now embody this. The compound table shown in connection with this drill is very heavy and neat in design, so rigid that it is practically impossible to spring it. For jig and tool-room work it is most desirable, as work can be clamped on the table and brought in proper position to be drilled by use of the cross and lateral feeds. By fitting a milling arbor in the drill spindle this style of table allows milling and key seating to be done on work that cannot be done to advantage on a milling machine. The table can be swung round a column, leaving the base plate free for larger work if necessary. These tables are of very ample dimensions, and are furnished on any machines, from 24 inches up. The 21-inch Cincinnati heavy pattern drills are furnished in stationary head design in four styles, plain, wheel and lever, with back gear, with power and automatic stop, or complete wth back gear, power feed or automatic stop; and any of these machines can be furnished with their patent geared tapping attachment, round or square tables, as may be desired. The Cincinnati heavy pattern sliding head drills are furnished in the following sizes: 24, 28, 32, 36 and 42-inch, and can all be furnished with the patent geared tapping attachment, compound table, square or round tables, as desired. Any of the machines can be furnished with motor drive, either direct geared or belt driven. The new 1904 catalogue will be mailed on addressing the Cincinnati Machine Tool Co., Spring Grove Avenue and Township Street, Cincinnati, Ohio.



Cincinnati Machine Tool Co.'s Upright Drill.

VACUUM PRACTICE AS APPLIED TO LOW TEMPERATURE EVAPORATION.*

By H. G. Spurrier, Toronto Junction.

In all steam power plants of any magnitude, the vacuum pump is one of the necessities of economical power production, and in this connection its operation is well understood. But of late years much of great chemical and mechanical import has been developed. Modern industries and developments have demanded the production of materials that were, a few years ago, scarcely more than curiosities. Research has shown that many bodies can be produced of better quality and more cheaply by aid of the low temperature boiling points secured in vacuum apparatus than by any other method. And, as is always the case, the manufacturer has followed close in the wake of the scientist, and

* A paper read before the Canadian Association of Stationary Engineers.

has converted the science of the laboratory into the art of the factory.

I will confine my remarks to one particular line in which I have, for some time past, been accumulating experience of more or less value. The enormous increase of mining and other operations has resulted in a much increased demand for dynamite, which, in its turn, has much increased the demand for glycerine, which, as you know, is the all important constituent of nitro-glycerine. Glycerine is produced from the animal and vegetable fats and oils which contain from 5 to 11 per cent. This is the source of all the glycerine produced, and it comes by way of the soap industry almost entirely.

It may not be uninteresting to know that fats and oils are definite chemical compounds of fatty acids with glycerine, and in the manufacture of soap the soda used seizes the fat acids forming a soda compound with them, and, at the same time, expelling the glycerine, which is subsequently found in the spent lye. Only a few years ago these spent lyes—which were a long way from being spent—were discharged into the sewers, carrying with them a valuable freight of soda, salt, and glycerine. This is now all changed and no modern soap factory is without its chemist and glycerine plant. After the lyes have been purified and filtered through presses, they are evaporated in an apparatus of considerable size, as large volumes must be handled, the one essential of successful operation being a high vacuum of great steadiness.

At this point we reach the crucial difference between vacuum pan-practice and condensing engine practice. The engine uses and passes on to the condenser a definite volume of steam varying only as the load on the engine, and in direct relation thereto. Should the vacuity increase, the steam can come no faster than it is permitted by the opening of the exhaust valves. But, on the other hand, the higher the vacuum the less will be the steam consumption, because the mean effective will be increased by the increase of the vacuum. So vacuity in engine practice is important only as an economizer, but it is otherwise in the glycerine plant. Here it is as though the condenser is hitched up to a low pressure boiler, for we have a large steam drum continually pouring heat into the liquor in the machine and the vacuum must be kept uniformly high to avoid loss. To emphasize this point, let us suppose that we have 10,000 lbs. liquor in our evaporator, and we are running on a low vacuum of, say, 24″ corresponding to a boiling point of 141 deg. F., and for some reason, such as cooler injection or perhaps a lower steam pressure in the steam drums our vacuum rises to 28″ corresponding to a boiling point of 109 deg. F. We have a difference of 109 to 141, equal to 32 deg. F. in the boiling point. Now, 1 deg. F. per lb. is equal to 1 B.T.U., but we have a difference of 32 deg. F. in each pound, which amounts to 32 x 10,000 = 320,000 B.T.U. suddenly set free. But a compensating occurrence mends matters somewhat, viz., that at 28″ vacuum the latent heat of vaporization is 1043 units, as against 1015 units at 24″ a difference of 28 B.T.U. This multiplied by our 10,000 lbs. would use up 280,000 of our 320,000 thermal units, leaving a balance of 40,000 units of superheat which is suddenly used up in vaporizing the liquor.

Now 40,000 thermal units will vaporize 40 lbs. of liquid boiling at 28″, each pound of which vapor will occupy 334 cubic feet at 28″ vacuum, and 334 x 40 = 13,360 cubic feet. Of course, this sudden generation of vapor so lowers the degree of vacuity, in consequence of which the B.P. rises; but the vacuum again tending to rise brings down the boiling point again with the consequent evolution of large volumes of vapor. The consequence is that large fluctuation and loss ensues. These remarks apply precisely to steam generation in boilers; for suppose we have a boiler at 100 lbs. gauge pressure you have nominally 115 lbs. absolute pressure, whereas at 28″ so-called vacuum you have about 1 lb. absolute pressure. The sudden generation of vapor, consequent upon the sudden rise in vacuity, is the exact counterpart at different pressure of that class of priming in boilers brought about by a suddenly increased demand for steam; for vacuum is only another name for pressure so low that it is less than that which the atmosphere imposes upon us. If steam rises faster than 2 to 3 ft. per second from water, it will carry spray. It would result in making matters much more easy and less ambiguous for engineers were all pressure gauges to read from absolute pressure. We have in the Fahrenheit thermometer a similar misnomer in the zero and below zero degrees, which arose from the ignorance prevailing at the time this thermometer was constructed. We know to-day, and frequently record the fact, that Fahrenheit's zero is not zero—or point of no heat—when we register degrees below zero; and we have in physics also an absolute zero, or, as we would say, 488 deg. F. below zero.

In order to become warned in time of the disastrous fluctuations of vacuity, the author has devised a special gauge and alarm (described elsewhere in this issue), which has resulted in the saving of much valuable material.

In practice our spring gauges show how many inches of vacuum we realize, but they give us no idea of what per cent. of vacuity is reached. For instance, 26″ vacuum on the gauge would represent 92.8 per cent. of vacuity on a day when the barometer read 28″, but the same gauge reading on a day when the barometer read 29.7 would be only 87.6 per cent. With the object of having an instrument which would infallibly show how far short of perfect vacuity we come, another little device was arranged which has also been of inestimable advantage. A glass tube of about 3-16-in. internal diameter was sealed at one end and bent into the form of a close U, the open end being longer than the closed end. This tube was nearly filled, very hot (to avoid the presence of any moisture), with mercury. When erected, the mercury filled the closed leg, the bend, and about 1-in. of the open leg. On connecting this tube with the exhausted apparatus, the mercury will descend in the closed leg and will, of course, rise correspondingly in the open leg, till the level of the mercury in the two legs differs by an amount exactly equal to the difference between the vacuum realized and absolute vacuity (neglecting, of course, the loss due to the vapor tension of mercury which at ordinary temperatures is infinitesimal).

Some few points in regard to pumps and joints may be of practical interest, as coming from practical experiences. In an evaporating glycerine plant there are necessarily many large joints and an almost bewildering number of valves from ¼-in. to 10-in. diameter. On our joints we invariably lavish a generous supply of "asphalt paint," which will stand exhaust steam heat and is immune to the action of acids and alkali, and will allow when warm of the thickened masses being sucked into leaks successfully stopping them if not too large, but, very large leaks may be stopped by adding dry red lead to the paint.

In regard to pump valves, the lighter the better, commensurate with sufficient strength, and in regard to springs I have discarded them entirely on the suction at times and have benefited thereby. In operating stills where the dry vaccum pumps are used only enough water passes to seal the valves, and it is well that they be slung on the underneath of the suction valve plate, the springs being only just strong enough to raise them to their seat. The great importance of a high vacuum on glycerine stills has led to the connecting of a second pump to the discharge of the first. It is manifest that on the dry vacuum pump there must always be sufficient atmosphere of some sort to move the valves from their seats, hence the importance of light valves and carefully adjusted springs—nevertheless on this class of work we have regularly run up to within ⅝-in. of perfect vacuum. Surface condensers are used on this class of work, the condensed material being valuable. In the plant where I am now engaged our pump on the evaporators discharges against a vertical head of 22 feet, and a horizontal run of about 73 ft.; but as this pump handles large volumes of water, we still find it possible to average 28½-in. vacuum. The discharge passes down through a cooling tower, thereby enabling us to operate on about 3,000 gallons.