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The Canadian Engineer.

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

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THE TELEPHONE ENQUIRY.

The Postmaster-General is to be congratulated on the progress already made by the select committee on telephone systems now sitting at Ottawa. In the short period the committee has been in existence, some 500 pages of valuable and instructive testimony has been secured. Among the points brought out by this evidence the following are worth keeping in mind: That there are already a large number of rural telephone systems in Canada being operated by small companies and co-operative associations at a cost which is a revelation when compared with what the Bell Telephone Company demands for the supply of a similar service; that these rural systems require connection with the local exchanges in the adjoining villages or towns, also with the long distance lines, and cannot obtain these facilities, except on terms which are prohibitive; that municipal telephony, so far as it has been tried in Canada, has been a success, financially, and also as regards the number of subscribers, and quality of service given; that the long distance rates are excessive, and that the Bell Telephone Company has entered into agreements with nearly every railway company in the Dominion, and at least one navigation, and one cartage company, for the purpose of creating a monopoly in the use of telephones, by preventing subscribers to other systems from having connection with the offices of these companies.

By far the most important evidence is that relating to the operation of independent and co-operative systems in those parts of Ontario and Quebec, which the Bell Telephone Company has apparently considered of such minor importance as to leave them entirely outside its zone of operations. In each of these cases it has been shown that after the Bell Telephone Company had been approached, and prohibitive terms demanded, those interested had set to work and established a service in their own locality, with the most satisfactory results. These systems have cost from $35 to $50 per telephone for installation, and the expense of operation and maintenance has been so small as to be hardly worth considering, in fact, the tolls paid by non-subscribers is more than sufficient to meet these contingencies.

Very interesting and important testimony was given by Dr. J. T. Demers, manager of the Bellechasse Telephone Co., which operates about 1,200 miles of lines in Quebec, starting at Cap a la Baleine, in the County of Matane, and going up to St. Jean des Chaillons in the County of Lotbinière. The company has 1,300 subscribers, its principal exchanges being at Levis, Montmagny, Rivière-du-Loup, and Rimouski. At the last named place the "Bell" had originally an exchange of 33 subscribers, but so strongly entrenched was Dr. Demers' company that the great monopoly was threatened with ruin unless it sold out to its small competitor, and the "Bell" handed over the system for $2,000. The Rimouski exchange has now 120 subscribers. Farmers in this company's territory obtain a service over the whole of their own county for $12 per annum. The rates in the towns and villages are $15, $20, and $25, according to the number of counties in which the subscriber requires connection. As an illustration of what might be done in regard to a cheap long distance service the witness stated that between Levis and Rivière-du-Loup, a distance of 155 miles, his company charges 25 cents for five minutes conversation, while the "Bell" charges its subscribers 60 cents for three minutes. The Bellechasse Company's line is a copper metallic circuit, and the service between these points is in every respect equal, if not superior to that of the "Bell." So successful has this company been in its operations that a seven per cent dividend has been paid each year since its inception, and Dr. Demers stated this year he anticipated a net profit of fourteen per cent.

This enterprising French doctor has certainly given a practical demonstration that there is more money in telephones legitimately handled for the public benefit, than in medicine.

Ex-Mayor Dyke, of Fort William, also gave important testimony regarding the municipal exchanges at Fort William and Port Arthur, but as the descriptions have already been given of these systems in the Canadian Engineer it is unnecessary to repeat the details here. This witness stated that municipal telephones in these towns are an unqualified success, Fort William having 500 subscribers, and Port Arthur 540, all paying. The number of families in these towns is about 1,000, of which three-fourths are supplied with telephones, and the demand, said the witness, for service "is greater than we can supply, and this without any canvassing."

The evidence submitted to the committee merely shows the necessity of setting free the long distance lines from monopolistic control, and making sure that there shall be no discrimination in regard to the right of all telephone users to connect with the offices of railway and transportation companies.

Much more evidence has to be heard, including that of the Bell Telephone Company, and we have no doubt from the manner in which the select committee is conducting the enquiry, that whatever policy is decided upon the result will be in the interest of the general public, and the telephone business will be relieved from the disabilities which now exist under the "Bell" monopoly. If the Government decides to own the long distance telephone lines, leaving free play to local enterprise and local control, the reform would gain to Canada an ideal service, and at the same time would bring to the Government a new source of income which would increase in importance as this greatest of all modern means of communication extends throughout the Dominion.

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It is now apparent that the ice-breaking steamer Montcalm has not accomplished what she was expected to do in breaking up the ice of the St. Lawrence, and thus opening that great ocean avenue before Nature chooses to unlock the gate. The first attempt of the Montcalm resulted in the breaking of several of her propeller blades. After repairs she steamed out to attack the ice at Cap Rouge, seven miles above Quebec, but this was found to be about twenty-five feet deep, and the vessel had not sufficient depth of hull to cut a complete channel. After working some time she became stuck in the ice and it was several days before she was released. From the interviews of our representatives with captains of river boats and ferry steamers at Quebec, these river men evidently think it impossible to effect an earlier opening of navigation by means of these ice breakers. Russia has succeeded with ice breaking problems, however, in spite of similar predictions of failure, and the Minister of Marine is to be admired for his determination to see the test more thoroughly made, and not to accept mere prophecies of failure as the final word.

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The past month has demonstrated the success of the two new turbine steamers of the Allan line, the Victorian and the Virginian, the first of the regular ocean liners to adopt the turbine principle of propulsion. The Turbinia, of Hamilton, placed in service on Lake Ontario last year, was the first vessel of that type to ply on the Great Lakes, and thus it falls to the honor of Canadian ship owners to be the pioneers of the turbine steamer in the western world. It is now ten years since the original Turbinia, a vessel of 100 feet, appeared in the Solent to astonish the world by doing her 34½ knots an hour. She was regarded as a freak by the majority of marine engineers, who had come to regard all types of rotary engines as among the impractical things; but it was not long before the steam turbine was shown to be even better adapted to large vessels and long voyages than the small craft, and the success of channel turbine boats, culminating in the achievements of the Victorian and Virginian, ships of 12,000 tons, places the turbine engine in the front rank of marine engines of the present day. The last-named made the record voyage from Liverpool to Halifax, namely, in six days and eighteen hours, though she had been delayed somewhat by ice. One day's run was 403 miles. The Victorian was delayed much by fog and bad weather, but in both cases the engineers, captains, and passengers were convinced of the success of the vessels, the passengers in particular being delighted with the smooth running of the ships, and the absence of all vibration. It is just half a century—or to give the exact date, 1856— since the Allan Brothers started running steamers to Montreal with vessels of such primitive types as the Canadian, of only a few hundred tons, after carrying on trade with Canada for years in sailing vessels only. The Allan steamer Hibernian, which was sent out to Montreal in 1861, was the first Atlantic steamer with a promenade deck extending from stem to stern, affording protection to the deck houses. As these ventures were considered bold ones in those days so the present advance is an evidence of courage and foresight characteristic of the company, which has been so intimately associated with the progress of Canadian trade in the past half century. That the present directors of the Allan line appreciate the identity of interest which has led it to keep step with the development of the country is evident from the sentiments of Nathaniel Dunlop, senior member of the company, who, in the course of a speech at a luncheon at Liverpool before the Victorian sailed, said: "Canada has to bide its time, but I have the most absolute confidence that the day is coming, and is not far distant, when its trunk lines of railway will connect with a great terminal port nearer the open ocean than the existing one in the St. Lawrence, and then Canada will become the great highway of the American continent, and its ocean route will be unequalled for speed and comfort."

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The troubles of the town of Napanee have served to set forth in a very strong light the extent to which a community may be made to suffer under the Conmee Act of Ontario when a private company chooses to avail itself of every coign of vantage which that Act gives it in dealing with municipalities. The Act was intended to prevent a city or town from "confiscating" the property of a private company in the process of expropriation, and the framers of it have certainly succeeded in fortifying themselves against that contingency. It is a question whether they have not overshot the mark, as private corporations that deal with public franchises are apt to do, when the Act enables an enfranchised private company to play the dog in the manger to the extent of refusing to give service, and yet preventing a town from serving the citizens on its own account. By the sketch of the Napanee case given in another part of this issue it is apparent that grave mistakes were made in the designing of each of the three plants, and no one of them could have been reorganized without a loss. None of them paid dividends, and what the owners wanted was that the town should pay for the loss entailed by these errors of judgment. And when the town refused to be "held up" the company simply shut off its lights and power, and left the citizens to coal oil lamps and lanterns. When the town proposed arbitration, the company replied in the language of the United States press when the Alaska boundary dispute came up, "There's nothing to arbitrate." Then when it became evident that the town was appealing to the Legislature the company consented to arbitrate on condition that the town would buy one of its useless plants—a proposal that would take out of the field of arbitration the only point worth arbitrating, from the town's side of the case. The result of this effort of private ownership to obtain the full pound of flesh is that Napanee has been entirely freed from the restrictions of the Conmee Act, and that measure stands condemned in one important respect. From losses arising out of their own mistakes private companies cannot expect to be exempt any more than other individuals, who have to suffer for their want of knowledge or want of judgment. The fact of their holding a public franchise confers upon them no right of immunity in this regard, and where they appeal to public sympathy they should at least show some consideration for the public needs in return. The exemption of Napanee from the Act is not enough; the Act itself should be amended so it will be just as impossible for a private company to play the dog in the manger with a town as it is now impossible for a municipality to confiscate the property of the private corporation.

THE METRIC FALLACY.

Editor Canadian Engineer:

In the March issue of the Canadian Engineer, there appeared a letter by Albert S. Merrill, supporting the Metric System, but containing so many errors that they should not be allowed to pass without correction.

Mr. Merrill says: "It is of little consequence to know the exact number of countries which have adopted this system." Did you ever see a dish of sour grapes? A list of countries to the number of forty-three, which are assumed by the metricites to use this system, forms a stock part of all pro-metric literature; but now that it has been shown how imperfect is the adoption of the system in many of these countries, Mr. Merrill tells us that the list is of "little consequence." Whatever your readers may think of this, they will, I think consider it of much consequence that the metricites have based their case upon simple assumptions which have now been proven to be untrue.

Of the "Reports of Her Majesty's Representatives Abroad," to which Mr. Merrill refers, it should be said that, like all enquiries of this kind, prior to the one undertaken by Mr. Dale and myself, they related to commercial and not to factory units of measure. Her Majesty's representatives did not discover, for example, that while French silk fabrics are *sold* by the meter, they are *made* by the aune; they did not discover that while German cotton fabrics are *sold* by the meter they are *made* by the English yard.

It is useless to quote the results of enquiries regarding commercial units against the results of our enquiry regarding factory units. The metricites have always assumed that in metric countries factory units were, of course, purely metric, whereas wherever Mr. Dale and I have succeeded in getting behind the factory doors, we have found old units in swarms. Until our facts are disproven—which they cannot be—our case must stand.

In the countries which Mr. Merrill quotes from, these reports the commercial use of the system is, without exception, compulsory. The people use it commercially because they are compelled to do so—because they have no choice in the matter. Whenever we enquire into the situation in countries in which the use of the system is optional, that is in which the people are given a choice, we uniformly find that they condemn the system by refusing to use it, and this is true of many of the countries which form part of the regular list of countries which, according to the metricites long ago, (in the case of Greece 70 years ago), "adopted" the system. There are many of these countries in which the use of the system is optional among the people, and in no country of this kind is the system the usual one in trade and commerce. These statements are facts, which no amount of metric sophistry can obscure.

Mr. Merrill says that Monsieur Chalon "demonstrated by numerous examples that the old names, which persist in France, were not the old measures; they were simply popular expressions habitually used to express certain metric and decimal divisions." It is well known that the old French inch is the common short unit of measure in French textile mills, and it is also well known that it measures 37 to the meter. I have in my possession a scale containing these French inches, and the above is their ratio to the meter. Will Mr. Merrill please name the metric unit for which the French inch stands, and also the metric unit of which it is a decimal division? M. Paul Lamoitier, one of the collaborators of l'Industrie Textile, says in that paper, when speaking of the conditions in the French textile industry, "we are as much in the anarchy of weights and measures in the textile industry as at the time of the Revolution, for we have the denier . . . the aune . . . the moque . . . the livre, the quart, the sous, the yard . . . etc. Ah! the famous aune, do you know its value? Exactly 3 feet 7 inches 10 lines 10 points, or, in other words, 1,188,447 meters."

Will Mr. Merrill be so good as to tell your readers for what new units these old names stand, especially the aune, the value of which is given with so much exactness by M. Lamoitier?

The livre is equal to half a kilogram, and none of the other units in this list can by any stretch of the imagination be called metric. This explanation is born of desperation and is not true. Repeating this disproven story does no credit to Mr. Merrill's knowledge of the facts.

Mr. Merrill tells us: "The Metric System has been repeatedly endorsed by congresses of textile manufacturers in Europe," and he is quite right. They have endorsed, re-endorsed, and endorsed it again, but somehow the textile mills go on using the old units. Your readers should understand that Mr. Dale has demonstrated that, except in the cotton industry in France (which uses the meter as a long and the inch as a short unit of length) the textile mills of metric Europe do not use the Metric System as a mill system. Of what matter is it if congresses go on endorsing it to the end of time so long as the mills ignore their recommendations?

Your readers will recognize, if Mr. Merrill does not, that the object of these numerous European textile congresses—the introduction of the Metric System in the textile industry—is a confession that the system is not now used in that industry as are all their recommendations that it be used. They will also recognize that the congresses flatly contradict all claims that the old names are "popular expressions habitually used to express certain metric and decimal divisions."

In his reference to these endorsements, Mr. Merrill exhibits the weakness of the metric case, which rests on resolutions and laws and not on the practice of the people.

Their list of metric countries is made up of those that have passed laws of some kind favorable to the system, these laws ranging all the way from those which, like our own, merely permit the use of the system to those which compel its use, but all of which are treated alike. Do you doubt it? Then turn to page XVIII. of any number of the Monthly Bulletin of the International Bureau of American Republics, issued from the Government Printing Office, at Washington, and you will find the following printed from standing type:

"The Metric System has been adopted by the following named countries: Argentine Republic, Bolivia, Brazil, Chili, Colombia, Costa Rica, Ecuador, Honduras, Mexico, Paraguay, United States of America and Venezuela."

I will not characterize this statement for it is unnecessary. Your readers should take it as an illustration of how little is needed to place a country in the metric list, for our country is not the only one there which is placed there because it has passed a permissive law and done nothing more. Information which I have, and which is referred to more at length in the next paragraph, shows that in many of the countries of the above list the system is not used by the people any more than in our own.

Mr. Merrill objects to my statement that "nowhere has the system been adopted by any people except under compulsion." I have in my possession a collection of letters from

United States Consuls residing in metric countries, the result of a circular letter of enquiry, from which, together with other information, which is equally reliable, it appears that the scheme which is behind the bill still, in a technical sense, before Congress, viz., the adoption of the system for Government purposes in the expectation that the people will soon follow the example of the Government, has now been tried fourteen times, and that laws providing for such Government use are now in force in fourteen countries. These laws are of all ages up to seventy years in Greece, and the information referred to demonstrates that in none of these countries has the example of the Government been generally followed by the people, and that in most of them the people use the system practically not at all. Whatever opinion one may have of the merits of the Metric System and of the wisdom of its adoption, no sensible man can read these consular letters without the conviction that our proposed law is foredoomed to failure, and that the only rational thing to do with it is to abandon it. Fourteen failures ought to be enough. This may sound like "extravagant language" to Mr. Merrill, but more important than this it is true. In view of the disclosures which have now been made, the old claims for the universality of this system can now be repeated only by those who are ignorant or crazy.

The metric case is based upon a supposed state of confusion, a supposed superfluity of units and a supposed series of bad ratios between those units; all of which this bill is intended to remove. Similar laws elsewhere have only served to increase the number of units in a given country, and to introduce far worse ratios between the old and the new units than any previously existing; in other words to do the very opposite of what was intended. In view of this experience continued advocacy of the measure by the metricites is only a case of self stultification.

It is literally true that no people have ever been induced to make common use of this system except by the force of compulsory laws, and I am unable to understand why it should be necessary to compel people to use such a wonderfully superior thing as this is represented to be.

Mr. Merrill says: "The adoption of the Metric System need no more affect the present trade sizes than it would affect the size of a shop in which the articles are manufactured." But he contradicts himself near the bottom of the same column, where he says: "When he [the manufacturer], makes new patterns and drawings, he will naturally make them in the Metric System." Unless the adoption of the system is accompanied by a change in trade sizes then its adoption is meaningless and purposeless. Its adoption in other countries has uniformly meant this very thing, and to the extent to which the system has been adopted this change has been made. In all manufacturing countries there are, however, many exceptions in which the change has not been made, and in these exceptions they use the old units.

Mr. Merrill refers to the opinions of those who have used the Metric System which have been published in the American Machinist, and in this connection it is pertinent to refer to the vote taken among its members by the National Association of Manufacturers a year ago. The questions submitted were so worded that those who had used the system could be identified and their opinions separated from the others. One of the questions asked was if any advantage could be seen from the adoption of the system, and to this, those who had used it, voted 1.44 to 1 that they could see no such advantage, this vote rising in the case of those whose industries came into the metal trade classification, in which you and I are chiefly interested, to 4.1 to 1.

Mr. Merrill says: "The active opponents of the Metric System in the United States are few." In reply to this, I will remind you that the vote of the National Association of Manufacturers—the largest association of its kind in the world—stood 3.35 to 1 against the adoption of the system in Government business. This association not only polled its own members, but it asked many other associations to do the same. As an answer to Mr. Merrill's assertion that the active opponents of the system are few, I include below a clipping from American Industries, the official organ of the National Association of Manufacturers, in which is given the result of this great canvass. So far from Mr. Merrill's statement being true, the fact is that the metricites are too few in number to be worth counting, though it must be acknowledged that they make up in noise what they lack in numbers:

"In order to obtain a still wider expression of opinion, the Association invited a considerable number of other commercial and manufacturing associations to poll their members upon the subject, and in a gratifying number of cases its suggestion has been acted upon. The results are given in Table 4, in which are also incorporated the positions of some associations which have been taken without suggestion on the part of the Association.

"In most cases the vote was upon the following questions, which were sent out by the Association, in order to assist in insuring uniformity:

"In favor of the adoption of the Metric System of Weights and Measures as the legal standard in the United States?

"Against the adoption of the Metric System of Weights and Measures as the legal standard in the United States?

"In favor of the adoption of the Metric System in the Departments of the Federal Government?

"Against the adoption of the Metric System in the Departments of the Federal Government?

"In a few cases other questions were added to the ballots, and in a few others the votes took the form of resolutions passed at conventions."

"The following table contains the results of all pollings of associations of which the Association has any official knowledge. Similar tables which have been published elsewhere have been found to contain so many errors as to make it necessary to omit them:"

Manufacturers' and Builders' Associations.

Against Measure, 21.

American Iron and Steel Association, Philadelphia, Pa.
Carriage Builders' National Asso., Wilmington, Del.
Worcester Metal Trades Association, Worcester, Mass.
National Association Heating Engineers and Contractors, Boston, Mass.
Buffalo Foundrymen's Association, Buffalo, N.Y.
Syracuse Foundrymen's Association, Syracuse, N.Y.
Cook County Foundrymen's Association, Chicago, Ill.
Engine Builders' Association of U. S., Syracuse, N.Y.
Southern Lumber Manufacturers' Asso., St. Louis, Mo.
Pennsylvania Lumbermen's Association, Scranton, Pa.
Manufacturers' Association of New York, Brooklyn, N.Y.
Evansville Manufacturers' Association, Evansville, Ind.
Builders' Exchange League, Pittsburg, Pa.
Contractors' Association, Cincinnati, Ohio.
National Association of Builders, Boston, Mass.
Master Builders' Association, Denver, Col.
National Brick Manufacturers' Asso., Horseheads, N.Y.
Founders' and Employers' Association, Los Angeles, Cal.
National Association of Machine Tool Builders.
The Furniture Association of America.
National Metal Trades Association.

For Measure, 2.

American Foundrymen's Association, New York.
For q., 10.
Against q., 11.
Manufacturers' and Producers' Association of California, San Francisco.

Commercial Associations.

Against Measure, 14.

Holyoke Business Men's Association, Holyoke, Mass.
Merchants' and Manufacturers' Association, Bessemer, Ala.
Board of Trade, Tampa, Fla.
Board of Trade, Indianapolis, Ind.
Minneapolis Retail Hardware Asso., Minneapolis, Minn.
Trade Journal Association, Detroit, Mich.
Merchants' Association, New York.
Iowa Implement Dealers' Association, Nevada, Ia.
Board of Trade, Kansas City, Mo.
Quincy Freight Bureau, Quincy, Ill.
Business Men's Exchange, Erie, Pa.
Chamber of Commerce, Tacoma, Wash.
Chamber of Commerce, Milwaukee, Wis.
Georgia State Agricultural Society, Augusta, Ga.

For Measure, 9.

Boston Chamber of Commerce.
Board of Trade, Bridgeport, Conn.
Merchants' Association, Evansville, Ind.
Chamber of Commerce, Galveston, Tex.
S. W. Mercantile Association, St. Louis.
Pacific Coast Hardware and Metal Association, San Francisco, Cal.
For q., 10.
Against q., 11.
Business Men's Association, Elkhart, Ind.
Board of Trade, Los Angeles, Cal.
Board of Trade, St. Paul, Minn.

Engineering and Technical Associations.

For Measure, 3.

Boston Society of Civil Engineers, Boston, Mass.
Engineers' Society of Western Pennsylvania, Pittsburg.
Western Society of Engineers, Chicago, Ill.

Against Measure, 7.

American Society of Mechanical Engineers.
Association of Railway Master Mechanics.
Master Car Builders' Association.
Providence Association of Mechanical Engineers.
Society of Naval Architects and Marine Engineers.
American Society of Heating and Ventilating Engineers.
Society of Engineers of Western New York, Buffalo, N.Y.

To offset this exhibit the metricites have, to the best of my knowledge and belief, no national association representing mechanical manufacturing interests except the American Institute of Electrical Engineers, and they have that by a vote of its board of directors, and not by a vote of its members; and the American Foundrymen's Association, which divides upon the two questions submitted. Of their case and its support it may be said: "Behold, how great a matter a little fire kindleth."

Mr. Merrill says also: "They appear not to see that we are really in the transition period." The assumption that the metric system is already in considerable use in this country is a favorite one of the metricites, but, like their other claims, it will not bear examination. The vote of this great association of manufacturers, numbering at that time 2,800 members, succeeded in disclosing just fifteen members who had used the system to the extent of five per cent. of their product or more, and sixty-six others who had used it in occasional and sporadic cases.

Further comment is, I think, unnecessary, except to say that it is time for the metricites to come down from the cloud of speculation and consult the facts. It is time for them to give up assuming anything on earth to be true, which they would like to have true, and to base their case upon fact, and not fancy.

FREDERICK A. HALSEY.

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AN ACETYLENE EXPLOSION.

The Dominion Government steamer Scout was the scene of a disastrous explosion on the 18th ult., while she was in Kingston harbor. The Scout is a buoy tender and is fitted with an acetylene generator and tanks. The buoys are filled on board the steamer and at the time of the explosion two had been filled and the crew were working on a third. The explosion was so violent as to shatter windows a mile away, while the sound was heard at a distance of thirteen miles. One man, Fred. Mullen, mate, is known to have been instantly killed; two others, Evan Gillard and Capt. Fred. Couillard, are believed to have been blow to pieces, no traces of them save a few shreds of flesh having been found; and Capt. Allison, of Morrisburg, was so badly burned and otherwise injured that he died the next morning. Other members of the crew were slightly injured. Immediately after the explosion, the boat became a mass of flames, the acetylene on board affording fuel which kept the fire raging for an hour in spite of the efforts of the fire department.

At the inquest which was held over the body of Mullen, it was fairly well established that the explosion was due to defective welding in the buoy. J. R. Arnoldi, of Toronto, testified that the metal in the buoys was far from uniform, and he further held that there was frost in the buoys and that this aided in the explosion. Several witnesses were called and examined as to the properties of acetylene, etc., but, unfortunately, the men who could throw most light on the incident are dead. The jury brought in a verdict as follows:

"That the deceased, Frederick Mullen, came to his death through the explosion of a buoy filled with acetylene gas, from the Government steamer Scout. We are of the opinon that the evidence does not definitely show the cause of the explosion. We are strongly of the opinion that the buoys should be thoroughly inspected each year and subjected to a sufficient pressure test. We would strongly urge that all such buoys should be filled at some place where the safety of the general public would be least imperilled."

Fig. 1.

The Government has appointed a board of enquiry, consisting of Edward Adams, chairman of the board of steamboat Inspectors, Ottawa; John Dods, boiler inspector, Toronto; and J. P. Thompson, boiler inspector, Kingston. The enquiry will be most thorough, and up to time of writing the investigation is not complete. George T. Merwin, agent for the manufacturers of the buoys, testified that a pressure of fifteen atmospheres was put into the buoys, and in his opinion they should be safe under this pressure. No guarantee, however, was ever asked of the manufacturers, but the purchasers were simply told that the buoys had been tested to 300 pounds. Members

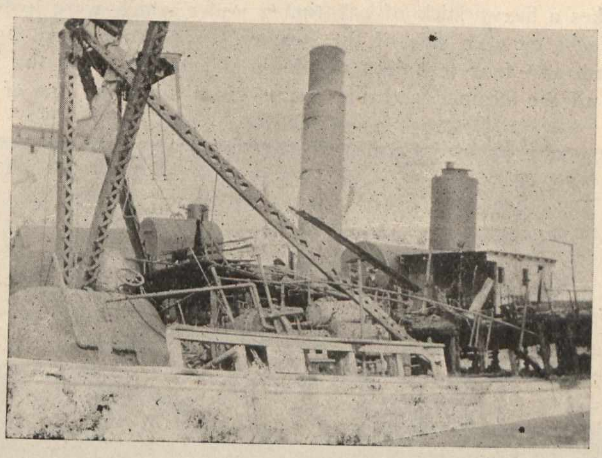


Fig. 2.

of the crew have been examined but no other information was brought out beside what had been given at the inquest. Capt. Fraser, Commissioner of Lights, was examined, and he stated that the buoy had been found structurally weak, and no other reason could be advanced for the explosion.

The general opinion seems to be that the buoy exploded because of defective construction, and the escaping gas was ignited by coming into contact with the fire in the furnace of the boat

In Fig. 1 will be seen a complete buoy which, although partly charged, did not explode. To the left are shown the bottoms of the two exploded buoys. The one nearest the complete buoy shows three distinct flaws in the welding of the bottom part of the tank. The buoys were made in Germany, and it is stated that no such welding job would have been allowed in Canada, but rivets would be used. The buoys are made of ¾" plate. Their size may be judged by the snubbing post shown on the pier.

Fig. 2 is a view amidships looking down off pier, and it will be seen how cabin, upper structure, and even boiler and engine room were torn up by the explosion. The effects of the fire are also plainly visible.

Fig. 3 shows a general view of the boat after the explosion.

The Scout was built in 1897, at Morrisburg, and is employed in handling buoys between Kingston and Quebec. As originally built, she was 75 feet long, 23 feet wide, 10 feet deep, and 7 feet 6 inches in draft, with very full ends, bluff scow bow, built very heavy with double frame to stand the heavy work required of her. As the demands of river navigation increased, a better buoy service was necessary, and it was decided to lengthen the Scout by 25 feet to be added to the bow, change her engines, increase her speed, lighten her draft and

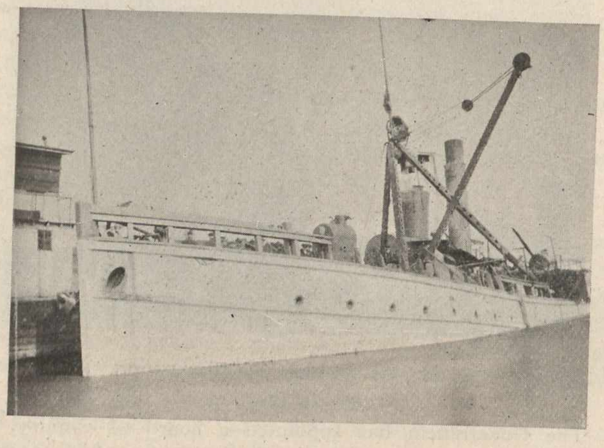
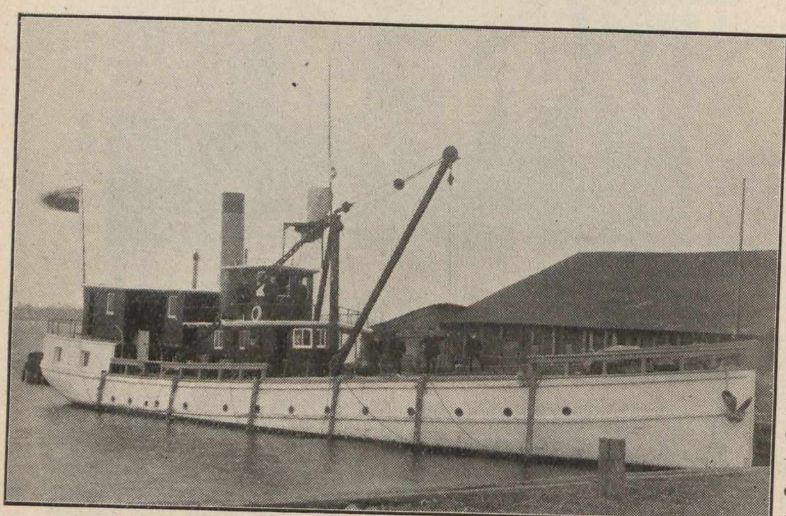


Fig. 3.

improve her accommodations. The contract for lengthening the steamer was taken by the Davis Dry Dock Co., of Kingston, and was executed during the winter of 1903-04. At the time the contract was taken the steamer was frozen solidly in 12 inches of ice with no dock or railway open upon which to do the work, so the contractors raised the forward part of the boat above water (the stern resting on hard bottom in eight feet of water), by placing through the hull below the clamp strakes a heavy stick of oak timber under which were hydraulic jacks on each side of the steamer. A pontoon about 25 ft. square and four feet deep was built and placed under the bottom of the steamer, and piles were driven along the line of the



Dominion Government Steamer Scout, before the Accident.

new keel when it was laid. New machinery was supplied by the Kingston Foundry. The steamer had twin screws driven by 10 by 12 high pressure engines, but the engines were replaced with fore and aft compound 9 and 16 by 14 using the same boiler, shafts and wheels. The advantages gained by the changes were: draft reduced from 7 ft. 6 in. to 6 ft. 2 in.; speed increased from 7½ to 10 miles per hour; saving in fuel of from 10 to 15 per cent.

(Photos 1, 2, and 3, are by A. W. McMahon, Kingston.)

DOMINION TELEPHONES.

"The Bell telephone octopus is finding it more difficult to plant its fibres in every nook and corner of the Canadian structure than it was to secure the control of this essential public service in the States. The Government has given a pledge that during the current year a careful investigation will be made with the view of ascertaining if it may be expedient to have the Government own and operate the entire long-distance system. Inspired by this hope, the General Assembly of Manitoba has refused to confer a franchise which would cover that entire territory and unite all its municipalities in the one general system. Likewise the town of Fernie has refused to grant a local charter, believing that even the local "calls" should be under the general province system. With characteristic progressiveness all the cities of the Western Provinces have joined this public ownership crusade, and are applying collectively to the Dominion Parliament at Ottawa for legislative protection against the Bell Telephone Company, which has of late, in its last determined struggle, been establishing its charter right to make use of the streets and highways not only without the consent, but against the direct will, of the municipal corporations charged with the maintenance and supervision of city thoroughfares. The outcome is too remote for specific prediction, but it is very evident that the public demand for a national telephone service is widespread. The "Toronto Globe" insists that it is the first public utility that the Government should control. It is not an institution of costly operations like either the telegraph or the railroads. In fact, it is infinitely simpler and more profitable than the post-office. For Canada's good let the Dominion Telephone come. Then the United States may learn through Canada's doing."—Collier's Weekly.

POWER FROM GARBAGE.

The question of using garbage destructor plants for generating electric power having recently come before the Toronto city council, Mr. Rust, the city engineer, was asked to make a report on the subject. In this report which has now been presented, Mr. Rust says that while a number of destructor plants in England are used for generating steam for electric lighting and other purposes, no city in America has adopted this practice, largely owing to the low calorific value of the waste material. In England a large amount of unconsumed coal is obtained from the open fires, whereas in this country the coal is almost entirely consumed. It is found that to realize satisfactory and economical results, it is necessary to obtain an evaporation of at least one pound of steam per pound of refuse, and he doubts that such good results could be obtained in this country. In England the best results are obtained in the mining district where coal is cheap.

Among cities in England where successful steam raising destructor plants have been in operation are, Oldham, Farrington, Fulham, St. Helens, Shoreditch, Cambridge, Accrington, etc. The results obtained from these cities demonstrate that a considerable amount of energy can be obtained from refuse furnaces and that the refuse from each locality has a particular and fairly distinct calorific value. A great difference may be noticed among these plants in the amount of water evaporated per pound of refuse burned. This, however, may be usually accounted for owing to the different class of refuse dealt with or the design of the plant. It has, however, been found that in most continental cities it is impossible to raise steam of any value.

Regarding the Shoreditch (London) plant, Mr. Rust quotes the following from a technical journal:—

"The Shoreditch Combined Electric Supply Works and Refuse Destructor is perhaps the largest of this kind at present at work. The average amount of refuse received per day is 84 tons. After leaving the electric light engines, the exhaust steam is passed from a main to heaters in the public baths and wash house, adjoining the generator station and the gas from the feed pump is used for heating a free library. Experience at Shoreditch shows that in operating coal fires in conjunction with refuse, the full efficiency of the coal is not obtained as in an independent boiler, the reason being that during the process of clinkering the refuse furnaces, a considerable amount of cold air unavoidably finds its way to the boiler tubes. The clinker and fine ash are used for making mortar and concrete and artificial paving stones. There is considerable fluctuation of steam pressure which is troublesome at times. The calorific value of refuse at Shoreditch works out from the tests as practically one pound of water per pound of refuse burned. The trouble with a destructor plant in conjunction with an electric light plant was that the material was delivered practically steadily all day, whereas in the ordinary electric light station, the peak came on at the beginning of the dusk and went off very quickly from 6 to 7 o'clock. The type adopted at Shoreditch is, two furnaces are placed one on either side of a water tube boiler and the gases from the destructor pass sideways into the boiler furnace and thence between the tubes to the flues."

It has been found that there is often considerable difference between the value of the winter and summer refuse, the winter refuse generally being of higher value. To satisfactorily operate high temperature destructors, it is necessary to have forced draft, preferably heated, appliances for drying the refuse before putting it on the grates, and a combustion chamber in which all gases are mixed and brought to a high state of incandescence and their temperature equalized as far as possible.

NOTES ON CONCRETE.*

Cement.

This paper will consider concrete made from hydraulic cement only, as we now have on the market such a number of brands of this cement (both native and imported), of such excellent quality and such reasonable price, that in very rare cases will it be advisable to use lime in important engineering structures, requiring strength or durability when exposed to the action of water.

Such hydraulic or "Portland" cements are generally manufactured by the grinding together and fusing and subsequent grinding of clay and limestone in proper proportion. The clay may be in the form of shale, and the limestone in the form of marl, and we, therefore, have "rock cements" made from shale and limestone or from argillaceous limestones or "marl cements" made from marl and clay.

Cement made from blast furnace slag is made extensively in Europe, and appears to be highly esteemed.

By careful attention to the chemical constituents and fine grinding, the tensile strength and uniformity of behavior of these artificial cements have been very greatly improved of recent years, and in these and all other good qualities, I am glad to be in a position to state that several of our Canadian cements are excelled by none in the market.

"Standard Specifications for Portland Cement," prepared by a committee of the C. Soc. C.E., January, 1903, requires that:

"A maximum residue of 10 per cent. shall be retained on a sieve of 10,000 meshes per square inch, and the whole of the cement shall pass through a sieve of 2,500 meshes to the square inch.

"The specific gravity shall be between 3.09 and 3.25 for cement not over two months old."

Tensile strengths in pounds per square inch are required as follows:

	Tensile Strengths.			Compressive. Strengths.
	3 Days.	7 Days.	28 Days.	28 Days.
Neat	250	400	500	....
3 standard sand to 1 cement	....	125	200	2,000 lbs.

The above specification is lenient, and it is common to specify a fineness such that at least 95 per cent. shall pass through a 100 mesh sieve, and that neat cement shall bear a tensile strain per square inch at 3 days of 300 lbs.; 7 days, 450 lbs.; 28 days, 600 lbs.

The writer has been offered Canadian cement at market price guaranteed 95 per cent. to pass through a 100 mesh sieve, and about 80 per cent. to pass through a 200 mesh sieve, to test neat, in 2 days, 250 lbs.; 7 days, 800 lbs.; 28 days, 900 lbs.; and 3 to 1:—7 days, 250 lbs.; 28 days, 350 lbs.; 3 months, 400 lbs.

The time of setting generally desirable is for initial set from one to two hours, final set about 5 to 8 hours.

Perhaps the most important quality of cement (that of "soundness"), is best tested by making neat cement mortar pats about 3 inches diameter and ¼-inch thick in centre with thin edges on clean pieces of glass. These pats are allowed to set under a damp cloth and are then exposed to warm vapor—about 130 degrees F—in a covered vessel for several hours, and afterwards boiled in water for several hours longer. These pats on removal from the water should not be curled up nor distorted nor show cracks on the surface. When separated from the glass the pats should, when broken, break with a sharp, crisp ring and show a good measure of strength.

The above boiling test for soundness is generally considered severe, and probably some good cements will not stand successfully the boiling test, which is not definitely specified by the committee of the C. Soc. C.E. At the same time most manufacturers in Canada sell their cement subject to this test, and it is believed that an unsound cement will fail under this test.

The test for soundness is given more in detail than some of the other tests because, for small or not very important works, it is not practicable to start a complete laboratory for testing, and in such cases, the engineer is perfectly safe if his cement stands the test for soundness, feels fine like flour when rubbed between the fingers, and sets in a reasonable time. For all extensive or important works a testing laboratory is necessary, and should be established under charge of a competent engineer to test all concrete materials, to determine not only the quality of the cement but the amount of clay in the sand, gravel and broken stone, and the most economical proportions of these materials to use in the different portions of the works.

Before leaving the subject of cement, it may be noted that though we know so much about the chemistry of cement, there are many problems yet unsolved, and among them is the effect of varying proportions of magnesia which is not yet satisfactorily determined, though generally we specify that cement shall not contain over 3 per cent. of magnesia.

Sand.

Sand to be used with cement is generally specified to be sharp, clean and coarse. Standard sand used for testing purposes is quartz crushed to pass through a 20-mesh screen and be retained on a 30-mesh screen. Experiments made by E. C. Clarke, of the Boston Drainage Works, show that the finer the sand the less the strength. Experiments made by O. B. Suhr, resident engineer of the Niagara Construction Co., of Niagara Falls, Ont., indicate that the best results were obtained with a sand containing all sizes of particles in proportions to make a dense mixture, and, therefore, pit sand briquettes gave higher tensile tests than crushed granite sand, and crushed limestone —to pass through a ⅛-inch mesh—used as sand, gave about the same tensile strengths as pit sand.

The results of experiments carried out by the writer during the past season are in accord with these results.

Tests for abrasive strengths carried out by Mr. Suhr, show that cubes of neat cement, crushed granite sand and cement 3 to 1, pit sand and cement 3 to 1, and crushed limestone and cement 3 to 1, showed results advancing in strength in the order named, probably on account of the limestone and cement being of comparatively equal hardness, while the quartz particles in the granite sand broke out leaving the softer cement exposed to the wear.

Captain H. Taylor made experiments with standard sand, beach sand from mouth of Merrimac river and crusher dust with cement 3 to 1, 4 to 1, and 5 to 1. He found the tensile strength of the dust mortar to be about double that of mortar made from standard sand and about 2½ times that from beach sand. In accordance with these results, it was determined to construct the Boston Harbor Works on concrete, using crusher dust for sand.

Clarke found that adding clay gives a much more dense, plastic, water-tight paste. Half a part of clay did not seem to weaken mortar materially except in the case of sample blocks exposed to the weather for 2½ years after a week's hardening in water.

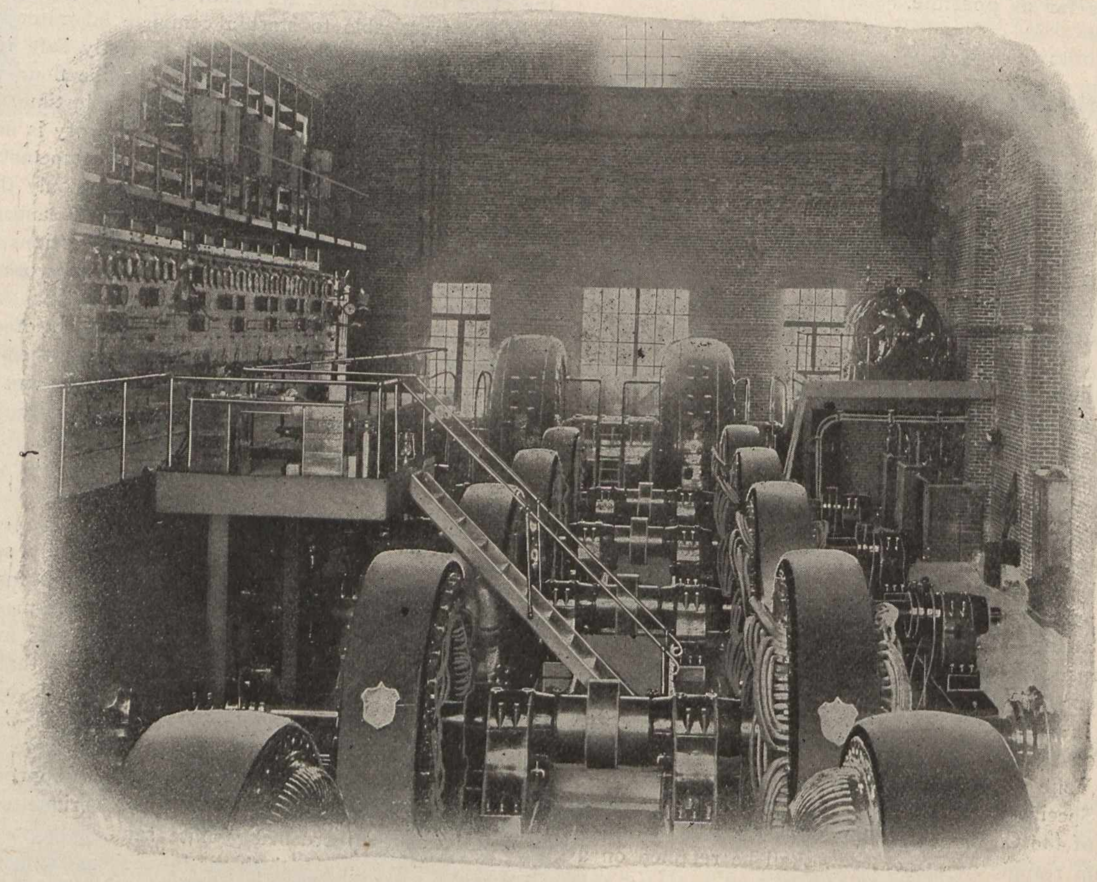
Some experiments noted in the Engineering News during the past year indicate that a small proportion of clay added to the mortar gives it an increased tensile strength.

(To be continued.)

*Abstract of a paper read by R. W. Leonard, C.E., St. Catharines, Ont., before the Canadian Mining Institute, Montreal meeting, March, 1905.

MONTREAL SUB-STATION OF SHAWINIGAN WATER AND POWER CO.

A notable feat in electrical engineering has been the building, erection, and operation of the machinery at the Montreal sub-station of the Shawinigan Water and Power Co., required to convert 15,000-h.p. received from Shawinigan Falls, 86 miles distant for use in the city of Montreal. We are enabled this month to show a photograph of the interior of this sub-station, and in this connection we give some details of the equipment at the risk of repeating some information published last month. The contract called for delivery at 60 cycles, and as it was more convenient to transmit at 30 cycles, it was decided to change the frequency at Montreal by synchronous motor-generator sets. For this purpose there have been installed by Allis-Chalmers-Bullock, Limited, who had the contract, one 8,000-h.p. frequency changer, five 1,000-h.p. frequency changers, and two 900-K.W., three-phase transformers, built by the Bullock Electric Manufacturing Co., of Cincinnati. In addition there have been installed two 800-K.W. rotary converters, built in the shops of Allis-Chalmers-Bullock, Limited, Montreal, to supply direct current to the Montreal Street Railway.



Montreal Sub-station of Shawinigan Water and Power Co.

The 8,000-h.p. frequency change consists of a 5,750-K.W. alternating current generator, an 8,000-h.p. synchronous motor, and a direct connected induction motor for starting purposes, all on the same base, 30 feet in length. This set is not only the largest frequency changer ever built, but is composed of the largest alternating current generator in operation at the present time, and the largest electric motor ever built.

The view of the power house, here given, shows the five smaller frequency changers in the foreground. The large one is at the end of the building. Owing to the lack of space, it was necessary to mount the exciter for this on a platform about 12 feet high, shown at the rear corner. The exciter consists of a 200-K.W., 120-volt, direct current generator directly connected to a 300-h.p. induction motor of 400 revolutions, built by Allis-Chalmers-Bullock, Limited, Montreal.

❧ ❧ ❧

Smith's Falls is to have a wireless telegraph station connecting with Ottawa, Toronto, Montreal, and other large centres.

ESSENTIAL ELEMENTS IN THE DESIGN OF DAMS.

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

(Continued.)

Theoretical line for forward movement of face of dam when under pressure.

The amount of the forward movement of the upper portions of the dam when under pressure will depend upon the resilience of the material of the structure and of the sub-base.

The resilience of the structure will develop decrement of length in the connecting columns between the pressure points, such as P^1 P^2 P^3—P^{10}, and the points of adhesion A^1 A^2, A^3—A^{10} in Fig. 22.

In a mass of masonry or concrete the number of these columns would be infinite, and their size would be infinitesimal. We may, however, demonstrate the action of the forces at work by assuming individual columns connecting A^1—P^1, A^2—P^2, A^{10}—P^{10}.

These columns will have a decrement of length under pressure expressed by

$$D = \frac{PL}{KE}$$ Where D = Decrement of length.

P=Pressure.
L=Length of A^1-P^1, etc.
K=Area of section.
E=Modulus of elasticity.

As all columns in Fig. 22 have similar area, and all may be supposed to have similar modulus of elasticity, we have the values of D varying as PL.

As the pressures at P^1 P^2 P^3—P^{10} vary with the depth of water, and the lengths of columns A^1 P^1, A^2 P^2—A^{10} P^{10} vary with the height above the base, we can write the figures .5x9.5, 1.5x8.5, 2.5x7.5, 3.5x6.5, 4.5x5.5, 5.5x4.5, 6.5x3.5; 7.5x2.5, 8.5x1.5, 9.5x.5, equalling 4.75, 12.75, 18.75, 22.75, 24.75, 24.75, 22.75, 18.75, 12.75, 4.75, as expressing the ratios of the versed sines of the curve c b d e.

These values should be multiplied by the sine of the assumed angle, viz., $45^0 = .7071$, if we were working out the exact values of the vers-sines of the arc.

As we have only ratios, this will be unnecessary, and the arc shown is the true theoretical curve for a series of independent columns.

If we assume these columns replaced by blocks of masonry we will have Fig. 23.

In an actual wall we would have shear operating in all these lines o—e, with power to compel any two adjoining columns to act in unison, the result being that decrement of length in A^6—P^6 would affect A^5—P^5, and in A^5—P^5 would affect A^4—P^4, and each and all of these would affect A^3—P^3, A^2—P^2 and A^1—P^1, and in this way additional loads would be thrown on columns A^3—P^3, A^2—P^2, and A^1—P^1 with the result that the actual versed-sines would be reduced at P^7, ^{6} and ^{5}, and increased at P^3, ^{2} and ^{1}, so as to give a movement that would be represented by a straight line with a maximum movement at the top.

Shear acting alone could not do this, but the face of the wall would act as a beam, assuming its own necessary depth, such as x—y, and in this way distribute loads from P^6, ^{5} or ^{4} to P^3, ^{2} and ^{1}.

It will be clearly seen that the columns at P^1, ^{2} or ^{3} are not provided for any loads but their own, and any increase will put tension in the fibres connecting A^1 with A^2, A^2 with A^3, etc., which would be undesirable, and it would be better to load the point A sufficiently to take up the extra load, but it is impossible to determine what this extra load is.

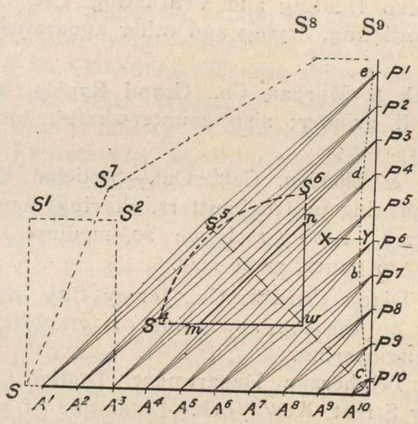


FIG. 22

If we take out the centre of the wall, as shown by the triangle m n w, we can more definitely determine the loads on A^1, A^2 and A^3.

In loading A^1, A^2 and A^3 we will be erecting another wall S, S^1, S^2, somewhat similar to the face wall.

This is additional proof that considerable height of wall is required at the down-stream face of dam, and is in line with arguments adduced on pages 14, 16, 50 and 51.

A curved line through S, S^2 P^1, with a hollow space S^4 S^5 S^6, would evidently give a stable structure.

The line may also take the course S, S^7, S^8, S^9, Neither of these sections need exceed in area the amount of wall contained in the original triangle A^1 P^1 c, but will be in all respects very much better and stronger.

Returning to Fig. 1, we find that we have resilience of

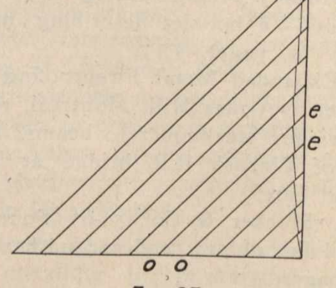


FIG. 23

the sub-base still to consider. This may be infinitesimal, but it must be borne in mind that the fact of a mass of solid material having resilience has been proven, and our plain duty is to search for any movement that may result therefrom.

The first apparent fact in connection with the sub-base, then, is that it is more heavily loaded towards A^{10} than towards A from weight of mass.

It will be similarly treated under loading from pressure of the water, but if A^1, A^2 and A^3 receive more than their share of pressure from P^1, P^2, P^3 from causes spoken of above, then we may assume extra decrement of length of sub-base under A^1, A^2 and A^3. Also, if tension be set up in the lower horizontal fibres so as to increase the distances between A^1 and A^2, A^2 and A^3, etc., then the position of the base of columns A^1—P^1, A^2—P^2 having been moved, the top ends of such columns will move in sympathy therewith. These unknown and apparently infinitesimal movements may all be factors in making up the total summation of movement known to occur in high masses of masonry.

In this investigation the overturning movement is, for the purpose of discussion, not taken into account.

(To be continued.)

MUNICIPALITIES AND THE TELEPHONE.

The Union of Canadian Municipalities is co-operating with the House of Commons Telephone Committee by obtaining statistics that will be of service to the committee. Municipalities are being requested by the Union to answer the following questions:

Have you a municipal telephone system? If so, please send all particulars of capital cost, operation, extent of business, progress, satisfaction, and all other useful particulars. What telephone company or companies are operating within your municipality? Have you any agreement with the company? If so, what are its terms? What is the annual charge by the company (a) for business phones, (b) residences, or (c) party-line services? Any other charges? What is the annual contribution of the company to the funds of the municipality? Does the company furnish free phones for corporation use? If so, how many? When does the franchise expire? Is the company subject to any right of the municipality as regards placing of poles and wires, character of poles, conduits, opening up of pavements, etc. If so, what are the facts? If there are more than the two systems, what are the facts? Is your municipality interested in telephone questions? If so, why?

The offices of the Union are at 107 St. James St., Montreal.

ENGINEERS' CLUB OF TORONTO WILL NOT AMALGAMATE.

The following resolution, recently passed by the Engineers' Club of Toronto, is self-explanatory:

Moved by F. L. Somerville, seconded by A. B. Barry: "That the Canadian Society of Civil Engineers be requested to withdraw the proposition to constitute the Engineers' Club of Toronto as the Toronto Branch of the Canadian Society of Civil Engineers (conforming to the methods and by-laws of the Society). Should, however, a local branch of the Civil Engineers be formed in Toronto, and the Club's privileges be asked therefor, the same to be granted upon equitable terms, to be agreed upon at a special meeting of the Club called for that purpose."—Carried.

LITERARY NOTICES.

Modern Gas Engines and Producer Gas Plants.—By R. E. Mathot, M.E.; authorized translation by Waldemar B. Kaempffert. 300 pages, 7x9; 175 illustrations. New York: Norman W. Henley Publishing Co., 132 Nassau Street. Price, $2.50.

This book is a guide for the gas engine designer, user and engineer in the construction, selection, purchase, installation, operation and maintenance of gas engines. Above all Mr. Mathot's work is a practical guide. Recognizing the need of a volume that would assist the gas engine user in understanding thoroughly the motor upon which he depends for power, the author has discussed his subject without the help of any mathematics and without elaborate theoretical explanations. Every part of the gas engine is described in detail, tersely, clearly, with a thorough understanding of the requirements of the mechanic. Helpful suggestions as to the purchase of an engine, its installation, care and operation form a most valuable feature of the work. Each chapter is profusely illustrated with intelligible, carefully prepared diagrams that elucidate the explanations of the text. Thoroughly modern in its treatment of the subject, the work discusses at considerable length the generation of producer gas and its utilization in gas engines. The author of the work is a consulting engineer who has made gas engines a special study, and who has supervised their installation in the principal industrial centres of the world. His book treats the subject from the standpoint of the best American and European practice.

The Automobile Pocket Book.—By E. W. Roberts, M.E. 330 pages, 3½ x 5¼, with 52 diagrams. Bound in limp leather. The Gas Engine Publishing Co., Cincinnati. Price $1.50.

E. W. Roberts is well known as the author of the Gas Engine Handbook, and his new book on the automobile will be welcomed as a convenient treatise on the essential points in automobile design and operation. The historical side of the subject is entirely omitted, and Mr. Roberts goes straight to the core of the matter, and in a concise manner gives the information needed without any padding or superfluous material. The convenient size of the book and the useful nature of the information it contains should make it a desirable part of any automobile equipment.

Fireside Astronomy.—By O. W. Horner, F. R. Met. Soc. 105 pages, illustrated. Published by Witherby & Co., 326 High Holborn, London. Price, 1s. 6d. net.

Now that astronomy is becoming a popular study, the attempt made in this little book to still further popularize it by giving a plain account of things that happen in the sky will be welcome. It is written in simple and entertaining style, and technical terms are used only to explain their meaning. It treats of the sun and moon, their motions and eclipses, the phenomena observed on them, and a section is devoted to each planet. A chapter is devoted to comets and meteors, and one to the chief constellations of fixed stars.

The second part of the 1904 report of the Ontario Bureau of Mines is a monograph on the limestones of Ontario by the Provincial Geologist, Willet G. Miller. The book contains over 125 pages, besides forty illustrations from photographs, showing quarries, kilns, limestone buildings, etc. The amount of work entailed in the compilation of this report is indicated by the fact that it contains over 260 extracts from papers by various writers. Literature published during the last sixty years on the subject has been consulted, and this fact alone should make Mr. Miller's report a book of great value to anyone looking for raw material for any of the lime industries, and to all interested in the resources of the Province.

CATALOGUES RECEIVED.

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

Consolidated Engine-Stop Co., 100 Broadway, N.Y.—Booklet describing the Monarch engine-stop and speed-limit system. 24 pages, 4 x 9.

C. W. Hunt Company, 45 Broadway, N.Y.—Catalogue of coal-handling machinery, including elevators, conveyors, railways, etc. 56 pages, 7 x 9. Also Catalogue 053, the Hunt Noiseless Conveyor, with many illustrations of plants in operation. 52 pages, 7 x 9.

Allis-Chalmers-Bullock, Limited, Montreal.—Bulletin on Induction Motors, type AN. 16 pages, 8 x 10.

Emerson Steam Pump Co., Alexandria, Va.—Catalogue describing a system of pumping for all purposes, with data as to boilers, water, etc. 40 pages, 6 x 9.

B. F. Sturtevant Co., Hyde Park, Mass.—Bulletin of electric generating sets of sizes from 3 to 100 k.w. capacity. 8 pages, 7 x 9.

Wellman-Seaver-Morgan Co., Cleveland, O.—"What We Do," a booklet showing, principally by illustration, the variety of work undertaken by this firm. 36 pages, 4 x 9.

National Electric Co., Milwaukee.—"Plants and Types," a booklet to give a general idea of the company's electrical product. Nothing but illustrations. Printed in two colors on buff paper. 32 pages, 6 x 9.

G. & H. Barnett Co., Philadelphia.—Illustrated catalogue of files and rasps. 50 pages, 5 x 7.

Newhall Chain Forge and Iron Co., 9-15 Murray Street, New York.—Catalogue No. 99, Cross-arm Braces, Guy Clamps, Pole Steps, etc., for telephone and other equipment. 24 pages, 6 x 9.

North-West Machinery and Iron Co., Limited, Winnipeg.—Catalogue of blacksmiths' and carriage-makers' tools and supplies. 112 pages, 5 x 8.

Kitts Manufacturing Co., Oswego, N.Y.—Steam specialties, including traps, feeders, alarms, etc. 30 pages, 4 x 7.

Corliss Engine Works, 4041 N. Fifth Street, Philadelphia.—Rickards' Corliss steam engines. 16 pages, 6 x 9.

H. E. Gidley & Co., Penetanguishene, Ont.—Canoes, skiffs, gasolene launches and boat fixtures. 40 pages, 9 x 6.

Wm. Hamilton Manufacturing Co., Ltd., Peterborough, Ont.—Setting machines for sawmills, to be operated by hand, steam or power. 20 pages, 6 x 9.

McEachren Heating and Ventilating Co., Galt, Ont.—Heating, ventilating, drying and other apparatus. 75 pages, 4 x 9.

Wilmarth & Morgan Co., Grand Rapids, Mich.—"New Yankee" drill grinder; also counter-shafts, loose pulleys, etc. 32 pages, 6 x 9.

Sheldon & Sheldon, Galt, Ont.—Sectional Catalogue 19, steel plate planing mill exhausters, shavings separators, etc. 28 pages, 6 x 8. Also Catalogue 20, medium blowers and exhausters. 16 pages, same size.

Joseph Dixon Crucible Co., Jersey City, N.J.—A group of circulars on the use and value of graphite lubrication in marine engineering.

United Telpherage Department, Dodge Coal Storage Co., 49 Dey Street, New York.—Catalogue of apparatus for overhead transporting of loads from one part of works to another. 16 pages, 6 x 9.

Nernst Lamp Co., Pittsburg.—A 12-page booklet showing electric lighting equipments for churches, 6 x 7.

Watson Jack & Co., Montreal.—Sheet showing advantages of Skelton's beams in structural steel work.

Friestedt Interlocking Channel Bar Co., Inc., 1408-1412 Tribune Building, Chicago.—Catalogue describing channel bar steel piling system, with photographs of the system in use, and testimonials from users. 64 pages, 6 x 9.

Wells Bros. Co., Greenfield, Mass.—Price sheet of stocks and dies with bushing guides for pipe.

Electro-Dynamic Co., Bayonne, N.J.—Eight-page bulletin on inter-pole variable speed motor, giving description, specifications, and efficiency curves.

T. D. Robinson & Co., Limited, Derby, Eng.—Price list of rivets, bolts, coach screws, etc.

The Philip Carey Manufacturing Co., Cincinnati, O.—"The Carey Roof," a booklet describing magnesia flexible cement roofing. 40 pages, 5 x 7.

St. Louis Expanded Metal Fireproofing Co. (Earnshaw Bradley, 3 Place D'Armes Hill, Montreal, representative).—Johnson's tables for steel-concrete beams; also photograph and diagrams of Wabash R.R. bridge at St. Louis, built with corrugated bars.

McDowell, Stocker & Co., 59-61 South Canal Street, Chicago.—April list of new and second-hand machine tools for sale. 36 pages, 3 x 6.

Westinghouse Electric and Manufacturing Co., Pittsburg.—Wattmeters and How to Read Them, Westinghouse Fan Motors for Direct Currents, Westinghouse Fan Motors for Alternating Currents. Three booklets of uniform size, 3 x 6.

Darling Bros., Montreal.—Price list of Victor low-pressure steam trap.

INDUSTRIAL NOTES.

The Belleville Hardware Company is extending its plant by adding two stories to the present premises.

The Morris Gasoline Engine Company, a firm which at present has a large plant in the United States, intends locating in Canada.

The city council of London have decided to issue $9,000 debentures to cover the cost of proposed waterworks main and hydrant extension.

The Avery Stamping Co., Cleveland, manufacturers of steel shovels, scoops and spades, will begin operations at St. Catharines by September 1st.

The Sharples Tubular Cream Separator Company, of West Chester, Penn., are negotiating for a building in Brantford to start a Canadian branch of their factory.

Material is on the ground for the commencement of the new $60,000 armories, which will be erected on Tecumseh Park, Chatham, by the Dominion Government.

Tenders will shortly be invited for a new armory, at Brandon. The plans are in the hands of W. N. Lailey, architect and call for brick and stone, to cost $20,000.

The Simplon tunnel, the longest in the world, was put into operation April 2nd, when from the Swiss and Italian sides the first trains passed through, meeting at the centre.

The work of piping for natural gas by the Niagara Power and Fuel Company, which was started last fall, will be resumed shortly, and St. Catharines will burn natural gas this summer.

The Munro Wire Works, of New Glasgow, N.S., are building a branch factory at Winnipeg, and have placed an order for the necessary steam plant with the Robb Engineering Co., of Amherst, N.S.

Woodstock is to have three new factories this summer. The Cyclone Wire Fence Co., Toronto, the Ann Arbor Machine Co., and the Eureka Planter Co., of Windsor, have secured sites in that city, and will erect large factories at once.

The bridge over the Metapedia River, near Metapedia Station, is in course of construction. It consists of three spans of 190 feet each from centre to centre, and will replace the old wooden bridge there. It is to be finished in October.

The Restigouche Lumber Company has been organized to operate a large wood-working factory at Dalhousie, N.B. The Robb Engineering Company, of Amherst, N.S., have received the order for the steam plant.

A. M. McCannel and J. Currie, Toronto, are organizing a joint stock company with a capital of $40,000, to manufacture sand cement brick and cement building blocks, at Guelph, Ont. The bricks will be manufactured by the Alley-Smith process. The company will start operations as soon as the stock is subscribed.

The secretary of the Peterborough Lock Manufacturing Company, Peterborough, Ont., is inviting tenders for the erection of complete new buildings. According to plans the main building will be 175 feet by 44 feet, and three stories high. The foundry will be 160 feet by 70 feet.

Brockville ratepayers have endorsed by-laws granting a loan of $30,000 to the Canada Carriage Company, whose premises were destroyed by fire early in January last, and a $1,000 site and exemption from taxation for ten years to the D. H. Burrell Company, of Little Falls, N.Y.

A project is under way by prominent financiers allied with the Ogilvie interests to organize a company, capitalized at ten to twelve million dollars, for the purpose of constructing three to five hundred elevators throughout the North-West, and also two flour mills in Great Britain.

The contract for 44,000 feet of ten-inch cast iron tubing to be used in installing the pneumatic postal system in Toronto and Montreal, has been awarded by the Dominion Government to the Alexander Maclaren Co., of Glasgow, at $1.50 per foot. The work of digging the trench and laying the pipe will be done by the Toronto Pneumatic Tube Co., a branch of a Boston concern. The distance to be covered is estimated at 18,000 feet. The entire cost is placed at $300,000.

The Colonial Ink Co., of Peterborough, has decided to remove its plant to Hamilton.

At Norwood fire destroyed the saw-mill and electric light plant owned by Douglas B. Harrison. Loss about $8,000; not insured.

The Belleville Board of Trade is endeavoring to have the bridge across the bay, which connects the city with Prince Edward County, made free.

The Canadian Fairbanks Co., Limited, have been offered sites for their proposed factory by various cities, among these being London, which offers a ten-acre site free.

The Lakefield Portland Cement Company have broken ground for their new works. It is expected the new plant will be in operation by the fall.

An English syndicate has made an offer of £650,000 for the property of the New Brunswick Petroleum Company, of which Hon. H. R. Emmerson is the head.

At Embro, Oxford county, Ont., Andrew Bain and Malcolm McNeil have secured the latest improved machinery for manufacturing brick and cement on a large scale.

The Northern Elevator Company will erect a big flour mill in Winnipeg this year. The estimated cost is $250,000 for the mill and elevator, and the capacity 3,000 barrels per day.

The Western Electric Light and Power Company, Brandon, Man., proposes to undertake an extensive water-power development on the Assiniboine river, five miles east of Brandon.

The Royal Screw and Specialty Company, Montreal, capital, $40,000, will manufacture screws, bolts, tools, dies, etc. T. McS. Ryall, and W. S. Leslie, of Montreal, are among the charter members.

The Dominion Coal Company have, it is said, purchased 30,000 tons of steel rails from the Cumberland Railway and Coal Co., and are negotiating for the purchase of 250,000 tons more.

The Ruggles-Coles Engineering Company, of New York, have ordered from the Robb Engineering Company a 350 horse-power Corliss engine and two 175 horse-power boilers for the cement works being built at Sydney, C.B.

The Crucible Steel Co. has been incorporated at Hamilton with a capital of $50,000. The company has purchased a plant, and will commence operations shortly. The directors of the company are: Dr. G. E. Husband, G. L. Husband, B. K. Husband, E. Husband and J. Scott.

Dr. R. V. Rogers, trustee for the bondholders of the Kingston Street Railway, intimates that the line is in the market for sale to the highest bidder. The bondholders would like to treat with the city for a purchase, but the corporation is unwilling to negotiate. If a purchaser cannot be secured to run this road its effects will be sold as scrap.

The Belleville Cement Works have commenced manufacturing, a representative of this journal being present at the turning of the first wheel on the 27th ult. The engine-room is thoroughly up-to-date, there being installed an Inglis tandem compound steam engine for pumping purposes, and a Westinghouse-Parsons direct connected steam turbine for supplying electric power. This is the first steam turbine operating for industrial purposes in Canada. The capacity of the works is 1,000 barrels per day, which may be tripled at small expense. The plant is the only one in Canada making cement from rock. K. W. McNab is general manager, and E. B. English, of Allantown, Pa., is chief engineer, and had full charge of construction.

The site of the new blast furnace and docks at Port Arthur will probably be changed. Manager Jones recommends that the works be located at a point west of the Canadian Northern roundhouse, a mile to the east of the proposed site.

Lymburner & Matthews, brass founders and machinists, of Montreal, have now about completed a large new shop at the foot of Berri St., facing Commissioners St. The new structure, of which A. Piche is the architect, is three stories high, and 130 x 70 ft. area. The top story is occupied by the brass foundry and die shop, and the second flat devoted to brass finishing, plating and oxidizing, and to the pattern shop. The offices, store-room, machine shop and blacksmith shop are on the ground floor; and the boiler and engine room and coal room are in the basement. The building is of brick with steel frame, and mill construction is adopted throughout. The works which will employ 80 to 100 men, will be chiefly devoted to ship repairs and fire station equipment.

The Diamond Flint Glass Company, of Toronto and Montreal is arranging to open a new glass factory in Hamilton. It is proposed to use the old glass furnace building, and plans for additional buildings are being prepared. From 100 to 150 hands will be employed.

The recent fire at the Greening Wire Co.'s works, Hamilton, did not destroy any of the works except the tower used in the painting of screen cloth. All other departments were uninterrupted by the fire, and the painting department was running as usual a few days afterwards.

The foundry, factories, etc., of Desjardines Co., at St. Andre, Que., were destroyed by fire on April 25th. The plant consisted of a stove foundry and other shops for the manufacture of carriages, agricultural implements, etc. The loss is $50,000, with little insurance. The origin of the fire is a mystery.

The Friestedt Interlocking Channel Bar Co., of Chicago, hitherto a private company, has been incorporated with a capital of $1,000,000. This company are patentees of a system of steel piling, which is not only water-tight and can penetrate quicksand to any depth, but can be repaired. It is adapted for mine shafts, coffer dams, sea-walls, subways, power-dams, deep foundations, or irrigation works, and has strong endorsements from engineers and contractors in the United States.

MUNICIPAL WORKS, ETC.

The town council of Rat Portage has changed the name of the town to Keenora, with the sanction of the Legislature.

A high pressure water system, to cost $350,000, for fire protection only, was authorized by the Winnipeg city council recently.

Morrisburg ratepayers carried by-laws to develop power on the Rapid Plat Canal and to grant free power, water and light to a tinplate industry.

A storm sewer system is being planned for Brantford. T. Harry Jones is city engineer, and Willis Chipman, Toronto, consulting engineer.

The town council of Rosthern, Sask., are discussing telephone and electric light service, which the rapid development of the town has made necessary.

Moncton, N.B., has ordered a 450 horse-power Corliss engine for direct connection to electric generator, from the Robb Engineering Company.

The citizens of Indian Head, N.W.T., have given the town council permission to prepare a by-law calling for $140,000 to install a waterworks, sewerage and an electric system in the town.

Glace Bay, N.S., has ordered from the Robb Engineering Company a 375 horse-power Corliss engine and a 150 horse-power Robb-Mumford boiler for the extension of their electric lighting plant.

The corporation of Calgary, N.W.T., have retained the services of R. S. Kelsch, consulting engineer, Montreal. The tenders for complete municipal lighting plant have been received, and the council will place contracts, as soon as report on tenders is prepared.

Western towns are busy getting ready to make extensive local improvements. Prince Albert will spend $160,000 in sewers, sidewalks, and waterworks; Calgary, $60,000 for an electric light plant, and Indian Head $150,000 for sewers, light, fire protection, and waterworks.

John Galt, C.E., Toronto, is preparing designs for improvements and additions to the water supply and sewage systems of Fort William. It is expected that water will be brought from Loch Lomond by gravitation and the pumping from the Kaministiquia river abandoned. Designs will be prepared for a complete sewage system, part of which will have to be pumped.

Willis Chipman, C.E., Toronto, has been appointed engineer for the construction of the new waterworks and sewage system at Prince Albert, N.W.T., which will cost $150,000.

The corporation of Portage la Prairie, Man., may proceed with the construction of the projected waterworks and sewage system by day labor, under the supervision of Willis Chipman, C.E., Toronto.

John Galt, C.E., of Toronto, has submitted his report on the water supply of Sarnia. The present location calls for $60,000 expenditure for improvements, while a proposed new location farther up the river at Point Edward would require an outlay of $150,000.

In connection with the sewage and water system of Lethbridge, N.W.T., Willis Chipman, who is engineer for these works is leaving with the municipality a valuable record in the form of a blue-print book of 90 pages, 6 x 8 in., backed with linen, showing the location of all the hydrants, valves, special castings and sewer connections along with the width of the street, and the areas of the town lots, which will be available for reference at any future time. In the case of Gananoque, Ont., for which Mr. Chipman is also engineer, the record is in the form of a portfolio volume of 50 pages 20 x 26 in., giving the geological chart, showing the areas of rock, clay, etc., and indicating by colored lines and symbols, the buildings and class of material used in the same, the location of sewers, manholes, and connections, the water-pipes and location of valves and hydrants, etc. This portfolio is neatly done on tracing cloth, and is a very complete surveyor's record.

MINING MATTERS.

The output of the Chrome iron mine of Quebec was 6,000 tons in 1904, against 3,000 tons in 1903, mostly in concentrates.

The miners at Acadia Mine, Westville, N.S., are out on strike. They have a number of grievances against the manager.

The Eustis Mining Co., of Eustis, Que., has put up an electric plant of about 500-h.p for its works, the power being generated at the Coaticook River.

It is reported that W. H. Hearst, a well-known barrister, of Sault Ste. Marie, Ont., has been offered the position of Minister of Mines in the Provincial Cabinet.

Twenty tons of gold, valued at $9,000,000, have been produced by the Klondike proper, the district within a radius of fifty miles of Dawson, since January 1st, this year.

A nugget of almost solid silver, twenty-five inches wide and two inches thick, weighing eighty pounds, and valued at $380, has arrived at the office of the Director of Mines for Ontario. It is from the Trethway Cob silver mine, near Cobalt, on the Temiskaming Railway, from which neighborhood, since the discovery of the veins there, it is said, $500,000 worth of ore has been spread.

The Big Dipper Mining and Milling Company of Ontario has been formed at Peterboro, with an authorized capital of $2,500,000, the proposal being to carry on development work in the Barrie Township, Frontenac County, Ont. The company owns 1,934 acres of mineral lands through which a valuable gold vein has been traced. S. Sager, Peterboro; J. S. Waldron, Jackson, Pa.; J. M. Fletcher, Buffalo, and J. A. Jamieson, Myres' Cave, are members of the company.

The greatest gold find in Canada is said to have been made recently near New Liskeard in the Cameron mine, owned by the Temiskaming and Hudson Bay Mining Co. Upon making an analysis, the ore was found to contain a percentage of gold equalled by only four other mines in the world. It may, however, prove to be a "pocket."

The American Asbestos Co., of Boston, of which H. M. Whitney is president, has bought the King asbestos property at Thetford, Que., and has been operating it since January under the same management. This company owns the Black Lake asbestos mine, in which a new milling plant has been installed. This plant is now operated by electricity, generated at the St. Francis Hydraulic Power Co.'s plant. It was equipped by Edward Slade, and is the first application in the world of electricity to the mining of asbestos. A duplicate steam plant is provided in case of breakdown. It is expected that other asbestos mines will follow the example of the American Co. The output of the asbestos mines will be 15 per cent. over that of last year.

In the Ontario Legislature the other day Mr. McGarry, one of the new members arraigned the late Government's management of the Temiskaming Railway, and also attacked the policy of the Canadian Copper Company, which represents the nickel trust in the town of Copper Cliff. "The Company," he said, "owned every inch of the ground on which the town was built, and induced people to erect houses and stores there, but refused to give a title when asked. If men did not vote as the company required they were promptly dismissed. The company controlled the business of the town, and the speaker had affidavits from merchants and workmen concerning these proceedings. No municipal buildings could be erected, as the company refused to sell land for the purpose. They had, without any magisterial authority, fined a woman $5 because her cow grazed on their land. There was no resort to the courts, as the company was too powerful, and with the numbered ballot they forced all their employees to vote as they dictated."

LIGHT, HEAT, POWER, ETC.

The Robb Engineering Company is building two 125-h.p. boilers for the Lethbridge Electric Company, of Lethbridge, Alberta.

It is stated that the Toronto and Niagara Power Co. has purchased all the electric power and light plants between Niagara Falls and Rochester, N.Y.

A staff of engineers are working on the Niagara-Welland electric project, with instructions to rush the work on the transmission lines.

Cecil B. Smith, Consulting Engineer, Toronto, is reporting on water powers on the Blanche River in Nipissing district, and on a water power on the Ottawa River, at the foot of Lake Temiskaming.

The International Railway Company, Niagara Falls, Ontario, have just completed the installation of a 2,000-h.p. vertical, direct-connected turbine and generator in their hydraulic power-house. C. B. Smith, Consulting Engineer, W. B. Chace, Resident Engineer.

The Lake of the Woods Milling Company has purchased two 400-K.W. direct-connected, 60 cycle, 600 volt, three-phase generators, switchboard, and nine three-phase, 550 volt induction motors, ranging from 25-h.p. to 75-h.p., for the plant at Keewatin, Ont. This apparatus will furnish power for the grain elevators, stave factory, cooper shop, etc.

The Ingersoll Waterworks Company have made arrangements to substitute electric power for steam power at their pumping house. The power will be furnished by the Ingersoll Electric Light and Power Co., and it is expected that the work will be completed by the first of May.

Legislation is being sought in the Ontario Legislature to confirm an order-in-council passed by the Ross Government permitting the Electrical Development Co., of Ontario, to develop 250,000-h.p. or 125,000-h.p. more than was called for under the present agreement. The company agrees to furnish power to municipalities in Ontario at prices to be fixed by the Lt.-Governor-in-Council.

The Canadian Westinghouse Company, Limited, held its annual meeting at Hamilton last month. The financial statement showed the affairs of the company to be in a flourishing condition, a net profit of $160,596 being indicated, and assets of $2,926,724. The directors' report stated that the new manufacturing plant was practically completed, and in a short time the manufacture of electrical apparatus would be commenced. Unfilled orders already on hand amounted to some $560,000, and attention was called to the advantage of entering upon the manufacture of new apparatus only after the processes had been tested by experts of the American Westinghouse Companies.

Napanee, Ont., will build a lighting plant. R. S. Kelsch, Montreal, is the consulting engineer.

Paul Wood, Sutton, Man., who will develop a water-power for electric light and power and pulp mill, has retained the services of R. S. Kelsch, consulting engineer, Montreal.

Work has begun on the power dam at Fort Frances, Ont., and machinery is arriving daily. The cost of the dam will be over $3,000,000, and 300 men will be employed. Penniman & McGuire, Providence, R.I., are the contractors.

The Ottawa and Hull Power and Manufacturing Co. are supplying power over the new 12,000 volt transmission line. The Cement Company will take 3,500-h.p. to operate the new cement works, which are said to be the finest on the continent.

The Sherbrooke Power, Light, and Heat Company, Sherbrooke, Que., will increase the capacity of their water-power plant. The system will be changed from 133 to 60 cycles. The plans contemplate new water wheels, 750-K.W., d.c., 60 cycle generators and direct current exciters.

The Kakabeka Power Company have completed their surveys, and plans are under way. The work on the canal will be started this month. It is intended to deliver power in Fort William and Port Arthur, May 1st, 1906. The falls are twenty-four miles from Fort William on the Kaministiquia river.

Philip Lahee, electrical contractor, who has the contract for the electrical equipment of the new C.P.R. Hotel at Winnipeg, has decided to manufacture his own switch boards and other apparatus, and is this month opening an office and shop in the Temple Building, Montreal.

L. A. Campbell, manager of the West Kootenay Power and Light Co., announces that his company had entered into contracts to supply the Granby Mining and Smelting Co. and the British Columbia Copper Co. in the Boundary with 4,500-h.p. The new installation now in process of construction at Bennington Falls will cost $1,000,000.

Among the announcements of policy made by the new Provincial Government of Ontario, two of the most important are that there will be a reform in the timber regulations, especially those relating to pulp-wood, and that the water-powers controlled by the Crown will hereafter be disposed of by public auction to the highest bidders instead of by private treaty as before.

The Stave Lake Power Company, Vancouver, B.C., will develop their water-power on the Stave river, forty-two miles from Vancouver. The power will be transmitted for distribution in Vancouver, New Westminster, and vicinity. The immediate installation will be for 10,000-h.p. with an ultimate capacity of 35,000-h.p. R. S. Kelsch and Wm. Kennedy, Jr., of Montreal, are the engineers in charge.

The Montreal Light, Heat and Power Co. have installed in their Maisonneuve sub-station, an induction regulator believed to be the largest piece of apparatus of the kind in the world. It has a capacity of 5,000 amperes at 2,400 volts, designed to raise or lower the pressure 10 per cent. The regulator will be used in connection with the permanent plans of consolidating the Montreal Light, Heat and Power Company's two-phase, 66 cycle, with the Lachine Rapids Hydraulic and Land Company's 60 cycle, three-phase system. The work is being carried out under the supervision of R. S. Kelsch.

At the annual meeting of the Canadian General Electric Company last month, it was reported that the profits for 1904 were $582,519, against $512,210 for 1903. Dividends and interest on the company's floating debt to the banks aggregated $392,763. Of the balance, $113,612 has been written off for depreciation, $75,000 transferred to reserve, and $1,143 added to the credit of profit and loss account, which now stands at $81,913. The Reserve Fund is now $1,239,770, and the total surplus $1,421,683. In their report the directors say: "Your directors are pleased to say that the business of the company materially increased, and we carry over to 1905 uncompleted contracts amounting to $1,885,000 in the Electrical Department, and $845,000 in the Foundry Department, or $2,730,000 in all. Your directors are able to advise that the business of the first two months of the current year is the largest in the history of the company for a like period. From 1st January to 5th March contracts to the amount of $1,007,000 have been closed by the electrical department, and $381,000 by the foundry department. These amounts added to the total unfinished business carried forward from 1904, make a gross total of $4,118.000, or over 35 per cent. more than the capital of the company." Owing to the continued growth of the business, the directors recommended an increase of capital, application for which has since been made to parliament, increasing the total capital from $3,000,000 to $5,000,000.

MARINE NEWS.

The plans for the million-dollar elevator at Port Colborne will shortly be completed.

The Manion bridge and the Patterson bridge, over the Payne river, Stormont, Ont., were partially destroyed and carried away by an ice jam.

The new turbine steamer, "Victorian," in its recent trip, covered 2,509 miles in a little more than seven days. The average speed was 13¼ knots per hour, and the best hour's run 16½ knots.

The Toronto Ferry Company has appointed J. W. Aston, Collingwood, chief engineer of the company's various ferries. He will have general oversight of the engines and machinery on the boats owned by the company.

The United States and Dominion Transport Co., Chicago, announce the appointment of the following engineers: Steamer Caribou, Joseph Cosford, 1st; Robt. Isbester, 2nd. Steamer Manitou, Robert Grierson, 1st; Robert Sinclair, 2nd.

It is stated that 4,000 ft. of the pier at Port Colborne will have to be faced with cement at a cost of about $26,000 in order to prevent the timber of the new harbor works from bulging out and releasing the filling. Unless this is done, the Government will be put to great expense for dredging at the entrance to the Welland Canal. Tenders will shortly be called for this work.

The Montreal and Lake Superior Navigation Co. have placed an order with the Caledon Shipbuilding Co., of Dundee, for what will be the biggest packet freight boat in the Canadian waters. It will be 3,600 tons, and 300 tons larger than the Manacondah and Neepawah of the same line. The length of the boat is 257 feet. The boat is to be delivered at Montreal by August 20th, this year.

The ice-breaker Montcalm became imprisoned in the middle of the ice bridge at Cap Rouge, and occupied so critical a position that it was thought she might be completely crushed between the two masses of ice in the event of the ice shove from above. After several days in her precarious position she floated off and went down the river with the ice. She was only slightly damaged.

Following is the complete list to date of appointments of first engineers by the Richelieu and Ontario Navigation Co.: Str. Montreal, Geo. Gendron, Montreal; str. Berthier, E. Denis, Montreal; str. Cornwall (formerly Algerian), C. Gendron, Montreal; str. Beaupre, F. Lacroix, Montreal; str. Prescott (formerly Bohemian), G. Gendron, Montreal; str. Boucherville, A. Crepeau, Montreal; str. Picton (formerly Corsican), A. Demartigny, Montreal; str. Murray Bay, Nap. Beaudoin, Montreal; str. Brockville, Jas. Conlin, Montreal; str. St. Irenee (formerly Canada), J. Hamelin, Quebec; str. Varennes (formerly Cultivateur), — —; str. Chambly, — —; str. Hamilton, B. Pintal, Montreal; str. Hosanna, J. St. Michel, Sorel; str. Kingston, A. R. Milne, Toronto; str. Laprairie, C. Hamel, Montreal; str. Longueuil, — —; str. Fire Fly, A. Gendron, Sorel; str. Quebec, — Guertin, Montreal; str. Chicoutimi (formerly Saguenay), G. Gagnon, Quebec; str. Belleville (formerly Spartan), W. S. Parker, Montreal; str. Terrebonne, E. Beaucage, Montreal; str. Three Rivers, J. Matte, Montreal; str. Toronto, W. A. Black, Toronto; str. Tadousac (formerly Virginia), M. Latulilipe, Quebec.

PERSONAL.

T. J. Tilley, Peterborough, has been appointed manager of the Bell Telephone Co.'s business at Lindsay, Ont.

Frank McDougall, M.A., of Maxville, Ont., has been awarded a scientific research scholarship of £150 under the London Exhibition Commission of 1851. Mr. McDougall is a tutor in chemistry at Queen's.

C. A. Biggar, civil engineer and surveyor of Ottawa, has left to take charge of the field work of the Canadian section of the Alaskan boundary survey. Under him will be three parties, one in charge of White Fraser, Victoria; another under A. J. Babazon, Ottawa, and the other under Mr. Ratz, Ottawa.

P. K. Perry, of the Car Service Department, Canadian Freight Association, has been one of the movers in the formation at Toronto of an association of travelling representatives of the various transportation lines, to be known as the Canadian Transportation Club. A meeting will be held on the 5th inst., in Room 315, Toronto Union Station, when a permanent organization will be completed. W. B. Bamford, travelling freight agent for the C.P.R., is chairman pro tem, while Mr. Perry is temporary secretary.

F. W. McNaughton, a graduate in civil engineering of the School of Practical Science of '98, and until recently town engineer of Cornwall, Ont., has been appointed Deputy Minister of Public Works for Manitoba. Mr. McNaughton is a member of the Association of Ontario Land Surveyors, and has had a wide experience in drainage and municipal engineering. He has also been connected in an engineering capacity with several projects of the Dominion and Provincial Boards of Works.

A. W. Connor has just opened an office as a consulting and constructing structural engineer at 36 Toronto Street, where he will be associated with Cecil B. Smith, the well-known hydraulic and railway engineer. Mr. Connor is making a specialty of buildings and bridges in steel or reinforced concrete, in which work he has had ten years' experience with leading bridge companies. He is a son of Mr. J. W. Connor, B.A., late principal of the Berlin Collegiate Institute, a double honor graduate in arts of the University of Toronto, and a graduate of the School of Practical Science ('95).

The business of Allis-Chalmers-Bullock, Limited, Montreal, has increased so rapidly recently that it has been necessary to make a number of important additions to the staff. T. F. Kenny has been appointed Mechanical Engineer. He graduated from the department of mechanical engineering at McGill University in 1896, and then spent two years with the British Columbia Iron Works. For the past six years he was Mechanical Engineer for the Jenckes Machine Co. James F. Forbes has been appointed to take charge of the Pumping Engine Department. He is a native of Philadelphia, and has had large experience with the water companies owned by the Delaware Company, of New Jersey. Later he became Superintendent at Dennison and Uhricksville, and had charge of the construction of a slow sand filter plant, and also of a mechanical gravity filter plant. Under his superintendence the pumping facilities were largely increased and re-arranged to suit the filter plant. Since 1902 he has been travelling salesman with the National Meter Company, making Chicago his headquarters.

Among Canadians of prominence who passed away during April was Arthur Harvey, of Toronto, widely known as a writer on scientific subjects. Mr. Harvey was a native of Hallsworth, Suffolk, England, and received his education in France and Holland, and at Trinity College, Dublin. He came to Quebec in 1856, and was for several years editor of The Morning Chronicle. In 1862 he was appointed chief statistical clerk of the Auditor-General's Department, which he resigned in 1870 to come to Toronto as manager of the Provincial Insurance Company. He founded in 1867 the "Year Book and Almanac for B.N.A.," which he edited for several years, and he has been the author of many essays and papers. He was president of the Canadian Institute from 1890 to 1893, was a fellow of the Royal Statistical Society, and was vice-president of the Astronomical and Physical Society of Toronto.

The direct connection of sun spots with terrestrial magnetism, which was heralded a few days ago from London, England, as a discovery of the present year, was explained by Mr. Harvey as long ago as 1896, and some recent data on the subject were given by him in an article contributed to the Canadian Engineer last year.

Kivas Tully, late engineer and architect for the Public Works Department of Ontario, died on the 24th ult, at his home in Toronto, aged 86. Among the monuments to his professional ability in Ontario are Trinity College and the Customs House, Toronto; Welland County court house and town hall, and Victoria Hall, Cobourg. After resigning the engineership of the Department of Public Works of Ontario he was appointed consulting engineer and architect, holding that position till the time of his death. He was a charter member of the Canadian Institute, and was a member of the Deep Waterways Convention of 1894. He was the second son of Commander Tully, R.N., and was born in Queen's County, Ireland, coming to Canada in 1844.

RAILWAY NOTES.

The G.T.R. have made plans for the erection of a new depot at Exeter.

The Levis County Electric Railway is again in operation, with H. H. Moore as superintendent of the road.

The equipment of the Toronto Street Railway with new air-brakes to replace hand-power brakes will begin this month.

Fire caused by a live wire broke out recently at the power house of the Brantford Street Railway Co. A quantity of supplies costing $1,000 was destroyed.

The G.T.R. locomotive repair shops at Stratford have closed for an indefinite time for the purpose of repairing and cleaning them. About 1,000 men are out of work.

The I.C.R. contemplates making improvements at St. John in the way of building bridges, lighting plants and better station facilities.

The Lake Superior Corporation will extend the Algoma Central Road to a connection with the Canadian Pacific Railway Company's line.

The C.P.R. will have 60 miles of track finished in the Sudbury district by June 1st. This division will run from Byng Inlet to the main line at Sudbury.

The Temiskaming and Northern Ontario Railway Commission are examining into the possibility of electric traction on their road now in operation between North Bay and New Liskeard.

W. H. Cross, of Clarkson & Cross, who inspected the books of the Kingston Street Railway Company, on behalf of the city council, reported the value of the road at about $200,000.

The promoters of the Lake Erie and Port Dover Radial Railway Company are reviving their scheme of building from Brantford to Port Dover, running through West Brantford.

Messrs. Mackenzie & Mann have purchased 20,000 tons of English rails for the James' Bay Railway, deliveries to be in amounts of 4,500 tons per month in May, June, July and August, and the balance in September.

The New Brunswick Railway, which runs from Norton, a point on the I.C.R., to Chipman, will in all probability form a part of the Grand Trunk Pacific Railway. The entire road is said to be in good condition.

The Cataract Power Co., Hamilton, have already had nine bridges constructed for the extension of the Hamilton Radial Electric Railway from Burlington to Oakville, besides having purchased the poles, ties and ballast. The cars will likely be Canadian built.

A bridge on the Intercolonial Railway, near Torryburn, was taken out recently and a new steel one put in its place. The crew started to work at 7 o'clock in the morning, and by 5 o'clock in the afternoon the road was in its usual running order.

It is understood that the H., G. and B. Electric Railway will not be extended to St. Catharines this year. The seven miles between Vineland, the present eastern terminus of the H., G. and B., and St. Catharines contains a number of ravines, over which expensive bridges would have to be built.

J. S. Scott, manager of the Lake St. John Railway, reports that English capital has been secured to continue that line to Port Lanay in James Bay. The railway from its present terminus at Roberval to Port Lanay will be about 400 miles long. In Mr. Scott's opinion it will make the country through which it passes worth thirty-five million dollars to the Province of Quebec.

The V., V. & E. Company will build to the Pacific coast as quickly as the surveys can be completed and the work of construction carried out. It is expected that over one hundred miles on the eastern end, where the surveys are nearly ready, will be built during 1905, and that the whole road to New Westminster bridge will be finished within three years.

The C.P.R. with incredible swiftness, has flung another bridge across the Saskatchewan at Saskatoon. It was a masterly piece of work, huge gangs of men working day and night putting in the twenty-nine bents carried away by the turbulent spring floods on March 28th. Four days later heavy freight trains crossed the bridge. This is a record in bridge construction.

The contracts for a large portion of the concrete work on the central division of the C.P.R. have been awarded. The bridges on the Emerson, Prince Albert and Portal sections have been awarded to Grant, Smith & Co., Minneapolis, while the concrete arches and rail-top culverts on the Ignace, Rat Portage and LaRiviere sections have been awarded to Kelly Bros. & Shane.

A syndicate of Canadian and United States capitalists has been formed for the purpose of building a railroad to cost $37,000,000, from the city of Mexico to Merida, State of Yucatan, with a branch line to Belize, the capital of British Honduras. The road will be more than one thousand miles long, and will traverse a part of southeast Mexico, which is now without railroad transportation facilities. James McNaught, vice-president of the Great Northern Railway, is at the head of the enterprise.

The Canadian Pacific Railway has placed with Allis-Chalmers-Bullock, Limited, Montreal, an order for four Lidgerwood 25-ton pull rapid unloaders. This is a compound geared winding engine of two sizes—25-ton pull and 60-ton pull—mounted on ordinary flat cars, and supplied with steam from the locomotive. The engine of the smaller size has double 10 x 12 in. cylinders, is capable of exerting a direct pull on the cable of 25 tons, and of drawing in the same at the rate of 125 feet per minute. The drum is 41 in. diameter, and is grooved for 1¼ in. cable. This new device is in strong contrast to the old method of drawing the plow by use of locomotives. It can be operated by any locomotive strong enough to pull the train. By actual test two Mogul locomotives failed to unload by the old method a trainload of frozen clay after trying for three hours. The Rapid Unloader, with an ordinary locomotive unloaded an identical train in seven minutes. The Canadian Pacific Railway have already fifteen of these machines in operation. One of them working at Westmount unloads a train of twenty-five standard flat cars in nine to ten minutes.

Another railway is before Judge Winchester charged with discriminating against Canadian employees. This is the Erie and Huron and the London and Port Stanley lines, which were recently acquired by the Pere Marquette Railroad Co., of Michigan. Since the acquisition of the Ontario lines by the American company complaints have been made that the passenger train service has become inefficient, and a number of passenger and freight trains have been taken off altogether, so that shippers were unable to get goods through, and but scant attention has been paid to the wants of the travelling public. These complaints were laid before the Canadian Railway Commissioners, and have been followed by the complaints regarding the dismissal of Canadian employees, who were replaced by men from the United States. Judge Winchester, who had conducted the enquiry in regard to the discrimination against Canadians by United States officials on the Grand Trunk Pacific, was appointed to conduct the present investigation, which opened a few days ago at St. Thomas. The evidence there has developed the fact that nearly all the officials and a great many of the men on the road are American citizens, and that they were brought here to take the places of Canadians discharged.

NEW INCORPORATIONS.

Dominion.—Laurie Engine Co., Montreal, $250,000; D. Yuile, C. E. L. Porteous, A. E. Modley, J. M. Mackie, Montreal, and A. E. Woodworth, St. Lambert, Que.

Dominion St. Maurice Construction Co., Montreal, $100,000; R. MacKay, J. Beattie, H. Murray, W. S. Hart, W. J. Henderson, A. W. G. Macalister, Montreal.

The Gananoque Bolt Co., Gananoque, $125,000; W. T. Sampson, E. L. Atkinson, C. A. Atkinson, P. Sampson, D. Bain, Gananoque, and F. B. Cowan, Franklin, Pa.

Canadian Trenton Potteries Co., St. Johns, Que., $60,000; W. S. Hancock, J. A. Campbell, D. K. Bayne, Trenton, N.J.; H. Black and W. A. Campbell, St. Johns, Que.

Wobun Steamship Co., New Glasgow, N.S., $48,000; G. Stairs, Halifax; J. D. McGregor, J. C. McGregor, T. Cantley, G. F. McKay and H. Graham, New Glasgow.

The Grand Falls Power Co., Grand Falls, $200,000; C. Van Horne, R. B. Angus, Montreal; R. Proctor, Proctor, U.S.; H. H. McLean, St. John, N.B.; F. R. Kimbley, New York.

The Metallic Roofing Co. has increased its capital from $20,000 to $200,000.

The William Gray & Sons Co., manufacturers of carriages, etc., has increased its capital from $150,000 to $500,000.

The Ottawa Stone Co., Ottawa, $20,000; H. Robillard, B. Robillard, T. G. Brigham, W. T. Hayes and P. J. Delaney, Ottawa.

Harbinger Steamship Co., River Hebert, N.S., $9,000; J. Rutherford, A. M. Rockwell, H. Kelly, C. Kelly, and A. W. Pugsley, River Hebert.

Universal Motor Manufacturers, Montreal, $500,000; F. H. Leonard, W. G. Morden, J. Gelinas, A. Pageau, Montreal, and H. R. Harmer, Toronto.

Dominion Motor Car Co., Montreal, $20,000; H. S. Bryant, Westmount; F. B. Stockwell, F. N. Seddall, W. F. J. Hart and H. N. Chauvin, Montreal.

Wasis Steamship Co., New Glasgow, $18,000; G. Stairs, Halifax; J. D. McGregor, J. C. McGregor, T. Cantley, G. F. McKay and H. Graham, New Glasgow.

Quebec.—La Compagnie Electrique, Maniwaki, $49,000; T. Bonhomme, H. Bourassa, J. S. Bock, H. J. Letreau, Papineauville, and F. Cornu, L'Ange Gardien.

La Compagnie Télephone de Portneuf has increased its capital from $10,000 to $49,500.

Ontario.—Harris Oil Co., Windsor, $100,000; F. C. Harvey, J. Hartenstein, G. R. Harris, J. C. Goodrich, H. C. Colburn, Detroit.

The Continuous Steel Rail Co. Toronto, $500,000; F. B. Allan, W. McConnell, A. F. Webster, J. M. Smith and C. Bonnick, Toronto.

The Haileybury and Cobalt Telephone Co., Haileybury, $5,000; H. McQuarrie, T. J. Gorman, P. A. Cobbold, C. C. Farr, D. Myles and J. F. Gillies, Haileybury.

The Eugenia Falls Water Power and Electric Co. has been changed to the corporate name of the Georgian Bay Power Co.

The Parkin Elevator Co., Hamilton, $40,000; J. Parkin, E. Parkin, A. Winckler, W. A. Gibb and E. Parkin, Hamilton.

NAPANEE vs. THE CONMEE ACT.

The Private Bills Committee of the Ontario Legislature has rendered an important decision during the last month affecting the Conmee Act. The decision resulted from a complaint from the town of Napanee, where three lighting companies—one gas and two electric—have been in operation in recent years. The gas company was started in 1875, but has no provision for lighting the streets, and even now its mains only cover half the town. The Napanee Electric Light Co. was started in 1886 with a capital of $10,000 and as its plant, which was not designed for house lighting, has not been renewed since, it is naturally obsolete. The third company, the John R. Scott Electric Light Co., came into the field in 1898, undertaking to furnish both light and power, and to do street and private lighting. Its generating station was nine miles out of town, and the water power did not always prove sufficient. These rival companies fell to cutting rates, and as each was unable from the nature of its equipment to give by itself a complete service for the town, none of them paid dividends, and none of them satisfied the citizens. The Scott Company collapsed five years ago, and the owner of the gas company having acquired control of the stock of the other electric company, the three plants came under one man's control. In 1903 private lights were nearly all shut off, and complaint is made that for the past two years the town has been practically without service, and can neither get a reasonable working arrangement with the trinitarian monopoly nor make effective the arbitration clauses of the Conmee Act, the controller of the companies refusing to appoint an arbitrator on his side unless the town would first agree to buy out the Scott water power plant, which the town apparently looked on as a useless investment. Acting under advice of its expert, the town offered $3,500 for the lighting plant, but this was refused. When it became known that the town was appealing to the Legislature, the company at last consented to arbitrate, but only on condition that the town would first agree to buy the Scott plant. The Municipal Act, however, provides that the town may not own a water power more than three miles from the town limits, and when it was seen that this proviso precluded such a deal, the company offered to light the town for $2,000 a year on condition that it loaned the company $20,000. The town rejected these terms, but offered the company $2,000 a year for ten years for the service, leaving it to improve its own plant. The company declined this offer, but said it would agree to a mortgage for the $20,000 loan. When asked to give particulars as to how the money would be spent, it transpired that $7,000 would be devoted to improving a water power belonging to a private individual on whose property the town would have no right to hold a mortgage.

In view of the failure of these attempts at an understanding the town appealed to the Private Bills Committee of the Legislature, which, after a short hearing, passed a bill exempting the town from the provisions of the Conmee Act. In commenting on the hardships suffered by the town which, while it had to put up with coal oil for churches, factories and stores, and lanterns for outdoor lighting, could neither get arbitration nor the power to establish its own plant because of the Conmee Act, Henry Carscallen, the chairman of the committee, observed that this Act was not one of the laws of the Medes and Persians, that could not be altered. "The passing of this bill," he added, "will have a good effect by showing these corporations that the Legislature will not stand any nonsense. It was never intended that a municipality should be prevented from having the common conveniences of life."

—The Diamond Chain Factory, located at Indianapolis, Ind., has been purchased from the Federal Mfg. Co., by the Diamond Chain and Mfg. Co., headed by Lucius M. Wainwright, who for the past five years has been the manager of the plant, and who is generally regarded as one of the best informed men in the United States on the subject of chain transmission of power.

PORT COLBORNE HARBOR WORKS.*

BY J. M. HOGAN, S. CAN. SOC. C.E.*

(Concluded.)

Concrete Blocks.

These blocks, 4-ft. by 4½-ft. by 7-ft., were moulded in timber forms made of 2-in. dressed pine, tongued and grooved. A piece nailed to side of mould gave required joggle to block. The moulds were tied across by two ½-in. round rods with nuts, threaded both ends. The lower rod passed through the partition forming end mould of block.

Sides were held in position by the shoulder formed by lapping on 3-in. by 4-in. upright. To remove moulds, nuts are slacked and uprights taken down, when the sides will remove in one piece and may be utilized again. These moulds were filled with concrete in layers and allowed to set for 48 hours before removal of moulds. After five days these blocks were sufficiently set to be removed by derrick.

In top of the block is seen a basin-like depression, while in the side a slot or joggle is moulded. When blocks are placed side by side, the mass concrete of wall filling up joggles, etc., forms

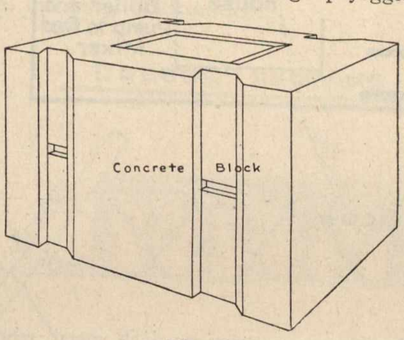


Fig. 6.

a strong joint between each block and between top of block and wall above, and prevents any lateral displacement of blocks relative to the wall which might be caused by impact of the heavy seas or vessels.

The joggle also allows of the simple method of handling the blocks, shown in Figure 4.

Much difficulty was experienced in setting these blocks level and close jointed, especially the latter. This was due to the uneven character of the bed left by the dumping in of stone filling and the difficulty of levelling same in 2-ft. and 3-ft. of water. As an aid to obtaining close joints the blocks are now made with a batter of 2-in. from face to rear of block which allows of the front face being brought closer to the neighboring block.

Moulds for concrete wall are of similar material to block moulds and similarly fastened, except the lower rod, which

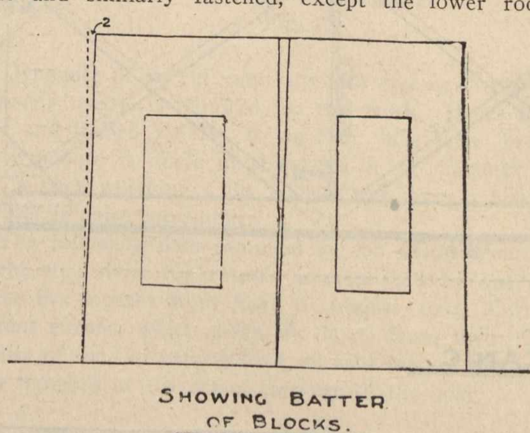


Fig. 7.

rests on the block and supports outside upright which overhangs the face of wall. This rod remains in the wall. The rear upright is wedged into the joggle. Moulds were erected in sections of 60 to 75 feet, a day's work. The next day's work began at finishing point of previous day, which allowed sufficient expansion. Canvas nailed to inside face of mould and allowed to drape over the block, was extensively used to prevent washing out of concrete by seas before thoroughly set at the level of block.

*This paper was awarded the prize offered by the publishers of the Canadian Engineer for the best student's paper read before the Canadian Society of Civil Engineers in 1904.

Concrete.

Concrete was 1. 2. 4. mixture. Owing to the large area covered by the works, it was impossible to set up a permanent plant anywhere. The convenient approaches to most of the work being by water, the plan of utilizing a floating plant was adopted with good results.

A large deck scow was equipped with a derrick, mixer, and crusher, and storage provided for cement and sand. The lay out was so arranged that the derrick, having a 68-ft. boom, controlled all the operations. Materials for the day's work were loaded each morning, and the scow towed to the site. The stone for crushing was obtained directly from the back filling of the cribs and hoisted to the crusher platform in tubs, where two men fed it continually to the crusher. This stone, being dredged from the bottom of the lake, was clean and excellent for concrete. The stone thus crushed runs out below into another skip or tub. When 3-in. or 4-in. have accumulated the spout door is closed and a wheelbarrow of sand from the pile close at hand is dumped in and spread, followed by two or three bags of cement. This alternate process is con-

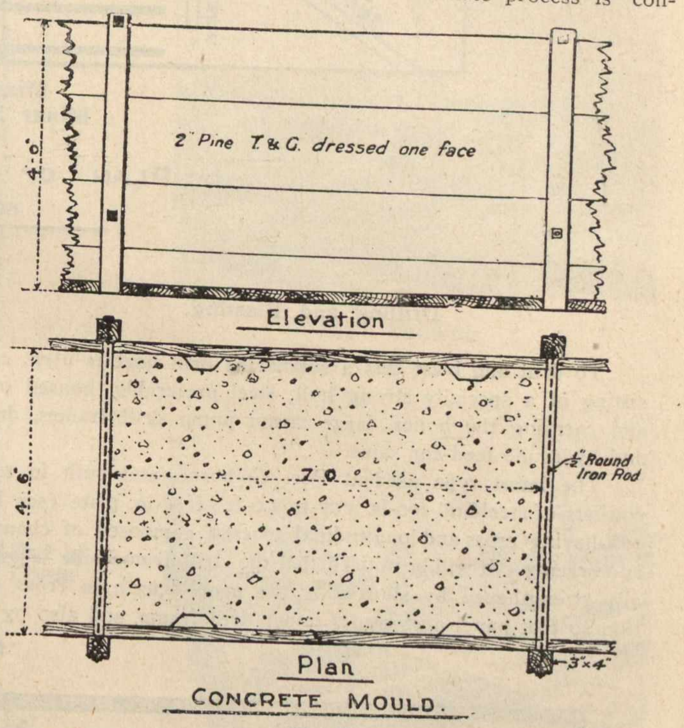


Fig. 8.

tinued until the box is filled, when it is hoisted up and dumped into the incline bin of the mixer, and thus runs in a continuous stream through the mixer itself and into moulds below. Besides being continuous, this system is compact. Where stone was not available from filling it was brought alongside in scows and used as wanted.

The mixer used consists essentially of a sheet of iron spout having small iron rods placed perpendicular to line of flow to give a tumbling or turning over motion to the concrete. A perforated pipe, controlled by a valve sprays water over the dry mixture as it passes. A door at the bottom of spout is operated by a man, who also controls the water. The door is kept closed till the lower chamber of the spout is filled when concrete is released and door closed for another batch, or about two shovelfuls.

A large boiler on the scow provided steam for hoist, crusher and engine, and small pump, which fed water to mixer.

An average day's work consisted of 65 to 75 yards for a gang of 18 Italians, foreman and hoistman, or about 50 cents per yard for labor. Cement used (at least 40,000 barrels to date), was Rathbun "Star," made in Deseronto, Ontario, and the results obtained have been excellent.

The mixer moved on tracks, and both could be lifted off and set up on a wall within radius of boom, and the concrete process go on as before. Such a method was used in laying concrete slab covering of docks.

Excavation.

The principal item of this part of the work consisted of the drilling, blasting and dredging of 300,000 cubic yards of very hard flinty limestone over a great area. The above quantity is in place, not scow measurement. The cut varied from 6-in. to 6-ft. but to get down to grade it was necessary to drill and blast to 2-ft. or 3-ft. below the grade to avoid pinnacles and ledges being left. No payment is allowed, however, for this extra depth. Owing to constant interruptions by storms this has been the most troublesome part of the work.

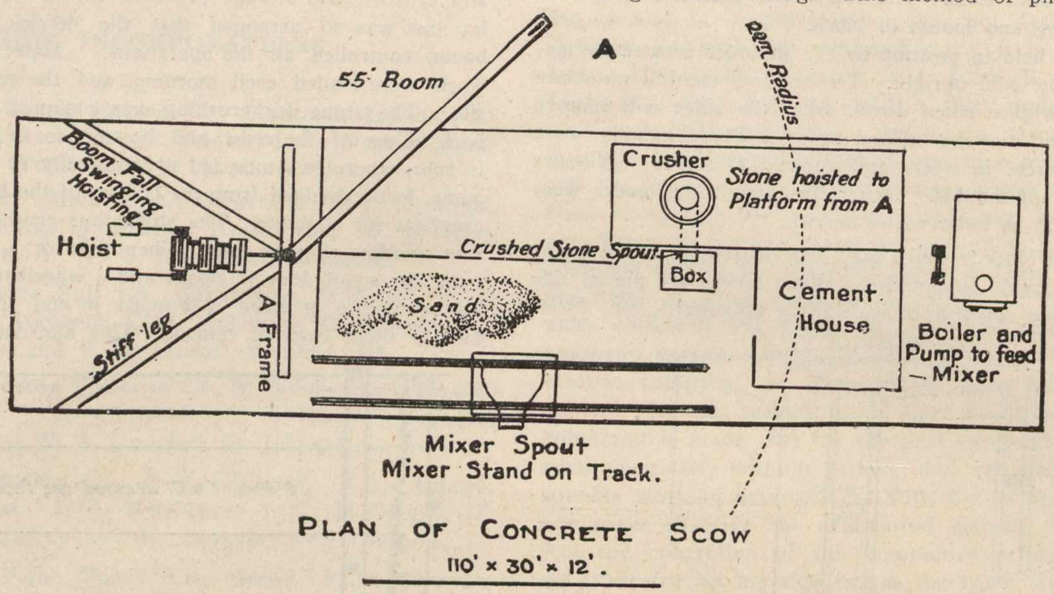


Fig. 9.

Drilling and Blasting.

To drill and blast this a submarine drill boat is used, consisting of a specially strong hull, steel preferably, housed over and carrying the boiler, large steam pump drill frames, drills and hydraulic feed for same.

The latest type used at Port Colborne, and built in 1903, consists of steel hull 100-ft. x 27-ft. x 6-ft. of ⅜-in. plate (see Fig. 10), having cross and longitudinal trusses, composed of channels and bracing. It will be noticed that the drill frame side is specially strengthened by shortening the panel length in cross section so that panel post comes under drill frame, and also by the use of ½-in. by 12-in. plate and bracing longitudinally. The stresses are here a maximum, owing to constant pounding of drills and the impact of the blast underneath. The boat is pinned up, i.e., part of her weight, possibly 60 tons, taken on oak spuds 14-in. by 16-in. at each corner. She is thus held in place. These spuds run in guides and have cast iron racking sunk even with their face on inner side. A gear wheel attached to slides works in this racking and lowers or hoists spuds. A single upright engine operates a series of shafting under deck which connects by a sprocket wheel and chain to the gear wheel working in the racking. This method of pinning up is considered preferable to an engine on slack speed, where winter work is to be done. This is an improvement on the old method of an engine attached directly to each spud, as owing to these engines freezing up, no winter work could be done.

The drill proper is attached to a carriage composed of two angles latticed, and having a saddle at top. This carriage moves on two uprights, i.e., the drill frame. An hydraulic ram, working between these uprights and attached to the saddle takes the place of the hand feed on land drills. This ram is controlled by a three-way valve, by which the drill carriage is lowered or raised, and, of course, the drill with it. A duplex force pump, to which is attached a governor to control the

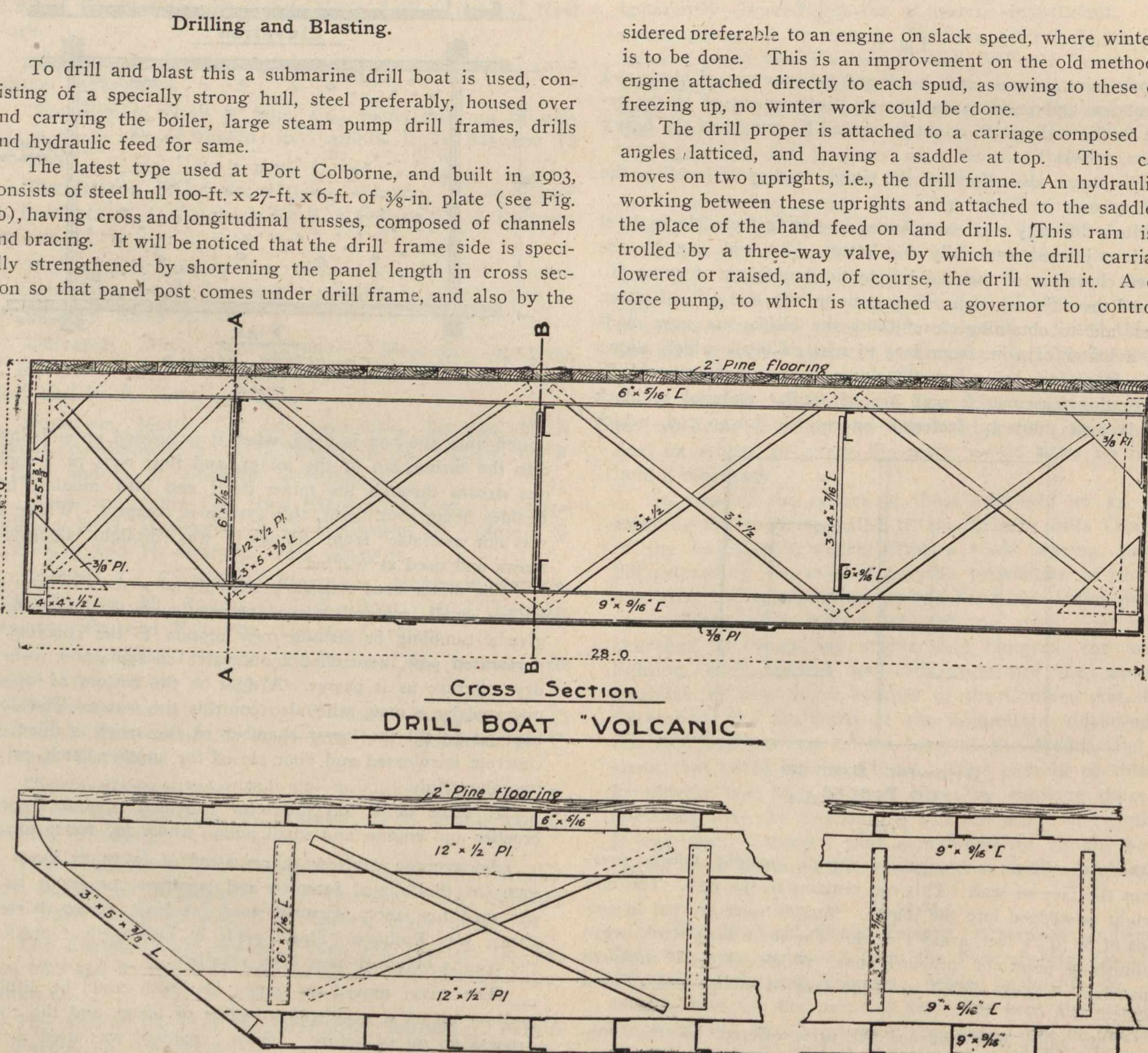


Fig. 10.

speed of pumping to requirements, supplies hydraulic power for rams. This pump works against a constant pressure of 300 lbs. The drill bar is of 1¾-in. round machinery steel to which is welded a piece of 2-in. octagon steel to form a cutting end. The drill having 8½-in. stroke is run by steam similar to a land drill.

Three drill frames are mounted on the boat on rails and movable by ratchet and level attached to the axle of the drill truck wheel.

To load holes a cylinder is used having a smaller diameter than the hole and of sufficient length to admit the whole cartridge. This cylinder is slotted on one side to insert cartridge and connecting wire. To cylinder is attached a long piece of 1-in. gas pipe coming well above the water. The drill bar being withdrawn, this apparatus is put down into the hole and a long pole, run down through the pipe, forces the cartridge from the cylinder into the hole. The loading apparatus is then withdrawn and charge exploded by battery.

From two to four drills can be operated off one scow, depending upon its dimensions. Three drill boats have been employed steadily on this work for the last four years. The crews vary with the number of drills, a three-drill machine having 12 men, including blacksmiths.

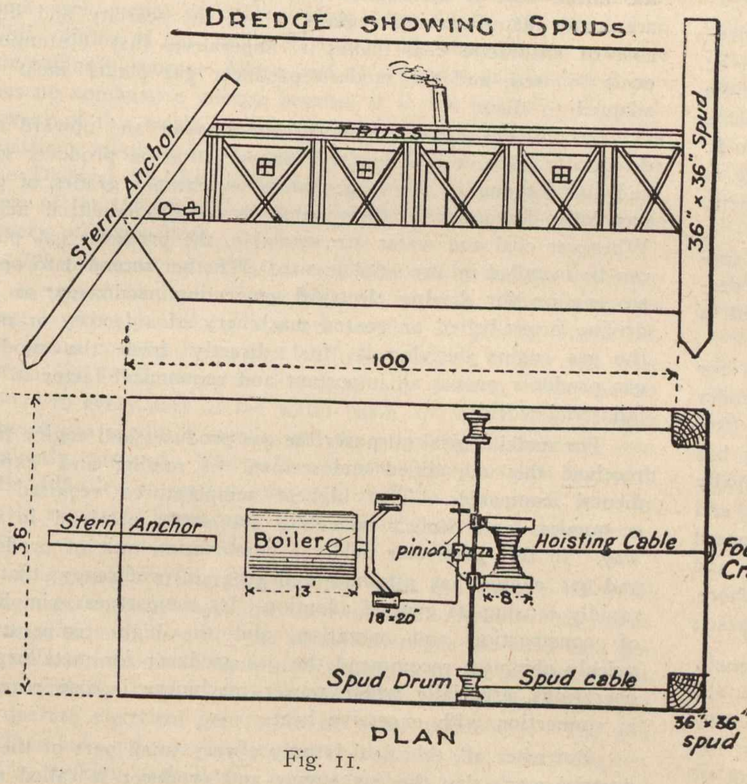


Fig. 11.

Dynamite of 70 per cent. strength (as against 40 per cent. ordinarily used), is required for this work. Holes placed 6-ft. apart and loaded 7½ lbs. to an 8-ft. hole give best results. The dynamite is made in sticks 1¾-in. in diameter and 3-ft. long, a stick weighing 5 lbs. The shock from a blast in 16-ft. of water is quite perceptible.

The following data compiled by the writer from foreman's reports, etc., show the results accomplished by one drill boat for the five months from April to August, 1904. Owing to the constant storms, which drive the boats from their ranges and the loss of time in getting back on said ranges, the records are not a measure of the actual capacity of the boat:

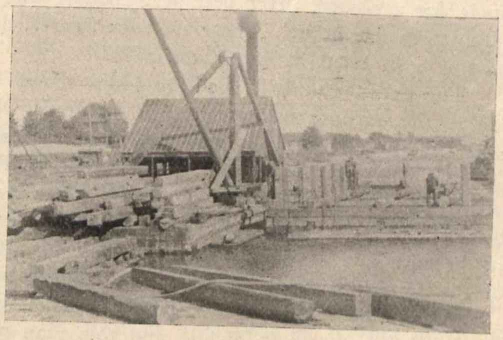
	Days of 12 Hrs. Worked.	Holes.	Feet Drilled.	Lbs. Powder.	Ft. per Hr. Per 3 Drills.
April	49	2,282	10,170	8,527	18
May	43	1,348	6,280	5,624	12.2
June	50	1,453	8,133	6,947	13.5
July	43	1,512	6,950	6,104	13.4
August ..	43	1,348	6,478	5,511	12.5

Days worked included the time to set up on ranges and the time the drill was on the range, but could not drill owing to weather. Night and day crews were worked. The time the drill lay idle in the canal basin weather-bound is not included in "days worked." The month of April shows larger results because the drill worked in a sheltered position in the canal. The depth of drilling seems to make little difference to average result as seen from June and July records, the depth of drilling in the former month being in excess of the latter. A deep hole requires an extra drill bar which takes time to insert, and deep drilling is also troublesome on account of binding, etc., but this is off-set by the extra blasting in shallower drilling, and loss of time in starting holes.

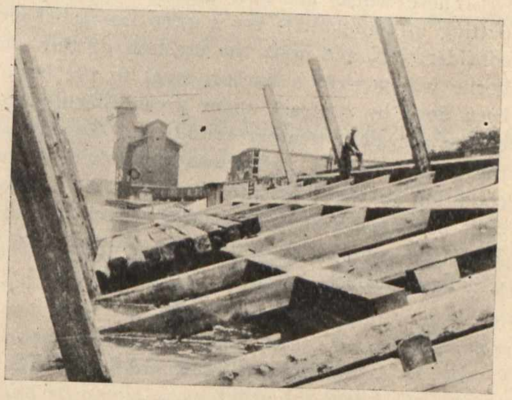
The best performance, as indicated by the record, was the drilling of 323 holes, or 1,615 feet, in 72 hours, day work, from April 4th to 9th, or an average of 22.4 feet per hour, per three drills. Best day's work was 315, or an average of 27-ft. per hour.

Dredging.

The dredges used to dig this rock are of recent construction. i.e., 1902 and 1904, and possess great power. The hulls are of steel ½-in. plate at sides and 1-in. at bow. The dredge is pinned up on two forward spuds (see Fig. 11), 36-in. by 36-in., British Columbia fir, running in slides. These spuds form the



Crib Building.



Launching Crib.

front corners of the hull, which gives a clear side with no projections to be knocked off. At the stern (scow type), a single spud 20-in. square placed in centre of boat and at an angle to the vertical holds boat up against the bank, and prevents swinging. This spud is geared similar to drill spuds, and has a separate engine, while forward spuds are operated by cables from main engine. The feature of the hull is the extra strength of machinery Kelsons, which instead of being small I beam box girders, consist of a stiff truss the depth of hull and fastened to deck channels above, as well as to floor or bottom of boat. This greatly stiffens the vulnerable part of the boat, the bow, and prevents working of Kelsons under the pull of the engines and consequent opening of bottom and bow plates. Another feature is the carrying of the over-head truss the full length of the boat, thus affording a secure fastening of the stern anchors and a better distribution of the stress it exerts, besides adding to the general stiffness.

The power is got from two 18 by 20 horizontal engines fed by Scotch marine boiler 11-ft. by 13-ft., furnishing 140 lbs. pressure. A small pinion on engine shaft operates a larger pinion on a shaft, to the ends of which are attached two more small pinions operating the main hoisting drum, which is 8-ft. in diameter. The first series of shafting is extended in bearings to the sides of the boat, and has attached to it the drums for lifting spuds. When boat is pinned up these drums are thrown out of gear and spuds held up by friction brake, operated on deck by the crew. To lower away the dredge it is only necessary to slack the friction brake.

The hoisting cable is of 2¼-in. wire rope, and the life of a cable in digging rock with these powerful dredges is not over two months. The dredges are of the single whip variety, no system of pulleys or blocks being used on crane to obtain power, but a single line of cable from drum to bucket. Anchor cables are of 1¾-in. wire rope, while a special engine and 1¼ test chain is used for swinging.

These dredges operate a three-yard bucket in rock, and a five-yard bucket in clay or soft digging. Their performances vary greatly, for the frequent hauling of drills from ranges for safety causes many undrilled areas of small extent, which make difficult and almost solid rock dredging. As little as 250 yards a day is sometimes got. Tests taken of the new 1904 dredge in well drilled material loaded in skips of five yards' capacity showed an output of 4,385 cubic yards in six days of twelve hours. Deducting five hours' delay for repairs, this gives an actual average of 65.5 cubic yards an hour. No effort was made for a record. Her best performance was 1,000 yards (in tubs) in twelve hours. These are rock figures, the dredges never having been tried in soft material.

The excavation is loaded in dump scows or tubs, according to the purpose for which it is required. No filling can be done by dump scows in less than 7-ft. of water. To handle skips, a large A frame steel derrick with 65-ft. boom, capable of lifting 20 tons, was built. To carry this a special scow 120-ft. by 36-ft. by 11-ft. was built, having steel trusses, etc. Owing to its breadth and stiffness it was possible to lift to the capacity of the derrick without any pinning-up apparatus.

While this derrick was an experiment, it proved most successful, being easier to handle and tow than regular spud derrick, and besides requiring no time to pin up, it provided a large space for carrying materials.

These works are now almost completed. The tenders for putting in foundations for a 2,000,000-bushel elevator are under consideration, and with the erection of this elevator Port Colborne will possess a harbor equal to the best. The work has been done by contract under great difficulty, caused principally by the prevalent weather conditions. Storms arose rapidly, and the drills, dredges, and scows were driven from their exposed condition in the lake into the basin for shelter. Scows and drill boats were sunk and cribs wrecked and driven ashore. With the completion of the two breakwaters, however, vessels will have perfect shelter.

PRODUCER GAS UNITS.

By Geo. E. Walsh, New York.

The practical utility of producer gas by power companies has been greatly stimulated in the past year or two by the development of individual gas generating units that are readily adapted to various commercial uses. The operation of the gas engine on city gas has its limitations. For small industrial purposes requiring engines no larger than 25-h.p., city gas proves a most economical fuel; but above this size the cost of operation rapidly increases, and the profitable employment of large gas units on city gas is practically prohibited. The economy in the first place is due to the difference in the cost of labor. Owing to its automatic operation, the small gas engine can be trusted to an ordinarily intelligent employee, and the saving in the salary of an engineer more than compensates for the high cost of city gas as fuel. The extension of the gas engine has, therefore, been dependent upon the production of a cheaper form of gas. The standard gas engines will deliver a brake-horse-power-hour for each 12,500 British thermal units. The difference in the quality of the fuel does not materially affect this result, and gas from the blast furnace, which is particularly poor and low in quality, will produce as effective power as the best city gas in proportion to the number of thermal units supplied. In order to utilize the cheaper grades of gas, the engines simply had to be constructed with a capacity for handling a larger quantity of gas.

Producer gas generating units have steadily improved, and their services have been demonstrated abroad and in this country in numerous ways. The combination of the producer gas generating plant and gas engine for burning the fuel form compact and excellent types of modern improved power machinery. The continuous and satisfactory operation of such combinations have recently given a much wider range of usefulness to this form of fuel. The question of economy of installation and operation in comparison with a steam plant is one that attracts the attention of the engineer. The gas producers have the advantage of being able to utilize a cheaper grade of coal, and they can be depended upon ordinarily to furnish one brake-horse-power-hour from one and a quarter pounds of anthracite pea coal. This form of coal is considered the best for the average gas producer, but almost any grade or quality of fuel can be utilized. Manufacturers of gas producers endeavor to adapt the plants to either anthracite or bituminous coal, although unless there is a great difference in the cost of coal the use of hard coal is always more economical. The difference in the cost of using the two fuels is caused by the great amount of hydrocarbons found in the soft coal. In order to prevent the hydrocarbons from condensing in the form of tar and gum in the engines, mechanical washers have to be installed in the producer plant, and the expense of this increases the initial cost of installation and operation. However, there are many manufacturing regions where the scarcity and high cost of anthracite coal makes it imperative that bituminous coals be used, and the modern producer gas plants must be adapted to them.

Gas engines of one thousand horse-power and upward are designed to-day in this country for operation on producer gas, and the running of the larger units on cheaper grades of gas has fully demonstrated their value in certain industrial fields. Wherever coal and water are available, the producer gas plant can be installed in any suitable size. Whether intended to operate engines for driving electrical generating machinery, or for driving direct-belted or geared machinery of a factory or mill, the gas engine deriving its fuel directly from the modern gas producer proves an important and economical factor in the industrial world.

For metallurgical purposes the gas producer and engine have received the unqualified endorsement of mining and experimental companies. The highest temperatures required for economical and perfect annealing are easily obtained in this way. In this particular field the combination unit of producer and gas engine has attained a degree of proficiency that is rapidly causing its general adoption. Its compactness, simplicity of construction and operation, and the high temperatures quickly obtained, recommend the gas producer for metallurgical operations, especially where power machinery is also required in connection with excessive heat.

But after all, this field is only a very small part of the industrial work that the gas engine and producer is called upon to perform, and its development in manufacturing lines is the most important. The different forms and modifications of producers have to some extent caused a slight confusion in the minds of some. In the effort to refine the gas so that its calorific value will be higher, the cost of production has been increased. The fact seems apparent to-day that a sacrifice of refinement may often result in actual economy of operation. Simplicity of design and operation is more to be desired than costly, bulky and complicated machinery for refining the gas or for recovering the by-products. A simple and easily adaptable producer for power purposes alone appears to be the demand to-day.

In the Morgan producer automatic feeding of fuel eliminates some of the former problems which made cheap gas production on a small or large scale difficult and expensive. In many of the old types of producers, the feeding was carried on at irregular intervals, and the coal was dumped in large quantities into the fuel bed. This fresh coal falling upon the incandescent bed immediately caused a great rush of gases at comparatively low temperatures. The result of this was a considerable loss of fuel and efficiency, and particularly so when a period of very lean gases followed. In order to secure perfection and uniformity of work, the fuel must be fed with automatic regularity, which keeps the rush of gases at a high temperature normally regular throughout every hour of the day.

The automatic feeding of the American type of producer has accomplished such satisfactory results that it has been adopted abroad in a number of instances. In England the cupola type of gas producer developed by Mr. Thwaite has sought to reach this same end in another way, and it has received a good deal of popularity abroad. It is reported that in the Thwaite cupola type the combustion or gassification of the fuel is complete, and also in the Duff-Whitfield type.

In the American Morgan type of producer, the coal is dumped into an upper reservoir from whence it falls automatically through an inclined spout to slowly revolving discs. The fuel is thus allowed to work through gradually, and the coal is uniformly distributed throughout. Water seals have to be provided to prevent the revolving part of the producer from leaking so the gas cannot escape.

A Korting blower with steam jet supplies the air blast to keep the fuel in an incandescent state. The jet of steam passes through the lower bed of ashes, and serves to reduce the clinkers and absorbs a large proportion of the heat of combustion. The result of this latter process is that the gas is rendered cooler and richer through the process of breaking up the heat of combustion into oxygen and hydrogen, so that the oxygen thus freed can more readily combine with the carbon.

The gas from such a producer is supplied in immense volume, each pound of coal yielding from 65 to 75 cubic feet. This volume of gas, however, is not all immediately available for engine purposes. About half of it is nitrogen, and this carries no combustive energy because it is too heated. The recovery of this waste heat for raising steam has been one of the questions involved in the development of the gas producer. In the Dellwick-Fleisher water gas producer from 15 to 20 per cent. of the total fuel used is said to be utilized through the recovery of waste heat.

The removal of the ashes and clinkers in the gas producer is an important item of trouble and expense. Where the air blast is accompanied by a steam jet this is greatly simplified, for steam coming in contact with the clinkers in the hot zone soften and break them so they gradually descend. Easy access is had to every part of the water basin in which the Morgan type of gas producer stands, and the ashes falling here are conveniently removed. The soft, wet ashes can be taken out with little difficulty at certain intervals, and the fire itself can be partly regulated by digging them out or permitting them to remain.

Engineers are tolerably familiar with gas engines of small and large units to-day, and their perfect operation has made them of general use; but the combination gas producer and gas engine has introduced some new problems in the subject. This is particularly true in making estimates of the plant required to operate electrical generators or other machinery. The gas engines have no overload capacity, such as the steam engine, and in making preliminary estimates the total or maximum of power needed must first be carefully ascertained. In designing a steam engine or electrical dynamo, the overload capacity always leaves a margin of safety that figures prominently in the original estimates. This factor, however, must be entirely eliminated when the gas engine and producer are considered.

The other problem that requires satisfactory solution before estimates are requested or designs made is the nature of the fuel to be used. An exhaustive study of this question at the beginning ensures satisfactory returns in the end. It may not always be the cheapest fuel, but it is always the fuel that will give the highest returns for a given expenditure. An engine designed for a low grade gas can never give the highest results on gas of a much richer quality. In designing the producer, the question of the grade of coal to be used must be considered along with the quality of the gas to be produced. With several types of gas producers designed and adapted to different needs, it is not difficult to find a satisfactory solution for these questions. The cost of the producer and engine will vary considerable according to the grade of fuel to be employed, and generally the cheaper that the fuel is the more expensive is the initial construction of the plant. A producer adapted to hard coal is thus much less expensive to construct than another built for utilizing bituminous coal. On the other hand, gas producers for soft coal have been built at a slight increase over those for hard coal, and their economy of operation and efficiency have proved eminently satisfactory.

The cost of removing the hydrocarbons in the gas by washers varies considerably. The condensing of the tar and gum in the gas engine is one of the worst troubles that can happen. This is sure to occur from producer gas made of soft coal fed to plants not provided with mechanical washers. A great many devices have been employed to break up and destroy the tar. The formation of this tar occurs under certain temperatures, and if slightly changed it can sometimes be broken up into permanent gases. Excessive temperatures will furthermore disintegrate the tar and cause it to be deposited in the form of lamp-black.

Gas scrubbing and cleaning devices have developed gradually into the centrifugal scrubbers, which apparently give the best results; but they have not yet reached the point of perfection when low grades of soft coal are used as fuel.

For an electrical central station, the gas producer and engine possess advantages under certain conditions over steam, but the cost of installation of the complete producer plant must be much less than that of a boiler plant to secure economical results. It is for this reason that simplicity of design, with little attempt at refinements to produce a higher grade of gas, is essential to success in the industrial field. With this question properly settled, the gas producer and engine gives better results on light loads, showing a considerably higher efficiency than a steam engine of the same size. Quick starting of the gas engine is always a point in its favor, and also the ease of extending equipment. The cost of maintenance is generally in favor of the gas engine, and the less number of parts required is also a factor of economy in making repairs. The use of the waste heat in the jacket water is sometimes of importance in heating buildings, but this is a factor that cannot always be depended upon. However, its consideration in the final comparison of the two systems may in a few cases prove the determining factor. As soon as a gas engine is shut down all heat loss ceases, but to secure this in the combination of gas engine and producer, storage tanks for the gas must be provided. The continuous operation of the producer night and day proves the most economical, and to shut this down whenever the gas engine is thrown out of service causes a loss.

A CANADIAN DELLWIK-FLEISCHER WATER GAS PLANT.*

Ernst A. Sjostedt, Sault Ste. Marie, Ont.

It should be a matter of some pride and interest to Canadians to know that one of the most important improvements of the age in gas making—the Dellwik-Fleischer water gas process—was early adopted by a Canadian firm; but as this plant still remains the only one of its kind in all America, in spite of its great merits and economic adaptability for many and diverse purposes, I gladly take this opportunity of giving it the endorsement which it deserves.

In looking through the voluminous literature on water gas of only a few years ago, we are certain to arrive at the same opinion as expressed by some of the foremost gas engineers in America and of manufacturers of well known gas producers when they describe water gas as "a gas which never can play any very important part in the industrial field, owing to the large loss of energy entailed in its production, although there are places and special purposes where it is desirable, even at a great excess in cost per unit over producer gas." This, I fear, represents fairly well the general opinion of many should-be users of water gas at the present time, but such a view has long since become obsolete, and it is about time for us to wake up to this fact, and to the realization of the great possibilities in store for the Dellwik water gas.

The Dellwik Water Gas.

The difference between the old (Lowe) water gas and the Dellwik gas is not one of chemical composition, nor one of application, but is in the simple and economical manner in which it is produced. Water gas making by the old system was an intermittent process in which the gas was made by blowing up

*A paper read before the Canadian Mining Institute. Montreal meeting, March, 1905.

the fuel bed of the producer with a light blast of air to a high state of incandescence (and in some cases utilizing the resulting lean producer gas), then shutting off the air and forcing steam through the fire, thereby dissociating the steam into its elements of O and H, the former combining with C of the coal, and the latter being liberated:

$$C + H_2O = CO + 2H$$

The result of such a procedure is the consumption of about 75 per cent. of the fuel in the production of the required heat for dissociating the steam, leaving only 27 per cent. of the fuel for water gas generation; three-quarters of the time being devoted in the heating-up stage, and only one-quarter of the time for water-gas production.

By the Dellwik-Fleischer system this has all been reversed. The water gas generation by this method produces no carbon monoxide during the period of heating, but brings about a complete combustion of the carbon, under the formation of waste gases only (CO_2 and N), and the time of heating up occupies less than 20 per cent., while that of the gas generation is over 8c per cent. of the total. The yield of gas from the fuel is consequently also greatly altered in favor of the Dellwik-Fleischer method; the total yield of the water gas per lb. coke by the old process being only 15 to 20 cubic feet (= 30,000 to 40,000 cubic feet per ton coke), whereas by the new system 35 to 45 cubic feet are obtained per pound of coke (or 70,000 to 90,000 cubic feet per ton).

In order to explain how these results (which at first were pronounced impossible by the German Patent Office and many eminent investigators), still are attainable, the following figures are presented: Under the supposition that in one case the C is burnt to CO, and in the other to CO_2 (in each case with the theoretically proper quantity of air), we find that:

		B.T.U.
By the old process:		
1 mol. C = 12 lbs. burnt with 16 lbs. O to CO develops (12 x 4450) = ...		53400
The escaping 28 lbs. CO (at 1300 deg.-F) carry away (28 x 1300 x .248) = ...	9027	
And the accompanying 52.9 lbs. N carry away (52.9 x 1300 x 0.244) = ...	16780	25807
Leaving available heat units in coke bed...		27593
By the D-F process:		
1 mol. C = 12 lbs. burnt with 32 lbs. O to CO_2 develops (12 x 14544) = ...		174528
The escaping 44 lbs. CO_2 (at 1800 deg. F.) carry away (44 x 1800 x .217) = ...	17186	
And the accompanying 105.8 lbs. N. carry away (105.8 x 1800 x .244) = ...	46467	63653
Leaving available heat units in coke bed..		110875

From this we see that after the heating up of the coke bed about four times as much heat remains available for the production of water gas by the Dellwik-Fleischer as by the old process.

Having reached incandescence in this direct and rational way, the fuel is now subjected to the action of the steam, the supply of which is carefully regulated so that the oxidation of CO to CO_2 by steam, which always takes place to a certain extent in the old process, is here avoided, and the result is, as above indicated, that with a fair coke the usual practice is to produce 70,000 cubic feet gas per ton coke by the Dellwik-Fleischer system, as against 34,000 cubic feet by the old process.

Compared with producer gas (Siemen's, Dawson's, Mond's & Taylor's), water gas is practically all combustible, while the producer gas generally contains about 60 per cent. (by volume), incombustible constituents, as seen from the following table, showing their general chemical composition:

	Water Gas, Theoretically.	Water Gas, Practic. Av.	Producer Gas, Practic. Av.
Carbon monoxide	50	40.0	30.0 to 27
Hydrogen	50	51.5	3.0 to 18
Marsh gas	..	.5	4
Carbon dioxide	..	5.0	4.5 to 5
Nitrogen	..	3.0	63.5 to 46
Total combustibles.	100%	92%	33% to 49%
Available heat per cub. ft. gas	322 B.T.U.		139-157 B.T.U.

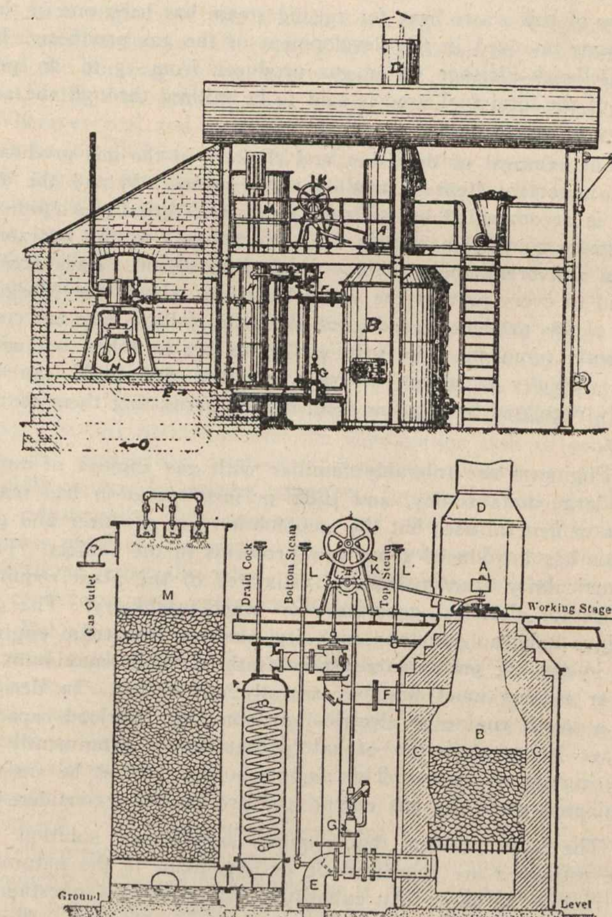
The Lake Superior Power Co. Water Gas Plant.

All these facts came to our notice a few years ago, and after having investigated the subject carefully and visited plants in active operation in Germany and Sweden, the Lake Superior Power Company decided to avail themselves of the new invention, and to erect a water gas plant, based on this principle in connection with their process for desulphurizing the pyrrhotite used in the manufacture of SO_2 gas for the production of a bisulphite liquor for their sulphite mill, and for the manufacture of liquid sulphurous anhydride.

This plant consists of two No. IV. generators complete with scrubbers, blowing engine, boiler and gas holders, each generator having a capacity of producing about 20,000 cubic feet water gas per hour, and the two operating will, when allowance is made for time lost in cleaning grates, etc., produce a total of 800,000 cubic feet of water gas per 24 hours.

The general construction of the plant is shown by the attached illustrations and the modus operandi is as follows:

The coke is charged into the generator at A, until a bed of 3 to 4 feet depth is formed, when to the ignited coke a strong air blast from the blowing engine N is admitted through blast pipe E, under the grate, top valve A being open. Under full combustion of the carbon and the formation of CO_2, which escapes through chimney D, an incandescent heat of the coke bed is obtained in less than two minutes, when by means of an ingenious interlocking system of valves, operated by ratchet



Diagrammatic Representation of Dellwik-Fleischer Water-gas Plant.

wheel K, the blast is cut off at G, gas valve I opened, top valve A closed, and steam admitted through L or L1 (alternately from top and bottom of producer, so as to maintain uniform heat and prolong the life of the brick-work lining). During eight to ten minutes, or until the test flame shows indication of a weak gas, the steam is thus admitted and the water gas process continued, after which the valve system is reversed, the steam valve shut off, the water gas valve closed, top valve opened, coke charge admitted, and the blast again turned off for heating-up and preparing the coke bed for another water gas period. The water gas thus produced enters through gas main F, either direct or by way of the intermediate steam superheater H, to scrubber M, where it meets a water spray from sprinklers N, and is thereby cleansed from dust and sulphur vapors. From the scrubbers the now dry and purified gas passes through the gas outlets O to the gas holders, which in our case are two in number, each holding 20,000 cubic feet of gas. From here the weight of the holder forces the gas through a system of pipes, leading to places of consumption.

From first to last our water gas plant has given us great satisfaction, no trouble having been encountered, nor any accident having occurred to detract from its general usefulness. Having improved our roasters so as to make any auxiliary fuel unnecessary, the plant has been used very intermittently; but we have found it economy and a great convenience to operate the same for use in our laboratory and for welding purposes in the machine shop. The simplicity of the plant and the ease with which it can be handled make it a simple matter to start up and shut down at leisure, running the same for a few hours while filling our gas holders, which require only a couple of hours' time and the labor of two men. The cost of the gas, with coke at $6 per ton, varies from 15 cents (when running the two producers continuously), to 50 cents per thousand cubic feet (when running the plant intermittently, as above referred to). Counting on the production of 70,000 cubic feet of water gas per ton coke, a day's running expenses will be made up of the following items:

Expenditure:	
Coke, 11.5 tons at $6	$69 00
Steam	20 00
Labor, four men at $2.50	10 00
Superintendence, power, water, light, depreciation and repairs	21 00
	$120 00
Product:	
800,000 cub. ft. water gas at 15c.	$120 00

Applications of the Dellwik Water Gas.

The yield of water gas by the Dellwik invention is more than double that of the old process, and the consumption of coke in the heating-up stages is reduced by one-half. The quantity of fuel required for producing the necessary amount of steam for power and gas-making is from 15 to 20 per cent. of that used in the generator, consequently we obtain from the Dellwik water gas the remarkable net yield of 75 to 80 per cent. of the heating power of the fuel. For this reason and owing to its high calorific value and high temperature of combustion with air without preheating or regeneration (3,500 to 4,000 deg. F.), the value of this gas for many and various purposes is self-evident. Speaking generally, its advantage consists of a saving in fuel, time, labor, and of an improvement in the quality of the work produced, especially where a high and even temperature is required. For cheapness, quickness and excellence of work, it offers particular advantages for welding, brazing, soldering, forging, tempering, annealing, and smelting of metals, in the manufacture of open-hearth and crucible steel, pipes, steam boilers, car wheels, in glass blowing, china and pottery firing, in burning lime, cement and plaster, in calcining, drying, heating and evaporation, for fuel and lighting purposes, and for motion power in engines for diverse purposes.

Several of the above applications deserve special mention, and I will now briefly point out the more important ones, using for my authority Inventor Carl Dellwik and Chief Engineer Hugo Dicke, of the Water-gas Syndicate, Frankfort-on-the-Main.

Welding.—In the welding of iron plates for boilers the consumption of gas is about 750 cub. ft. (corresponding to about 19 lbs. of coke), per foot welded joint, of which 40 ft. of welded joint of ⅜-in. to ½-in. iron plate can be finished per shift of 10 hours. In welding gas and water pipes, boiler flues, gas cylinders, poles for electric tramways and arc lamps, the use of water gas will increase the output from three to four times over that obtained by coke firing, and requires only about one-half the number of laborers. In making car wheels, the welding of one wheel-star ordinarily requires 220 lbs. of coal and 132 lbs. of coke at a total fuel expense of about 28c., whereas by water gas seven wheels per hour are turned out with 8,800 cubic feet of gas, at the cost of fuel of about 15 cents per wheel. In specially constructed furnaces for the purposes of chain welding, the cost of fuel is reduced by at least 40 to 60 per cent., while the clean heat of the gas and the consequent absence of dust and slag from the welding surface result in a better and more reliable weld.

Brazing and Soldering.—For this purpose water gas is particularly advantageous owing to its applicable source of heating; consequently it is being used in the manufacture of bicycles and tubes of thin metal, for gas cylinders for railway carriage lighting, self-lighting buoys for compressed gas, etc., also in the manufacture of ornaments and jewelry. On account of its purity, it has also proved especially suitable for lead burning, which ordinarily is done with hydrogen gas, the production of which costs about twenty times as much.

Forging and Heating.—When objects of similar size and shape are to be made, water gas is particularly well adapted, but even for ordinary forges in machine shops, etc., the Dellwik gas has been applied with great success, having been found to be a great advantage to the blacksmith owing to the iron being exposed to view during the process of heating besides giving a clean fire and a constant supply of heat, easily controlled by the simple turn of a valve. Iron bars 2⅜-in. square are welded together with water gas in four minutes, 1⅝-in. square in three minutes, 1-in. by 1¾-in. square in two minutes, and 1¾-in. round in about one and one-half minutes. For the purpose of heating rivets, very convenient and effective heating furnaces for water gas have been devised and have proved to offer even greater advantages than the blacksmith forges.

Tempering.—The application of water gas for the manufacture of knives, scissors, swords, saws, tools, etc., was made before the Dellwik system of water gas-making was invented. Experience shows that not only is the heat equally distributed, but the bars come out all one even color and temperature; and three times more work is turned out now, at half the price, as compared with tempering by coal fire. This gas is also used in the manufacture and tempering of watch springs, needles, etc.

Annealing.—Special stress is laid on the advantage of water gas in annealing of jackets of ordnance and of plates for the outer-sheeting of torpedoes and in the tempering and annealing of rifle barrels.

Steel Manufacture.—The advantage of mixing water gas with producer gas in an open-hearth furnace of ordinary construction has long been appreciated at an English steel works, where the charge is smelted with a mixed gas, after which the water gas is shut off and the process continued with unmixed producer gas until an hour before tapping when water gas is again added, so as to make the steel as hot and liquid as possible. The result of adding 1,800 cubic feet of water gas per ton steel (= 90 cubic feet, per cwt.) is an increase in production of about 26 per cent. Used unmixed in open-hearth furnaces, water gas should also be highly advantageous as the heating effect of the water gas is about 39 per cent. higher than that of the producer gas; and when we further consider that in the production of producer gas about 70 per cent. of the heat value of the fuel is consumed and that in making water gas 85 per cent. of the actual heat value of the coke is obtained, it is evident that the total heating effect of pure water gas is $(85 \div 70 \times 1.39 =)$ 1.68 times as great as that of producer gas. Consequently, there seems to be no doubt of the importance to steel makers in adopting an exclusive Dellwik water gas firing.

Glass-Making.—For the purpose of glass smelting and glass blowing, water gas is used to great advantage in Bohemia and Stockholm, resulting in a considerable reduction in the cost of fuel. At a glow-lamp factory, making from 5,000 to 7,000 lamps per day, and where city coal gas was previously used, the introduction of the Dellwik gas reduced the cost of fuel about 80 per cent. in soldering the glass bulbs and in heating the lamp during the vacuum pumping; and for the carbonization of filaments, which previously was done by means of petroleum, at a cost of $4.50 per barrel, a corresponding amount of work was afterwards performed for $1.65 expended in water gas, besides making a saving of one man per shift. In smelting enamels in the Perrot furnace, Dellwik water gas accomplishes an equal amount of work as coal gas at about one-eighth the cost of fuel.

Boiling, Evaporating and Distilling.—Comparative tests have shown that under exactly similar conditions 1,000 cubic feet of water gas will evaporate an equal amount of liquor as 450 cubic feet of coal gas, and as the average cost of this gas amounts to about $1 per 1,000 cubic feet, the use of the Dellwik water gas reduces the cost to about one-third.

Power.—Water gas is eminently adapted for driving gas engines on account of its smokeless combustibles. In small motors, where 35 cubic feet of coal gas are required per horse-power hour, 70 cubic feet of water gas suffice, and in a large engine, averaging about 23 cubic feet coal gas per horse-power hour, 45 cubic feet of water gas are required. A gas engine designed for illuminating gas works equally well with water gas, and the cheapness of the Dellwik gas makes this gas the most economical source of power. As compared with the producer gas, the cleanliness and high calorific power of the water gas constitutes important advantages. The following table will show the economical results obtained (in England), using different gases in a 250-h.p. gas engine (with coal gas at 70 cents per 1,000 cubic feet, boiler coal at $3 per ton, gas coal at $3.25 per ton, coke and anthracite at $4 a ton, and wages at 8 cents per hour):

	Cost of Fuel.	Total Cost.
Coal gas (23 cub. ft.) per h.p. hour	.660c.	1.61c.
Steam (3.3 lbs. coal) per h.p. hour	.426	.57
Dellwik water gas (45 cub. ft.) per h.p. hour.	.248	.36

Illumination.—On account of its high flame temperature water gas lends itself admirably for incandescent gas light and is used for such purposes in industrial establishments, as well as in some towns where non-carburetted Dellwik gas is distributed. Incandescent lamps for water gas are of simpler construction than those for coal gas lamps, but should be provided with a stronger mantle, owing to the high temperature of the water gas flame. In those places where no gas works as yet exist it would be advisable to make pure water gas, both owing to the cheapness of the plant (one-half to one-quarter of the cost of a coal gas plant), and the price of the pure water gas (about one-third that of coal gas). The capacity of existing coal gas works can be largely increased at a comparatively small cost by the erection of an auxiliary water gas plant for the purpose of mixing water gas with coal gas, especially in places where a good market for coke does not exist, as by converting the entire output of coke into water gas the capacity of the combined plant would be four times that of the original coal gas works.

One pound of coal yields 4.65 cubic feet of coal gas and about .65 lbs. of coke. If we, from this, take the coke required for firing retort (about 15 per cent.) there still remains .5 lbs. of coke to be converted into (16 cubic feet) water gas. Thus we will receive 20.65 cubic feet mixed gas per pound coal. With such a mixture the Welsback lamp, consuming 7 cubic feet per hour, will produce 100 Heifner (=88 Eng.) candles equal to 14.3 H. candles per cubic feet, or 293 H. candles per pound coal; while the coal gas will consume 3.8 cubic feet per hour and produce 60 H. candles, yielding 72 H. candles per pound coal. Consequently we obtain from the mixed gas about four times as much incandescent light by distilling one-quarter of the coal and converting the resulting coke into water gas. To carburet this mixed gas with oil is also easily accomplished.

In the following table is given the approximate cost (in England), of the different lights used (with retort gas at 55c. per 1,000 cubic feet, water gas at 20c., and carburetted water gas at 56c.):

	Average, Candle Power.	Cost Per Hour.	Cost Per 1,000 C.P., Hr.
Petroleum	40	.814c.	20.4c.
Retort gas, ordinary burners..	16	.280	17.5
Retort gas, Argand burners..	30	.504	16.4
Retort gas, Welsback burners.	50	.256	5.12
Pure W. gas Welsback b'n'rs.	75	.144	1.92
Carburetted W. gas, ordinary burners	22	.28	12.72
Elec. light, glow lamp b'n'rs.	16	.4	25.

Heating.—Compared with the heating of dwellings by means of coal gas, the Dellwik water gas has the following advantages: (a) The cost of a water gas plant is only one-third that of a coal gas plant of equal capacity; (b) labor wages in operating a water gas plant is only one-quarter to one-fifth that of a coal gas plant; (c) the relative value of the water gas for heating purposes is to retort gas as .588 is to 1; that is, 1,000 cubic feet water gas corresponds to .588 cubic feet coal gas.

Below is shown the cost (in Germany), of heating with coal gas at 75c. per 1,000 cubic feet, with water gas at 25c. per 1,000 cubic feet, and with coal at $3.75 per ton:

Coal Gas.—(550 B.T.U. per cubic ft.); 100 pounds of coal yielding 465 cubic ft. gas, with a useful effect in the stove of 90 per cent., will deliver (465 x 550 x .9 =) 255,000 B.T.U. The cost of this gas is (465 x .75 =) 34.9c.

Water Gas.—(275 B.T.U. per cubic ft.). To produce 255,000 B.T.U. from water gas, allowing the useful effects in the stove of 90 per cent., (255,000 ÷ 275 x .9 =) 1,030 cubic ft. would be required, costing (1.030 x 25 =) 25.7c.

Coal.—(1,266 B.T.U. per pound): With the usual stove efficiency of 16 per cent., it would require (255,000 ÷ 12,600 x 0.16 =) 121 pounds of coal to develop 255,000 B.T.U., or a fuel expense (121 x 375 ÷ 2,000 =) 22.2c. Thus we see that the Dellwik water gas for heating purposes is about one-third cheaper than coal gas, and only a little dearer than coal, besides possessing the advantages for freedom from soot and smoke, which again would mean a salutary, refreshing air that soon would be appreciated in any community in the event of pure water gas being introduced for heating and cooking purposes.

THE HEROULT ELECTRIC STEEL PROCESS.

The following is a description of the process of making steel in the electric furnace invented by Dr. P. Héroult, as carried out at La Praz, France, and reported upon by the special Government Commission, recently sent to Europe under Dr. Haanel, Superintendent of Mines, Ottawa:

Steel at the work of the Société Electro-Metallurgique Française at La Praz is made from scrap melted down, purified by the making of a number of slags, and carbonized in the furnace by carburite. This process, unlike that adopted at Gysinge, permits of the purification of the materials employed, and different grades of steel are made without difficulty.

The furnace is of the tilting pattern (see Plate I. and Figs. 1, 2, 3, 4 and 5). It consists of an iron casing lined with dolomite brick H H, and magnesite brick around the openings. The hearth is formed of crushed dolomite K, rammed on top of the dolomite brick lining of the bottom of the iron casing. Two electrodes E E pass through the roof of the furnace, which, in the Kortfors furnace, were water jacketed for a short distance above and below their passage through the iron casing of the roof. The current passes from one electrode through the narrow air gap left between the electrodes and the slag line, into and through the slag to the molten metal, along it, through the slag and second air gap, to the other electrode. An alternating current of 4,000 amperes and 110 volts was delivered to the electrodes. The intensity of the current passing through the bath is regulated by adjusting the width of the air gap between the electrodes and the slag line. This adjustment is effected either by hand or automatically by a specially constructed regulator. In the former case (See Figs. 1 and 3), the motor P is thrown out of action by lever T. Z, operating on pinion S, which engages the teeth of rod R, is rotated right or left handed to lower or raise the electrodes. Diagram (Fig. 6), illustrates the principle of the action of the automatic regulator, and plate II. gives a general view of the pair of regulators employed at La Praz.

In Fig. 6, B is an iron wire connecting the bath of metal with the iron casing C of the furnace. The current due to the difference of potential between the metallic bath and the electrode E passes through the volt-metric suction coil S, the movable outer coil of which, operating the rod D pivoted at T, and regulated by spring A, imparts motion to the horizontal staff D' in a vertical plane, with every variation of difference of potential in the circuit. N, a pulley driven by a small motor, operating by means of the crank M and the connecting rod L, oscillates the part U, which is pivoted at Z. The dogs X X' attached to U partake of the oscillation of U, but in their backward and forward motion fail to clutch the staff D' as long as the variation of voltage in the circuit does not exceed 2 volts; when this limit is exceeded either way D' rises sufficiently high, or is depressed sufficiently low, to be clutched by either X or X'. When this occurs the projection n of the respective dog is brought into contact with the respective side of the triangular plate G G, to which the prongs H H, pivoted at Z, are attached by springs K K. This results in bringing the copper piece O, the suspending rod of which is also pivoted at Z, into contact with the respective carbon block Q. From the diagram it will be seen that the direction of the rotation of the motor P, which raises or lowers the electrodes E E, depends upon the contact made by O with either Q or Q', and hence upon the rise or fall of the voltage in the circuit beyond the limit of 2 volts.

Mr. Héroult states that the cost of the furnace (charge 2,500 kgs.), building and necessary equipment, such as ladles, moulds, crane, etc., is about 50,000 francs, or $10,-

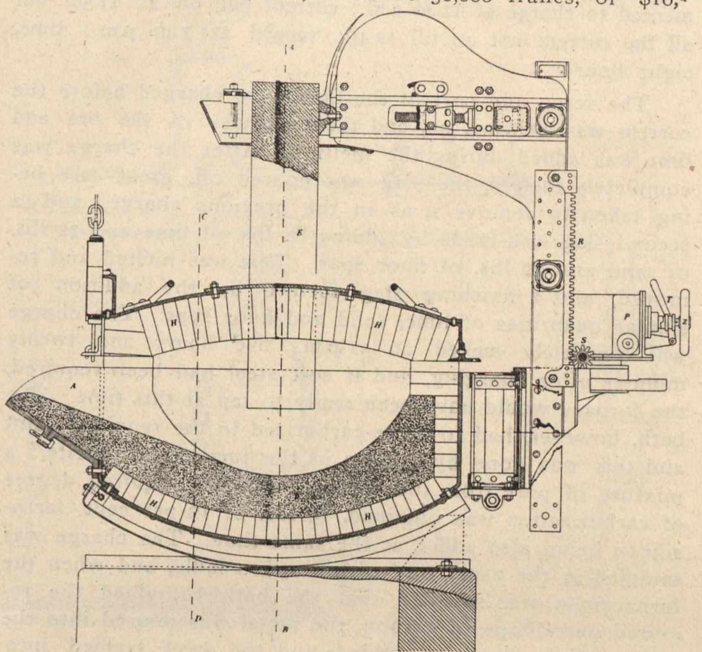


Fig. 1. Transverse Section E F.

000. This does not include the turbines and electrical machinery. The electrodes are square prisms 360 mm on the side and 170 cm long. They are made from retort coke which contains from 1 to 2 per cent. of sulphur. The binding material is tar. The coke delivered at La Praz costs 50 francs per metric ton, and the finished electrode 10 centimes per kg. The electrodes are not entirely consumed, and the short ends remaining are worked over into new electrodes, at a cost of 2 centimes per kg. The plant for making electrodes for one furnace is estimated by Mr. Héroult to cost $5,000.

A Thompson recording wattmeter had been rented in Paris from La Compagnie pour la Fabrication des Compteurs, and ordered to be sent to La Praz, to be used for the determination of the electric energy absorbed. Unfortunately, however, the meter did not arrive in time to enable us to have it put in circuit. The electric measurements at La Praz were, therefore, made with the instruments (of Hartmann and Braun's manufacture), permanently mounted on the switch-board of the power house. The absorption of electric energy per ton of steel amounted to 0.153 electric horse-power years (English units). If tapped before completion of purification, the product to be employed for structural steel, the energy consumed amounted to only 0.1 electric horse-power years per ton.

Cost of Converting Scrap into Steel.

In a memorandum furnished by Mr. Harbord, at La Praz, the estimated cost of converting scrap into steel by the Héroult process, exclusive of cost of scrap and metal, amounted to $14 per ton of product.

The following classes of steel are made at the La Praz works and at the selling prices per ton of 2,000 lbs. set opposite the description:

Steel of exceptional hardness	$363 60
Class 1—Extra hard steel	272 60
" 2—Very hard steel	272 60
" 3—Hard steel	218 00
" 4—Medium hard steel	218 00
" 5—Tough, medium hard steel	145 40
" 6—Tough steel	145 40
" 7—Tough mild steel	123 20

Production of Pig.

Mr. Héroult was good enough to make some experiments for us in smelting iron ores. The furnace employed was exceedingly simple, consisting of an iron box of square cross-section open at top, and lined with refractory material. The bottom of the casing was provided with a carbon plate, which constituted one terminal of the electric circuit, the other terminal consisted of a carbon electrode of square cross-section about 3 feet in length, and placed vertically in the open top of the furnace. By hand regulation the distance of the electrode within the furnace could be varied. The charge was placed between the carbon plate at the bottom of the furnace and the vertically-adjustable electrode, and packed around the latter in the space between it and the walls of the furnace. The ore employed was in a more or less finely divided condition. The gases developed in the zone of fusion and reduction could not, therefore, readily escape, and whenever the pressure of the formed gas exceeded the weight of the charge above it, a blow-out would occur ejecting part of the charge. This, of course, would not occur if the charge consisted, not of fines, which prevent free egress of the gases formed, but of coarse material, with interstitial spaces for the discharge of the gases. These experiments were made for us by Mr. Héroult for the purpose of demonstrating the simplicity of the process of reducing iron ores by the electric process, and it was not intended to demonstrate a figure of cost per ton of pig produced by this process.

The Héroult process is covered by several patents in Canada. A letter from Dr. Héroult was received by Dr. Haanel at Ottawa since the Commission's report was published: I have the pleasure of informing you that since your last visit to La Praz the steel furnace you saw there has

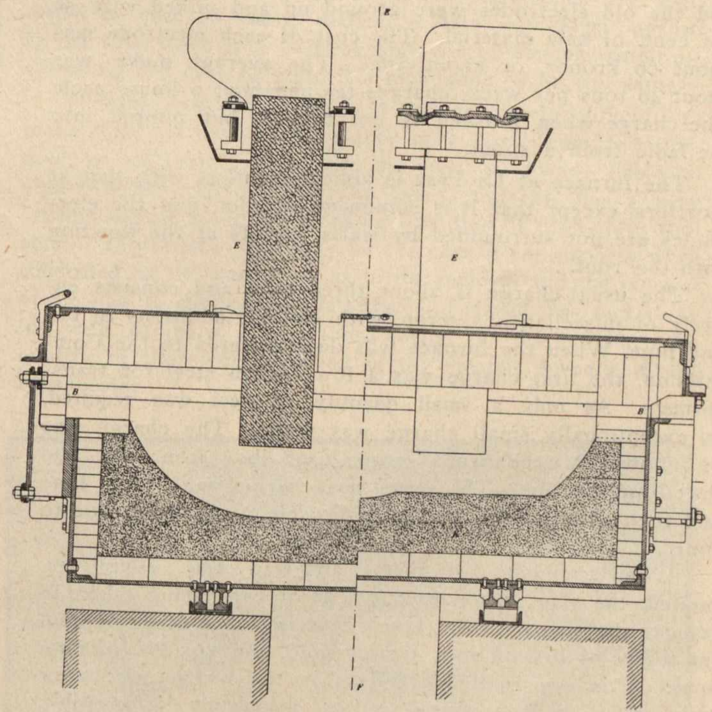


Fig. 2. Longitudinal Sections A B and C D.

been materially improved by the addition of water jackets round the electrodes. The effect is this: The output of the crucible has passed from four tons to seven tons in twenty-four hours. The absence of air is so complete that we obtain percentage of carbide of calcium in the slag. The loss of raw material has also greatly diminished.

F. W. Harbord, consulting metallurgist to the Government of India, in his report on this process says the furnace in use at Kortfors is similar to the tilting furnace used for the Siemens or open hearth process, except that the gas ports at each end are replaced by charging doors, and the temperature is maintained by carbon electrodes which pass through the roof. The furnace was about four-tons' capacity, basic lined, and the charge was entirely miscellaneous steel scrap. The electrodes were surrounded by water jackets where they passed through the roof of the furnace, and were raised and lowered by automatic electric regulators. The electrodes did not touch the surface of the bath, but were kept just above the slag line. Ore and lime were added from time to time, and the slag removed three times during the melting and a new slag made by further additions of ore and lime, by which means the impurities

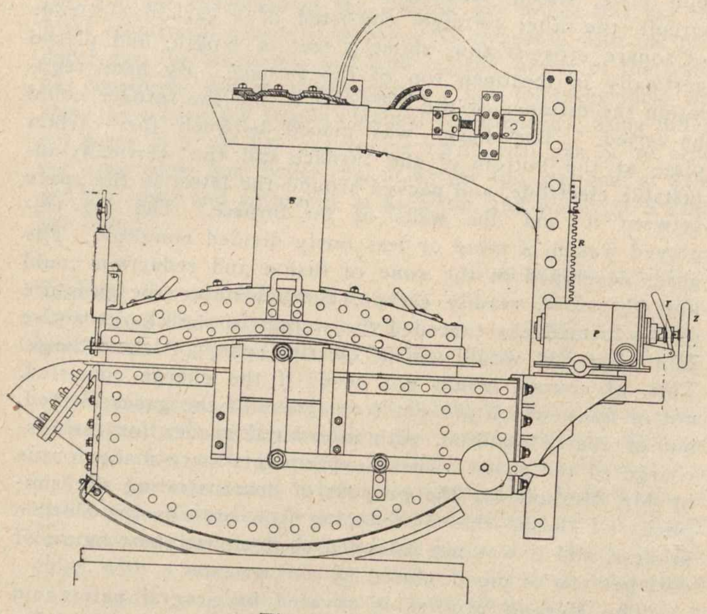


Fig. 3. Profile.

in the scrap were almost entirely removed. The electrodes were two meters long, and 400 mm. square in cross-section, and weighed 500 kilogrammes. They lasted one week, and the old electrodes were ground up and mixed with 50 per cent. of new material. The cost of each electrode was about 60 kronor, or about $16. The average make was about 40 tons per week, charges taking about 9 hours each. The charge when finished is not tapped, but poured into the ladle from a spout.

The furnace at La Praz is almost identical with that at Kortfors, except that it is somewhat smaller, and the electrodes are not surrounded by water jackets at the junction with the roof.

The usual charge is about three tons, and consists entirely of miscellaneous scrap, with suitable additions of ore and lime. When the furnace was demonstrated to the Commission, the first charge was a low carbon steel for transformers. As only a small quantity of steel was required, an exceptionally small charge was made. The charge was as follows: Miscellaneous scrap, 3,307 lbs.; iron ore, 330 lbs.; lime, 246 lbs. The scrap was charged with some lime and then additions of ore and lime were made from time to time.

When the bath of metal and slag was completely melted, the slag was poured off, great care being taken to remove the slag entirely; a new slag was then made by adding about 55 lbs. of lime, 15.5 of sand, and 15.5 lbs. of fluor spar. This was melted and kept in the furnace for some time, when it was poured off as completely as possible, the last traces being raked off the furnace through the pouring door. Another addition of lime and fluor spar, etc., in the same proportion as the last, was then made to form a finishing slag to remove the last traces of impurity; about 1.5 lbs. of ferro-manganese was added, and the charge was poured into the ladle, a little aluminum being thrown into the ladle before the metal was teemed into the ingot moulds. The furnace was ready charged at 7.45 p.m., and the current put on, and it was poured at 12.15; time, 4½ hours. The very short time taken for the operation was due to the smallness of the charge and to the fact that no time was required for recarburizing the very low carbon steel. The steel when teemed ran from the ladle freely, no appreciable scrap being left behind; it was very quiet in the ingot moulds, and the steel ingots were exceptionally sound for steel of this quality. The yield was: Ingots, 2,820 lbs.; scrap, 9 lbs. This was a special steel for transformers, and M. Héroult said before it was made that it would not weld, as to obtain the special qualities required for the electrical firms he purposely sacrificed the welding qualities. In other respects the steel gave excellent results; it forged remarkably well, without trace of red shortness, and gave very good cold bending tests.

The electric energy consumed was 1,410 kilowatt hours, equivalent to 0.216 electric horse-power years, equal to 0.153 horse-power years per ton of steel produced.

Another charge was for a high carbon steel. The same scrap was used, and the charge was as follows: Miscellaneous steel scrap, 5,733 lbs.; ferro-silicon, 19 lbs.; iron ore, 430 lbs.; lime, 346 lbs.; ferro-manganese, 3.3 lbs. Commenced to charge at 11.40 a.m.; current put on at 11.50, but all the current not on till 12.45; tapped at 7.40 p.m.; time, eight hours.

The scrap and part of the lime were charged before the current was switched on, and the remainder of the ore and lime was added during the melting. After the charge was completely melted, the slag was poured off, great care being taken to remove it as in the previous charge, and a second slag was made by adding 88 lbs. of lime and 22 lbs. of sand and 22 lbs. of fluor spar. This was melted and removed, and a finishing slag formed by the addition of similar quantities of lime, sand and fluor spar. The charge was completely melted at 5 p.m., five hours and twenty minutes after charging, and if soft steel had been required, the furnace would have been ready to tap at this time. The bath, however, had to be re-carburized to the required point and this was done by adding in the furnace "carburite," a mixture of pure iron and carbon, until the required degree of carburization was obtained, 19 lbs. of 12 per cent. ferro-silicon being also added at the same time. The charge was sampled in the usual way with a spoon ladle, and when the furnaceman was satisfied that the bath contained the required percentage of carbon, the metal was poured into the ladle, a little aluminum added, and the steel teemed into the ingot moulds. The metal ran very freely, leaving no skull in the ladle, was quiet in the moulds, and forged ex-

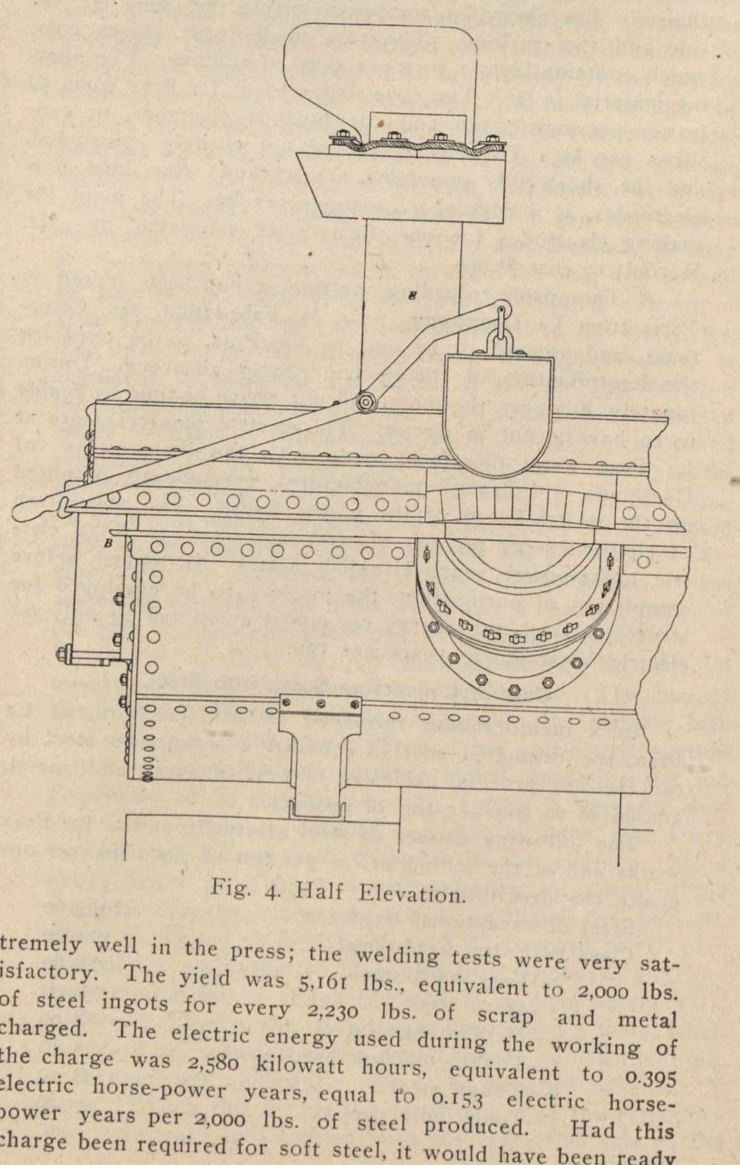


Fig. 4. Half Elevation.

tremely well in the press; the welding tests were very satisfactory. The yield was 5,161 lbs., equivalent to 2,000 lbs. of steel ingots for every 2,230 lbs. of scrap and metal charged. The electric energy used during the working of the charge was 2,580 kilowatt hours, equivalent to 0.395 electric horse-power years, equal to 0.153 electric horse-power years per 2,000 lbs. of steel produced. Had this charge been required for soft steel, it would have been ready to tap at 5 o'clock, when the consumption of electric energy was 1,680 kilowatt hours, equivalent to 0.257 E.H.P. years, equal to 0.100 E.H.P. years per 2,000 lbs. of steel.

It will be noted here that, starting entirely with nearly carbonless scrap iron, the first product obtained is soft steel; to produce high carbon steel this has to be carburized by suitable additions. Consequently, the metal has to be kept longer in the furnace to produce high carbon steel than low carbon steel, and the consumption of electric energy is greater in the former than in the latter case. This is just the reverse of the method of working at

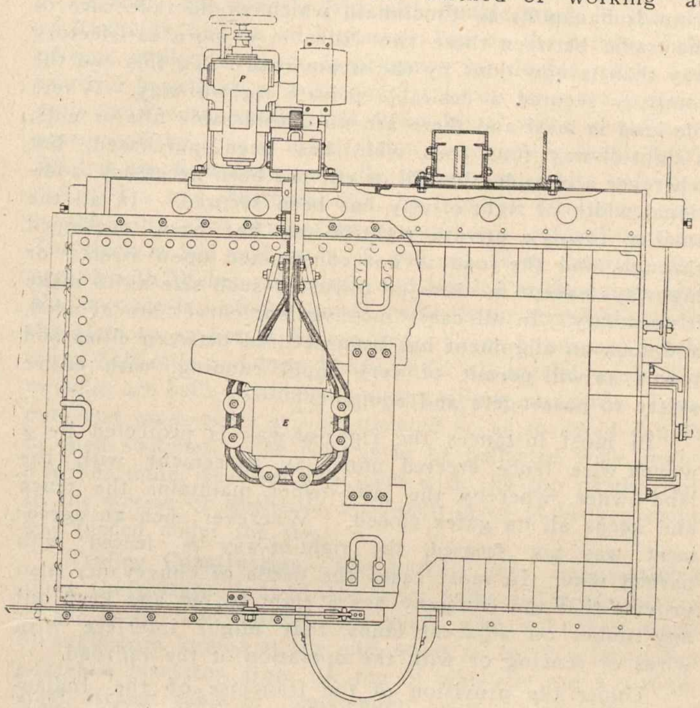


Fig. 5. Plan.

Gysinge, where the time taken in producing soft steel is longer than for high carbon steel. The methods of working, however, in each case depend more upon the materials available than any other consideration, and there would be no difficulty in making high carbon steel without recarburizing, by melting down a suitable mixture of pig iron and scrap in the La Praz furnace; and on the other hand, pure scrap could be melted down in the Gysinge furnace and recarburized at the end of the operation, if desired.

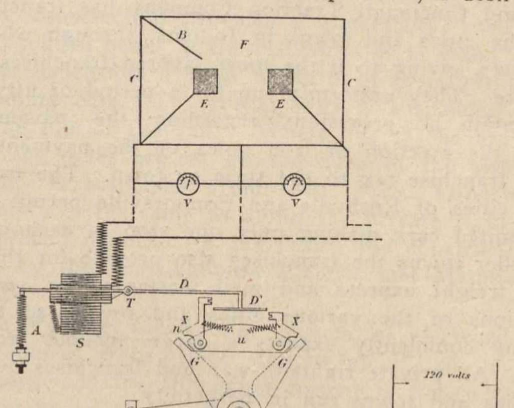


Fig. 6. Diagram showing Operation of the Regulation of the Electrodes.

Cost of Production.

On this aspect of the subject, Mr. Harbord says: "The consumption in electrodes, when working continuously, was 500 kgs. per week, and 50 per cent. of old material, costing two centimes per kg., was mixed with 50 per cent. of new material, costing 10 centimes per kg., thus costing about 30.00 francs for an output of 30 tons of steel. The average output per 24 hours was four tons; figures furnished by M. Héroult from his book showed an output of 120 tons for 30 days' consecutive work, and he considers that he can make 150 tons in this time. The average time for each charge was nine hours, and there were five men employed on the furnace each shift, including the foreman. In these men are included the ladleman and pitmen. The repairs and renewals are somewhat heavy; burnt dolomite, costing 3 frs. per ton of steel produced, magnesite 1.5 frs., and acid refractories, including roof, about 2.5 frs. per ton, making a total of $1.40 per ton for refractory materials. It is extremely difficult to make a statement showing the cost per ton, as this will necessarily depend upon the price of scrap, labor, and refractories in the district; but as any scrap is suitable for this process, the price of the raw material is never likely to be very high and may, as a rule, be taken to be about the same price as pig iron delivered at the same place. In England, the price of common scrap will vary from 45s. to 60s. per ton, but can generally be bought at about 50s.

The cost, as regards materials and labor, will be practically the same as for a gas-fired Siemens furnace of the same size, making similar steel. Any difference in the cost will be due to the cost of electric energy and electrodes, as compared with the cost of fuel. Repairs will probably be higher, but not sufficiently to affect the cost of production. In a small Siemens furnace of this capacity, the fuel consumed would vary from 1,000 lbs. to 1,800 lbs. of good slack coal, i.e., small coal, per ton of steel produced. Such coal would probably cost $5 to $5.50 per 2,000 lbs., in Canada, and assuming 1,200 lbs. to be used per ton, this would be $3 per ton of steel. The cost of electric energy, at $10 per E.H.P. year, would be $1.53, and electrodes are estimated to cost 20 cents, making a total of $1.73 against $3, so that there is a balance in favor of electric smelting, assuming the cost of materials and labor to be the same.

I think, however, it would be extremely difficult to make steel of such high quality in a basic gas-fired furnace, as with the greatest care the steel is always liable to absorb some sulphur from the gases, and this has a very serious influence on the working qualities of high-class tool steel. This would especially be the case if the process were conducted on the same lines as to the removal and the renewal of the slag, to eliminate the last traces of phosphorus, and working with ordinary scrap, there seems no doubt that the quality of the steel produced in the electric furnace would be superior.

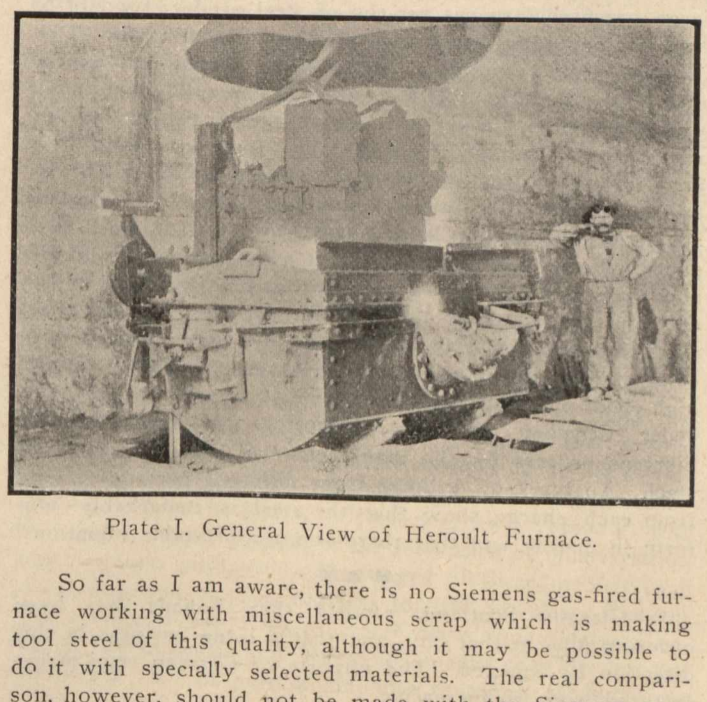


Plate I. General View of Heroult Furnace.

So far as I am aware, there is no Siemens gas-fired furnace working with miscellaneous scrap which is making tool steel of this quality, although it may be possible to do it with specially selected materials. The real comparison, however, should not be made with the Siemens process, but with the crucible process, as it is with crucible steel that electric steel is competing, at all events at present. The advantage in working costs with the electric furnace is so considerable, that under the same conditions as to labor, it should eventually supersede the crucible process, especially as there seems every reason to believe that the special alloy steels now being so largely introduced for high speed cutting tools could be readily made in this furnace. How far this electric furnace can compete with the ordinary Siemens process under the conditions prevailing in Canada is a much more difficult question to decide, as the cost of production largely depends upon the output, and to get a large output with low labor charges means very large furnaces, as practically a 30 or 40-ton furnace requires hardly any more men than a three or four-ton furnace, provided mechanical appliances are arranged for charging.

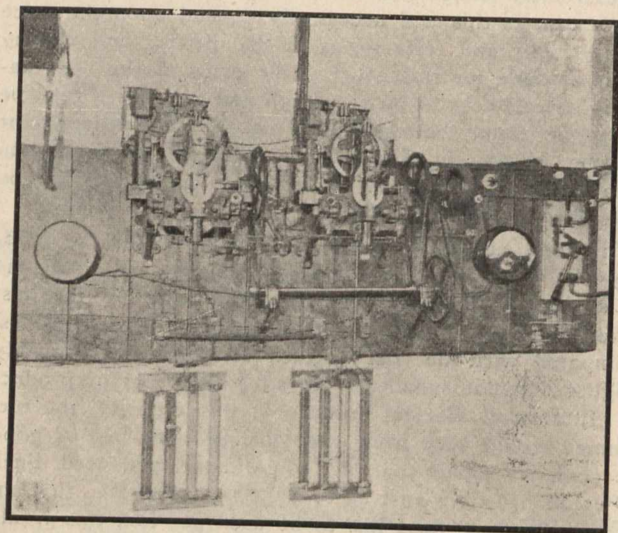


Plate II. Regulator of Electrodes.

The Héroult furnace is extremely well designed, and I see no reason why furnaces up to 10, or possibly 15 tons should not give satisfactory results; but at present I should hesitate to recommend larger furnaces than this. I do not think, therefore, that furnaces of this size could hold their own against gas-fired furnaces of 40 to 50 tons' capacity, or against the still larger furnaces of 100 to 200 tons working on the Talbot system, where labor charges are reduced to a minimum. It must also be remembered that in making structural steel in large quantities, pig, ore and scrap would have to be used, as it would not be possible to get sufficient quantities of scrap to supply a large plant. This would take a longer time to convert into steel than scrap charges, and the consumption of electric energy would be greater. On the other hand, the consumption of fuel in the large gas-fired furnaces per ton of steel produced would be less, not exceeding 800 lbs. of small coal, costing $2. Taking our electric energy as the same as was found experimentally, viz., 0.153 E.H.P. years per ton, and assuming it was the same for a pig and ore charge in the larger furnace and the cost of electrodes the same, we should have $1.73 for electric energy and cost of electrodes against $2 for fuel, and the larger furnaces would still have considerable advantages in smaller labor charges per ton of steel produced. Notwithstanding the slight advantage shown in the above assumptions in favor of electric energy, I am of the opinion that, although the Héroult furnace is admirably adapted under existing conditions for the manufacture commercially of highest class tool steels, ordnance steels, high-class wire, and similar steels, it cannot at present, under Canadian conditions, compete with the ordinary Siemens process for the manufacture of structural and rail steel. Analyses of drillings from different parts of ingots from each charge show that the steel is remarkably uniform in quality and that there is no appreciable liquation."

—Glasgow, Scotland, reports that Canada has been ordering pipe in that city, and that a large business in this direction is expected. The imports of German semi-manufactured iron are increasing.

—The Niagara Frontier Bridge Company is incorporated by a bill introduced in the New York Assembly to construct a bridge across the Niagara river, between Niagara Falls and Lewiston, for electric and steam cars, vehicles and pedestrians.

INDIANAPOLIS AND CINCINNATI TRACTION CO.

The opening of the present year marks the beginning of a new era in electric transportation, for it finds the alternating current railway system a commercial reality. The Indianapolis and Cincinnati Traction Company was organized in 1903 to build a traction line from Indianapolis, via Rushville and Connorsville, Indiana, and Hamilton, Ohio, to Cincinnati. The dominant idea in the minds of the originators was to build a double track through line from Indianapolis to Cincinnati, which would take care of the traffic between these two cities in a more satisfactory way than is now done by the steam roads. To this end the company secured a desirable private right-of-way. Where the land is level and there are no considerable fills or cuts, a right-of-way four rods wide has been purchased, but wherever a considerable fill or cut has been necessary, additional width of right-of-way has been secured. In all the smaller towns a private right-of-way has been continued through, and the road is not constructed upon streets or highways except in cities or towns of such size as to make it necessary. In all cases inconvenient curves are avoided, and such an alignment has been secured between cities and towns as will permit of very rapid running, with entire safety to passengers and equipment.

In most instances the right-of-way is protected by a woven wire fence erected under an agreement with the land-owner, whereby the land-owner maintains the fence and keeps all its gates closed. Wherever such an agreement was not secured, the right-of-way is fenced with barbed wire. In most cases the deeds of conveyance also provide that the company has a right to cut and keep out any timber on adjacent lands that might interfere with wires or fencing or with the operation of the railroad.

Under the provision of the franchise of the Indianapolis Traction and Terminal Company, interurban lines are allowed to enter the city over the tracks of the city company by such routes as the city designates, upon payment to the city company of an agreed or ascertained compensation. The Indianapolis Traction and Terminal Company has made a uniform agreement with interurban roads for entrance into the city over its tracks, whereby interurban roads pay four cents for each passenger carried on the interurban cars while on the city lines, and this entitles them to all of the privileges of the terminal station, where all the interurban roads enter. The Indianapolis and Cincinnati Traction Company has franchises in all of the cities and towns in Indiana through which the line passes, giving to it the most favored franchises within the State. They uniformly run for a period of fifty years, and contain no provisions regarding the pavement of streets, the erection of iron poles, or the payment of a certain franchise tax to the state or town. The franchises of the cities of Rushville and Connorsville permit of running limited cars, making only one stop in each city. In all smaller towns the franchises also provide for the carrying of freight, express and mail matter under reasonable regulations of the various cities and towns, so that the company confidently expects a large income from this source. All private rights-of-way and franchises outside of the cities and towns run in perpetuity.

The line has already been constructed between Indianapolis and Rushville, a distance of forty-one miles, and a through service between those towns will soon be established. At an early date the road will be extended to Connorsville.

Roadway.—The track is graded in accordance with the best practice for steam roads, cuts and fills being made so as to avoid excessive or frequent grades. Between Indianapolis and a point eight miles east of Rushville—a distance of nearly 50 miles—there is no grade exceeding 1½ per cent. So far as the profile of the road has been as yet determined, the heaviest grade will be 4 per cent., and it is believed that no greater grade will be necessary on the entire line. The roadbed is graded 28 feet wide on top for a double track, with slopes on fills and in cuts of 1½ to 1, and upon a grade line that puts the track in most instances above the level of adjacent lands, so as to avoid trouble on account of snow.

Bridges.—The bridges across all streams are constructed either with concrete arches or steel girders with stone abutments. The upper structures are of steel of a capacity sufficient to carry a train of cars with a gross weight of one hundred tons for each car. All abutments are built for double track; the superstructures at this time are laid for one track only. Provision is made for the increased demand for size of cars and length of trains likely to come in the near future.

Track.—The road is laid with double track in the city of Rushville, and on all highways; but on the private right-of-way, while the grade is prepared for double track, only one has been laid, as a second track can be more conveniently and economically put down later, when a sufficient portion of the road is in operation to require a double track. All ties are first-class, no culls or seconds, white oak, burr oak, and a few chestnuts, 6-in. by 8-ft. long, 3,280 to the mile. The bridge ties are of long leaf yellow pine. The track is laid with 70-lb. T rail, in 60-ft. lengths, connected with Weber rail joints, and bonded at the joints with No. 0000 10-in. copper bonds, with ⅞-in. terminals under the plate so as not to be exposed. Cross bonds are put in every half mile and long bonds under all special work. The switches are built according to steam railway standards. Turn-outs and cross-overs are constructed so as to avoid danger of open switches. The road is to be ballasted with gravel 8 inches under the ties and level with the top of the rail. In the streets of Rushville, an 8-inch layer of broken stone was placed under the ties.

Trolley Construction.—The trolley wire is suspended along the private right-of-way from poles set in the centre of the grade one hundred feet apart, with a bracket made of angle iron looped at the end, so as to carry a large, flat porcelain insulator, from the top of which is run a 7-16-in. steel strand cable or "messenger" wire. The No. 000 grooved copper wire is carried 8-in. under the messenger cable, to which it is attached every 10 feet with specially made steel clamps, a construction known as the catenary suspension. The steel messenger wire is drawn tight. With this construction danger from trolley breaks is reduced to a minimum. The insulators are large and strong and are not likely to break, but, if they should, the steel cable would remain suspended from the top of the bracket. As the trolley is attached to the steel cable every 10 feet, breaks will be very infrequent, and, if one should occur, not more than 10 feet of the trolley would be loose. The catenary construction provides a practically level trolley with no sudden bends at the insulators as is found with the ordinary suspension, a point which is of great advantage to fast running cars. The trolley wire is suspended 18 feet above the top of the rail. Where the tracks are in the streets, the poles are set on the sides of the streets and the trolley is suspended from span wires. Otherwise the construction is the same as along the private right-of-way. The overhead material for the entire line construction was supplied by the Westinghouse Electric and Manufacturing Company.

High Voltage Lines.—The system of electrical distribution requires transformer stations about ten or twelve miles apart, and the alternating current is transmitted from the power-house to these transformer stations at 33,000 volts, single-phase, 25 cycles per second, and is reduced and fed into the trolley at a potential of 3,300 volts. The high tension current is carried from the central power station to the transformer stations on No. 4 bare copper wires, two wires to each transformer station. They make a complete circuit and permit the placing of the circuit-breakers and switches at the central power house, so as to do away with the necessity of attendants at the transformer stations. The high tension lines are carried on a separate line of poles set near the edge of the right-of-way, provided with carefully and strongly constructed cross arms and equipped with large porcelain insulators on iron pins.

Telephone Lines.—The entire system is provided with two metallic circuit (4 copper wires) telephone lines, one of which is used exclusively by the train despatcher. The other line is used for general company business. Each car is provided with a telephone, by means of which the conductor can talk with the train despatcher at fixed points. Jack boxes are placed on the poles at intervals of 2,000 ft., from any of which the conductor of a car or any one else with a telephone can call up to report an accident or for any other purpose. The four telephone wires are carried by porcelain insulators on cross-arms near the top of the trolley poles, and are thus far removed from the high tension lines. The wires are transposed every 500 feet in order to avoid disturbances from the current in the transmission lines.

Poles.—The poles are all of select white cedar. Those for the centre trolley construction are 40 feet long with 7-inch top. The side poles for the high tension lines are 35 feet long, with 7-inch top. All are set 6 feet in the ground and are carefully tamped. Along streets on the side where there are no feed wires and the poles are used only to support the span wires, 30-foot poles are used, while on the other side, where the high tension line runs, the poles are of varying height from 40 feet to 60 feet, so as to carry the feed wires above the shade trees. All of the side poles along the streets are neatly shaved and painted and are set in concrete. The tall 60-feet poles are of Idaho cedar, beautiful, smooth and straight as if turned in a lathe. The work is of such excellent character throughout as to attract the attention of even casual observers, and among experienced linemen it is conceded to be superior in its substantial character and artistic appearance to any other line in the country.

Trolley Voltage.—Within the limits of the city of Indianapolis, a distance of approximately three miles, the cars will be run over already existing lines, and will be operated by direct current at 550 volts. Within the limits of the city of Rushville, they will be operated by alternating current at the same potential; on intervening sections the trolley will be fed by alternating current at 3,300 volts, 25 cycles per second, single phase. Thus the first single phase railway exemplifies the possibility of operating the same equipment from both direct and alternating current lines and illustrates the voltage flexibility of the system, one of its most advantageous features. The power station from which it is intended to operate the entire road is at Rushville. From this plant 33,000 volt transmission circuits are run to the points of transformation and there reduced to 3,300 volts before connection to the trolley.

Transformer Stations.—As has been stated, the road is divided into sections of ten and twelve miles, each of which is supplied with current from a transformer station. The transformer houses are very small, measuring but 21 feet by 23 feet, but are carefully and substantially built. The foundations are of concrete; the walls are of brick laid in cement mortar; and the floors for both the first and second stories are of concrete upon steel beams. The roof is built upon concrete base. The doors and windows are provided with steel shutters, and the whole structure is made thoroughly fireproof and can be closed and left alone with safety. In each of the transformer stations there are at present installed two 300-K.W. oil-insulated step-down transformers, 33,000 to 3,300 volts. Space has been provided for an additional transformer of the same capacity. On the second floor of each transformer station there are installed the lightning arresters and disconnecting switches. There are no automatic switches of any type in these stations, as they are controlled only through the switchboard in the power station. There is nothing at the station which requires constant attention and only occasional inspection will be necessary. This does away entirely with the expense usually incident to the sub-station of other systems, which usually amounts to the wages of three men at each sub-station, aggregating not less than $6 per day. The annual saving in wages on the three transformer stations between Indianapolis and Rushville made possible by the alternating current system amounts therefore to $6,570, or a total annual saving of the ten transformer stations between Indianapolis and Cincinnati in wages alone of $21,900. In addition to this, there will be a large amount saved in the maintenance and repair of machinery. The electrical equipment of the transformer stations was furnished by the Westinghouse Electric and Manufacturing Company. The power house serves as an additional transformer station, and contains two 300-K.W. lowering transformers, wound for 3,300 volts primary and 550 volts secondary circuits, which are used to feed that portion of trolley included within the limits of the city of Rushville.

Power Station.—The power house at Rushville, Indiana, is a strictly fireproof building of brick, concrete and steel, with rooms well lighted and skilfully arranged for future addition and enlargement. The boiler room occupies one side of the building and is at present equipped with three 300-h.p. Babcock and Wilcox boilers. Natural gas is now being used for fuel, but provision is made for the burning of coal, if at any time the supply of gas becomes insufficient. The engine room occupies the other side of the building, and is separated into two parts by a heavy brick partition. In the main room are installed the two generator units which consist of a 500-kilowatt Westinghouse revolving field alternator, 25 cycles per second, direct-connected to a 700-h.p. Corliss type, cross-compound, condensing engine. Both engines and generators are designed for an overload capacity of 50 per cent. Each engine is equipped with an independent jet condenser, which take their water from an underground tunnel connecting to a large mill-race. Two pairs of 250-kilowatt air-blast transformers are arranged to change the current which comes from the generator at 2,300 volts, three-phase, to 33,000 volts, two-phase, for transmission to the transformer stations along the lines. Air for these transformers is supplied by two motor-driven blowers. The generator field is excited by direct-current generators, one of which is direct-connected to an alternating current type C Westinghouse induction motor; the other to a Westinghouse compound steam engine. The marble switchboard controlling panels are also located in this main engine room, and the controlling apparatus is installed in the other portion of the building which is known as the high tension chamber. The main bus bars are located in the basement, and are supported upon a masonry structure and separated by barriers of alberine stone.

Car Shops.—The car shops are located near the power station. The entire building is 205 feet by 104 feet, and is divided as follows: Offices and waiting room for train crews, store-room, blacksmith shop, car wash-room, machine shop, truck repair shop, room for winding and drying armature and field coils and for other electrical work, paint shop and carpenter shop. Six tracks enter the building, each of which is provided with a working pit. A transfer track runs across the centre of the building. The construction of the building is fireproof throughout, with concrete foundations and floors, brick walls and steel framing. The roofs are made of asphalt gravel laid upon a cinder and concrete base, with louvers and skylights, all in steel frames. Concrete partitions are used where brick walls have not been constructed, and there is a Kinnear rolling iron door over every track. The machine shop is occupied with a full equipment of modern tools. Provision is made in the centre for a travelling crane to run the entire length of the building.

Cars.—The present equipment consists of ten passenger cars. Each car measures 55 feet over all, and is divided into three compartments. The first compartment is 9 ft. 10 in. long and is intended to carry baggage. It is provided with doors opening on either side. The cars are intended for single-end operation, and space for the motorman is provided in front of the baggage compartment, from which it is separated by a strong railing made of pipe. The middle compartment has a seating capacity of sixteen people, and is intended for gentlemen desiring to smoke. The third compartment occupies the remaining portion of the car, and has a seating capacity for thirty-eight people. The car is finely finished in mahogany, has plate glass in the windows and art glass in the ventilators and the upper part of the windows. The car body is mounted on Baldwin Locomotive M.C.B. trucks with steel tired wheels 36 inches in diameter, 6-inch axle and 5-inch by 9-inch journals. Each truck is equipped with two 75-h.p., single-phase, alternating-current, Westinghouse motors. Cars are equipped with the Westinghouse unit switch system of multiple control, and so may be operated either singly or in trains. The motors are controlled by the rheostatic system and may be operated on either alternating or direct current. Both straight and automatic air-brakes are provided on each car, the straight being used when the cars are run singly, the automatic system when the cars are run in trains. The motors on the present car equipment are geared for a maximum speed of 45 miles per hour for local service. Each car is equipped with two trolleys, one of the Union Standard type with trolley wheel, to be used when operating from the direct-current lines, in Indianapolis, or from the low-voltage, alternating-current lines in Rushville; the second trolley is of the bow, high speed type, and has been designed for service at 3,300 volts, alternating current. It is confidently believed that with the high-voltage, alternating-current trolley wire and the sliding contact bow trolley adopted by this company, that heavy freight can be hauled advantageously, without experiencing those difficulties heretofore encountered when service of this kind has been attempted on the direct-current system.

Operation.—Local cars are operated each way every hour, making stops upon signals at all of the cities and towns and at the principal crossings of the country. These cars are all provided with compartments in which baggage and light express matter may be carried. They are designed to run at a schedule speed of thirty miles per hour. To properly take care of the through service, additional "limited" cars will be put on the line; each of these will be equipped with four 150-h.p. motors, designed to operate at a schedule speed of 50 or 60 miles per hour, as under the provisions of the various franchises they will not have to make any stops in the country or at any of the smaller towns and will only be required to make one stop at each of the larger intervening cities. It is expected that when the road is completed from Indianapolis to Cincinnati these "limited" cars will be able to make the trip from the centre of one city to the centre of the other in three hours' time. It is the intention at a later date to run two express cars per day in each direction, taking care of the light freight and express business. This road has been built in every detail with a view to the handling of heavy freight, even to the extent of carrying it in long trains. Whenever, in the intervening cities, short radius curves could not be otherwise avoided, the private property of the inside corner has been purchased, and the sidewalks and curbs set back so as to make easy curves and permit the handling of heavy trains.

Fares.—An average fare of 1½c. per mile is charged by the company for carrying passengers, the road being divided into 5c. sections; no fare less than 5c. is charged for any ride. A school children's ticket is issued, good for use one hour before or after school hours. A mileage or sectional ticket is also issued at a reduced rate, giving 160 5c. rides for $7, a reduction of 12 per cent. from the ordinary fare. No other tickets are sold and cash fares are collected on the car.

The most interesting feature of the new installation is the absence of rotary transformer sub-stations and the small amount of feeder copper used. It should be noted that in the trolley line, which is composed of No. 000 copper wire, no feeder circuit is necessary other than the No. 4 high potential transmission line, which carries the current from the power house to the transforming points.

WATER-POWERS OF QUEBEC.

By J. C. Langelier, Quebec.

There is not a country in the world which has so many and such immense water-powers as the Province of Quebec. These may be counted by the dozen; waterfalls capable of developing from 25,000 to 75,000 h.p., and there are several that exceed 450,000 h.p. The Great Falls of the Hamilton river, at 150 miles from the head of tide, are 302 feet high, and, regard being had to the volume of the river's water at this point, it is calculated that this fall is capable of producing a motive force exceeding one million horse-power.

Carefully made measurements establish that the first fall of the Manicougan, about twelve miles from the sea, and 110 feet in height, can develop 331,456 horse-power. The second fall, some ten miles above, is 165 feet high, and could develop a force exceeding 500,000 horse-power. The power of the third fall, 115 feet in height, and about thirty miles further up, is estimated at 265,000 horse-power; that of the fourth fall, some sixty miles still higher, where the river makes a plunge of 175 feet, might produce a force equal at least to 220,000 horse-power. That is to say, that taking only the principal falls in the first 125 miles of its course, reckoned from the sea, the Manicougan river could furnish to manufacturing industries a motive force of 1,316,456 horse-power. A couple of miles from the first falls of the Manicougan, on the west side, there are, on the Outardes river, falls of a force of 180,992 horse-power. On all the other numerous rivers emptying into the Gulf of St. Lawrence, on the north shore, there are at a little distance from the coast, falls capable of furnishing considerable motive power. Those of the Portneuf and Ste. Marguerite rivers have been purchased by capitalists for the purpose of establishing pulp and paper factories there.

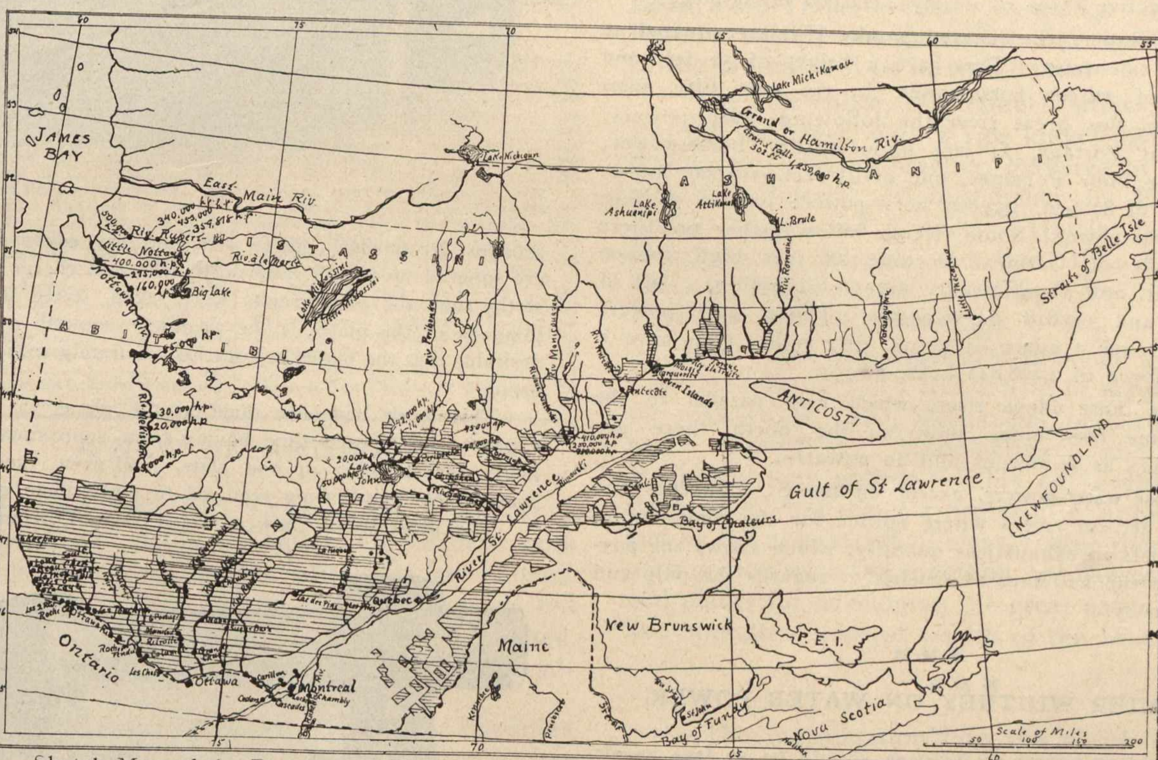
On the Saguenay river proper, the first falls are met with about six or seven miles above the town of Chicoutimi. thirty miles to the north-west, fifty to the west, two to the south, and about ten to the east, would take in water-powers of a a collective capacity of 653,248 horse-power.

On the St. Maurice, omitting the water-powers of lesser importance, there are the Shawinigan Falls, capable of developing 250,000 horse-power, those of Grand Mère of about 40,000 horse-power, those of Grandes Piles, 23,000 horse-power, and those of La Tuque, of 79,000. These four water-powers are spread over a distance of 75 miles.

On the Richelieu, the falls of Chambly Basin are utilized to furnish electric light and power to the city of Montreal, and provide about 21,000 horse-power.

On the St. Lawrence, the Cascades and Coteau Rapids, some thirty miles from Montreal, and those of Lachine, in the immediate vicinity of the city, are capable of producing an immense sum of motive power.

The Ottawa is, so to speak, a long series of water-powers; the great volume of the waters of this river, which, from the measurements of Engineer Russell, has a flow of 2,100,000 cubic feet per minute, gives to the slightest fall a considerable force. The damming of the Carillon Rapid, whose fall is 21 feet, and of that of Grenville, whose descent is 45 feet, would furnish a vast sum of power for industrial



Sketch Map of the Province of Quebec, Showing the Location and Power of a Few of the Unappropriated Water-powers of the Northern Regions. The Shaded Parts are those now under Timber License.

The measurements made by the officers of the Department of Crown Lands establish that these falls have a power equal to 92,000 horse-power. At Chicoutimi itself, the fall formed by the river of that name furnishes the motive power for a pulp mill of a capacity of over 100 tons per day, and the force necessary for the electric lighting of the town. On the Grand Peribonka river, about fifteen miles from the shore of Lake St. John, there is within a distance of a dozen miles, according to measurements made by Government officers, a series of seven falls, giving, respectively, the following horse-power: 39.000. 36,850, 36,500, 35,000, 18,425, 61,500, and 73,750, or a total of 301,025. On the Little Peribonka, some ten miles to the west, there are falls which are actually being utilized for a pulp mill. On the river Mistassibi, about fifteen miles further west, there is a water-power equal to 11,750 horse-power. One mile further is the first fall of the river Mistassini, of a force of 42.988 horse-power. On the Chamouchouan, there are several falls of a power varying from 10,000 to 60,000 horse-power. From a calculation published in the Report of the Commissioner of Crown Lands for 1898, it appears that a line drawn around Lake St. John, a dozen miles to the north, some purposes. The first of these rapids is situated 27 miles from the mouth of the Ottawa, and the second about five miles further up. Mr. Surtees, the engineer, estimates at 60,000 horse-power the capacity of the Chaudiere Falls, great and little, actually not used, between the town of Hull and the city of Ottawa. He gives the following figures for some of the falls which are found higher up: Deschenes, 15.000 horse-power; the Chats, 141,000; Portage-du-Fort, 49,000; La Montagne, 62,000; Grand Calumet, 186,000. Further up there are the water-powers of La Cave, 8.300 horse-power; Des Erables, 11,300 horse-power, and of La Montagne, which are considerable. Above Lake Temiscaming, the series of falls known under the name of Rapids des Quinze might furnish from 30,000 to 45,000 horse-power.

Engineer Surtees assigns to the principal water-powers on the lower portion of the river Lièvre the forces following: Buckingham, 9,000 horse-power; Rhéaume, 4 000; Dufferin, 12,500; Upper Falls, 12,500; Cascades, 2,000; High Falls, 36,000 horse-power.

On the Gatineau, in the first fifty miles from its junction with the Ottawa, the same engineer has noted the following water-powers: Farmer's Rapid, 24,500 horse-power;

Chelsea Mills, 47,790; Eaton's Chute, 24,508; Cascades, 14,000; Wakefield, 12,000; Pangan Falls, 73,500. There are on this same river, further up, the falls of Maniwaki, of La Montagne, of Castor Blanc, Betobee, Big Eddy and several others, which form water-powers of enormous capacity.

But all this is eclipsed by the water-powers of the Nottaway and the Rupert rivers, in the Abitibi territory. On the first sixty miles of the Nottaway, from its source at the Height of Land, there are several water-powers varying from 250 to 750 horse-power, and ten miles lower, at Red Flower Hill Portage, there are cataracts of 66 feet, terminating in a steep fall of 14 feet, of a total capacity of 30,000 horse-power. Ten miles below this, the superb falls of Kiask Sebee, 30 feet in height, can furnish 13,000 horse-power, and a couple of miles further down, there is another power equal to 4,000 horse-power. The outlet of Gull Lake, about 155 miles from the Height of Land, would give by a single damming a force of 85,000 horse-power. After leaving Lake Mattagami, the Nottaway forms, by its falls and great cataracts, the following water-powers: At 150 miles from the Height of Land, 50,000 horse-power; at 175 miles, 106,000 horse-power; at 200 miles, 275,000 horse-power; at 330 miles, 400,000 horse-power. As may be seen, on this stretch of about a hundred miles, the water-powers of the Nottaway have a collective force of nearly 1,000,000 horse-power.

On the Rupert, the falls of Smoky Hill are situated at the head of tide-water. They have a height of 52 feet and a capacity of 300,000 horse-power. In the next fifty miles there are on this great river the following water-powers: Falls of Cat Portage, 74 feet high, 419,025 horse-power; Falls of the Four Portages, one of 63 feet, 340,000 horse-power; one of 80 feet, 453,000 horse-power; one of 32 feet, 177,000 horse-power. Some twenty miles further up there are the Falls of Oatmeal Portage, 18 feet high, 100,000 horse-power, and about twenty miles still higher, a fall of sixty feet and 329,818 horse-power. Those water-powers are spread over a space of about fifty miles, and have a collective force of 1,128,843 horse-power.

On the East Main river, which runs parallel to the Rupert, some fifty miles more to the north, there are water-powers as numerous and as powerful.

All those water-powers, except on the St. Lawrence and Richelieu, are on rivers where spruce for the manufacture of pulp exists in exhaustless quantity, which shows the possibilities of the Province of Quebec as regards the pulp and paper industry.

PREMIER WHITNEY ON WATER POWER.

"The water power at Niagara should be as free as air, and, more than that, I say, on behalf of the Government, that the water power all over this country shall not in future be made the sport and prey of capitalists, and shall not be treated as anything else but as a valuable asset of the people of Ontario, whose trustees the Government of this Province are. It should be provided that when a Government enters into an agreement with capitalists relating to any, of the great resources of the country, such agreement should have to pass through the crucial discussion of this House, and be ratified by the representatives of the people before the capitalists should have the right to take the benefit of it. Yet the late Government deliberately repealed that law, and capitalists and Government ran riot through the Province of Ontario. However, the law was re-introduced, and is now on the statute book. You will not find this Government doing anything like their predecessors in this respect, and the power at Niagara shall be as free as air. How? Free in this way: That monopolists shall not have control, but that every man, every British subject, and every ratepayer of the Province of Ontario shall, under proper conditions, be free to utilize the power which God has given to the Province."

Fort Frances town council will build a combined town and fire hall.

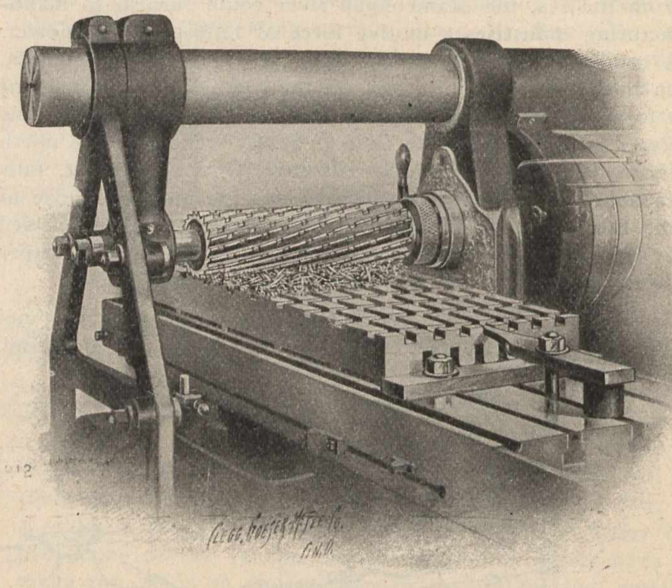
MACHINE SHOP NOTES FROM THE STATES.

By Chas. S. Gingrich, M.E.

XV.

I have the pleasure of showing you this month the process in use in the shops of the General Railway Signal Co., Buffalo, N.Y., for machining parts for railway signals. These parts consist of cast iron plates 12-in. wide and have grooves cast into the faces.

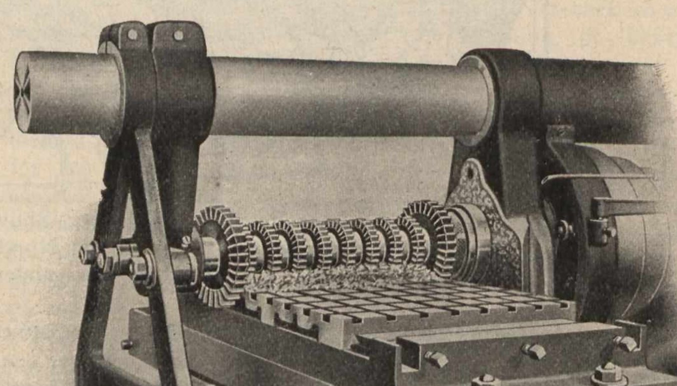
These pieces must first be roughed off on top, then the



grooves are finished out to size, and the edges of the piece are squared up. R. P. Deardorff, who had charge of this work at the time the photographs were taken, stated that the chief thing about the plates is the accuracy required, it being highly desirable that the plates go together accurately without any hard-fitting.

This work had been done on the planer at considerable expense, the allotted time having been approximately eighteen hours for finishing up one plate, and even then there was considerable hand-fitting required to make them go together.

The illustrations show a No. 4 Plain Cincinnati Miller at



work on these pieces as they are finished now. The actual time required is two hours for each plate, just one-ninth of the time formerly required, and when the pieces leave the miller, they are accurate and go together nicely.

This job seems of particular interest at this time, when in the majority of work not only accuracy, but rapidity is essential in order to successfully meet competition, throwing, as it does, additional light on the possibility of making great gains by replacing older tools and methods by modern machinery and up-to-date methods, wherever possible.