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The Canadian Engineer

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The Canadian Engineer.

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CONTENTS OF THIS NUMBER:

SOUTH AFRICA, ITS PEOPLE AND TRADE.

CAUSES OF THE BOER WAR.

ARTICLE III.

To give an idea of all that has been suffered by the Uitlander population of the Transvaal would be impossible in so brief a sketch as this, but a few of the grievances may be stated. First stands the franchise. As already mentioned, when the internal independence of the country was granted in 1881, it was, of course, believed that all white races would be treated alike, and Kruger, in the most distinct manner, promised this. The franchise was at first to be given on a property qualification or upon one year's residence; but in order to cut off those who came in after the annexation, the Volksraad (Parliament) afterwards changed this to five years, and then when time passed by and the five years' citizens looked to the time of enfranchisement, the law was again amended so that a man had to be a constant resident in the country for fourteen years. When the conditions were looked into, it was seen that even when the fourteen years should have elapsed, the Uitlander would not get his vote, because the claim had to be based on the field cornet's records, and in nine cases out of ten, there were no records of the registration. In many cases the field cornet could not read or write, and in cases where he could, there was a temptation to neglect the duty. In a majority of cases he collected the taxes without making any returns, so that the omission of the names gave no record of the fraud, thus serving the double purpose of concealing his stealings and depriving the Uitlander of his vote. But even if this were honestly carried out, the Uitlander was further discouraged by the provision that he should first have to renounce allegiance to his own country, remaining a political eunuch for these fourteen years, and then when this time expired, he would have to get the recommendation of a majority of the burghers of his district (whom he knows to be hostile), and still after that his application is liable to the veto of the President and Executive. We see the pitfalls so artfully prepared, in order that a man would certainly fall in one if he escaped another. Can it be wondered at that the High Commissioner and the British Government wanted to make sure of the details of the recent proposals made by Kruger at and since the Bloemfontein conference? As President Kruger is a great reader of the Bible, it would be curious to know what he would have to say to the franchise provisions laid down in the 47th chapter of Ezekiel, verses 21 to 23? The Montreal "Witness," in pointing out this principle of Old Testament law, remarks that "the most curious thing in Boer legislation is that they should by special enactment exclude from participation in the land and liberty they enjoy, the very people to whom they are indebted for the Scriptures they prize so highly, and who, even before the Babylonian captivity, extended to the stranger, who came among them, the benefit of the ancient ordinances. This instance, however, only goes to confirm the estimate made of the Boers by Dr. Livingstone, who described them as narrow, stupid and cruel."

The Boer Government not only excludes both Jews and Roman Catholics from the franchise, but even from working in the civil service. If it is found out that a railway, post office, or other civil servant is a Jew or Catholic, he is quietly but speedily dismissed, and a Boer, Hollander, or German appointed to take his place. The Germans and Hollanders would, however, not be called in if it were not that very few Boers are sufficiently educated to fill these places.

By the trickery and breach of faith before described, the voting-power was kept, as before, in the hands of the Dutch burghers. As not one out of a thousand of the Boers of the rural districts had enough education to fill civic offices of responsibility, many Englishmen held public posts for a time after 1881, but one by one these were dismissed and Hollanders and Germans imported to take their places, until British subjects were almost as completely shut out from all share in the civic life of the country, as they were from political influence. One of the first fruits of this oligarchic rule was the system of plunder by concession. Each session of the Volksraad brought a horde of speculators, who purchased by bribery the sole right to manufacture or sell this or that article in the Transvaal. These mono-

polies, or "concessions," were secured chiefly by Hollanders and Germans, and hence, we see one mainspring of the active sympathy of Hollanders and Germans in the present contest, for between the fat salaries of the imported officials, and the dividends from the operation of the monopolies, a good stream of money has been flowing into Holland and Germany for some years past. When we consider this, and the extortions of the Netherlands Zuid Afrikan Railway Co., owned and managed by a group of Hollanders, and when we consider that by every device possible, British trade is hampered and Dutch and German imports favored, we see why the cause of the Boer should be so warmly espoused in Holland and by sections of the German press, even if race affinity were not a factor in the case. We may add to this the work of the Transvaal political agent in Europe, Dr. Leyds—a Dutch pocket edition of Talleyrand—who has been supplied with means to make the agency a nest of intrigue against Great Britain ever since his appointment. The Netherlands Railway Co. has practically controlled the finances and legislation of the State. It has been able to levy the outrageous freight rate, averaging 8½d., say 17 cents per ton per mile, as compared with 6 cents per ton per mile on the Cape and Natal railways, which themselves return a good dividend to their governments. Yet, when some of Kruger's own friends protested against these extortions, he said he considered this contract a matter of high policy, and would not even hear the subject discussed.

The art by which the combined Boer and Hollander legislators framed laws, which, while appearing to the outside world to be quite fair, yet could be made to work out to the particular disadvantage of the Uitlander, amounts to a positive genius. For instance, the school laws, while apparently giving a show to English children, are so worked as to school hours, etc., that in practice English children can neither get a chance to learn English or Dutch, while the school tax is so artfully fixed that the English parent, whose child is robbed of its chance of education, has to pay £7 against the Boers' £5. A law, to forcibly suppress all English private schools even, was proposed in the Volksraad, and only defeated by two votes. The school law is so beautifully arranged, in the case of Johannesburg, that the grand sum of £650 a year is spent on the children of Uitlanders, who have to pay nine-tenths of the £63,000 spent on education there. Then there is a tax of £20 recently levied on farms. Here the unsuspecting foreigner would see a tax levied on the Boer element entirely. Kruger cannot be so unfair after all. But look at it a little closer, and you will notice that farms on which the proprietor lives are exempt; look still closer and you see that it applies to farms owned by companies only. Now the Boer never buys stocks or bonds, and never goes into partnership, so you see it hits the Uitlander, who has bought up a Boer farm at five or ten times its agricultural value, on the chance of minerals being found on it. Another example of Boer "slimness": A poll-tax was recently introduced. It was to be levied on all male inhabitants, and there was no distinction or discrimination. Surely this was fair to all? Time answered the question in the same old way, when it became known that the tax of 18s. 6d. was faithfully collected from all Uitlanders, but not one Boer or Hollander has ever been made to pay. These are just a few samples of Krugerite equity.

We are familiar with the press law, by which Kruger has imprisoned and brought financial ruin on editors who have had the courage to run up against him. Of the same brand is the law giving it into the discretion of a policeman to break up a meeting, in the open air, of more than seven persons.

If the torture and degradation of thousands of Englishmen, Americans, Australians, and other peoples, accustomed to free institutions, were not in question, it would be amusing to those knowing the facts, to observe the injured innocence which glowed in the official despatches of the Boer Government right up to the time of the ultimatum. "If these people," said one of these despatches dealing with the petition of 40,000 Uitlanders made direct to the Queen, "instead of complaining to the British authorities had only come to this Government direct, their complaints would have had attention." What had they been doing all these years but complaining to a Government which treated their entreaties with scorn and contempt and only changed the chastisements by whips for those of scorpions? In 1893, a petition for the redress of grievances, signed by 13,000 Uitlanders, was presented to the Raad, and was received with a general laugh of derision. In 1894, another petition, praying for reforms, and signed by over 35,000 adult male inhabitants, was presented, and received more seriously, and it is due to some of the Dutch members that they made a stand for fair play; but the only response from Kruger, who moulded the Executive at his will, was new restrictions on the Uitlander's liberty, and new burdens on his industry. When the vote was taken on this petition, one of the Boer members was heard to say: "Nothing can settle this but fighting, and there is only one end to the fight. Kruger and his Hollanders have taken away our independence more surely than Shepstone ever did." It is only fair to say that many members of the Raad, who might be called progressive, by comparison, saw what Kruger's policy was leading to, and urged concessions to the Uitlander element. These were supported by a slowly-growing minority of burghers, who were almost as jealous of the Hollander faction as they were of British. But Kruger had his will; and when he found occasions arising where he could not carry his point by straight legislation, he went past the Volksraad and did it illegally, as head of the Executive. On several occasions he upset the decisions of the High Court, and ended by forcing the resignation of Chief Justice Kotze, who refused to prostitute the court, and make it the tool of the Executive. A more pliant man was put in his place, and Chief Justice Kotze was deposed without a pension or other allowance or support to his old age. A sample of the direct and easy way in which the Government overrode the decisions of the courts was furnished by the Doms case, among others. A man named Doms sued the State, but while the case was pending, the Government passed a resolution declaring that Doms had no right to sue! And so Doms was thrown out of court, lost his property, and is now a cab driver in Pretoria. When the Government wished to defeat the ends of justice, even in the High Court, all it had to do was to declare itself by resolution, and it was done whether the resolution conflicted with the

grondwet (constitution), or not. It is scarcely to be wondered at that the Uitlanders lost all hope of fair play when such things could be done.

(to be continued).

For THE CANADIAN ENGINEER.

DESTRUCTIVE DISTILLATION OF SAWDUST.

A series of experiments have been made in Ottawa in October with a machine for the destructive distillation of sawdust, which is designed not only to get rid of the dust, but also to turn it to financial account. These runs were eminently satisfactory, exceeding even the expectation of those who knew most about the machine. Much has been written, and more said, about machines designed for the destructive distillation of sawdust and the products therefrom, but many difficulties have to be overcome before the desired object can be achieved. Sawdust offers so much resistance to the passage of heat through a mass of it that it is necessary to bring successive quantities of dust in contact with the heated plates, or to bring a mass successively into contact with the plates of the retort.

The machine referred to may be described as a cylindrical retort, to the ends of which are bolted flat castings, in the centre of which are holes to allow of the introduction of a short but large hollow shaft. On the outside of the end castings are stuffing boxes and glands to prevent gaseous and liquid matters escaping. Through the end openings pass the shafts, which just clear the end castings and then spread out to form four arm spiders which are bolted to a drum. In the centre of this drum and extending its entire length is a tube which is rigidly fastened to the end spiders.

In the spaces between the tube and the drum, and between the drum and the shell, are arranged plates which encircle respectively the tube and the drum, one forming a right hand and the other a left hand helix or conveyor. This arrangement ensures a continuous circulation of dust through the machine. The machine is fired in a way specially designed to maintain an even temperature throughout. No direct fire is allowed to come into contact with the shell. The machine is carried by lugs in an oven, the hot gases from which pass through the tube above referred to, thereby providing a large internal heating area ; from this tube the gases pass into the chimney

Charging is accomplished through an opening on the upper side of the machine, and the discharge is situated at the bottom or underside, and at one end, and is automatic. It is perhaps hardly necessary to state the nature of the products, but it may be interesting to some who may not have a knowledge of chemistry to know that destructive distillation is a process—broadly described as the decomposition by heat in a closed chamber, of a body the elements of which recombine, on cooling, to form compounds differing chemically and physically from the parent substance. When sawdust is submitted to this process it breaks up into bodies widely different from one another and from the parent substance. These bodies are principally pyroligneous acid or crude acetic acid, wood oil or wood creosote, tar, naphtha, or pyroxalic spirit, a large quantity of combustible gases, mainly carbon monoxide, and a residue of charcoal dust which is unequalled as a form of carbon for the manufacture of calcium carbide, showing as it does 98.95 per cent. carbon and only 1.05 per cent of ash. There are in addition to the above, smaller quantities of furfurol, acetone, methyl acetate, ammonia, etc., formed. The chemistry of these products is interesting and offers several alternatives in the methods of preparation for the market.

Although the machine was a proved success nearly a year ago it has been difficult to obtain reliable information in regard to it, as those interested were anxious to be disabused of any doubt as to the details and financial standing such machines would establish for themselves.

Patents have been granted in the U.S.A., Canada and nearly all industrial countries.

The machine has been tried in the utilization of other than mill refuse, but in this respect nothing will be stated till arrangements, mechanical and commercial, have been completed. This invention will be received by the public as a boon, effecting as it will a considerable, if not complete abatement of the sawdust nuisance. The interested parties have wisely avoided anything being printed until the machine had been proved in the presence of one of the largest lumbermen in the country.

The inventor of the machine, who at present desires to remain unknown, is also at work on a new method for the production of acetylene at a cheaper rate than is now possible, and hopes to be able to use the carbon from the machines whilst still hot.

A NEW ONTARIO.

It would appear that Ontario is about to come into her own. The courts have just sustained the Government in the matter of the manufacturing clause in the timber licenses, and in future the forests of Ontario will not be cut down solely to create United States millionaires and Michigan saw-mill cities. We will have saw mills of our own which will supply the United States consumer, and the millionaires will be cultivated to the north of the international boundary.

On the day that the decision of the court was handed down in the appeal case of the United States lumbermen, already referred to, the Hon. G. W. Ross, the new Premier of Ontario, announced a somewhat similar policy with regard to the nickel-copper bearing ores which, we have often pointed out in THE CANADIAN ENGINEER, are one of the chief sources of wealth of Ontario and, indeed, of the Dominion of Canada. All mining licenses of nickel-bearing lands granted in future in Ontario will contain a clause prohibiting the export of the ore or matte, and permitting the export of refined nickel only. The Government would take power, also, if deemed expedient, to restrict the operations of the holders of existing licenses in the same way. It also appears that the Ontario Government has for over a year past been endeavoring to interest the Imperial Government in the use of nickel steel armour plate for the royal navy, and that there is a possibility of the Imperial Government assisting in the establishment of works for its production.

We do not wish to add ourselves to the stately procession of influential journals which, in a couple of days following Mr. Ross' announcement, each claimed that it had forced the Government to take what must, on all sides, be conceded as a splendidly advanced position. We are satisfied to point to our discussion of this subject, which has been widely quoted throughout the country. THE CANADIAN ENGINEER wishes to offer its most hearty congratulations to the new Premier of Ontario for the work he is doing in developing our great country; we hope that we may soon be able to offer similar congratulations upon the settlement of the Niagara power question (which still needs to be settled), so that the greatest possible amount of power may be supplied to the largest number of

users and the greatest possible share of the profits be divided among the people of Ontario—not among the members of the Government.

The policy of the new Ontario Ministry on the nickel question is in fine contrast to that of the Dominion Government which—in spite of the protests of individuals of its own party—has played into the hands of the foreigu corporation which has held a monopoly of our nickle industry in a most questionable manner.

PROGRESS OF ACETYLENE LIGHTING.

A recent number of the Canadian Electrical News contained a table, attributed to a committee of the Canal dian Electrical Association, purporting to show the position of acetylene lighting in Canada. This table was compiled from replies received in response to circulars in which a series of questions was asked as to the number of generators installed, the number discontinued, the cause of accidents, etc. These circulars could only be sent to those who were known to have installed acetylene lighting plants. Unfortunately for statisticians a large number of people who receive such circulars never take the trouble to reply, and when this fact is taken into account, and the further fact that large numbers of business firms and private citizens have installed acetylene plants of which the compiler, could have known nothing, it will be evident that the table could be of very little value for statistical purposes. Indeed a footnote to this table states that it is "probably inaccurate as to the number of generators installed, the number in use, the capacity of light, the period of use etc." In other words, the compilers make the Canadian Electrical Association responsible for putting forward a table of figures which they admit to be inaccurate in every detail, including the "etceteras," which are supposed to comprehend the comments of those correspondents who reported. According to these tables there were installed in Canada last year 217 acetylene lighting plants, of which 62 had been thrown out, leaving 155 in use, and in 30 of these installations accidents were reported. Even if these returns were complete, a moment's reflection would show the inadequacy of the record. Every gas company and electric light company knows that a certain proportion of customers change their house and store lighting, throwing out one system and putting in another, or they discontinue their light by reason of removal to another place, but these changes, which are constantly going on, are no argument against either gas or electricity as an illuminant. Then as to accidents, the wonder is not that there were thirty accidents (the period of time in which these occurred is not stated), but that there were not three times that number. We must reflect that practically all these acetylene lighting plants were isolated ones; so that to make the comparison fair we have only to imagine that gas lighting had just been introduced when acetylene lighting was tried, and that each house was lighted by a separate generator as in the case of acetylene. Assuming that as little was known of the nature of gas as acetylene, we could then imagine how the record of accidents would compare.

The apparent purpose of these statistics was to show that acetylene was making no headway as an illuminant. That this conclusion is hardly justified may be deduced from the fact that the world's output of calcium carbide (the source of acetylene gas) has grown from a few thousand dollars annual value in 1895-6 to the value of $19.228,300 in 1898, the quantity of carbide being 282,380 tons. The countries principally producing this are the United States, Canada, Germany, France, Italy and England. As far as most countries are concerned, including Canada, the difficulty with the users of acetylene is that the supply of carbide has not kept up with the demand, and many people have had to give up actylene lighting simply because they cannot depend on getting the carbide. This deficiency may soon be remedied in Canada by the establishment of such works as those now being established by the Bronsons at Ottawa, which will be prepared to turn out 15 tons a day in the spring and will later on produce about 30 tons a day. The firm of A. Holland & Son, of Ottawa, who deal in calcium carbide, showed a representative of this journal orders from many foreign countries, some of them requiring a supply of several tons per month. These orders Mr. Holland has had to turn away because he could not guarantee the supply of carbide. The same difficulty is experienced at the Willson Carbide Works at Merritton. There is plenty of room in the industrial world for all three illuminants, and certainly the demand for calcium carbide for the production of acetylene gas is quite remarkable.

—F. G. Moon, Ottawa, an employee of the Post-Office Department, has invented another roller boat. A large working model has been built and a futile attempt was made a short time ago to make it roll. Like other roller boats, however, the trial of the model reveals a number of problems which the inventor had not taken into account. The roller principle of navigation has been tried in many places in Great Britain, Europe and the United States, but judging by its past records it is not likely to prove a success, except possibly for the navigation of sheltered rivers having a quiet current.

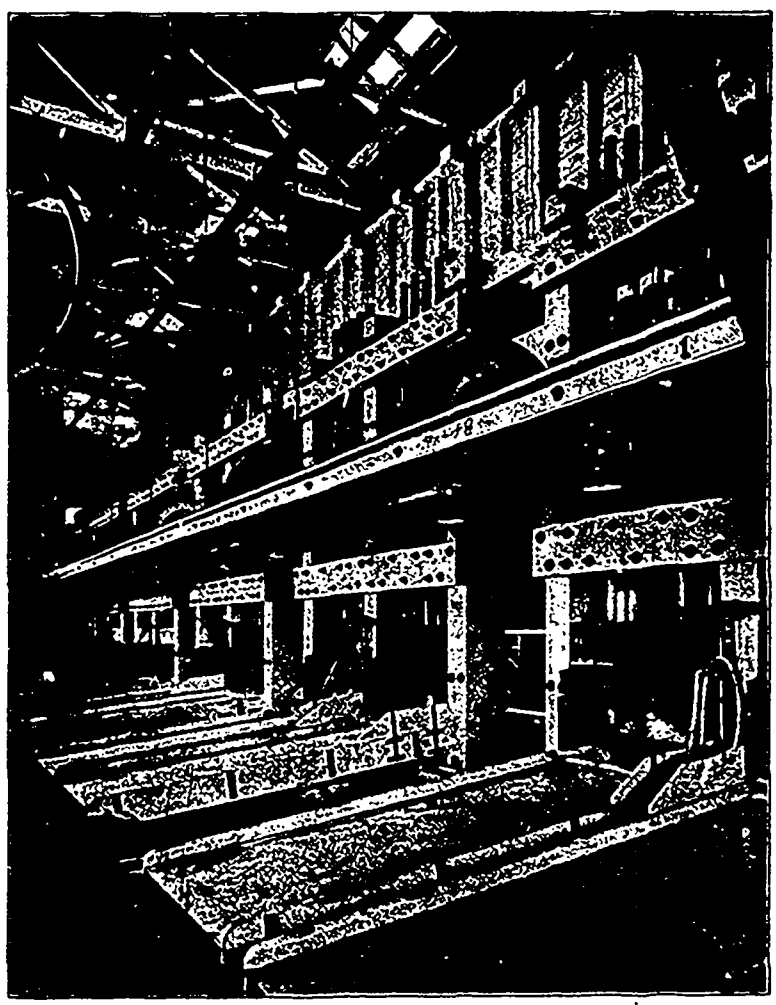
—The Bricklayers' and Masons' Union in Ottawa has passed a resolution condemning the proposed introduction of technical instruction into the public schools of Ontario. That such an act of folly should be succeeded the next week by a resolution of the executive committee of the Canadian Manufacturers' Association opposing the introduction into Canada of the metric system is almost enough to justify those amongst us whose croakings about the smallness of our industries and the hopelessness of their competition in the world's markets, at last have nearly been put to silence by the rattle of machinery in our overworked factories. The Manufacturers' Association has estimated that the introduction of the metric system would cost $2,000,000. With their all-sufficient wisdom these good people fail to offset this sum by the foreign trade of Canada, of which we stand in danger of losing a large part if we adhere to our present clumsy system. The metric system is simply applying to weights and measures the advantages we have in our monetary system. Would any Canadian discard our decimal system of money and go back to the "*old* Canadian currency," or the sterling system of coinage? As we realize the simplicity of the decimal system of money so we would see the immense gain in time and convenience in the adoption of the decimal or metric system of weights and measures. When even in conservative England a body like the Associated Chamber of Commerce, representing the crystallized opinion of the great commercial associations of the Kingdom, pronounces so emphatically on the necessity of this reform in order to save British foreign trade, we may realize that it is a change which must come. With ourselves it is only a question whether we or the United States shall be first in the field, for the latter country is now agitating for the change and has commenced an educational propaganda with that object. As to the Ottawa labor unions who wish their children to grow up without technical education in the schools, they should remember that when the steam

engine was introduced, it was their intellectual ancestors, was it not, who denounced and fought against that invention as a devilish machine which all pious laborers should destroy to save their children from starvation?

MILLING THE GOLD ORES OF THE WITWATERSRAND.*

The mill, in Witwatersrand practice, is but the first stage in the general metallurgical process, preparing the ore not only for its own treatment, amalgamation, but for the second step, the cyanide process, for it must be remembered that, but for the cyanide process, a very small percentage of the mines on the Rand would pay, and that the industry as a whole owes its salvation to this method of gold extraction. To examine the question of milling alone without considering the subsequent cyaniding of the tailings would produce a false impression, conveying the idea that the stamp practice on the Rand, in percentage of gold extracted, compares unfavorably with that of California or other places. The object is to get the greatest extraction at the least cost, by combining the two processes, the tendency being towards a high crushing capacity rather than a high extraction by amalgamation at the expense of crushing, relying on amalgamation for a fair percentage of the catch, and increasing the extraction by the subsequent cyanide treatment. While it is usual on the Rand to amalgamate in the batteries, less attention is paid to the practice than is common elsewhere. The easily amalgamated gold is caught on the outside plates, and the more refractory portion is treated by cyanide. Coarser crushing would be the rule, were it not necessary, in order to secure the best results in cyanide treatment, to have the ore crushed fine. The first mill, a battery of five stamps, at which any of the banket of the Witwatersrand was crushed, was erected in 1885 by H. W. & Fred. Struben, about ten miles from the place where Johannesburg now stands, for the purpose of working quartz reefs. The following year several samples of conglomerate were crushed, the highest yield being 8 dwts. per ton. H. W. Struben, in an interesting letter dated January 17, 1893, says: "We milled conglomerates from Vogelstruisfontein, both for ourselves and for others, at our private mill, long before anyone else had a mill."* The state mining engineer's report for 1896 gives the number of stamps for that year on the Witwatersrand at 4,291, and the number of tons crushed at 3,980,682, the yield being £5,346,527, or an average of 26.36 shillings per ton. Including treatment by cyanide and chlorination, the total yield was £7,781,845, or 38.95 shillings per ton, and the average duty per stamp per twenty-four hours 4,392 tons. Eight hundred and sixty stamps have been dropped since 1896.

There are few mills of less than 60 stamps on the Rand today and those of 100 and more are in the majority. The tendency of the newer mills, for large claim area, is toward 200 stamps, those of the Crown Deep, Rose Deep, Nourse Deep, Jumpers Deep, and Robinson Deep having this end in view, while the new mill at the Simmer & Jack Proprietary Mines, Ltd., has 280 stamps erected and in place, and the combination mill of the Angelo and Dreifontein Con. mining companies, now nearing completion, is to have 220. The older mines on the outcrop have mills with 60 to 160 stamps.



60-STAMP MILL, NOURSE DEEP.—STAMPS GROUPED BY TENS.

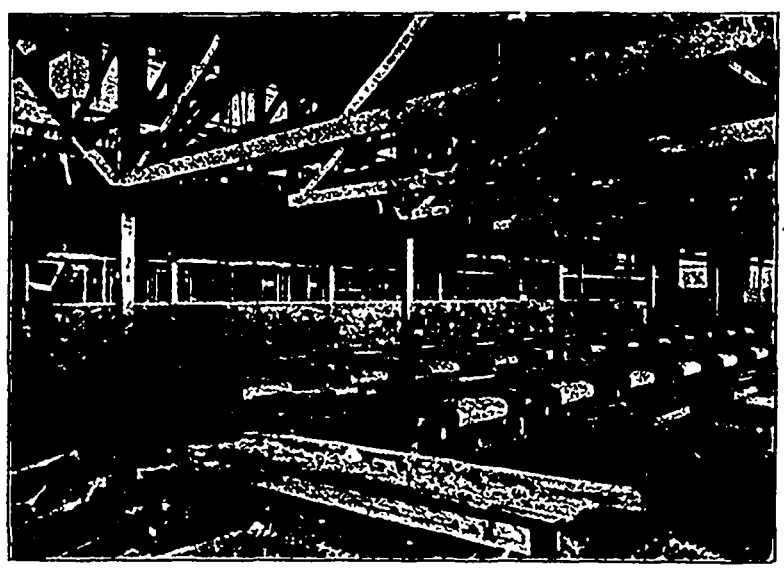
In the more recently constructed mills of the Rand the "banket" is delivered into the mill, after having been sorted and crushed, either at a central station or at stations at the shaft's mouth, and is fed from the ore-bins, by mechanical feeders, to the stamps, where, in the majority of the mills, a preliminary amalgamation takes place in the mortar box. The pulp flows over copper plates for further amalgamation, and in a few instances is delivered to frue vanners for concentration, the tailings going to the cyanide works, but the general practice of the Rand mills is to deliver the pulp direct from the amalgam plates to tailing wheels, or, sometimes, to pumps, to be elevated

*Abstracted from an article by H. H. Webb, and Pepe Yeatman, in the Engineering Magazine.

*"Diamonds and Gold in South Africa," by T. Reunert.

to the height necessary for the requirements of the cyanide plant, a rough concentration by means of spitzluten being, as a rule, the first step preliminary to the cyanide treatment. Where frue vanners are employed, it is customary to use three for every five stamps, but, because of the heavy duty per stamp, they are often overloaded. The product from the vanners, being generally pyrites of high grade, is subjected to chlorination for the extraction of the gold. The mills are almost invariably placed near the mine rather than near the water supply. The building itself is framed with timber and covered with corrugated iron. Good foundations are put in, and the construction of the building is very strong. The timber is generally Oregon or pitch pine.

The ore bins are placed on strong masonry foundations, and are made of heavy timbers, well bolted together, the bottoms of the bins sloping towards the batteries at an angle of from 40° to 45°. In a few instances, as at the Simmer and Jack and the New Croesus, flat bottoms are used. Bottoms and sides are usually made of double thickness of 2-inch or 3-inch planks, with a lining of sheet iron. These bins hold from a day's run to four days' run. The feeders used are of the "Hendey Chal-



Arrangement of Frue Vanners in George Goch Mills.

lenge Ore Feeder" type, and are practically universal. There is no feeding by hand anywhere. The mortar boxes resemble the homestake pattern, the main differences being in the height of the feed opening and in the length and width of the boxes. Fraser and Chalmers and the Sandycroft foundry have supplied most of the batteries. As the stamp mills on the Rand are rather larger than the average, the mortar boxes, too, are larger and of greater thickness. At the issue the boxes vary between 11½ inches and 18 inches. Most of the mortars have heavy cast iron or steel linings in the front, back, and sides of the boxes, to ensure a longer life. Below the dies false bottoms of cast-iron are put in. Several thicknesses are often employed, to ensure uniformity of depth of discharge as the dies wear down. The mortars are placed on piles 12 to 15 feet in length, which rest on 1½ to 2 feet of concrete. The piles consist of heavy pine timber about 14½ inches square, and are bolted together firmly, both lengthwise and crosswise. The pile pits are excavated to hard rock, where possible. The walls of the excavation are built of heavy masonry or concrete, and the space between them and the mortar blocks is filled either with sand, or with tailings well rammed, or with concrete. Between the mortar block and mortar is placed a thick sheet of rubber or, occasionally, felt. The boxes are held down by eight bolts about 1½ inches in diameter, which at the lower ends are recessed into the wooden piles and are held by cotters. They are tightened by nuts on their upper ends. There is plenty of clear space about the batteries, and all bolts can be easily reached.

The screens are of well woven iron or steel wire. The meshes range in number between 500 and 900 to the square inch, 760 being very common. The area of the holes ranges from .004 to .007 of a square inch. The life of the screen is very short —between two and three days on the average. The height of discharge in a battery is regulated by the use of chuck blocks as the dies wear down, or by having several sets of screens, which may be inserted from time to time. The width of the lower sides of these varies. The custom is to employ from two to three chuck blocks. There is a considerable variation in the height of the discharge. When amalgamation in the battery is considered an important feature, the discharge is raised; where rapid crushing is considered of more importance, a lower discharge is employed.

The first stamps employed on the Rand were considerably lighter than those favored at present. Stamps weighing from 750 to 850 pounds, the other parts being light in proportion, were used at first. In all the batteries now being erected, and in those that have been built within the last year and a half, the tendency is towards very heavy stamps, the weight varying between 1,100 and 1,250 pounds. The mills being erected under the supervision of the Rand Mines, Ltd., have stamps averaging about 1,150 pounds; those erected at the Simmer and Jack and at the Robinson Deep weigh nearly 1,200 pounds. Even with the old style of stamps, by adding extra tappets or putting in heavier heads, the weight has been increased, and, in consequence, the crushing capacity. According to the state mining engineer's report for 1896, the average weight of stamps was 973 pounds. In order to equalize the weight, it is the custom in some mills to use in one set of batteries heavy heads, and in another set lighter ones. New shoes are placed first in the second set, which, after being worn, are taken off and placed in the first. By this means the light heads always have the heavy shoes, and the heavy heads the partly worndown shoes.

Shoes are made of various varieties of steel, such as Chrome, Hadfield's Manganese, Firth's cast steel and forged steel, etc. They range in weight from 180 to 240 pounds. They are 8½ to 9 inches in diameter, and in height 9 to 12 inches. Heads and tappets are made of cast steel, the former weighing from 260 to 365 pounds and the latter from 106 to 130 pounds. Dies are 8½ to 9 inches in diameter and 6 inches high from the top of the 1-inch hexagonal bottom. They are made of Firth's, Hadfield's Manganese, or forged steel. Stems are tapered at both ends, and are made of fagoted iron. They range in weight from 350 to 475 pounds, and in diameter from 3¼ to 3¾ inches.

It is customary the world over to have five stamps to a battery. On the Rand two batteries are usually placed together, with a clear space of five to six feet between them and the next pair, each battery having its own cam shaft and separate driving-wheel. In some cases one cam shaft and one driving-wheel serve for ten stamps. At the Simmer and Jack four batteries are placed consecutively, with two driving pulleys and two cam shafts. The plan of having one driving pulley for each five stamps is favored by the mill men, as the delays occasioned by necessary repairs affect a smaller number of stamps at a time. Cam shafts are made of fagoted iron, and range from 5 to 6½ inches in diameter.

Cams are made of cast-steel, and vary somewhat in design

and in the manner in which they are attached to the shaft. The Blanton cam is deservedly popular; there are no keys, the cam being fastened to the shaft by means of a circular wedge, which is prevented from slipping by the short pins dropped into recesses in the cam shaft. This causes great saving of time in attaching cams and in replacing broken cams on the shafts. The George Goch has introduced for trial on one battery a cam which, instead of having a circular opening, has a decagon fitting on a cam shaft of the same section.

The drop of the stamps ranges from 7 to 9 inches, the average being about 8 inches. There is, perhaps, less variation in speed, this running from 92 to 104, the average being about 96. The order of drop is usually 1-3-5-2-4, although 1-4-2-5-3 and some others are employed.

The amount of water used in crushing ranges from 8 to 9 tons per ton of ore crushed. This does not mean that that amount of make-up water has to be supplied, as the water is used over and over again, the only loss being due to leakage, evaporation and absorption by the tailings. This loss, or make-up, is estimated at 25 per cent.

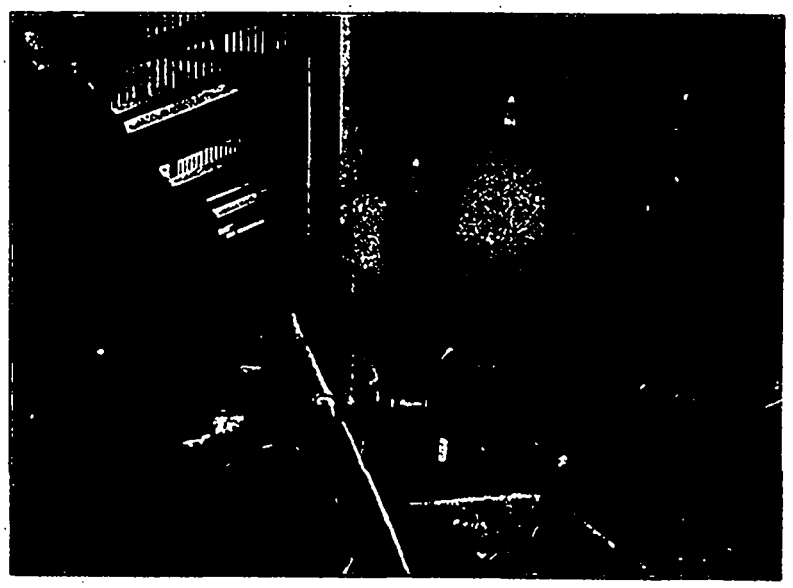
Apron copper plates are universally adopted. Inside the batteries both back plates and chuck plates are used, but the former are the most common. In some mills lip and splash plates are used. Apron plates are from 10 to 12 feet long, and from 4½ to 5 feet wide, and incline from 1 inch to 1¾ inches to the foot. Sometimes they are broken, but usually continuous. Back plates are from 7 to 11 inches wide, and chuck plates from 3 to 6 inches. The copper plate used is from ⅛ to 3-16 of an inch thick. They are rarely silver-plated, and, when a new mill starts up, considerable time elapses before the plates cease to absorb large amounts of gold.

One of the points of great difference in the Rand Mills is in the arrangement of the line shafts. These are either coupled directly to the mill engine or driven by rope-transmission. The latest mills erected by the Rand Mines, Ltd., employ direct coupling with the engine at one end. The new Simmer and Jack mill uses rope-transmission with two line shafts, one for each side of the mill. In the old Simmer and Jack mill, where the batteries were in line, the mill engine was placed in the middle, with fifty stamps on each side and with direct coupling. The Witwatersrand mill has the engine in the middle, but the line shaft is driven by rope-transmission. At the Geldenhuis Deep one line shaft is coupled directly, while the second is driven from the first by rope-transmission. Direct coupling works exceedingly well. Between the line shaft and the cam shaft various forms of belt tighteners are used. In many of the later mills patent clutch pulleys are employed, doing away with the tightening gear.

Very excellent power installations are the rule. In many instances the engine drives not only the mill itself, but also the tailings wheel, the electric light plant, the electric precipitation plant, the shops, and sometimes the crushers. Both vertical and horizontal engines are used, but the latter are in the majority. The usual type is the horizontal compound condensing engine with Corliss valves. To avoid delays an auxiliary engine is sometimes installed. This, of course, is a much cheaper engine than the main engine, and, while not compound condensing, is so made that it can be compounded if desired. The mills are well supplied with mercury traps made of wood, or, preferably, of iron, and have large and well-constructed launders with ample grades. One or more overhead crawls are used along each line of stamps for the rapid handling of the heavy parts of the batteries. The use of electricity for lighting is almost universal, and the old-fashioned, badly-lighted mill has become a thing of the past.

The clean-up room is well supplied with benches and the usual appliances for cleaning up. A pan, barrel, or batea run by machinery is used for the clean-up from the mortars. During operation the outside plates are rubbed every four hours, and the amalgam removed once a day. The general clean-up is made once a month. The percentage of extraction by amalgamation varies, but the average is from 55 to 65. Retorting and melting are not done in the mills, melting being done mainly in the assay office.

The amount of labor used is considerable, and, where one white man is employed in other parts of the world, at least one white and one native are employed on these fields. The labor employed at 100-stamp mill is as follows: 4 amalgamators per shift of 8 hours, 12; 1 engine driver per shift of 8 hours, 3; 1 blacksmith 9 hours shift, 1 carpenter 9 hours shift, 1 fitter 9 hours shift, 1 hoisting engineer 9 hours shift, 1 greaser; total whites, 20; 10 natives, assisting amalgamators, shift of 12 hours, 20; 10 natives assisting mechanics, 10 natives hoisting and dumping; total natives, 40.



ORE-SORTING FLOOR, FERREIRY GOLD MINING CO

Where lifts of more than 40 feet are necessary, plunger pumps are commonly used. The latter have given good service where the proper arrangements have been employed to apply clear water to the plungers to prevent scouring. However, for lifts of less than 40 feet the tailings wheel is most satisfactory, requiring but little power and little or no attention. These wheels are patterned after those used at the concentration works of the Lake Superior copper mines. The temperature being so mild, there are no troubles due to freezing. Tailings wheels, launders, spitzkasten, etc., need no shelter.

The mill of the Simmer and Jack Proprietary Mines being the largest gold mill in existence, and a type of modern mill construction, a description of it is given here: Built on level ground, as are most of the mills on the Rand, the approach to the ore-bins is a raised earthen embankment having a 2½ per cent. grade, over which are drawn, by locomotives, trains made up of trucks of 20 tons' capacity each, which supply the mill with ore from the different shafts of the property, where sorting and crushing have already taken place. The mill building is 269 feet long by 100 feet wide, exclusive of the engine room and boiler

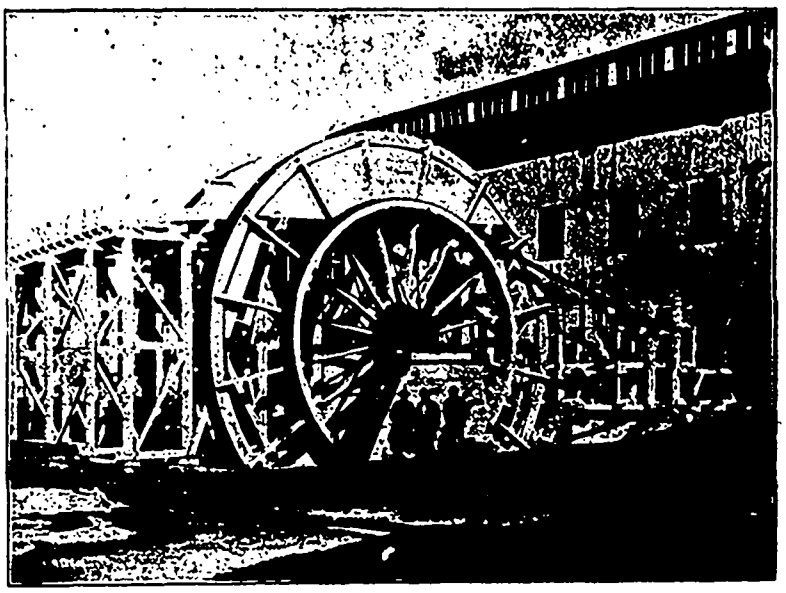
house, the frame being of wood covered with corrugated iron. The ore-bins are rectangular in cross section, the bottoms being flat, and have a capacity of 6,000 tons, or about four days' supply, with the full mill in operation.

The mortar blocks consist of eight karri wood piles bolted together, and the mortars are 4 feet 10 inches in length by 4 feet 8 inches in height, and are lined with steel. The sides are 1 inch in thickness, and the bottoms 9 inches. The feed opening is 3 feet 2 inches above the base, and has a width of 3½ inches for the full length of the box. The height of the discharge is 6¼ to 7¼ inches, and the screens, of 600-mesh steel wire, are 51¾ inches long by 10 inches wide, and have a life of three days, costing 54d. per ton of ore crushed. Amalgamation is done entirely on the outside plates or apron. This is a new departure at this property, as at the old mill inside amalgamation was also practised. The stamps are arranged in groups of twenty, ten being driven by each cam shaft, and weigh 1,200 pounds each. The drop is from 8 inches to 9 inches, and the order 1-5-3-2-4, the minimum of drops per minute being 95.

The cams are of cast steel, and have a sweep the outside diameter of which is 33½ inches. The cam shaft is of fagoted iron with a diameter of 6½ inches, and a length, over all, of 14 feet 3 inches. The cam pulley is of wood, having a diameter of 6 feet and a face of 17 inches. An overhead trolley is arranged under the cam platform for transporting shoes, dies, etc., to the mortar boxes. The mill has been running too short a time to enable an accurate estimate to be made of the consumption of iron and cost per ton of ore crushed. The battery tables have an effective surface 16 feet long by 4 feet 7½ inches wide, a fall of 1¾ inches per foot, and are covered with ⅛-inch sheet copper; they are constructed with one riffle 10 feet down from the mortar box end. A mercury trap is fixed at the end of each table. The pulp from the mortar boxes discharges on lip and splash plates before beginning the descent of the tables. There are two complete steel line shafts, one for each side of the mill, ranging from 10 inches in diameter at the engine end to 6 inches at the tail end. The pulleys for driving the cam shafts are 36 inches in diameter and 17 inches in face. The mill is driven by a compound tandem Corliss surface condensing engine, by Messrs. Yates and Thom, with cylinders 24 x 44 x 54, running at 70 revolutions, giving 900 i.h.p. The driving-pulley is 21 feet in diameter, having grooves for 20 1¼-inch manilla ropes, leading on to a pulley 15 feet 6 inches in diameter on the near line shaft, the two line shafts then being connected with rope pulleys 15 feet 6 inches in diameter for 10 1½-inch manilla ropes. Rope tightening gears are used on both drives. There are five 200 h.p. Heine boilers with two 200-tube economizers and one steel chimney 100 feet high and 6½ feet square. The launders in the mill have a 4 per cent. grade, and deliver the tailings to three 38-feet tailings wheels, to be elevated for delivery to the cyanide works. Such a gold mill varies but slightly from the general type in California and the west of America. Distinctly different from this in one feature at least, and peculiar to the mill construction of the Rand Mines Company, Ltd., is that of the single line shaft coupled directly to the crank shaft of the driving engine—a style of mill first introduced in the Black Hills of Dakota. Those of this type on the Rand are of 200 stamps, or constructed for 200 stamps as an ultimate; for instance, the Crown Deep, Rose Deep, Nourse Deep, Jumpers Deep, etc. The ore is delivered to the mill from a central sorting and crushing station, by rope-haulage up an incline, to bins of about 2,700 tons' capacity, and fed by challenge feeders to the stamps.

The mortar boxes are Fraser and Chalmers' No. 102, the height from the base being 4 feet 10½ inches, and length over all 4 feet 10½ inches. The average thickness of sides is 1½ inches; of bottom under the dies, 9 inches. The box is lined with steel. The height of the feed-opening is 4 feet 4½ inches above the base, and the width is 4½ inches. The height of the discharge is 8 inches, and the size of the screen 700-mesh with a life of 36 hours. Inside amalgamation is practised.

The cost of mill construction on the Witwatersrand may be placed at from £400 to £500 per stamp, depending on the size and design of the mill.



New Style Tailings Wheel Simmer & Jack Mill.

THE TALL BUILDING UNDER TEST OF FIRE.*

BY H. DE B. PARSONS.

The modern "sky-scraper" presents many problems, but none more generally interesting than the question of its security against fire. Many imagine that, because iron and steel are incombustible (in the common acceptation of the word), buildings constructed of such material, together with bricks, cement and glass, may be classified as fire-proof. The construction of a building out of materials in themselves non-combustible does not produce a fire-proof structure. The ruin of the Quinsigamond mill, Worcester, Mass., caused by fire April 5, 1896, shows this. The building was erected on the independent plan, a steel frame supporting the floors and roof. The columns were of built-up steel, carrying floor-beams of the same material. The window-boxes were of steel, and the walls were of brick built in between the frames so as to enclose the whole. Wood was used for the flooring on the "slow-burning" plan. The building was gutted, and the columns and beams twisted into a tangled mass. Witnesses of this fire state that the columns began to yield from fifteen to twenty-five minutes after the fire started, although the floors were not heavily loaded. Had this building been erected on the "slow-burning" principle, it would have resisted the fire much longer. In this type of construction heavy wooden columns and girders are used, which retain for a considerable time, when subjected to fire, sufficient strength to carry their

*A paper prepared for the Engineering Magazine, and published in the reports of the British Fire Prevention Committee.

super-imposed loads, permitting the escape of the occupants, the saving of valuables, and the arrival of assistance. Such examples show that plans for all buildings in crowded districts should be entrusted only to the best of designers. The design would be much simplified if there were no fear of fire. What constitutes a "fire-proof" structure? The term "fire-proof" has become generic, and is in many instances a misnomer. In its usual sense it is used to designate a certain style of modern structure that has become very popular. Structures of this type rely for their stability, support, and fire-resisting properties, on the steel and iron skeleton frame and on the other non-combustible materials used.

It has been repeatedly proven that metal construction cannot withstand fire, unless well guarded. No matter how "fire-proof" a building may be, it will be ruined, if sufficient combustible material is stored within to create a hot fire lasting for a considerable time. Manufacturers have produced many forms of fire-proofing protection, and have striven to obtain something that will not burn. Architects and engineers have given too much attention to the substance of which the fire-proofing has been made, and not enough to its proper application. It is, however, fortunate that the present tendency is in the direction of protecting the metal skeleton as a primary object, since upon it the self-sustaining properties of the whole structure depend. It should be a secondary object to so sub-divide the floors as to confine the fire.

Without injuring the usefulness or the efficiency of the building, the amount of combustible material now used could, by careful planning, be reduced. In the ordinary American office building wood-work is commonly used to a much larger extent than generally supposed. Taking as an instance a ten-story building of recent fire-proof construction, the wood-work in the floors, panels, bases, chair-rails, doors, window frames, and general trim amounted to about two pounds for each cubic foot of contents. This estimate did not include the furniture or movable office-fittings. The total weight of wood was about 1,200,000 pounds, or as much as the weight of the iron frame. In some of the largest and newest buildings the weight of wood-work has been reduced, but there are many in the sky-scraping class in which the wood considerably exceeds the weight of metal. A number of these tall structures are more vulnerable from fire without than from fire within. The design is often such as to render it difficult for a fire to obtain headway within the building before its discovery, while the same building would be most susceptible to damage if a fire should occur in the immediate vicinity. Designers fail, as a rule, to give due weight to the value of these external hazards. A good example of this is seen in the damage done to the Manhattan Savings Institution building, New York, through a fire on the opposite side of the street. The girders in this building were unprotected, and, failing, permitted the floors to fall.

Some three years ago a joint committee, representing the insurance, architectural and engineering interests, made some elaborate tests of the effect of fire on full-sized metal columns, finding that such columns failed when heated to a faint red color, representing a temperature of about 1,200 degrees F. The steel columns buckled at the centre, while the cast-iron ones bent, snapping, if not relieved of their load, when the amount of deflection began to exceed the diameter. The time required to cause destruction varied from 29 minutes to 2 hours, according to the character of the test—a result which agrees very closely with the failure in the Worcester mill. The cast-iron columns were heated to more than 1,100 degrees F., and were then suddenly cooled by means of a fire stream. No injurious effect was produced, beyond the cracking of the furnace brick-work. The result of our knowledge, based on actual experience and on experiment, is that iron and steel cannot support a load when heated to a faint red. The metal must be protected. It will not suffice to have simply a non-combustible protecting material; the material must be of such a character that it cannot be disintegrated or dislodged either by water or by expansion. The covering must be so fastened as to remain in place, and such fastening is best accomplished by self-bonding, and not by wiring or similar artificial means. The desire of the owner and real estate agent to obtain light for halls at the expense of safety, and to economize space by placing the stairs and elevators in the same well, should be strongly restrained.

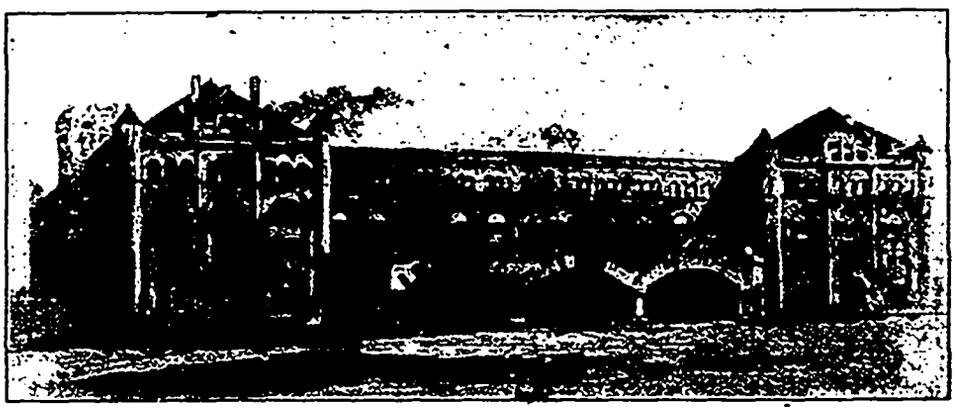
It has become possible to consider from a practical standpoint this important subject of a fire-proof building versus fire, by taking as an illustration a recent conflagration in New York city. The building in this instance was no doubt much favored in the assistance rendered by one of the most efficient fire departments in the country. On the night of December 4, 1898, a fire occurred in a five-story ordinary brick and wood building, situated on the southwest corner of Broadway and Warren street, occupied by Rogers, Peet & Co., as a retail clothing store. Adjacent to this, on Warren street, was another, but smaller building of similar design, used as an annex. On the south was the comparatively new Home Life Insurance Building, and, next to it, that of the Postal Telegraph Company. The Home Life Building has sixteen stories, and the floor plan is arranged with a light shaft in the middle of the north side. Along this light shaft are the elevators, and next to them is the staircase. The side and rear walls are of brick, while the front is of marble, built solid from the foundations. The building, with the exception of the front wall, is constructed on a skeleton framework of steel. The walls are lined with 2-inch porous terra cotta furring. The floor arches consist of 12-inch and 9-inch hollow, hard-burned, terra cotta blocks, the skew-backs covering with their soffit extensions the lower flanges of the steel floor beams. The columns are of steel, built up, H sections, and covered with 2-inch porous terra cotta furring blocks. The girders are protected on their sides with the same terra cotta blocks, while their soffits are covered with wire lath and plaster. The upper chords of all the girders, except one on the sixteenth floor, are buried in the floors. The principal partitions are made of 4-inch porous terra cotta blocks without metal supports. Many of these partitions are not continuous to the ceiling, being finished off with large plain glass transoms set in wood framing. All the windows were of glass set in wood sashes and window boxes. There are no shutters. The finish of the office floors consists of a wooden floor laid on sleepers placed across the floor beams, and not buried in ashes or cement. The walls and ceilings are plastered. There is a varnished base, chair-rail, window, door, and transom trim. Within an hour after the fire started, a strong northerly to northeasterly gale was driving the flames from the Rogers-Peet building against the walls of the Home Life building and into the light well, which acted as a chimney. The fire entered the unprotected windows of the eight upper floors, and found inside a natural draft through the elevator openings. The result was the total destruction of the contents of the upper eight floors, and the saving of the Postal building by its equally tall neighbor. As a fire stop, the Home Life building certainly succeeded admirably, for, had it not been there, it is fearful to contemplate what might have resulted during a gale of almost hurricane force. Such buildings are not, however, erected or designed as fire stops, and can be so treated only incidentally.

The vagaries of the flames were as peculiar as ever. In one room where the contents were destroyed a waste-paper basket remained, and in another a towel still hung on a rack unscorched, although the room was totally wrecked. The lower eight stories escaped the fire, but suffered from water. There was a total destruction of the finish of the various floors, nothing being left except the absolute fire-proof material. The plaster work, although not combustible, was absolutely destroyed, and in all of the rooms, from the ninth floor up, there is hardly any plaster left on the walls. The wire lathing used over the pipe chases in the walls and over the various irregularities in the building appears not to have stood the attack of the flames. This may have been due partly to the manner in which it was fastened, but more probably to the fact that the metal expanded sufficiently to throw off the plastering, which has no flexibility. The wood-work used in the finish of the building was not preserved in any of the rooms reached by the fire, except in a few in the rear of the building. In some of these a part of the office furniture still remained, although badly wrecked. In one room on the fifteenth floor a tall wall bookcase still stood. The book-shelves were protected by the closely-fitting books placed upon them, while the books were damaged beyond use. Had these shelves, however, been in the front of the building, they, no doubt, would have been destroyed, as there the fire appears to have been fiercest, probably because there were window-openings on the north wall of the east wing. Those

partitions which were cut for the purpose of inserting large transom windows near the ceiling suffered most. The glass in these windows no doubt broke, and permitted the flames to spread from room to room, thus removing the value of these partitions as fire stops. The main metallic frame-work was but slightly damaged. A large proportion of the injury was done by the firemen and the building inspectors, and cannot be attributed to the flames.

The destruction of the wooden flooring throughout the upper stories was largely due to the considerable air space between the wood and the flat floor arches This space should not have existed; had it been filled the floors would have stood much longer The effect of using other material than wood for flooring is plainly illustrated in the various halls, which were subjected to an enormous heat. The flooring of the halls was made of mosaic blocks. These blocks retained their position, and the floors were practically uninjured, although there is nothing left of the wood flooring in the rooms adjacent. The amount of wood used was no doubt excessive, viewed from the standpoint of best practice. Wood-work will not stand a hot fire, even when embedded in the walls. Other material can be adopted for chair-rails, bases, and panellings without injuring the appearance or the utility of a building.

The fire had no difficulty in entering the building, as all the windows on the north side were unprotected The building might have been saved, had these windows been equipped with iron shutters, and had wired glass been used in a metallic frame



NEW WINDSOR ST. STATION OF C.P.R. AT MONTREAL.

The wing on the left has been hitherto the Main Building. The frontage of the extended structure, on Osborne Street, is 325 feet The floor space is increased from 50,404 square feet to 102,131 square feet.

This wired glass will resist an immense amount of heat, and, although it breaks in time, the pieces remain in place Metal frames fitted with wired glass could have been used to advantage in all the partition transoms Such an arrangement would have given nearly as much light throughout the building and would have been a better fire stop The flames, on entering the elevator shaft, appear to have gone at once to the sixteenth floor as the destruction of the trellis work and iron framing around the elevator doors is greatest at that point. Owing to its position, the staircase was rendered useless as soon as the fire obtained considerable headway, although, as constructed, it was partially protected by the division wall between it and the elevator shaft. The stairs remained intact, so that they could be used as soon as the fire was extinguished. The front of the building was built of solid marble, the poorer pieces obtained from the quarry being used as backing. The facade was relieved with balconies and other ornamentations, and a row of columns supporting arches made a finish to the fifteenth and sixteenth floors. The fire totally wrecked the marble, wherever it was exposed. Marble and granite have but little fire-resisting power, and it seems useless to adopt them in a building intended to be fire-proof. They are so susceptible to heat as to be liable to injury by fires occurring at a considerable distance. A greater heat than that to which the marble was exposed was endured by the brick-work on the north face, and by the brick-work up the light well. The chief visible damage to this was the cracks caused by the expansion and contraction of the braces reaching across the light well and stiffening the two wings. Taken as a whole, the building resisted the action of fire remarkably well. Within a week many of the offices on the lower floors were again in use. The steel structure, with the exception of a few portions, such as the girder mentioned above, can remain without repairs. The damage to the floors was slight; and, although the total wreck was great, it was practically limited to the trim and contents of the various rooms on the upper nine floors. The front wall, however, was ruined from the eighth story up. No doubt the destruction would have been less, had as much care and energy been bestowed upon the details of construction and finish as were given to the main frame-work and general plan. The building contained its own fire apparatus, but it is reported that this failed early in the evening. Owing to the height of the building, it was impossible for the fire department to reach the seat of the conflagration. The fire, therefore, had great liberty, although it was effectually prevented from spreading to the lower floors.

Here was a building which was, in the ordinary sense, a fire-proof structure, and yet it was damaged. Again arises the question: "What constitutes a fire-proof building?" It is evident that, if fire is brought into contact with articles that are combustible, those articles will be burned; and that, if the fire must be confined to one specific space, that space must be enclosed effectually by absolutely fire-resisting material, which must be so constructed as to form practically a furnace. Such construction is not applicable to a building used for ordinary purposes. The next step, then, is to so arrange the structure that, when fire takes place, no damage shall be done to the main members, whether those members be of masonry, iron or steel. In all our cage constructions the members needing the greatest protection are the columns, girders and beams. It is not difficult to protect these members effectually, provided the owner and the designer are willing not only to spend the proper amount of money and care, but to give up the requisite floor-space. This part of the problem was fully illustrated in the Home Life building, as the only members seriously injured were the unprotected parts of the metal structure. It is axiomatic to state that floors should be separated from each other, so as to confine the flames. This is a condition difficult to attain, as perforations must be made for both stairs and elevators. These openings are generally placed so as to take a minimum of floor-space, and thus render a maximum area available for income-earning purposes. Nearly every intending builder examines the various buildings, estimates the amount of space devoted to public use, and concludes that the best building is the one that has given up the least percentage of space. While this effort is commendable from the purely income-earning standpoint, it not only has the effect of rendering the design dangerous to life and property, but makes it almost an impossibility to so design a building that it shall be fire-proof. In any building there must be, and always will be, an amount of combustible matter that cannot well be reduced. It is, therefore, essential that the least amount of combustible material shall be used in construction. In those

rooms in the Home Life building which suffered the least damage, it was clearly shown that the combustible materials placed near the ceiling were destroyed more rapidly and more completely than those nearer the floor. The heat and flames naturally follow the ceiling, and the ordinary fire-proof partitions in which there are large transom windows are thus rendered useless as fire stops. The use of transoms in these partitions is no doubt a necessity, but they should not be fitted with material so friable as ordinary glass. Even in a fire-proof building dependence must be had upon human aid. When the building is tall, it towers beyond the reach of the fire department, and reliance must be placed upon other means. A fire in the lower stories is easily accessible; the conditions to be most dreaded are those of a fire in the upper stories.

Many modern tall buildings are designed with their own pumping plant to supply a roof tank for fire and other purposes, and are equipped with a large stand pipe from six to eight inches in diameter, which is siamesed on every floor for hose connections. This stand-pipe is also arranged with a check valve and with siamesed branches at the foot, so that fire engines can be attached, in case of the disability of the self-contained plant. It is well so to arrange the stand-pipe that the engines can also operate in conjunction with pumps in the building.

In many cities which maintain a system of fire boats there are laid underground pipe lines of large diameter. As these fire boats are equipped with pumping apparatus far exceeding the power of the largest land engines, they are able to force water under heavy pressures to long distances, provided the mains are made of sufficient area to minimize the friction losses. This system, operated in connection with the building stand-pipe, would materially assist the firemen.

The question naturally arises whether it pays the owner to make a building thoroughly fire-proof. Unfortunately there are many who build for the specific object of obtaining the greatest income from a minimum outlay, and the effort to save on the first cost is so great as to render their judgment valueless as to what should or should not be done. Tall buildings of cheap construction are a menace not only to the owner and tenants, but to the community. Too much stress cannot be laid upon the great aid that could be rendered, but unfortunately is not, by the insurance companies. If they would be more strict in the classification of their risks, improvement would immediately follow. Are these tall buildings really good investments? The increase in height appreciates the value of the land, but how much of this appreciation is offset by the depreciation of the building, by the extra cost of maintenance, insurance, repairs, taxes, interest, etc.? In other words, would not a smaller building pay a greater percentage upon the money invested, if a careful and accurate balance sheet should be drawn up? Following the same line of thought, there has arisen the question whether the height of buildings should not be limited by law? If every building could be constructed upon utopian principles, probably there would be no reason to limit the height other than one of a purely aesthetic character. As such a state of affairs does not, and probably never will, exist, and as so-called fire-proof buildings are liable to be constructed, it seems that some form of proper restriction would be advantageous to the community.

THE SMOKE NUISANCE.

Montreal is taking active steps towards the abatement of the smoke nuisance. Complaints from people living within a considerable radius of a factory or public building where soft coal is used, are frequent. The smoke is a great inconvenience, as doors or windows cannot be opened for purposes of ventilation; clothes hung out on wash days are ruined; the houses themselves rapidly become dingy in appearance, and the smoke finds a lodging on the roofs of the buildings, lies there until rain comes and washes the combination of soot and water down the walls, leaving them streaky, and indelibly defacing the architectural beauties of many fine buildings. Manufacturers are consequently put to much expense and great annoyance in trying to do business, and at the same time keep the peace with their residential neighbors. Many devices are on the market which effectually burn the smoke and save the coal when properly handled, but what is needed is a smoke consumer, which can do the work, and yet be within the reach of all. The makers of the Redpath-Reid patent smoke consumer claim that with their machine the best results are achieved.

NEWFOUNDLAND'S MINERAL WEALTH.

Belle Isle is reached by a twelve-mile drive from St. John's to Portugal Cove, on the first road ever built in the colony, some 70 years ago, writes J. Ewan in special correspondence to the Toronto Globe. The Cove lies opposite the southern shore of the island, but between them there runs about as tricky a piece of water as there is around the coast of Newfoundland. The island presents a perfect precipice to the sea at all save two or three points. It is eight miles long by two in width, and contains farming lands that are superior to anything on the adjoining mainland.

The Nova Scotia Steel Company was the first to begin the extraction of ore at Belle Island. The idea appears to have been to get enough ore for its own use, and the company went to work in a tentative way. It was fortunate enough to secure the management of R. E. Chambers, a Nova Scotia man of wide experience and resourcefulness. As the original plans did not contemplate the getting out of a great deal of ore, it is remarkable that they were so laid as to be adaptable to a much larger output when the demand for the ore ran away beyond the original modest estimates. Work had not got well started before it was found that besides supplying its own iron and steel works in Nova Scotia, the company had the opportunity of selling the ore to German furnaces. It took all the orders of this kind that came, and latterly orders came from the United States, so that during the last year closed, instead of the few thousand tons that would have been sufficient for the company's own purpose, it will have shipped out 300,000 tons.

The side of the island on which the ore lies fronts a sea in which vessels would have no protection in a storm. On the other side facing the mainland, there was a slight recess in the bold shores where a vessel could lie at a wharf in comparative safety. The choice of this side for shipping necessitated the building of a cable tramway across the width of the island. It is a double track, two feet gauge, an inch steel cable passing around wheels at each end and down the centre of tracks. On to this moving cable the steel cars, containing each a ton and a third of ore, are attached as soon as filled at the mine, and they start their journey across the island to the pier. The cars are strung along the cable not more than ten or fifteen yards apart, and one of the sights of the island is this procession of little vans, those on the west track full and those on the east track empty, proceeding at a stately pace across the country. On arrival at the pier each is in turn automatically dumped into enormous pockets and starts in the procession of "empties" back to the mine to be filled again. The steamers are loaded from the pockets, and the facility with which this is done may be gathered from the fact that a steamer has been loaded at the pier with 6,400 tons of iron ore in four hours and a half.

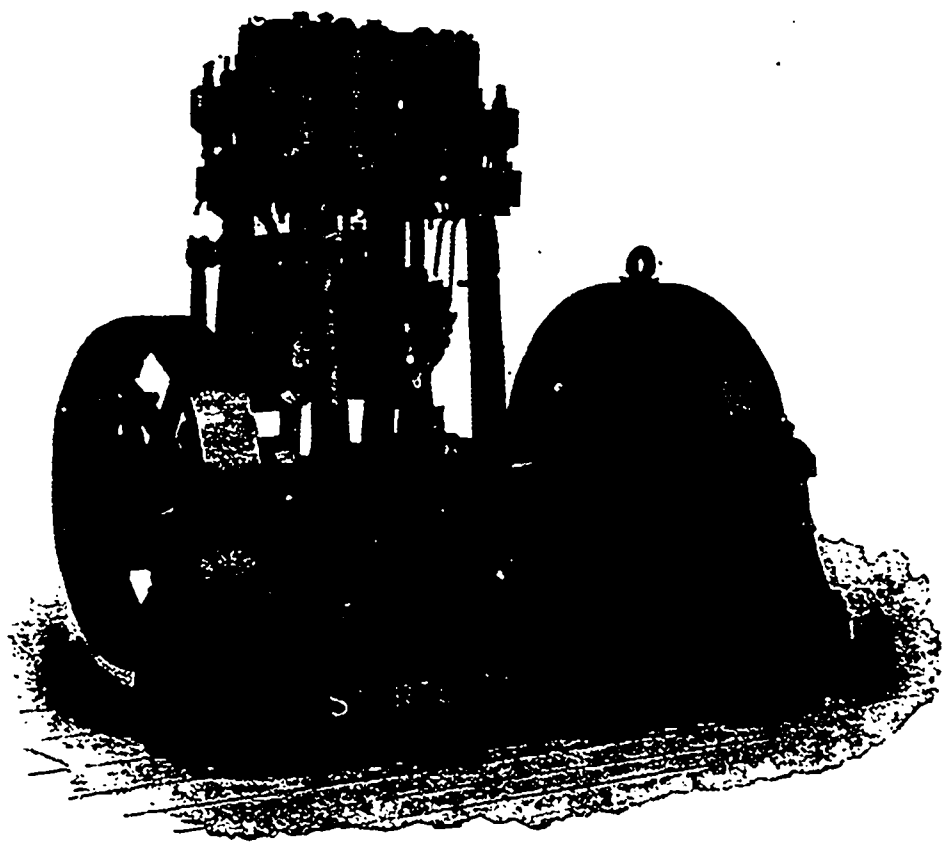
The pay roll of the Nova Scotia Steel Company on Belle Isle in October was $24,000, and when the other company gets to work next year that sum will be at least doubled. The Nova Scotia Company is by no means through with the island. It still retains the upper bed, and is at the present moment building a duplicate of the first pier at a sheltered spot on the coast to the west. The road-bed for a tramway is already laid across the island, and it is quite likely that its operations next year will be quite as great as this year. The statement is made that the Whitney Company will get out 500,000 tons of ore a year, and the construction of a second tramway, making the third across the island, seems to indicate that they contemplate a greater output than their predecessors. "What I like about Belle Isle," says Mr. Ewan, "and the other effects that flow from it, is their actuality. Here one is not stuffed with talk, but feasts his eyes on facts—on thousands of men at work, at vast vessels obeying their mistress, commerce, and ingenious machinery working the will of man. The whole arithmetic of the situation is that this ore can be laid down at Sydney at a cost of probably less than 50 cents a ton."

Not far from Belle Island is Bai de Verde, where an English company, the Newfoundland Iron Ore Co., has been at work for

a considerable time at the preliminaries to mining an iron deposit there. The main shaft is at Worthington, near Lower Island Cove. The ore is a red hematite and is said to be of a higher grade than that in Belle Isand. It is said that 500,000 tons are in sight. The company has spent a large amount of money, but as yet has extracted no ore. The Tilt Cove Copper Mine has been operated since 1868, and last year was perhaps its most profitable year. Every once in a while reports have been circulated that it was at the end of its tether, but it has always come up smiling, and let us hope that it will always do so. About 200 men are employed at the mine Petroleum has been found at Parson's Pond, at St. Paul's and at Port au Port, but the value of the find has not been demonstrated. There are fine slate deposits at Britannia Cove, Trinity Bay, the product being it is claimed better than any in the United States. The quarry has been sold very recently to Harvey & Co, an enterprising firm in St. John's, for the sum of $25,000 The facilities for shipment are excellent, and England is the market which the owners have in view. A gypsum deposit on St George's Bay has been leased by a company at a rental of $1,200, with a right to purchase for $30,000, and preparations are being made for an active output. And to all such enterprises every friend of the colony will bid God-speed.

A SUBSTANTIAL TYPE OF MARINE GENERATING SET.

In the design of the generating set illustrated herewith, the features of compactness, accessibility, economy and stability, with consequent lightness of parts, and ability to maintain an excessively high rate of speed during a long period, have, it is claimed, been most carefully developed.



The engine is two cylindered, the cylinders having their axes parallel, and being contained within the same casting. The diameter is very large relatively to the stroke, the size represented here being 9 inch cylinders with 5½-inch stroke. The valves, which are of the piston type, are two in number, placed in spandrels between the cylinders, and actuated from a yoke below, which in turn receives its motion through a rocker arm from the eccentric. The valves, which operate in unison, are so designed that steam is coincidently admitted to the top of one cylinder and the bottom of the other. The motion of the pistons is transmitted through large piston rods to slipper cross heads, and thence through marine type connecting rods to the double crank below. The crank pins are set at an angle of 180 deg, so that the vertical motion is balanced, one crank moving upward as the other moves downward. This feature is instrumental in the securing of a high rotative speed.

The cylinders are supported upon four heavy columns as shown, the rear columns supporting the guides for the cross-heads, and all being securely bolted at the bottom to the very substantial bed casting. This bed carries three main journal bearings, brass bushed in their lower halves, and provided with continuous oiling devices in connection with oil receivers beneath. The interior of the bed forms a basin, which collects all drip from water or oil.

The regulator is of special construction, and arranged to operate the valve in such a manner as to regulate the point of cut-off for all loads. It is exceedingly powerful, although sensitive to very slight changes in speed. The connecting rod and cross-heads are of forged steel, the cylinders are thoroughly lagged, and an oil tank is mounted upon each end of the cylinder casting, and provided with individual sight feed oilers, and connections to the various bearings.

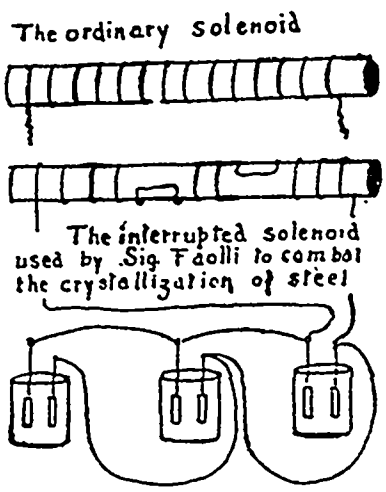
The generator, the armature of which is coupled to the engine shaft, is carried upon a continuation of the engine base, and is of the six pole type with outboard ring boiler bearing. Its capacity is 425 revolutions per minute (the speed of the engine is 40 k.w.). The field ring is of cast-steel. The cores are of wrought iron with cast iron shoes. The armature is built upon a spider, and is arranged for thorough ventilation through internal ducts, extending out through the armature windings. The armature in operation acts as a blower, and causes the passage of air through these ducts. The series winding of the field coils is of flat copper ribbon, and the shunt winding is of wire. Both windings are placed on the pole entirely independent of each other, and either may readily be removed. Their design is such as to permit of free circulation of air upon all sides. The generator is designed for sparkless operation under all changes of load from no load to 25 per cent. overload, with a limit of temperature rise to 90 deg. F., after a full load run of 10 hours. This set was designed by the B. F. Sturtevant Co., Boston, Mass.

Wilson & Smith, Worcester, Mass., are now occupying their new factory recently built for them, and though much more than the usual number of orders are in hand, they are filling them promptly. The firm is now carrying a larger stock of nuts and washers of all sizes than ever before. The chief output of this firm takes the form of specialties punched from cold iron, steel and brass and the making of dies for this class of work.

OVERSTRAIN IN STEEL.

Owing to the large use of structural steel at the present time a great deal of interest is being taken in the question of the probable life of structures, such as high buildings, bridges, etc., which depend wholly for their strength upon this material. An Italian electrical engineer, Emilio Fealli, has just made a discovery, which he claims is a means of effectively preventing crystallization. A bridge at Setro Ponente, about ten miles to the north of Genoa, Italy, collapsed on three different occasions within a dozen years. Another bridge near Pavia had only just been constructed and was being tested when it snapped in the middle. Making a study of these accidents lead Signor Faelli to experiment with overstrained steel, and finally, when experimenting with what is known as a "tired" razor and an electric cement, he discovered that the application of electricity would restore strained steel. He tried an electrical current traversing a solenoid placed around the razor, the current being controlled by the intercalation of a tuning fork. On trying the razor he found it in a relatively good condition for its ordinary work This was a proof that the crystallization had been partially nullified. His solenoid was one of perfect tubal curve, and he got better results with an interrupted spiral curve.

A solenoid, the coil of which is in one direction, carries current running in an unchanging course, and symmetrically magnetizing any soft iron that may be placed in its centre. A



solenoid, on the contrary, whose curve is interrupted, carries a current which changes with the frequency of the interruptions, and has peculiar effects on metal placed within it. It induces in the metal, independently of the extreme poles, as many interior poles as there are alterations in the coil.

The following is an abstract of a paper on the Recovery of Iron from overstrain, by Jas. Muir, B.Sc., Trinity College, Cambridge, which was communicated to the Royal Society by Prof. Ewing, F.R.S.:

It has long been known that iron which has been overstrained in tension—that is to say, strained beyond the yielding point, so that it suffers a permanent stretch—possesses very different elastic properties from the same iron in its primitive condition. The material is said to be "hardened" by stretching,[1] since the ultimate effect of such treatment is to raise the elastic limit, and reduce the ductility of the material.

More recently attention has been called to the fact that, primarily, the result of tensile overstrain is to make iron assume a semi-plastic state; so that the elastic limit instead of being raised by stretching is first of all lowered, it may be, to zero.[2] This plasticity may be shown by applying a comparatively small load to a bar of iron or steel which has just been overstrained by the application and removal of a large stretching load. When the small load is put on, the bar will be found to elongate further than it would had the material been in its primitive state: and a slight continued elongation—a "creeping" may occur after the small load has been applied. If this load be withdrawn a quite appreciable permanent, or semi-permanent, set will be found to have been produced; a set which diminishes slightly, and, if small, may vanish provided time be allowed for backward creeping to take effect. It may also be shown that if the reapplied load be increased the elongation produced will increase in a greater proportion. Thus if a stress-strain curve be obtained from a recently overstrained bar of iron or steel, it will show even for small loads a marked falling away from the straight line which would indicate obedience to Hooke's law.

It is recovery from this semi-plastic state induced by overstrain to a condition of perfect or nearly perfect elasticity, with raised elastic limit, that is referred to in the title of the paper of which this is an abstract. Such recovery is known to be effected by mere lapse of time,[3] and the object of the experiments described in the paper and summarized here, is to show the effect of moderate temperature, of mechanical vibration, and of magnetic agitation on this slow return to the elastic state; and, further to illustrate this recovery by means of compression tests. One section of the paper deals with the phenomenon of hysteresis in the relation of extension to stress which is exhibited in a marked degree by iron in the overstrained state. Incidentally attention is called to subsidiary points of interest.

The experiments were carried out in the engineering laboratory of Cambridge University, and were the outcome of suggestions by Professor Ewing. It was on his suggestion that the effect of moderate temperature on recovery from overstrain was tried, and the result of that trial led to much of the work incorporated in the paper. The straining and testing were done by means of the laboratory 50-ton testing machine, the specimens employed for the most part being taken from steel rods one inch in diameter, of a quality which may be described as semi-mild. The small strains of extension were measured by Professor Ewing's extensometer.[4]

After referring to the apparatus and the material employed, and describing the method of experimenting, there are first given in the paper examples of the slow recovery of elasticity with lapse of time. These examples are illustrated by stress-strain curves obtained, at succeeding intervals of time, from extensometer readings similar to those tabulated by Professor Ewing in his paper, referred to above. "On Measurements of Small Strains in the Testing of Materials and Structures." Recovery is shown to be at first comparatively rapid; but latterly very slow progress is made, and weeks or months may be required before an approximately perfect restoration of elasticity is effected. When this is brought about, the specimen may be subjected to a stress a few tons per square inch higher than that at which the virgin material yielded, before a yield-point is passed and the material once more brought into a semi-plastic state. If sufficient time be allowed to elapse after passing this second yield-point, an elastic state will again be assumed, and a third yield-point may be obtained about as far above the second yield-point as the second was above the first. In this manner four or five yield-points may be obtained with the same specimen before fracture occurs. A specimen broken in this manner shows greater ultimate strength, but less ultimate elongation than would have been obtained had fracture been brought about in the usual fashion, that is, without allowing intermediate recoveries of elasticity to take place.

The question of recovery of elasticity under stress is next considered in the paper, and it is shown that the process of recovery proceeds at practically the same rate whether the material is kept stressed or is allowed to rest free from load. A slight difference, however, is shown in the two cases, as restoration of elasticity takes place about the position of continued stress. After this, the phenomenon of hysteresis in the relation of extension to stress is considered, and a closed cycle is shown, having features analogous to those exhibited by a magnetic hysteresis cycle.[5]

The effect of moderate temperature on recovery from overstrain is next treated of, and it is shown that a slight increase in temperature hastens the restoration of elasticity to a remarkable extent. Three or four minutes at 100° C. proved to be more

[1] Ewing, "On Certain Effects of Stress," 'Roy. Soc. Proc.,' No. 205, 1880.

[2] Bauschinger, 'Civilingenieur,' 1881, or 'Mitthellungen aus dem Mech. Tech. Laboratorium in München.' An account of Bauschinger's work is given in Unwin's book on 'Testing of Materials of Construction.' Ewing "On Measurements of Small Strains in the Testing of Materials and Structures," 'Roy. Soc. Proc.,' vol. 58, April, 1895.

[3] Bauschinger, 'Dingler's Journal,' vol. 214, p. 5; or 'Mitthellungen aus dem Mech. Tech. Laboratorium in München.' Ewing both papers already cited. Reference might also be made to Lord Kelvin's discovery of the effect of a Sunday's rest on wires which had been subjected to torsional vibrations throughout the preceding week.

[4] For description see paper already cited, "On Measurements of Small Strains, etc.," Roy. Soc. Proc., vol. 58, April, 1895.

[5] Ewing, 'Experimental Researches in Magnetism,' 'Phil. Trans.,' 1885, or book on 'Magnetic Induction in Iron and other Metals.'

efficient than a fortnight's rest at the normal atmospheric temperature The effect of various temperatures below 100° C is then investigated, and so moderate a temperature as 50° C is shown to have a large influence in hastening recovery from overstrain The manner in which recovery proceeds with time when the specimen is kept at a constant temperature is shown in the paper by means of curves These curves show that at first* that is, before elasticity is fairly well restored—the amount of recovery, measured by the diminution in the elongation produced by a maximum load, is proportional to the square root of the time. For example, the effect produced by, say, four minutes at 80° C. was approximately double of that produced by one minute at the same temperature. By subjecting an overstrained specimen to temperatures above 100° C, no effect (other than the recovery from the temporary effect of overstrain) was found to be produced until a red heat was almost attained. When the specimen had been subjected to an annealing temperature, of course the whole effect of overstrain was removed, and the material assumed its virgin state.*

After the effect of temperature is discussed, that of mechanical vibration is next recorded in the paper; and it is shown that by striking a recently overstrained specimen with a hammer, so as to make it ring, the material of the specimen is made less elastic. That is, the effect of mechanical vibration is opposite to that of increase of temperature; recovery of elasticity is not hastened, but the material becomes more semi-plastic after mechanical vibration than it was before.

The influence of magnetic agitation is next described. A recently overstrained specimen was subjected to magnetic reversals by means of a coil giving a field strength of 140 C.G.S. units at its centre, but no change whatever was detected in the elastic condition of the material, the process of recovery seemed to be neither accelerated nor retarded.

For the compression experiments described in the paper, an instrument, specially designed by Professor Ewing, was employed to measure the small compressioned strains. By the aid of this instrument, the semi-plasticity of recently overstrained iron was readily observed, and the effect of moderate temperature in restoring elasticity was demonstrated by means of compression tests. The lowering of the compression yield-point which accompanies the raising of the tension one (due to tensile overstrain) was also clearly shown. This lowering, however, was not found to be such as to keep the total range of elasticity for the material constant; that is, the lowering of the compression yield-point was not found to be equal to the raising of the tension one. In conclusion, the characteristics of overstrained iron are considered as illustrating Maxwell's views on the "Constitution of Bodies," as set forth by him in the "Encyclopaedia Britannica."

AN IMPOVERISHED PHILOSOPHER.

There are times in his life when an editor wishes the readers of his work would promptly pay their indebtedness, and there are moments, such as when we opened the following explanation of a returned draft, when we are glad to have something coming to us, even if it is only a joke:

Biggar, Samuel. and, Co

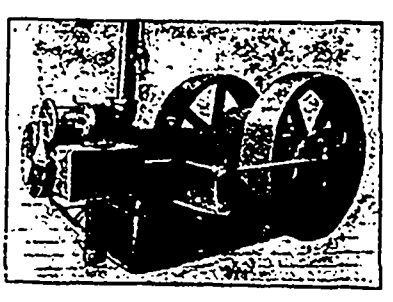
Montral, Canada.

Dears Sirs I received yours of 27 Contents Noted. My silance in the Past has not bin frome Eny Desier on my Part to avoid Payment, or to Shurk My Respsnoobiley the Matter in Question I had Hoped that Maters might git Better and, I Would be able to Pay you but as matters Was Worse each year I thought best to Stop your Paper forme coming longer in explaination of My Present financial condition. I Secured a Pattint on a Submerged Dredger (a World Beater) this was in 93 I of cors flirted with the goddis of Fortion that Presided over the destines of Patent Right Men, and Smile While they Build Air Castles. But Smash them With as little Remors as a Kansas Tornado Would dew. I listind to hir wewing for two years and when I Realised the truth of the Situation My finances, and financial Reputiton Was just in the fix of a Box Haus after the Kansas sicloun, Recognisable by Former Land Markes. I Will mention some of the Most Prominent land markes that exist to marke the Remains of What Wanst Was, namely a judgment for $6000 buy one Partey, a judgement for $800 but a nother Party, and $2,000 subject to judgment if the holder of the note cairs to take it, in all my missfortuns no one That Knos me acuses me of trying to Swindle them in further explanation I will state that I yet owe Borowed Money to some of my friends I cannot Pay other obligations untill I am able to Pay them something I ame to treat all my Credeter as just as, I can. I havent a sent in the Business, for when I waked up, I was not as, Ragged, as, Rip, VanWinkle but was, as Poar, and did not have a god, to comfort me, in conclusion I Will say. I fully Recognise the justness Your Bill You Pubelacation's good and I appreciated them and have most all of them yet. You bill is recorded on the Tablets of my Memorie, and Will Paid When Reached in ther turn if Gabral dont tute hir Horn and say to, me Robbins With you time is, nomore, then the vail that hides the imortal form them that, Reman Will be drawn, then we will be remembored onley, with, those that ar gon to that Born frome Whence no travler Return. We ar taught, in, the leson of Faith Hope and Charity that Faith ends at the grave, hope in Fuition but, Charity Endureth forever. We Hop that with Charity We may be judged. in conclusion I will say. I have for, 4, years, Tryed to keep forme furnish in a citison of a Foren Countrey, a sample of my spelling But you have cornerd me and her it is. Hoping we may soon have things adjusted to your satisfaction I reman as ever

Fort Worth, Texas, July 3rd, 1899. J. M. Robbins.

THE PEERLESS SELF-OILING AUTOMATIC ENGINE.

We here illustrate this new modern self-oiling engine now placed on the market by E. Leonard & Sons, London, Ont. The makers claim every possible improvement in connection with it that is now in existence on the best class of engines offered for sale in the United States or Canada. The points of great advantage claimed are as follows: The engine bed is of a new type, most rigidly designed to withstand high pressure steam; the governor is Ball's latest patent, Class E., much simplified, only having one spring and weight, and made now without the dash pot; it is so perfect in regulation that it will not vary 1 per cent. from no load to full load; the engine valve is perfectly balanced, has a double face and cannot leak. This firm have engines that have been in constant use for fifteen years, and never yet a case of leakage, and have no record of having any of these repaired. The self-oiling system supplies oil at a proper height, in the body of the frame, so as to lubricate the crank, cross-head and the engine bearings, without the least appearance of oil shown outside of the engine, doing away with all oil cups in this location. The engine shaft is made of forged steel. The cross-head is of steel, of the new slipper type, and is adjustable. The cross-head has very large wearing surface. A space is left between the cylinder and gland, which prevents the water following



the rod into the frame of the engine. The main bearings can be adjusted when the engine is in operation. All of the parts are made of the best material and workmanship, and the fixtures, as shown, are first-class in every way.

The recent sales made by this firm include: W. H. Fowler (tandem compound), St. John, N.B.; Acadia Electric Co. (tandem compound), Wolfville, N.S.; London Electric Co. (simple direct connected), London, Ont.; United Electric Co., of Toronto, Ont., for Henry Morgan, Sons & Co. (simple direct connected), Montreal, Que.; Electrical Construction Co., of London, Ont., for Victoria Hospital (simple direct connected), London, Ont.; Anderson Furniture Co., Woodstock, Ont.; Bennett Furnishing Co., London, Ont.; Messrs. D. W. Karn & Co., Woodstock, Ont.; Anderson Furniture Co., Woodstock, Ont.;

*See paper by Unwin "On the Yield-point of Iron and Steel, and the Effect of repeated Straining and Annealing." 'Roy. Soc. Proc.," vol. 57, 1895.

Wm. McMaster, Ridgetown, Ont., W. H. Meldrum, Paris, Ont.; Joseph Orr, Stratford, Ont.; Palmerston Pork Packing Co., Palmerston, Ont., Corporation of Dundalk, Dundalk, Ont., Smith's Falls Malleable Iron Co., Smith's Falls, Ont.; J. W. & W. A. Hutchinson, Berwick, N.S., H. Webster, Norwich, Ont. This firm have the following agencies: H. E. Plant, 169 Common street, Montreal, Que.; Geo. H. Evans, 62 Water street, St. John, N.B.; Thomas Nopper, traveling agent for Western Ontario, London, Ont.; Stuart & Harper, Winnipeg, Man.

THE MANUFACTURE OF STEEL FOR BUILDING CONSTRUCTION.*

BY F. H. KINDL.†

The first portion of the paper described in a popular way the processes which are gone through in the reduction of the iron ore, the conversion of the molten metal to steel, and its rolling into structural shapes. The paper then continues as below:

It is evident that for every different size beam, channel, or other shape, the entire set of rolls, from the cogging mill to the finishing rolls, must be changed; that is, the rolls and couplings must be removed and others put in their places. They must be reset and lined up true, so as to produce the proper design and weight of shape in the finishing pass. The weight of material moved—that is, rolls, couplings, etc., to be reset and relined—amounts to very nearly 175 tons in the large beam mill; and right here, gentlemen, it will become apparent to you that owing to the time required in roll changes we have a heavy factor in the time of delivery or, better, non-delivery in fixed time of your client's material. The cost of changing rolls, you can also see, must be considerable, and if we take but $1 per ton for labor of moving and resetting we have at once $175, and a proportional amount for the smaller mills, noting that no account is made therein for the cost of skilled labor required to reset and line up the rolls, taking from three to ten hours, depending upon the mill required to be changed.

A great deal of time is also required to change from one weight to the same shape and depth of another weight, so you can readily appreciate how it can occur that one building is erected so much quicker than another, and, I dare say, cheaper to your client, due simply to the use of standard sizes and shapes throughout in the construction of the steel skeleton, noting that the fewer the sizes used the quicker can the work be delivered. While this tendency toward the use of standard shapes has been very marked in the past few years, it could still be extended further, and it will no doubt interest you to know that in countries using the metric system architects and engineers long since adopted a standard of shapes, in conjunction with the mills, which are strictly adhered to, and none but the minimum weights in a fixed size are ever used. I am sure the sooner we adopt such a system the better it will be for all concerned.

But we must not forget our beam, which, no doubt, by this time, has left the last pass, or finishing pass of the rolls, and is now lying on the long roll table, ready to have a test piece cut from it and stamped with its blow number, representing the constituents of the steel, and to be cut into ordered lengths. The test piece is carefully prepared and sent to the testing laboratory, where its elastic limit, ultimate strength, and elongation and fracture are carefully measured and recorded, with the chemical constituents. The finished beam, cut to length, which has, until now, been lying flat on its side, is automatically turned up so as to rest on its flanges, as in its normal position in a building, and is quickly pulled across a series of rail skids, called cooling beds. Here it is allowed to rest until its turn comes to be straightened. The straightening machine is in direct line with the end of the cooling bed, and the beam is automatically guided through the machine, coming out of same true and ready to be shipped direct to destination, if plain, or transferred to the fitting shop, if work is to be performed thereon. Practically the same manner of manipulation as for beams applies to channels, rails, and other shapes.

For plates, the ingot is first reduced to a slab in the preparatory mill—called slabbing mill—which slab, as a rule, is reheated and then rolled flat to the required width and thickness in a plate mill. Plates having a width of over 48 inches or less than ¼-inch thick are rolled in an ordinary plate mill—that is, one having only horizontal rolls—and plates rolled in such a mill must have their edges sheared in the direction of the length of the plate, subsequent to rolling and straightening. For plates under 48 inches in width and over ¼-inch thick, this shearing is not necessary, as true edges can be obtained in a plate mill having, besides the same horizontal rolls as the ordinary plate mill, a set of vertical rolls. Such a plate mill is called a universal plate mill.

Plates 6 inches and less in width are worked in grooves cut into rolls similar to those for shapes, and can be rolled in the same way as shapes. It being a less expensive process than that used for plates, most bars are rolled in this manner.

All plates, after being rolled to the required width and thickness, *are apt to be buckled, owing to internal stresses or* unequal heating at different points of the plate, and must be straightened by means of subsequent rolling. A set of these straightening rolls is placed in line with the feed table in the plate mill, and the plates are automatically conveyed through them, being still quite hot. They are then carried on a long roll table to the template department, and there laid off to template, all this being performed while the plate is on the roll table. They are then carried along to the shears, placed at the extreme end of the plate mill department, and cut to the template marked thereon. From here they are directly shipped to their destination.

Having now completed the rolling of our plain material, we will visit the fitting shop for beams, where all our beams and channels are sent to be fitted, i.e., either to be—1st. Punched in web only, one or more size holes. 2nd. Punched in flanges only, one or more size holes. 3rd. Coped on one or both ends, after being punched. 4th. Riveted with connecting angles on one or both ends. 5th. Riveted into beam girders, with one or more cover plates. 6th. Bent or forged in blacksmith department.

As soon as the operation of the beams through one or more of the above processes is complete, i.e., when fitted as required by shop details, they are slid into the shipping yard on skids, ample room being left for this purpose between the different machines. Naturally, the less work to be performed, the sooner can the beam or other material be shipped, and in this respect the architect can materially assist in his plans and specifications. We will draw attention to some of the worthy points to be considered; noting, however, that they are not necessarily applicable in all cases, and good judgment must govern their use.

First. Specification, if possible, should call for only one size of hole to be used, namely, ¾-inch diameter, thus avoiding two operations and handling of material from one punch to another. Second. Avoid coping by setting the floor beams sufficiently below the top flange of the main beam or girder, providing this latter is of sufficient depth. Third. Avoid beam box girders, by the substitution of beams of greater depth. Fourth. Avoid blacksmith work—that is, bending, welding, etc., by proper design of riveted members.

We now take a hurried look at the column shop, and here are found machines to perform the workmanship on the various classes of material, which, after first being laid off and punched, are assembled and subsequently riveted together to the finished column, which is then faced to the exact length; noting that all parts inaccessible after riveting are painted.

The total cost of the structural steel erected in a building, of course, depends upon the weight required and the current quotations for the plain material, as well as upon the workmanship thereon, its hauling to and erection at the building site. The weight of structural steel in a building is very difficult to estimate, unless plans and specifications are first drawn up, as this will depend upon the design, the number of stories, the dead and live load to be carried per square foot of floor, the weight of brick or stone work resting on the outside girders, and the allowable unit stresses on the steel. While the allowable stresses per square inch are pretty well determined by our building laws, which are almost identical with each other, yet the former factors are of so wide range as to make each individual case different. However, for the weight of the steel skeleton of the average office building, whose walls are car-

*Extract from a paper read at the 33rd annual convention of the American Institute of Architects, at Pittsburg, Pa.

†Structural Engineer Carnegie Steel Company, Limited.

ried by the steel work, we have found by careful records of the weight of steel required that the following formula can be used with sufficient accuracy for preliminary estimates.

W — N x F (15 + 7/10 N), in which "W" is the total weight in pounds of the structural material required. N is the number of floors, including the roof as a floor, and F is the number of square feet in each floor. The first number inside of the parenthesis when multiplied by the quantity N F, will give the weight of the beams and fittings required in the floors, while the second number multiplied by the same factor represents the weight of the columns. Thus we have for the weight of the skeleton steel for such a building, having a floor area of 10,000 square feet and 15 stories high, 2,400,000 lbs. of beam work and 1,792,000 lbs. of column work, or a total of 4,192,000 lbs. of steel work.

As regards the cost, while this will vary somewhat, due to design, we might safely assume that unless the construction is complicated, owing to an irregular lot line or unusual construction such as is found in theaters, music halls, etc., the average cost for fitting beams will seldom exceed ½ cent per lb. above the price of plain material, including the painting, and for column work, 1¼ cents per lb. above the price of plain material. We have, therefore, for our building noted above, assuming that the price of plain material will average 2 cents per lb., the cost of the beams would be 2½ cents per lb., and that of the columns 3¼ cents per lb., or a total cost of, beams, $60,000, columns, $58,240, and a total amount of $118,240 for the steel work f.o.b. cars Pittsburg, painted. To this must be added the cost of freight, hauling and erection. The hauling can generally be done for 50 cents per ton, while the erection will seldom exceed $6.50 per ton, thus making the hauling and erection $7 per ton. The hauling and erection of the steel for our building would therefore be $14,672, making a total cost of $132,912 for the steel work, erected in Pittsburg, as per your plans and specifications. These figures are kept somewhat on the safe side, and appear high to-day, owing to the use of a base price of 2 cents per lb. for the plain steel, which, as you know, is almost double the market price of one year ago. Since writing this paper the price of steel has again advanced and the cost of our building would now be very nearly $15,000 more.

HEATING.

In the progress of civilization more efficient arrangements for heating have gradually been adopted. Fire-places, stoves and furnaces have, in the order named, been introduced as means of warming For small rooms, as in dwellings, they answer very well; but the effect of opening or closing windows and doors, and of changes in the atmospheric conditions, is too well appreciated to need recital here. It will certainly be admitted that a building can seldom be found where the heated air is properly and satisfactorily furnished and distributed by a furnace; some of these influences are sure to act, and at times it will be impossible to heat certain rooms without the closing of doors or shutting of registers in other rooms.

More exact are the methods of heating which are dependent upon the use of steam or hot water, confined in radiators or coils Under systems of direct radiation, these are placed in the rooms to be heated, but seldom with any provision for the introduction of fresh air. By the indirect method of placing the heating surface in ducts connecting with the rooms and permitting outdoor air to pass across such surfaces, a much nearer approach is made to good ventilation. But still it is practically impossible by such means alone to produce the air-flow, and maintain the temperature necessary for a large and crowded apartment. It is evident that some positive means, like the fan, must be applied to render such systems reliable at all times. Experience has demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems must be most intimately combined, for they are clearly interdependent, and when properly applied are so interwoven in their operation and results that disunion is certain to bring about failure. For the purpose of ventilation, the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and steam heater in marketable form were introduced by B. E. Sturtevant, that the so-called Blower System became a reality. This system is at once practical, successful and economical, for air being the natural conveyor of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forces the air into the apartment by the pressure or plenum method. When a fan is arranged to exhaust or withdraw the air from an enclosed space, the term vacuum, or exhaust method, is almost universally applied.

There are many objections to the adoption of the exhaust method in this country, and, as a rule, it should be avoided. When exhausting, a partial vacuum is created within the apartment, and all currents and leaks are inward; there is nothing to govern definitely the quality and place of introduction of the air, and it is difficult to provide proper means for warming it. Under this system provision is often made for drawing the air across steam pipes placed opposite windows, with the expectation that the air will become thoroughly heated in passing across them. Such often fails to be the case, for the most direct course is taken by the air toward the existing vacuum, and only a portion of the heating surface is utilized. On the other hand, when air is forced in, its quality, temperature and point of admission are completely under control; in a word, the method is positive; all spaces are filled with air under a slight pressure, and the leakage is outward, preventing the drawing of polluted air into the room from any source. But, above all, ample opportunity is given for properly tempering the air by means of heaters, either in direct communication with the fan itself or in separate passages leading to the various rooms. —From B. F. Sturtevant Co.'s Treatise on Ventilation and Heating.

GENERAL PRINCIPLES OF THE GAS ENGINE.

The general principles of the gas engine are explained in an article by E. W. Roberts in a recent number of Machinery, from which the accompanying illustrations are reproduced.

It will be necessary to briefly consider the series of operations which take place in the cylinder of a gas engine. With the exception of the Diesel motor, described in the last issue of The Canadian Engineer, all gas engines now being manufactured employ the Beau de Rochas cycle. The series of operations which comprise this cycle was first proposed by M. Beau de Rochas in 1870. It was not, however, put into practical form until it appeared in the first Otto engine in 1876. For this reason it is quite frequently called the Otto cycle, although the honor of its conception belongs unquestionably to Beau de Rochas. There is also in use a modification of this cycle in which a portion of the necessary operations are carried on in a separate device or its equivalent in order to permit the entire cycle to be completed during one revolution of the crank-shaft instead of two revolutions as required in the Beau de Rochas cycle.

The series of operations which take place during the four piston strokes necessary for the completion of the entire Beau de Rochas cycle is as follows: During the first forward stroke, gas and air are drawn into the cylinder and this mixture—called the charge—is compressed into a space at the end of the cylinder into which the piston does not enter. Just before the piston reaches the end of the compression stroke, or in some engines just as it reaches the end of the stroke, the charge is ignited. The ensuing explosion gives rise to a sudden elevation of pressure and temperature and during the next forward stroke the products of combustion expand. Just before the end of the expansion stroke, the exhaust valve is opened, permitting the contents of the cylinder to escape to the atmosphere. The following return stroke clears the cylinder of burnt gases, more or less thoroughly, according to the design of the engine.

The foregoing series of operations will be better understood by reference to Fig. 1, in which the indicator diagram given by the engine is placed immediately over the cylinder. For convenience of reference, the stroke of the engine is divided into ten equal parts, and lines are drawn from the cylinder to the diagram. Similar letters refer to the same point of the cycle and the letters are primed upon the diagram and capitalized upon the crank circle. The suction stroke starts at (e), the charge being drawn through the valve (v). Upon the return stroke, the admission valve (v) is closed and the charge is compressed into

the space between the piston (P), when at the end of the return stroke and at the end of the cylinder, that is, into the compression space. The point of ignition is indicated upon the diagram at (d). As shown by the diagram, the pressure rises more rapidly at this point than during the early part of the compression stroke and at the end of the stroke the charge becomes

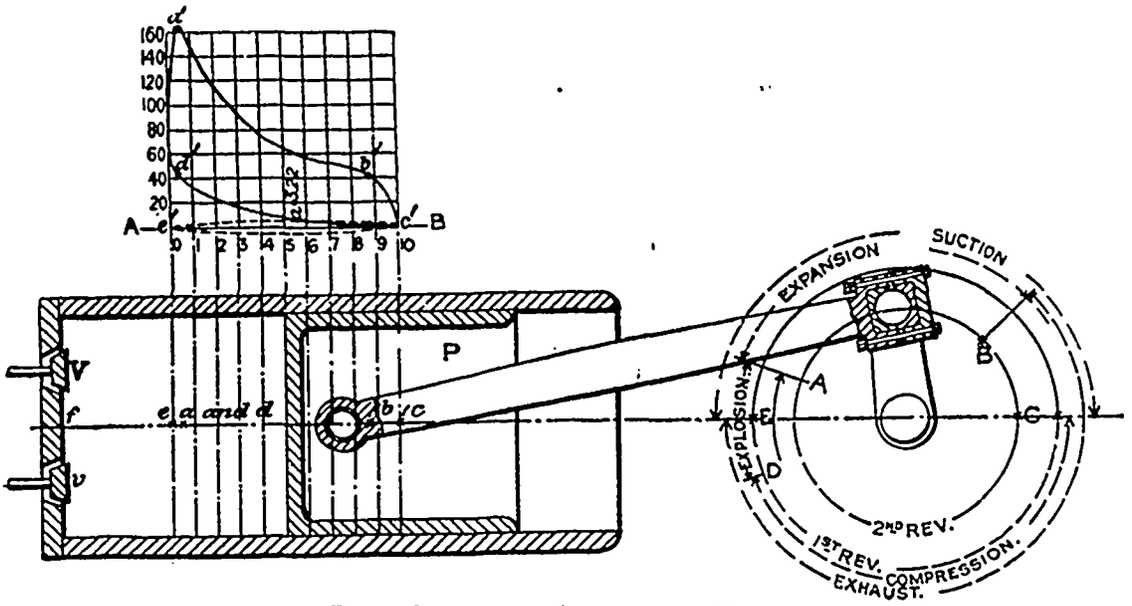


FIG. 1—SHOWING THE ACTION OF THE ENGINE.

fully inflamed, the pressure rising with great rapidity until the point of maximum pressure is reached, just before the piston starts on the expansion stroke (a), (b). The exhaust valve (V) opens just as the piston reaches (b), and from this point to the end of the stroke the pressure falls much faster than during true expansion. Upon the second return stroke, or while the piston is passing from (c) to (e), the products of combustion are driven from the cylinder.

The cycle is given in tabular form for easy reference:

1st Revolution—Forward stroke; suction. Return stroke; compression, ignition, explosion.

2nd Revolution—Forward stroke; expansion or power stroke. (Release).

The indicator diagram which is given in Fig. 1 is shown on a larger scale in Fig. 2. To have his engine produce such a diagram should be the goal of every gas engine designer. There appears to be no reason why such a goal may not be reached by everyone, since the diagram is an enlargement of one actually taken from an engine operating on the Beau de Rochas cycle. In the writer's experience the most successful engines operating on the market to-day are giving just such diagrams.

The notable points about the diagram shown in Fig. 2 are as follows: The compression curve is smooth and is a regular curve from the beginning of the compression stroke to the point of ignition. The gas ignited at (1), is fired just early enough to bring the point of maximum pressure at the beginning of the forward stroke, and the line (ab) indicating the rise of pressure lies at right angles to the atmospheric line (x), (y). The expansion line is smooth and does not show a series of steps as the pressure decreases. The release or point at which the exhaust valve opens is at (c), and it occurs at the proper moment to bring the point (d), where the expansion line meets the atmospheric line, directly at the end of the stroke. Wire-drawing on the suction and on the exhaust strokes would be indicated by a line similar to (xsy). The writer is aware that there is some difference of opinion regarding what constitutes an ideal gas engine diagram. This is especially true with reference to the point of stroke where ignition should take place. The majority are in favor of such a diagram as is recommended.

The diagram shown in Fig. 3 is a puzzling one. The wavy appearance of the expansion line is produced, not by conditions within the engine itself, but by the vibration of the indicator spring. A somewhat similar diagram might be expected from a badly mixed charge, in which case the rising side of the wave would be much steeper than the falling side.

Fig. 4 is reproduced from an actual diagram, and shows the effect of late ignition, which takes place at (i) after the piston has started on the power stroke. The amount of work which is lost because of the delayed firing is indicated by the area enclosed within the dotted line at the left of the diagram proper. No better argument for early ignition could be given.

When the mixture of gas and air is exploded at atmospheric pressure the resultant action of the gases depends upon two conditions, one of which is the quality of the combustible gas, and the other the proportionate amount of this gas to the air contained in the charge. A series of experiments made by Dugald Clerk, the well-known English gas engine expert, gave results which show the action of these mixtures. Mr. Clerk employed for his experiments the apparatus illustrated in Fig. (1). A chamber E, 7 inches in diameter by 8½ inches high, contains the mixture to be tested. A steam-engine indicator I, was attached to the explosion chamber E and the drum of the in-

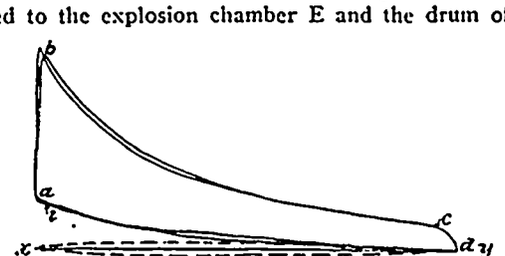


FIG 2

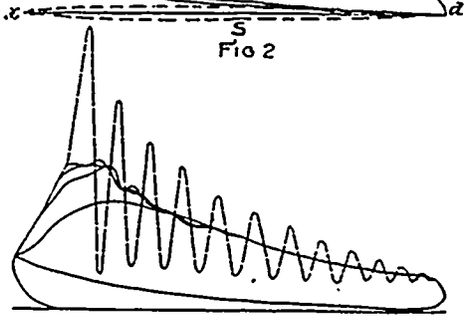


FIG.3

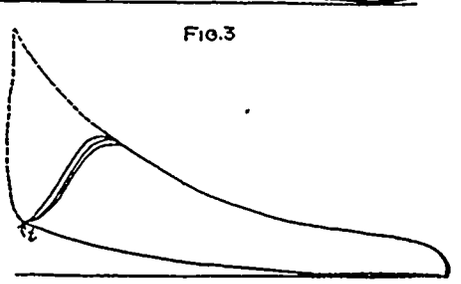


FIG.4

dicator was operated by clock-work as shown. The power to run the clock train was supplied by the weight W, and the speed regulated by the fan (F). By means of this arrangement, the pressure exerted in the chamber (E) was transmitted to the piston of the indicator, which in its turn raised the pencil (q). In the conduct of the experiments a carefully measured and proportioned mixture of gas and air was drawn into the chamber

(E), and the gases fired by means of an electric spark. The drum having already been set in motion, the pressure of the gas exerted on the indicator piston, compressed the springs raising the pencil (q). The pencil left a record upon the drum in the form of a curve somewhat similar to the upper portion of the ordinary gas engine diagram; vertical distances, measured on the line (xv) representing pressures and horizontal distances measured on the circumference of the drum representing intervals of time. With this piece of apparatus the successive alterations of pressure, from the time the gas was ignited until it had reached a pressure closely approaching that of the atmosphere, were determined Nine of the curves thus obtained are shown in Fig. 10, and they illustrate the action of one variety of gas when mixed with air in various proportions The different curves may easily be distinguished by the aid of the letters a, b, c, etc., which are placed at each end of the diagram.

Curve	a	b	c	d	e	f	g	h	i
Volumes of air to one of gas....	14	13	12	11	9	7	6	5	4

In this figure, only that variation of pressure which takes place during the first second is shown. The line (x y) is divided into twenty equal parts, each one of which represents a lapse of

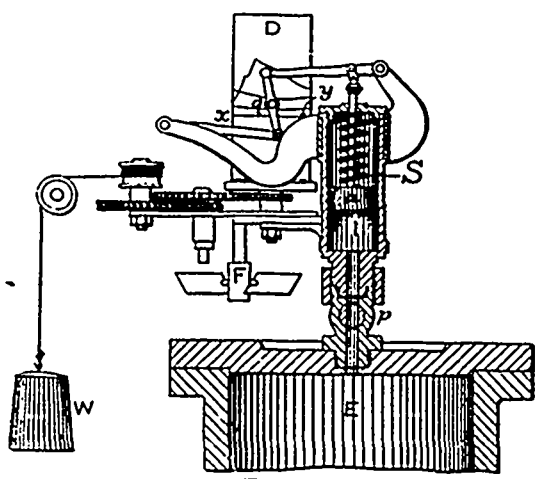


FIG. 5.

.05 second. The distance between each horizontal line represents a difference of pressure of five pounds. The time is measured from the moment when ignition takes place as indicated by the rise of pressure.

A careful study of the curves will show that when the mixture is weak in gas, the rise of pressure is very low, the time between ignition and the moment when the gases reach their maximum pressure being nearly .45 seconds for curve (a) and but .04 seconds for curve (g). This lapse of time indicates very closely the fraction of a second it takes for the gas to become one entire mass of flame, or to express it differently, the time required for full inflammation. The rate at which the pressure rises after ignition is indicated by the inclination of the curve. This inclination is of course very steep when inflammation is most rapid, and the inclination decreases as the rate of inflammation is lowered, the curve becoming more nearly parallel to the lines (xy). The rate of fall of pressure is indicated by the inclination of the line beginning at the point of maximum pressure and continuing to the right of the figure. This rate of fall is not shown as far as the point where the pressure of the mixture reaches that of the atmosphere. It may be stated that this point was reached approximately 1.88 seconds after the time when the ignition took place.

It must not be thought that when the mixture is totally inflamed the gas has been entirely consumed. A peculiarity of such mixtures as this is that at the high temperatures produced in the gas engine a certain proportion of the gas remains uncombined with air and is not burned until a lower temperature has been reached. The effect of this phenomenon, called dissociation, is that heat is constantly being added to the mixture by this late combustion, keeping the pressures upon the expansion line much higher than could be obtained without it, under the conditions which are present in the cylinder. This phenomena is no detriment to the operation of the engine, but is rather in the nature of an assistant. It must not be thought that the mixtures of gas and air which give the most violent explosions and consequently the highest initial pressures are the most economical to use. An illustration of this is given in the table shown below, the data being taken from the curves in Fig. 6:

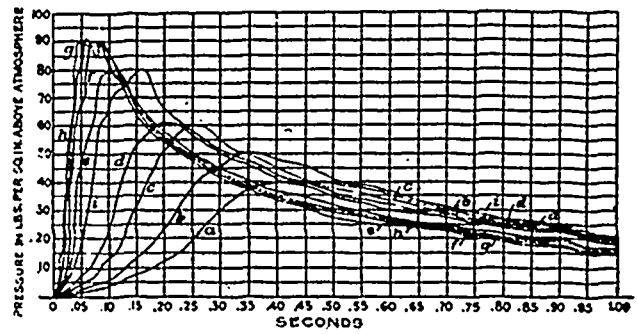


FIG. 6—SHOWING EFFECTS OF EXPLOSIONS.

1	2	3	4	5	6	7	8
Volumes of air to 1 volume gas.	Proportion of gas in mixture.	Maximum pressure in lbs. per sq. in.	Area of piston to each cubic inch of gas.	Total maximum pressure per cubic inch of gas.	Pressure per sq. in. .2 seconds after maximum.	Total pressure to each cubic inch of gas .2 seconds after maximum.	Mean pressure on piston for first .2 seconds after maximum.
14	1-15	40	15	600	31	465	532
13	1-14	51.5	14	721	40	560	640
12	1-13	60	13	780	42	546	663
11	1-12	61	12	732	44	528	630
9	1-10	78	10	780	44	440	610
7	1-8	87	8	696	47	376	536
6	1-7	90	7	630	52	364	497
5	1-6	91	6	546	50	300	423
4	1-5	80	5	400	46	230	315

Although the above table shows what would take place in an engine having no compression, and which draws the charge in for about half the stroke and then ignites it, it is of assistance to the designer in judging of the action of gases and in choosing the best mixture for a given engine. That proportion of gas to air which gives the highest pressures for the quantity of gas used, is undoubtedly the best. For instance, let the distance between the end of the cylinder and the piston be exactly one inch; then there will be one square inch on the surface of the piston for every cubic inch contained in the above space. In order to calculate the highest pressure which will be given with a certain quantity of gas proceed as follows: If the mixture contain one volume of gas to seven of air, there will be eight cubic inches of the mixture for each cubic inch of gas, and in a layer one inch deep the surface of the layer will be eight square inches. Since in the preceding table the maximum pressure for a mixture of the above proportion is 87 lbs. per sq. in., the total pressure exerted by each cubic inch of gas is $87 \times 8 = 696$ lbs.

That mixture which gives the best mean pressure for the first .2 sec. is that which gives 663 lbs mean pressure to each cubic inch of gas. This mixture is that containing 1 volume of gas to 12 of air. Could the power stroke be considered as taking place without increase of volume, the pressure given in column 7 would be that remaining at the end of .2 sec and that given in column 8 would be the mean pressure for the same length of time. Thus the figures in column 8 give a means of comparison of the powers to be obtained with the corresponding mixtures indicated in column 1. For instance, that mixture having one volume of gas to 13 volumes of air has more than double the power of the mixture containing one volume of gas to four volumes of air, the ratio being 640 to 315, the power considered being that available during the first .2 sec. after maximum pressure. Do not imagine that an engine could operate without increasing the volume of the cylinder; this assumption is taken as a convenient means of comparing the values of the various mixtures. It is important that in each of the above cases the gas be considered as if it gave its maximum pressure at the beginning of the stroke.

The Maritime Spice and Coffee Co., which has lately been organized at St. John, N.B., has ordered a 40 h.p. engine and boiler from the Robb Engineering Co.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS IN TORONTO.

The International Correspondence Schools, of Scranton, Pa., have just opened an office in the Temple Building, Toronto, No. 413, where they will make their Canadian headquarters. At these offices they have every facility for explaining their new system of education, and E. A. Seitz, the superintendent of the schools for the Dominion of Canada, tells us that all interested in technical education will be heartily welcome to examine their work, and look over the instruction and question papers of the different courses of instruction. There are two features in connection with the establishment of these offices of the International Correspondence Schools in Toronto, which are claimed to prove of great benefit to seekers after technical information along trades or profession lines. First, the schools propose giving a course of lectures for the benefit of students and friends, on the subjects of Electricity and Steam Engineering. F. Philip, the well-known superintendent of the mechanical department of the T. Eaton Co., will give a number of practical talks in connection with this series of lectures. Similar discourses, from a practical standpoint, will be given by others prominent in the various branches of engineering in Toronto. These lectures have no connection with the regular correspondence course of instruction carried on by the schools. The schools will also have at their Toronto offices complete sets of the instruction and question papers of all of their courses of instruction, handsomely bound. The range of subjects covered by these volumes will, the schools claim, make this the best *technical reference library in the city. The students of the* schools in Toronto will have the privilege of using this reference library at any time, the offices being open during the day and until 10 o'clock in the evening. The International Correspondence Schools have met with great success in their field of work. They state that they now have $1,500,000 invested in carrying on this system of education. They have over one thousand employees, and the buildings of the schools at Scranton, Pa., were erected at a cost of $250,000. In Canada alone the schools at present have over three thousand students and graduates. The remarkable success of the International Correspondence Schools is due to the fact that they give the kind of education needed. They enable men to pass the dead line of mediocrity, and make their way to the best positions in the engineering trades and professions. The schools point with pride to the army of students whom their instruction has placed in independent positions. The International Correspondence Schools claim to have solved the problem of how to educate the people. That problem, briefly, is how to put within the reach of the wage-earner the kind of education that will qualify him to climb the ladder of success. They believe that they have a perfect system, and it will well repay any wishing to better inform themselves along the lines of their work to examine into the practical results that have been accomplished by this system of study.

A TEST OF MECHANICAL DRAUGHT.

The possibilities in the way of reduction of fuel cost in modern boiler practice by the introduction of mechanical draught, are well exemplified by the accompanying results obtained at the United States Cotton Co., Central Falls, R.I. This record covers a period of 52 weeks, during which the number of hours run was 2,998, and the average indicated horsepower was 1,543.84:

Kinds of Coal.	Pounds burned.	Cost.
Buckwheat	6,074,400	$7,316 89
Anthracite	1,173,826	800 34
Cumberland	565,906	836 00
Total	7,814,132	$8,953 23

Cost per ton, $2.29. Cost per I. H. P. per year, $5.80.

Composition of Mixture:

Buckwheat	78 per cent.
Anthracite dust	15 per cent.
Cumberland	7 per cent.
	100 per cent.

The plant consists of three Babcock & Wilcox boilers of 325 rated h.p. each, a total of 1,005 rated h.p. The engine is a cross-compound Harris-Corliss, developing as will be noted, an average of 1,543.84 indicated h.p. The remarkably low fuel cost of $5 80 per I. H. P per year in a plant without economizers, is primarily due to the employment of a low grade mixture costing only $2.29 per ton, the burning of which has been rendered possible by the introduction of mechanical draught. The draught of the chimney, which was previously employed, lacked the intensity necessary to the free combustion of this fuel, and as a consequence it had been necessary to use Cumberland semi-bituminous coal. The installation of the fan, costing less than $600, brought about an annual saving of no less than $6,500 in the fuel bill. The fan, which was built by the B. F. Sturtevant Co., of Boston, is provided with a direct attached engine, the speed of which is regulated by a device of the Sturtevant Co.'s chief engineer, Thos. P. Burke, whereby a slight change in the steam pressure alters the speed of the fan, and consequently the intensity of the draught, and brings the pressure back to normal. As a result, it is claimed that the steam pressure remains almost constant.

THE TURBINE STEAMER.

At the meeting of the British Association for the Advancement of Science, held at Dover, a paper was read by the Hon. Charles Parsons, the inventor of the Parsons' steam turbine, in which he said that the compound steam turbine engine had been so fully described in the proceedings of the Institution of Civil Engineers and the Institution of Mechanical Engineers and the Institution of Naval Architects that it was only necessary to refer to its leading features when designed for the propulsion of fast passenger vessels. Generally speaking, it might be said that the larger the size of the propelling machinery of the steam turbine class the more favorable are the conditions for securing the highest degree of economy in steam with a minimum of weight and the greater the simplicity of the machinery. For fast passenger vessels, and especially for cross-channel service, the turbine system of propulsion offers great and important advantages over the ordinary screw or paddle engines. In the first place, the steam consumption of the turbine engines is no more—perhaps somewhat less— than the best ordinary triple compound engines. The weight of engines, shafting and propellers is under one-half that of ordinary screw engines, shafting and propellers, and under one-third that of ordinary paddle engines of the same power, so that there is much less weight to be propelled; besides this, the hull itself may be of lighter structure than is admissible with ordinary engines owing to the absence of racking stresses from the machinery. With turbine engines no lubricant whatever enters the steam part, so that the boilers become much less charged with oil than is the case with ordinary engines, and *express water-tube boilers of the smaller tube type may* be maintained in satisfactory working conditions for long periods; and, further, it is understood that the Board of Trade will be prepared to so modify their system of periodic inspection as to permit of such boilers being used for regular cross-channel service. But perhaps the most important considerations are the increased comfort to passengers, owing to the absence of vibration and a remarkable smoothness of motion analogous to that of a sailing vessel, also the greater depth at which the propellers are placed below the surface of the water, reducing the liability to racing of the engines, which enables the speed of the ship to be maintained in heavy weather in a way that is totally impossible in the case of ordinary screw or paddle vessels. A model was exhibited in the hull of a proposed cross-channel boat of 30 knots sea speed in moderate weather. If a service of 30-knot vessels were placed on the Newhaven and Dieppe line, it would become the fastest route from London to Paris; also if the system were properly carried out as suggested, the time on the Dover and Calais route between London and Paris would be shortened by about half an hour, and the duration of the sea passage much reduced. The draught of water with turbine engines does not necessarily exceed that of paddle-wheel vessels, and, as turbine engines are more readily and quickly manipulated than ordinary engines, and each side of the propelling machinery can be put ahead or astern independently, the manoeuvring power is practically equal to that of paddle-wheel propelled

vessels The particulars of the proposed 30-knot turbine boats are as follows: Length, 275 feet; beam, 30 feet; depth (moulded) 13 feet 1 inch to main deck, 21 feet to awning deck; draught, 9 feet 3 inches (about); displacement, 1,000 tons (about); speed, 30 knots; i h p., 18.000 Professor Dunkerley, in the discussion on Mr Parsons' paper gave some details of the trials made, by Professor Ewing, of Cambridge, with the Turbinia, in which the speaker had also taken part From the experience he had gained he then came to the conclusion that the steam turbine invented by Mr Parsons would play a most important part as the motor of the future Since that time further improvements have been made for marine propulsion, and he was now looking forward to the time when the crude instrument known as the reciprocating engine would be almost a thing of the past. The difficulty met with in going astern had been reduced. Mr. Barker, of Cambridge, the engineer to the Cambridge electric light station, bore testimony to the desirability of the steam turbine and the very small amount spent on repairs and renewals. This he gave as the result of a six years' experience. Captain Lloyd stated that in a preliminary trial of the day previously an Elswick destroyer with Parsons' turbine machinery had made 32 knots. He referred to the advantage given in a war vessel by the complete absence of vibration in regard to laying guns accurately.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of this society was held on Thursday evening, November 23rd, in the rooms of the society, 112 Mansfield street, Mr. St. George, vice-president, in the chair. After the reading of the minutes by the secretary, Prof. C. H. McLeod, a brief discussion took place as to suitable places for holding the next annual meeting; a lecture was delivered by Professor R. B. Owens, of McGill University, on the "Electrical Transmission of Power," the first of a series of lectures on the same subject, to be given during the winter.

Professor Owens commenced by stating that a distinction should be drawn between the "transmission" and "distribution" of power, the former referring usually to the transfer of energy over distances of five miles and upwards, and the latter to the transfer of energy in and about buildings, for lighting, and tramway service in cities, etc. The present lectures will deal with the problems of power transmission rather than those of distribution. He stated that as the development of power is distinct from its transmission and distribution, and had often been treated in previous papers before the society, it would only be considered incidentally.

Perhaps the first long distance transmission of power by electrical means was effected by Marcel Deprez, who nearly twenty years ago transmitted some 3 h.p. a distance of 25 miles over ordinary telegraph wires at a pressure of 2,000 volts, and obtained at the motor about 30 per cent. of the energy expended, but it was not until 1890 that the full capabilities of electricity, a a means of transmitting power to great distances, was appreciated That year, in connection with the Frankfort Exhibition, some 200 h p. was transmitted by 3-phase alternating currents at a pressure of 8,500 volts from Leuffen to Frankfort, a distance of 110 miles, with total losses of only about 30 per cent. Reference was made to the greatly increased use of alternating currents for power transmission, and distribution in recent years, but attention was also called to the many sources of trouble which a manager of an alternating current plant has to contend with, such as diminution of machine capacity with power factor of load, etc., many of which, he said, would disappear were continuous currents used. Several continuous current transmission plants in Europe were referred to. The general characteristics possessed by standard direct and alternating current apparatus were then discussed, and the usual methods for obtaining efficiency regulation, temperature, etc., of the machines given. His remarks were illustrated by large wall diagrams, showing the analysis of losses in several machines, efficiency and regulation curves, etc., under different conditions. Generally speaking, a large amount of copper and a small amount of iron mean good efficiency at light loads, but poorer regulation. With the majority of Canadian waterpower plants only maximum efficiency need be considered, as there was generally a surplus of power Attention was called to the fact that in direct current generators, the multi-polar type had nearly if not quite displaced the older bi-polar form, the reason being better commutation and slower speeds. The Lamme form of cross-connected armature was described and its advantages pointed out. A number of lantern slides were here shown, illustrating the various standard types of electrical machinery now in use, among them being a 1,500 k.w., double current generator of the Chicago Edison Co., a 1,500 k.w. revolving armature 2-phase alternator, used in the Snoqualmie Falls transmission plant; a 750 k.w. 3-phase revolving field alternator, as used at Lachine; a 2,000 h.p. inductor type of generator as used at Chambly, and several typical water-power transmission plants, as the St. Anthony Falls plant, the Mechanicsvilles (N.Y.), and the Big Cotton Wood plant, near Salt Lake City. In discussing the arrangement of apparatus in the generating station, among other points, the lecturer advised that exciters be all independently driven. Diagrams, showing the arrangement of winding for single polyphase generators and motors, were then shown. Attention was called to the importance of E.M.F. wave form in the parallel operation of alternators and in the operation of synchronous and induction motors and a number of actual wave forms were shown as obtained in the laboratories of McGill University. Means of independently varying the E.M.F. on feeders were then discussed and the Stillwell regulator described. Compounding of alternators for non-inductive load was then described, as also the recent composite wound revolving field alternator of the General Electric Co., which compensates for inductive as well as for non-inductive loads. The exciter armature is placed on the same shaft with the generator fields. A.C. current taken from series transformers placed in the line is passed into the exciter armature by means of suitable slip rings setting up a rotary magnetic field of the same period, but opposite in direction to the rotation of armature, thereby producing stationary poles in space. When an inductive load is put on the generator, the resulting lagging current has the effect of shifting these poles in such a manner as to increase the induction through the whole armature, thus raising the E.M.F. of the exciter and consequently the main generator E.M.F. Station devices, for indicating the E.M.F. at the end of the line, were then considered, and the Mershon compensator described, which allows for the inductive as well as the ohmic drop in the line. The difficulties of parallel operation of alternators, when driven by steam engines, were pointed out. The regulation and output of alternating current machinery, as effected by the power factor of the load, was then fully discussed and explained by means of suitable diagrams. The connection of several typical systems, 3-phase, 2-phase, mono-cyclic, etc., was also shown.

The next lecture, it was stated, would deal with methods of handling high tension currents, high tension transformers and the methods of line calculation.

A vote of thanks was extended to Professor Owens for his lecture.

The Civil Engineers' Club of Toronto held its regular monthly meeting at the Rossin House on the evening of the 7th ult. The following were present: Messrs. Canniff, Chewett, Chipman, Clement, Duff, Galbraith, Hanning, Hertzberg, Jennings, Smith, Speight, Spry, Stewart, Temple, Tully and Van-Nostrand. The topic of discussion for the evening was "The Necessity for a Topographic Survey of Canada." A congratulatory address to the Canadian Institute was adopted, the Institute having now been in existence fifty years. The trunk sewer problem will be discussed at the next meeting.

THE ROBERTSON CATCH BASIN.

Imitation is said to be the most sincere form of flattery, but when it goes as far as infringing on a patent it is time to call a halt. The deserved popularity of the G. A. Robertson catch basin tempted a foundryman in a western town to make up some catch basins on the exact lines of the Robertson, but without the trap feature, which is of vital importance. Steps have been taken to prevent a repetition of this illegal action, and the patentees wish to warn anyone else from following a similar course. The Robertson basin's reputation is steadily increasing, and quite a number of municipalities are adopting this basin for their sewage system. Among orders recently received are, Delorimier, Outremont and Montreal Junction.

COKE FROM NOVA SCOTIA COAL FOR USE ON RAILWAYS.

Numerous experiments have been made with the coke manufactured in Halifax by the People's Heat and Light Company as a locomotive fuel on the Intercolonial Railway. Lucious Tuttle, president of the Boston and Maine Railway, speaking of the introduction of similar coke on that railway system, says. Coke as produced by the New England Gas and Coke Company, is a perfect locomotive fuel, and we are changing over our locomotive equipment so as to adapt same to the burning of coke as rapidly as we can get engines into the shops. This process is naturally slow at this season of the year, when every engine is in use. We expect to have 50 locomotives changed over this summer and 100 before next January, unless some new conditions arise which we do not anticipate. We already have about a dozen changed over and are using most of them in our suburban service between Boston, Gloucester and Marblehead. We have one on our through Portland express, and it is fulfilling all our expectations. It costs about $50 to change over an engine by placing in water grates, which we find best adapted for the purpose. The coke creates such an intense heat that cast-iron grates are not serviceable. By building up our engine tenders we are able to run our engines from 125 and 150 miles without refueling, and we cannot do better than this with coal. Of course the great advantage in the use of coke is that it is dustless and smokeless. On the run from Boston to Portland there will hardly remain a handful of ashes, whereas, in the burning of coal almost three bushels of ashes would remain. The cost of coke is just about the same as bituminous coal, while the advantages are innumerable. Through the oiling of our roadbed and the burning of coke we will be able to give a passenger service as clean as electric roads. We estimate that the Boston and Maine will effect a saving of at least $100,000 a year that it now pays in damages by reason of fires from sparks. Coke as a locomotive fuel is only made possible through Mr. Whitney, for he sells coke as a by-product. If coal was turned into coke simply for the coke the cost would make its use prohibitive. The use of coke is just as economical for freight engines as for passenger, and when we can get to it, it will be used on both freight and passenger engines. The engineers and firemen much prefer it to coal, and understand its use. Bituminous coal requires constant firing, whereas coke only requires refiring about every twelve miles."

LITERARY NOTES.

The Locomotive Fireman's Magazine for November has a portrait of the Queen and a number of excellent views relating to the South African war.

The Canadian Magazine has issued a December number of unusual excellence. The front cover, "The Golden West," is the finest that has ever appeared on a Canadian publication.

The Street Railway Journal's convention number (October) contains 156 pages of reading matter, 284 pages of advertisements and each copy weighs 4 lbs. 10 oz. Our enterprising New York contemporary bulks large in the eyes of its readers.

The Prince Edward Island Magazine, Charlottetown, has in its November issue a very clear photo-engraving of the P.E.I. contingent for South Africa, and a very fine looking squad of men the islanders are. This magazine continues its interesting sketches of P.E.I. history.

The Use of the Slide Rule is a pocket sized volume, cloth bound, by F. A. Halsey, associate editor of The American Machinist. It contains a hundred pages of valuable advice and suggestions, and is well illustrated. D. Van Nostrand Co., New York.

Everyone who has ever planned a house or ever intends to do so, and these classes include all mankind, will take a great interest in Keith's Architectural Studies. The Moderate Cost Houses in Vol. 2 range from $800 to $1,200. W. J. Keith, architect, Minneapolis, Minn.

"The Methodist Churches of Toronto" is the title of a substantial volume illustrating and describing the growth of the Methodist churches of the Ontario capital, starting from the days of Governor Simcoe, and carrying the story down to the present day. The work is dedicated to Rev. Dr. Briggs, whose ability and integrity as steward of the Methodist Book room for many years have been so well recognized, and it contains in addition to 19 engravings of the 36 churches in Toronto, short biographical sketches of well known Methodists to the number of about 300. The editor and compiler is Thomas E. Champion, author of the "History of the Royal Grenadiers," the "Anglican Church in Canada," and other works, besides many valuable contributions to our magazine literature. The present work will be an instructive contribution to the already respectable bulk of Canadian Methodist literature.

The contributors to the December Ladies' Home Journal include Finley Peter Dunne (author of "Mr. Dooley"), Rev. Cyrus Townsend Brady, Ian Maclaren, S. T. Pickard, Mrs. Burton Kingsland, Edward Bok, George W. Cable, Albert W. Smith, Dan Beard, Franklin Fyles, Sara Beaumont Kennedy, and a half-score of other equally well-known writers. To the pictorial embellishment of the same number A. B. Frost, W. L. Taylor, H. C. Christy, Frank O. Small, Walter Russell, Lucius Hitchcock, and others have contributed their best efforts. The Christmas Journal covers an unusually wide field of interest. The great festal day is the theme of carol, story and pictures, and of various practical, useful articles, while numerous topics that are uppermost in the minds of women and helpful in the conduct of the home, are practically discussed. By The Curtis Publishing Company, Philadelphia. One dollar a year; ten cents a copy.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The monthly educational meeting of the Hamilton branch of the C.A.S.E. was held on Tuesday evening, November 21st. The increased attendance was such as to assure the officers of the success of their experiment in devoting one meeting a month to educational topics, and the indications are that all interested in mechanics and engineering will take advantage of these meetings during the coming winter. The subject of the first paper was "Powers of Numbers, and Square and Cube Root," being one of a series on Mathematics, given by C. R. T. Fessenden, of the Westinghouse Company. The fact was emphasized that an essential qualification of the modern engineer was the ability to calculate areas and cubic contents, and to do this it was necessary that he have a knowledge of square and cube root. Mr. Fessenden gave rules for measuring and obtaining areas of circles, squares, triangles, irregular figures, etc., and in answer to a question explained the method of calculating the difference between a square and circular inch. A hearty vote of thanks was tendered Mr. Fessenden. A feature of the meeting was the distribution of a leaflet on "Fractions and Decimals," the first of a series being issued by the Ontario Executive on educational topics. The next meeting of this nature will be held on December 19th, and an invitation to attend has been extended through the local papers to all interested in mechanics, engineering, electricity, etc.

WATERMAIN SCRAPING.

The pipe cleaning operation was resumed last summer by the city engineer of St. John, N.B., with almost the same apparatus as in the preceding year. After carefully studying the action of the cleaner, and giving it several runs it was found that an improvement could be made in the scraper, which was accordingly done, and each arm fitted with a steel cutter which would not clog. It was also found that the arms could be stiffened without any risk of the machine sticking, and this was accordingly done. This scraper cut through all the deposit and right into the bare iron, an inspection at the termination of the work having shown that only the scars or imprints of tubercles remained on the interior surface of the pipe, and it was almost as smooth as when first made. The whole amount of the material removed was not measured, as the flushing branches delivered into the brooks, and the supply of water having been abundant the dirt was generally carried off in liquid form. An estimate may be had by bearing in mind that the average thickness of the deposit was fully three-quarters of an inch, and the length of the main 23,000 feet. It will thus be seen that about 335

cubic yards were removed. In the Marsh Creek at the terminal flushing pipe, quite an extensive bar was formed by the material discharged from the main, and the current carried a large quantity away. When flushing into Little River by means of three different branches within one mile of Silver Falls the water of the falls assumed the color of strong coffee, and Major's Brook looked like ink at its confluence with the Marsh Creek, though it had received the flushings of the main 7,500 feet further up. These facts are given to show the impossibility of measuring the quantity of material taken out of the pipe. At No. 3 Hatch Box, where the cleaner had been taken out fifteen times when cleaning the upper end of the main, 108 bushels of heavy material, which would not flow off by the drain, remained, and had to be taken up in buckets as it accumulated, but all the more pulverulent scrapings were carried off in the drain, and as stated, blackened the water of the brook upwards of a mile away. At the other hatch boxes where the current was much stronger, an aggregate of 44 bushels of heavy material had to be hoisted out. The improvement in pressure ascertained in the same manner as at the end of the 1897 cleaning, viz., by sending the whole city's supply through Nos. 1 and 2 and leaving No. 3 shut off during the test, amounted to eleven feet. That is to say, that the two pipes, whose combined capacity before the cleaning began was only equal to that of raising the water 80 feet, can at the present time supply the whole district and deliver up to a level of 141 feet above high water datum in the harbor.

The lightness of the cleaner is a great advantage, the entire weight being but 263 pounds, and the bulky portion being made of wood, which weighs less than the water itself, it floated along with the water. This quality was well exemplified when the broken portion was taken from the main as related in last annual report. The hatch boxes were of cast iron, consisting of a section of pipe with the upper half removable and secured in place by means of screw bolts and nuts, the flanges being gasketed with Tuck's 1¼-inch round packing, which adapted itself to all the inequalities of the casting and to the curved form of the flange. Each one weighed about 3,300 pounds, and required 26 square necked bolts, besides about 18 feet of Tuck's packing. On completing each one, the pit was walled up with dry rubble and covered with timber, outside the city. Inside the city the covering was arched in masonry and cement, and an iron manhole left in the crown; the manhole being large enough to pass the cleaner through. The force employed to operate the cleaner consisted of a foreman, a mechanic, two watchers, six assistants and two express teams and drivers.

FIRES OF THE MONTH.

Nov. 2nd. Murray's planing mill, Winnipeg, Man.; damages, $12,000.—Nov. 3. The barrelling department of the Sun Oil Co., Hamilton, Ont.; loss, $6,000.——Nov. 4. Ontario Power & Flats Co., Toronto; the damages amounted to $17,000, divided among W. Spanner & Co., Gilchrist & Co. and Fraser & Co., woodworkers.——Nov. 5th. Webster & Boyes' carriage factory, Napanee; loss about $1,600.——Nov. 5th. D. I. Hamlin's evaporator, Port Hope, Ont.; loss, $4,000.——Nov. 9th. MacNeil's sawmill, West Devon, P.E.I., wholly destroyed.——Nov. 10th. T. Peters, tannery, St. John, N.B.; damages, $40,000.——Nov. 12th. Viau & Bro. biscuit and candy factory, Montreal; loss, $300,000. ——Nov. 15th. W. W. Gordon's planing mill, Glencoe, Ont.; total loss.——Nov. 22nd. R. T. Houston's sash factory, Tweed, Ont.; loss from $6,000 to $8,000.——Dilworth's elevator, High Bluff, N.W.T.; insurance, $12,000.

THE PRACTICAL MAN.

STANDARDS OF LENGTH.

The standard yard was first legalized in England, in 1824; this standard, however, was destroyed in 1834. The standard imperial yard "Bronze No. 1," was then prepared and legalized in 1855. Forty copies were made, and one of these, "Bronze No. 11," was presented to the United States by the British Government in 1856. At the same time another copy, known as the Low Moor Iron No. 57, was sent. These were accurately compared, before being sent, with the standard imperial yard, and the record of the variations sent with them. Although the Constitution of the United States empowered Congress to fix the standards of weights and measures, no legal standard of length was adopted until 1866, when a law was passed making the metre legal, the first and only measure of length legalized by the United States Government.

METRIC MEASURES.

The metric unit of length is the metre = 39.37 inches.

The metric unit of weight is the gramme = 15,432 grains.

The following prefixes are used for subdivisions and multiples: Milli = 1/1,000, Centi = 1/100, Deci = 1/10, Deca = 10, Hecto = 100, Kilo = 1,000, Myria = 10,000.

METRIC AND BRITISH EQUIVALENT MEASURES.

MEASURES OF LENGTH.

French.	British.
1 Metre.....	= 39.37 in., or 3.28083 ft., or 1.09361 yds.
.3048 Metre.....	= 1 foot.
1 Centimetre.....	= .3937 inch.
2.54 Centimetres.....	= 1 inch.
1 Millimetre.....	= .03937 inch, or 1-25 inch nearly.
25.4 Millimetres.....	= 1 inch.
1 Kilometre.....	= 1093.61 yards, or 0.62137 mile.

MEASURES OF WEIGHT.

French.	British.
1 Gramme.....	= 15 432 grains.
.0648 Gramme.....	= 1 grain.
28.35 Grammes.....	= 1 ounce Avoirdupois.
1 *Kilogramme*.....	= *2.2046 pounds.*
4536 Kilogrammes...	= 1 pound.
1 Tonne or Metric ton, 1000 Kilogrammes	= .9842 ton of 2,240 pounds, 19.68 cwts., 2,204.6 pounds.
1.016 Metric tons, 1016 Kilogrammes....	= 1 ton of 2,240 pounds.

MEASURES OF CAPACITY.

French.	British.
1 Litre (= 1 cubic Decimetre).....	= 61.023 cu. in., .03531 cu. ft., .2642 gal., 2.202 pounds of water at 62° F.
28.317 Litres.....	= 1 cubic foot.
4.543 Litres.....	= 1 gallon, Imperial.
3.785 Litres.....	= 1 gallon.

NEW CATALOGUES.

We have received Catalogue 64 of the Sprague Electric Co., which discusses Lundell Generators, direct connected and better types, from the Canadian agents of this company, Jack & Robertson, Montreal.

The Dodge Mnfg. Co., Toronto, Ltd., is sending out a catalogue illustrating a full line of power transmission machinery. This is a work of some 270 pages, and should be found very useful to superintendents of mills and factories, also to mill architects and mechanical engineers. The work not only illustrates and describes fully and completely transmission machinery, but it also provides complete dimension tables covering each line; so that work may be provided for and laid out accurately from the beginning. We think the Dodge Co. is to be congratulated upon the volume. The Dodge Co. makes a specialty of shafting, hangers, pulleys, friction clutch pulleys, friction couplings, self-oiling bearings, belt tighteners, rope driving, chain and sprockets, jack shaft equipments, etc.

The B. Greening Wire Co., of Hamilton, has just issued a catalogue on "Wire Rope" as the first of a series of special catalogues to be sent out soon. Besides being a price-list of all kinds of wire rope, it gives particulars of fixtures and appliances to be used with wire rope, and what we think a great many regard as most useful, a number of valuable tables as to the working, etc., of wire rope under different conditions. Inside the front cover is a telegraphic code to be used when ordering, and on the back of the book is a cut of the works showing the new power loom mill just erected. This catalogue will be followed by one of Wire Cloth and Perforated Metals, which is now in the press. The company will send any of these catalogues to readers of The Canadian Engineer, if they will say what department they are particularly interested in.

The Canadian Heine Safety Boiler Co. have sent us the eighth edition of their publication, called "Helios." It is a handsomely bound volume of nearly 200 pages, and besides giving a full description of the Heine boiler, also contains much information of a valuable nature from the pens of eminent writers regarding fuels, steam engines, and a number of tables and data for reference. Professional men, manufacturers and practical steam engineers will find it invaluable.

Machinists' tools and measuring tools describes the contents of Brown & Sharpe Manufacturing Co.'s new 140 page catalogue. It contains also much valuable information, such as reference tables, etc. It is beautifully illustrated, and no catalogue that has ever passed through our hands is more worthy of a place in the kit of the machinist or on the shelf of the buyer of fine tools. Many new lines have been added since their last issue of a general catalogue. In writing for this catalogue ask for No. 101.

Industrial Notes.

A new sawmill is to be built at Watford, Ont.

The Hamilton Distillery Co. has installed the Redpath-Reid automatic smoke consumers in its works.

A large brickyard is proposed at Orangedale, C.B., and it is said that the necessary site has been secured.

The Ontario Lantern Co., Hamilton, Ont., is building an addition to its works, 98 x 38 feet, three stories high.

The debentures for a new waterworks system at Calgary, N.W.T., have been signed and a contract will be let at once.

The city engineer of Toronto urges the city council to buy additional pumping plant to the extent of a ten million gallon pump.

John Duffy, St. John, N.B., has been awarded the contract for building a quarantine station at St. John, the price being $18,500.

Smith's Falls, Ont., has given C. T. Hookway, Syracuse, N.Y., the contract to build a trunk sewer in that town. The contract price is $17,590.

The new grist mill now in course of construction at Gagetown, N.B., will be owned and worked by J. H. Brown & Son, formerly of Apohaqui, Kings county.

G. P. Magann and Alex. Fraser, Toronto, and E. J. Fawke, and others, have been incorporated as the Magann, Fawke Lumber Co., Ltd.; chief place of business, Toronto; capital, $300,000.

R. H. McKee and T. H. Wright, J. A. Macrae, McLeod Stewart, Ottawa, and A. M. Perkins, Perkins Mills, Quebec, have been incorporated as the McKee Machinery and Lumber Company, Ltd.

T. J. Drummond, G. E. Drummond, J. T. McCall, C. E. Gudewell, C.E., Montreal; F. Thompson, Sherbrooke, Que.; G Gudewell, New York, U.S., have been incorporated as the Lennoxville Waterworks; capital, $50,000.

J. McBurney, J. T. Beattie and T. A. Rowan, Toronto; and J. A. Coulter and Rebecca M. Morrow, Ingersoll, Ont., have been incorporated as the McBurney, Beattie Company, Ltd.; chief place of business, Toronto; capital, $40,000.

The International Correspondence Schools, of Scranton, Pa., offer special privileges in the way of reductions in the price of books and technical outfits to all students who enroll before January 1st, 1900. Circulars, defining these privileges, will be sent on application.

The Goldie & McCulloch Co., Ltd., Galt, Ont., is very busy, and during the week ending November 25, shipped several large safes and three car-loads of flour mill machinery to different parts of the Northwest Territories, one car load of same to Lucan, one car load of boilers, etc., to Hamilton, two gas engines, and several minor shipments.

The employees of the Jas. Warnock & Co., with the members of the firm, banqueted together in Polson's Hall, Galt. Many of the men had been employed for over a score of years by this concern; a total of 355 years was the record claimed by thirteen employees. F. H. Hayhurst, the manager, in his address, referred to the fact that for over a year night work was necessary to keep up to their orders.

Harriston, Ont., has voted a bonus of $20,000 to the Harriston Pork Packing Co.

The Cornwallis Valley Packing Co., Kentville, N.S., has been incorporated; capital, $30,000.

The removal of the Canadian Locomotive and Engine Co. from Kingston, discussed so often, is again talked of. The city council has not agreed to the $50,000 bonus asked.

F. W. Thompson, western manager of the Ogilvie Milling Co., reports that a Canadian foundry will put in a plant at Fort William, Ont.

The Toronto Electric Light Co. has equipped its new Heine boilers with the Jubilee shaking grate bars, each boiler requiring 60 sq. ft. of grate.

The plant of the Berlin, Ont., Rubber Co. was given a test on Nov. 16th. The special machinery was supplied by the Birmingham Foundry Co., Derby, Conn.

Application has been made by the Dominion Oil Pipe Line Co., Sarnia, Ont., for the reduction of the capital stock to $500,000, and to change the headquarters of the company to Toronto.

L Page, liquid glue maker, is at the head of a company which is erecting a factory on Howe Sound, B.C., for the manufacture of glue and oil from the dog fish. R. J. Leckie, Toronto, is a member of the company.

A. O. Norton, Coaticook, Quebec, manufacturer of ball bearing lifting jacks, has added additional machinery to his plant, to keep up with the increasing demand for his product. He reports several large export orders received last month.

It is reported that the agricultural and implement works of Frost & Wood, Smith's Falls, Ont., are to be doubled in capacity next spring. A single English order recently received by this firm was for a thousand machines of the same kind.

The Canadian Rubber Co., Montreal, has placed contracts for a warehouse of large dimensions in that city. It is intended that the establishment will be 180 x 170 feet, occupying the entire block which faces Craig, St. Adolphe, Notre Dame streets and Papineau square.

In our advertising pages, E. Leonard & Sons, engineers, London, Ont., announce a new type of engine. This is a self-oiling automatic engine, adapted for either electrical or manufacturing purposes. We understand the firm will send a descriptive catalogue on application.

W. Currie, F. P. Currie, J. T. Shearer, Hon. J. A. Ouimet, J. Livingstone, Montreal, and T. E. Fee and E. S. Fee, St. Hyacinth, Que., have been incorporated as the Dufferin Falls Lumber, Pulp and Paper Company of Montreal, with a capital of $1,000,000; chief place of business, Montreal.

C. R. Whitehead has been re-elected president of the Montmorency Cotton Mills Co., of Montmorency Falls, Que. The company now employs 550 hands, and proposes to build a new mill next year to be devoted to the export trade. The new mill will ship cotton goods, chiefly to China and East Africa.

H. Pearce, Birmingham, Eng., H. Pearce, jr., Montreal; J. F. Beringer, T. E. Owens and Francis, Picton, Ont., have been incorporated as the Bloomfield Packing Co., Ltd.; chief place of business, Picton, Ont.; capital, $40,000.

Redpath-Reid automatic smoke consumers have been installed in the following plants among others: Mitchell Waterworks and Electric plant, Mitchell; American Rattan Co., Walkerton; Canadian Colored Cotton Mills, Hamilton; George Pattinson & Co., Preston; Lambton Woolen Mills, Lambton; Canadian Colored Cotton Mills, Merritton; Brighton Canning Co., Brighton, Ont., and Central Ontario Railway Co

The Canada Foundry Co., which was incorporated last month with a capital of $1,000,000, has bought the St. Lawrence Foundry, Toronto, from the Rice Lewis Co., Ltd., to serve as a centre, about which will be built up the vast business in iron castings, especially for architectural work, which the company announces it will undertake. The first directors of the company are. E. B. Osler, W. R. Brock, W. D. Matthews, Toronto; Wm Hendrie, Hamilton, Ont., F. Nicholls, T. W. Horn, Toronto and W. H. Winslow, of Winslow Bros., Chicago, who are said to be the largest architectural iron workers on the continent.

A bonus of $50,000 has been voted to the proposed steel shipbuilding company at Collingwood, Ont.

The Brantford, Ont., Co-operative Pork-Packing Co. has bought a site on which to build its factory.

Robt. Lillie, foundryman, Perth, Ont., has sold out to James Bros. The new firm will make and repair ploughs, stoves, etc. The foundry will be managed by F. Deacon.

Sproatt & Rolph, architects, Toronto, have let the contract for installation of blast system of heating, also the plumbing of the Lever Co.'s soap factory, Toronto, to W. J. Maguire & Co., Toronto.

Early in January McGill University will open a new course of instruction for graduates in medicine in Public Health. Such a step as this is most encouraging to those whose aim is the improvement of sanitary conditions.

The Chalcraft Screw Co., of Brantford, capital $75,000, has been incorporated with the following provisional directors: E. Chalcraft, F. Chalcraft, E. L. Goold and C. Cook, Brantford, Ont., and George Randall, Waterloo, Ont.

The Department of Railways and Canals, Ottawa, is calling for tenders for constructing an additional section of the Trent canal, viz., that from Trenton to Frankton, a distance of nine miles. The work includes the deepening of the Trent river, between these two points, the construction of seven locks and seven dams.

The industries of Hamilton are steadily progressing. Among other extensions the firm of J. N. Tallman & Sons, successors to Wm. Hunter in the well known brass founding business, are now erecting an addition to their works which, when completed, will make it one of the largest and best equipped brass foundries in Canada. Among the specialties of the firm are phosphor-bronze, zinc, copper and aluminum bronze castings, and anti-friction metals.

In the presence of a large number of the citizens Mayor Wilson formally opened the new buildings of the Victoria Hospital at London, Ont. A massive gold key was presented to the mayor by Thos. Gillean, jeweler, and the same gentleman also presented the hospital with a magnificent solid silver tea service. The architecture is colonial, and the architect, H. C. McBride, of London, was complimented highly on the results of his work. The buildings will cost completed about $100,000, and a saving of at least 25 per cent. was effected by letting contracts, and getting the building started last year before the rise in material took place.

At the national convention of ice manufacturers at Indianapolis, Ind., last summer, while the question of the best method of filtering was being discussed, one of the leading manufacturers made the statement that he had tried every scheme of which he had ever heard for cleansing distilled water from oil without satisfactory results, until about a year ago, when he put in an Austin Oil Separator, manufactured by the Austin Separator Co., Detroit, Mich. Since that time he has had absolutely no trouble, and has secured perfectly clear ice. As he used water distilled from exhaust steam, his experience will go far to clear up the problems which confront so many engineers who use exhaust steam, and have the troubles consequent to feeding oil in the boiler, or steam pipes where exhaust is used for heating. The Austin steam separator is also said to do equally good work in eliminating moisture from live steam.

Owing to the increase in its output the Atlantic Refining Co., Toronto, has decided that more central and commodious quarters are required. The company has leased for a term of years the premises formerly occupied by the Toronto Carpet Co. on the Esplanade at the foot of Jarvis street, and with the improved facilities for shipment, either by water or rail they will be in a much better condition for handling shipments. The Atlantic Refining Co. claims that its position in the oil trade is unique; it prides itself on being a thoroughly independent concern, outside of the combine, and its specialty is the supplying of lubricating oils made from Pennsylvania crude, and it is generally acknowledged that for the best grades of cylinder oil Canadian crude oil will not answer, the Pennsylvania stock being unrivalled for this purpose. The Atlantic Refining Co. will, in our advertising columns, deal more fully with its different wares.

Berlin, Ont., sewage disposal works are threatened by neighboring farmers with legal proceedings on account of offensive odors arising from the beds.

There having been granted $30,000 for the rebuilding of the interprovincial bridge at Portage du Fort, Que., $20,000 from the Federal Government and $5,000 each from the Ontario and Quebec Governments, work upon the new bridge is now going on.

The largest contract for pipe and boiler covering given in Canada is said to be that just awarded by the Lady Superior of the Longue Pointe Asylum, Montreal, to the Clappison Pipe and Boiler Covering Co., of Hamilton, and now being filled under the supervision of J. H. Clappison of that firm. The main building is 3,000 feet long with several wings, and it will take a month to instal and complete the heating apparatus.

The offices and warehouse of the Fairbanks Co., Craig street, Montreal, are a model of order and attractive display. The show cases of machinists' tools, valves and special mechanical appliances strike the eye at once, and there are many novelties to interest the visitor. Some of these specialties of the Fairbanks Co. have been described in previous numbers, but the engineer and machinist visiting Montreal will find in the five stories of this warehouse many other things that will instruct them.

Another failure to be added to the list of bonus-hunters, is that of N. Commire, Fils & Co., foundrymen, in Maisonneuve, a suburb of Montreal. Mr. Commire was long in business in Montreal without achieving any very material success, and in 1896 moved to St. Jerome, under a bonus arrangement from that town. He remained there but a short time, and moved to Maisonneuve two years ago, making a new arrangement with the latter town. A demand of assignment has now been made upon the firm.—Monetary Times.

Electric Flashes.

Seamen, Kent & Co., Toronto, are installing a 60 light dynamo in their factory from the works of the Jones & Moore Electric Co

The Canadian General Electric Co. is installing an electric lighting plant of 150 light capacity for the Georgian Bay Cement Co., Owen Sound, Ont.

Jno. Penman, Esq., Paris, Ont., is installing a model electric plant for the lighting of his residence, purchased from the Canadian General Electric Co.

The Canadian General Electric Co. have closed a contract with the Imperial Oil Co., Sarnia, Ont., for a standard 40 k.w. direct current generator, direct connected to Ideal engine.

C. M. B. Lawrence, proprietor of the Oakville, Ont., Electric Light Co., has purchased from the Canadian General Electric Co. a standard single phase alternator of 1,000 light capacity.

The Canadian General Electric Co. has received an order from the Acadia Edison Co., Wolfville, N.S., for two standard 25-k.w. multipolar direct current generators with switchboards, etc., complete.

New Westminster, B.C., has contracted with the Canadian General Electric Co. for a standard 150-k.w. monocyclic generator with switchboard, etc., for the supply of light and power throughout the city of New Westminster.

Wm. Kennedy & Sons, Ltd., Owen Sound, Ont., have purchased a 500 light electric plant from the Canadian General Electric Co., consisting of a latest type, Form H., multipolar generator with marble panel switchboard and wiring material for their works throughout.

The Nelson Electric Tramway Co., Nelson, B.C., has placed an order with the Canadian General Electric Co. for its entire requirements electrically, consisting of one standard 325-k.w. railway generator with panels, one 500 h.p. three-phase revolving field synchronous motor with panels, together with full complement of cars and motors. They have also contracted with the West Kootenay Power and Light Co., Rossland, B.C., for the power necessary to operate this plant.

The Nova Scotia Carriage Co. has purchased a 100 light dynamo from the Jones & Moore Electric Co.

D. G. Whiddon, Antigonish, N.S., has placed an order with the Canadian General Electric Co. for a 500 light direct current plant.

The Jones & Moore Electric Co. shipped five motors to Vancouver, B.C., during the month, and find difficulty in filling their orders. The demand is much in advance of former years

The plans for the new electric plant for the Toronto Rubber Shoe Mnfg. Co., at Port Dalhousie, Ont., were prepared by R. J. Parke, consulting electrician, Toronto.

The terms offered by the Niagara Falls Park Commissioners for the privilege of constructing an electric railway along the Niagara river have been rejected by the Fort Erie Electric Railway Company, and an alternative proposition is being considered

The Dartmouth Electric Light Co., Dartmouth, N.S., has placed an order with the Canadian General Electric Co. for a standard 30-k.w. single phase alternator with switchboard transformers and wiring complete.

The Canadian General Electric Co. is installing a standard 120 k.w. single phase alternator for A. Gagnon & Co., Victoriaville, Que. This is the second machine of this size and type which this company has installed during the past year.

The Montmorency Electric Power Co. is suing the Jacques Cartier Electric Light and Power Co. for $25,000 damages, and for an injunction restraining it from doing business in the city of Quebec, for which the complainants claim the sole right to supply electricity.

While repairing wires in the factory of the Union Carbide Co., Niagara Falls, N.Y., Nov. 25th, John Sheffield was instantly killed by coming in contact with the primary terminals of a switch, where he received a shock from a current of 2,000 volts. He was a scholarship man in electrical engineering.

The Dominion Iron and Steel Co. has placed an order with the Robb Engineering Co. for two 150-h.p. engines for electric lighting purposes. They have also recently bought from the Robb Co. a number of smaller engines and boilers for temporary use during the erection of their extensive plant.

Hon. F. Peters, ex-Premier of Prince Edward Island, and E. J. Fader, Vancouver, B.C., propose to turn to account the power of the tide in both the first and second narrows in Vancouver harbor, to operate an electric plant. They have applied to the Dominion Government for certain foreshore rights to enable them to proceed in the matter.

R. A. Ross, consulting electrical engineer, Montreal, has just returned from a professional tour through China, Japan, British India, and other eastern countries. He reports the electrical development of Japan as very complete, and the entire work in the hands of the natives who have been trained abroad. Mr. Ross states that a wave of electrical progress swept over India about a year and a half ago, and tramways are now to be seen in Calcutta, Bombay, Colombo and Madras, which are quite well equipped.

A meeting of the Toronto Street Railway Electrical and Mechanical Association was held last month, which was composed of representatives from all the different mechanical and electrical departments of the railway. The finances of the benefit fund were reported by Secretary Cox to be in a flourishing condition, and the sick and distressed members of the society have been well cared for. The following officers were elected: President, G. J. McCullough, chief electrician of the railway; vice-president, M. Power; secretary, William Cox; treasurer, R. Bunting.

The Canadian General Electric Co. has just received an order from the Trenton Electric Co. for a 75 light equipment of alternating series enclosed arc lamps, with automatic regulating transformers and switchboards. These are to be used for street lighting in Belleville, Ont., the current being taken from the three-phase transmission lines, coming from Trenton a distance of 13 miles. This is the third installation of this kind which is being put in in Canada; a 100-light capacity equipment having been installed in Sherbrooke, Que., and another 100 lights in Halifax, N.S., both of which are, it is said, giving eminent satisfaction.

The St. Catharines Cold Storage Co. have installed a 20 h.p. motor of the Jones & Moore Electric Co.'s make.

The Jones & Moore Electric Co. shipped eight motors to the Winnipeg Street Railway Co. during the last month.

The Patent Exchange and Investment Company, on behalf of B. R. Dodge, Post Mills, Vt., U.S., inventor of the Dodge system of telephony, has applied for a charter to put in a telephone system in Toronto. The city engineer will report upon the scheme.

The second electric locomotive in Canada has been put in service on the Metropolitan Ry., Toronto. The locomotive was manufactured at the Baldwin works, Philadelphia, and weighs when completely equipped nearly 50 tons. The power of draught of one of these engines is fully equal to a large mogul engine, and a guarantee accompanies it that it is capable of drawing a 30-ton car up a grade of 9 in 100.

Port Dalhousie is to be electrically lighted from a plant now being put into the Toronto Rubber Shoe Mnfg. Co.'s works there. The machinery, which is supplied by the Royal Electric Co., provides for 10 arc lamps and 500 incandescent lamps for the village, and 20 arc and 600 incandescent lamps for the factory. There will also be a 10 h.p. motor for the elevator, and a 15 h.p. motor to drive the machinery in the factory, besides a 20 h.p. motor for the heating and ventilating plant.

Ahearn & Soper, electrical engineers, Ottawa, have orders for motors to the aggregate of 4,000 h.p. for the Dominion Cotton Mills Co.'s two mills in Montreal. These are of the Westinghouse induction type, and form the most complete and extensive electrical equipment of any cotton mill in the world. Among other electrical installations by this firm in Montreal are a 100 h.p. motor for the Dominion Oil Cloth Co.'s new factory; a motor for P. Lyall's marble works, and three motors for the Wire and Cable Co.'s new works in Beaver Hall Hill.

The Massey-Harris Co., Ltd., has decided to equip its Toronto factories with a modern system of electricity for light, heat and power. They have contracted with the Canadian General Electric Co. for two 100-k.w. direct current generators direct connected to Ideal engines; in conjunction with these they are installing generator and feeder panels, arranged for controlling the system of lighting throughout all the different departments. This plant will be one of the largest isolated installations in Canada.

The Electrical Maintenance and Construction Co., of Toronto, Ltd., which began business less than a year ago, under the management of P. H. Patriarche, has had a remarkably successful career, the business having expanded till it has now contracts in hand aggregating over $100,000. In view of the development of its business it has been found necessary to increase the capital stock from $20,000 to $250,000. Mr. Patriarche was with the Toronto Electric Light Co. for some time, in which connection he gained the knowledge which has enabled him to organize and rapidly extend the business of the new company. One of the contracts this company now has in hand is the Orillia power plant, which will be referred to in another issue.

Incorporation has been granted to the Lake Simcoe Navigation Company, Ltd., capitalized at $90,000. Among the incorporators are, J. C. McKeggie, J. McNairn, Edward Adamson and Wm. Paul, Toronto, and J. L. Ross, Aurora, Ont.

—The Royal Electric Co., Montreal, is installing in the head office of the Merchants' Bank of Canada, Montreal, two 50-k.w. direct connected generators with Robb-Armstrong engine complete with switchboards. These generators are to operate at 250 volts, and the building is wired for lighting to operate lamps at 220 volts, and also two Sprague elevators.

The Rideau Navigation Co. is having a passenger boat built by the Davis Dry Dock Co., Kingston, Ont. It is 112 feet by 28 feet, and draught 7 feet. The upper cabin is to be 84 feet long, and will contain 32 staterooms. The engines are triple expansion, 8½, 13, 21 and 14 inch stroke. A speed of 12½ miles is guaranteed. The cost will be $20,000. The Davis Dry Dock Co. is also rebuilding the steamer "Constance," of Gravenhurst, Ont., at a cost of $3,500.

Railway Matters.

The Railway Committee of the Privy Council has ordered a subway to be built at the Lansdowne avenue C.P.R. crossing in Toronto. The cost will be about $30,000. to be borne equally by the city and the railway.

Officers of the Morris, Portage and Midland railway, a projected line for which a charter has been issued, were elected in Winnipeg as follows: J. W. Kastner, president; G. F. Birney, Morris, treasurer, and G. A. Glines, Winnipeg, secretary.

It is stated that according to present plans of the C.P.R. the old freight sheds near the Queen's wharf, Toronto, will be converted into car shops. These extend from the garrison bridge east to Bathurst street, and are the old Toronto, Grey & Bruce depot. The new workshops will employ about 150 hands.

Judgment has been given in the case of Beemer vs. the Pontiac & Pacific Junction Railway Company. This was a claim for $400,494.21, representing $342,903.47, amount of a claim transferred to plaintiff by F. Ross representing the estate Ross, and also $57,590.74, amount due by defendant to plaintiff for cash advances. The defendant did not appear, and judgment was rendered in favor of plaintiff by default.

Efforts are being made to have the Kingston & Pembroke railway extended into the mineral belt of Quebec in the vicinity of Bryson, which now cannot be developed for lack of transportation. Twelve miles of track from the Kingston & Pembroke railway terminus at Renfrew would bring the line to Portage du Fort, and eight miles' further extension would bring it to Bryson, the county town of Pontiac.

Iron and Steel.

Rhodes, Curry & Co., Ltd., Amherst, N.S., will, it is said, build workshops in Sydney, C.B.

It is stated that local capitalists propose to put $100,000 into manufacturing saws in Hull, Que. It is the intention of the syndicate to work in conjunction with the Ottawa Saw Works.

The Abbott-Mitchell Iron & Steel Co.'s new works at Belleville, mentioned in previous numbers, will be in operation in a few days and will be perhaps the most modern plant of its class in Canada.

F. R. F. Brown, consulting engineer, has been appointed secretary of the board of directors of the Dominion Iron and Steel Company, of Sydney, C.B. He will represent the company in Montreal.

Merrickville, Ont., is negotiating with the Canadian Engine and Locomotive Works, Kingston, for their removal to that town. It is reported that a bonus of $75,000 has been offered the works to move outside Ontario.

The Hamilton blast furnace is now working the Robertsville and Martell iron mines, and the Zanesville mine, near Calabogie, Ont. The iron mines along the Kingston & Pembroke railway are said to be able to amply supply the demands of the Hamilton company.

The Hon. R. W. Scott is largely interested in the reopening of the iron mines on the Gatineau river, near Ottawa. It is said 200 men will be at once put to work, and are taking out for the Ohio market. Thirty years ago these mines were exclusively worked by the Hon. James Skead and others. The Gatineau mines are three in number, two on the west side of the river and one on the east side.

The directors of the Dominion Iron & Steel Co. met in Montreal, November 21st, the following directors being present: H. M. Whitney, Sir William Van Horne, R. B. Angus, James Ross, M. Dyer, Senator Mackeen, and Messrs. Rogers, Pearson, and McLennan. Alfred Moxham, of the Lorraine steel works, near Cleveland, O., was appointed general manager. Mr. Moxham was formerly of Johnstown, Pa. Mr. Whitney says two of the four furnaces at Sydney will be in blast by the 1st of January next. The first of a fleet of 35 vessels, which will carry from Philadelphia to Sydney, C.B., upwards of 125,000 tons of structural steel, coke ovens, etc., began loading at that port Nov. 20th. This is material ready to be placed in position in constructing the blast furnaces, etc., at Sydney.

Mining Matters.

Rich finds of mica are reported as being opened up by J. Stewart at Cartwright, Newfoundland.

The Great Lakes Copper Co., a United States incorporation, is licensed to do business in Canada.

Seventy ovens are now turning out coke at the Acadia Coal Co.'s works, Stellarton, fifty at the back mines and twenty at the Foord pit.—Mining Record.

There is considerable activity in mica mining in the neighborhood of Ottawa. Munsen & Co., New York, are heavy buyers of mica through their Ottawa agents.

Joseph Lemieux, Charles Desmarais, F. X. Filteau and A. L. Laundry, Hull, Que., have bought a mica mine near Buckingham, Que. The claim bought is 700 acres in extent, and the price was $2,000.

At present the attendance of students at the School of Mining, Kingston, Ont., is the largest in the history of the school. After this session enlarging the school will probably be undertaken.

The Mumford improved boilers, which the Robb Engineering Co. has sent to British Columbia, have obtained such a good reputation for economy, that the Ymir Gold Mines Co., Ltd., Nelson, B.C., has ordered three of them for use at its mines.

Land in the township of Denison, south of the Creighton district, eighteen miles from Sudbury, Ont., in extent less than 200 acres, was sold last month to Dr. Ludwig Mond for $200,000. The vendors were R. J. Tough, of Toronto, and R. McConnell, and Mrs. McConnell, of Mattawa, Ont.

D'Arcy Scott, Ottawa, has bought at sheriff's sale the Walker plumbago mines at Buckingham, Que., for $70,000. The property is 1,200 acres in extent, consisting of plumbago deposits, with a factory and machinery for manufacture. In addition to the factory are quarters for employees, and a foreman's residence.

The Governors of McGill University have accepted the offer of Sir William McDonald (a cheque of $62,500), to found and endow a chair of Geology in the Faculty of Arts as a memorial to the late Sir William Dawson, emeritus principal of the University. The conditions attached to the gift were also assented to, namely, that an annuity of $2,500 should be paid to Lady Dawson during her lifetime.

R. R. Hedley, manager of the Hall mines smelter, Nelson, B.C., who spent several months examining Boundary Creek properties, says of the ores of the Boundary country: "I consider that possibilities are far greater in Boundary Creek district. There the variety is greater, and a perfectly self-fluxing ore is obtainable. Should the coal on development prove to be of good coking quality, and in sufficient quantity, a plant with a large capacity will treat ore as cheaply as anywhere on the continent. Even in bringing in coke at a cost of $12 per ton, laid down, I have no hesitation in saying that a 250-ton plant—two furnaces—using steam power, will smelt at a cost not to exceed $3.25 per ton."

An agreement has been made between the Ontario Government and a syndicate headed by Lloyd Harris, Brantford, and B. A. C. Craig, Toronto, by which the latter are to receive a concession of 2,000 acres in Dungannon, Monteagle, Carlow, Raglan and Brudenell, in Renfrew and Hastings counties, Ont. The concession embraces a series of locations in separate lots of 50 acres and over along the York branch, a tributary of the Madawaska river. In addition to paying the annual rentals as fixed by the Ontario Mines Act, the makers of the agreement are under penal bonds to spend $25,000 before September 15th,

1900; $50,000 within the next eighteen months, and $100,000 within the next three years. Of these sums it is provided that $3,000 shall be spent on experiments looking toward the production of aluminum from the rock in these locations, and a minimum of $25,000 on a plant for the manufacture of abrasive goods from corundum.

A number of practical tests are carried out each year by the staff of the Department of Mining and Metallurgy and the students of the mining course in their 4th year, in the metallurgical and ore dressing laboratories of McGill University. These consist of the milling and smelting of sample lots of ore, and are intended to apply as much as possible to the advancement of the mineral industries of Canada. At the present moment tests in concentration of low grade titaniferous and chromite iron ores, from the province of Quebec, are in progress, the success of which will have an important economic bearing. Different lots of the ore have been crushed in the various crushing machines of the laboratory, including the fine rolls, stampmill and Huntington mill. Experiments are now being conducted on these, with different sets of concentrating apparatus to determine the most suitable treatment for the ore. In connection with this work, a Browne hydrometric classifier, one of the latest additions to the ore dressing plant, is being made use of.

Personal.

A. E. Lewis, of the Atlantic Refining Co., left Toronto on the 29th ult. for Winnipeg and the Northwest in the interests of his company.

N. Hanson Greene, C.E., returned to Montreal recently from an extended trip through Central Ontario, where he has been engaged in reporting on proposed water power and harbor development works.

At the opening of the present session at McGill University the position of McDonald lecturer in Metallurgy and Assaying was left vacant by the resignation of John W. Bell, he having gone to California to take an important part in connection with a mining enterprise there. This vacancy has recently been filled by the appointment of F. W. Draper, M.Sc. Mr. Draper is a graduate of the Massachusetts Institute of Technology, having obtained his degree with high honors in the year '95. Since then he has been constantly engaged in metallurgical work, having been in the employ of a large lead and copper smelting company, for the greater part of the period, while for the last year he has held an educational appointment as Professor of Metallurgy in the University of Missouri. He gave up his position there to accept the lectureship at McGill. His attainments and experience clearly justify his selection, and it is evident that the appointment is a fortunate one for McGill, and that Dr. Porter has secured an able seconder of his efforts in the Department of Mining and Metallurgy.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades for the month of October and the ten months ending October, 1898-99.

	Month of Oct.		Ten months ending October.	
	1898.	1899.	1898.	1899.
Hardware	£1,472	£1,848	£18,842	£17,036
Cutlery	4,948	4,043	44,493	43,347
Pig iron	1,474	11,385	9,860	25,992
Bar, etc.	1,491	7,977	8,167	22,234
Railroad	—	38,979	9,119	152,881
Hoops, sheets, etc.	7,350	8,449	51,531	92,959
Galvanized sheets	10,938	8,520	54,650	57,589
Tin plates	19,578	46,925	121,015	188,565
Cast, wrought, etc., iron	2,537	10,500	22,387	50,250
Old (for re-manufacture)	—	883	3,574	5,073
Steel	3,644	40,663	43,032	110,340
Lead	3,172	7,691	31,090	41,788
Tin, unwrought	1,727	1,130	14,019	19,563
Alkali	10,339	7,891	42,048	33,196
Cement	5,825	7,894	23,518	30,537

SOME EXPERIENCES WITH PORTLAND CEMENT.*

BY W. K. ELDRIDGE, CITY ENGINEER, OF LAFAYETTE, IND.

The demand for Portland cements in all classes of work having been greater than the supply for several years past, has almost irresistibly tempted manufacturers to make premature shipments, adulterations and otherwise to issue defective goods, thereby placing an added burden and anxiety on the conscientious engineer in his endeavors to prevent the use of unseasoned and otherwise unsuitable cements, particularly in the construction of cement sidewalks. This he attempts by subjecting the cement before using to the usual tests now universally prescribed in all satisfactory specifications; but my experience of the past two seasons has indicated that the present method of conducting cement tests does not afford the engineer all the information he should obtain before an acceptance of the cement. Even if he takes the ill-spared time from his other duties to make a determination of the relative proportions of lime, silica and alumina, he would probably get no information of other possible ingredients of an injurious nature, and be left as helpless as before. Our tests as heretofore made are the usual ones for fineness, time of setting, constancy of volume and tensile strength; but it is easy to reason from a comparison of a number of results, including the action of the work after construction, that such tests may be and I believe are at times more or less deceptive and insufficient for perfect safety.

For instance, it is becoming customary for manufacturers to give artificial age to their cements by adding certain quantities of sulphate of lime. It has long been known that an excess of the sulphate is injurious to the cement, besides concealing certain actions that a test should be permitted to develop if it is to be reliable; but the temptation to go to excess in order to send out a product that will pass the usual tests without waiting for the proper age or requiring the extreme care necessary in its manufacture is evidently yielded to in many cases, our experience having fully shown that an honestly made cement not sufficiently aged will fail under the steam or boiling water test, thus betraying its immaturity, while a reinforced cement, though equally green, will pass all the tests that so far are customary. Any cement containing more hydrate of lime than is necessary for combination with the silica to form the tri-silicate of lime, runs the danger, in proportion to the excess, of the conversion of the free lime into the carbonate of lime, which action causes the cracking and seaming so common in cement walks. The boiling water test is intended to show this in a few hours, while it would require a long period of time otherwise. But since the presence of sulphate of lime will enable the cement to "boil" safely (and the greater the amount the surer it will "boil"), and further retards the action of the free lime in the work, sometimes to a late day, all value in this test is wholly lost when applied to "doctored" cements. Another inducement for the manufacturer to use sulphate of lime in dangerous quantities comes from the present demand for very finely ground, slow-setting cements; and as fine grinding hastens setting, a corrective must be applied, and if carried to excess, future disintegration is sure to occur, and the usual tests afford no warning. A demand for high initial strength is also called for in connection with slowness of setting, and those two qualities are also hostile; but since the immediate damaging effects of an excess of lime necessary to produce this high initial strength are concealed by the addition of sulphate of lime, we have a cement, *finely ground, slow setting, of high tensile strength, but very* dangerous to use. Having drawn a sample of a certain cement which failed under the boiling water test, I had the experiment made of ageing the cement artificially, using different proportions of sulphate of lime in regular proportions until the cement would not endure the test. No tests were made to determine whether the cement was over-limed or simply too new; nor was any demonstration made of any sulphate that might have been in the cement before making our additions. When more time permits we expect to go into this part of the matter more deeply.

It was noticed that the cement required more water for gauging as the per cent. of sulphate was greater. Summarizing the results of the experiment, it shows that the time of setting is retarded quite uniformly with the progressive increase of sul-

*From a paper read before the American Society of Municipal Improvements at the Toronto meeting.

phate, and also that the capacity of resistance to the effects of the boiling water was strengthened in the same manner. So we find that in this particular case the addition of 3 per cent. sulphate of lime made the cement acceptable according to the prescribed standard of tests. If the cement then were accepted and used it may be subject to one of three causes for disintegration. If too new, or if over-limed, or if under-burnt, in either case the damaging effect of the free lime is only suspended, its time of action only retarded. If carbonate of lime had been added instead, the effects are the same, except that the disruptive elements in the cement may not show themselves for a year or more after being made, so slow is their development.

The detection of over-limed cements is often attempted by taking the increase in temperature during setting. This is a certain test provided the cement has not been "doctored," when the test fails, and the effect of the over-liming is retarded for weeks or perhaps months, but is almost sure to make the finished work unsound. In one case, where the temperature rose 23 degrees in five minutes the addition of only 2 per cent. of the sulphate so changed the action that the rise in temperature was only 1 degree in fifteen minutes. It seems then, certain that under present conditions of manufacture the rise in temperature and boiling water tests do not ensure a sound cement. Again, the tests for tensile strength show the progressive action of the sulphate of lime in imparting what may prove to be a meretricious strength to the cement, with a corresponding deception to the user.

In all the voluminous literature on cements, references to this branch of the subject are meager and unsatisfactory, some of them being positively erroneous. For instance, in a book on engineering construction by a well known engineer of reputation, and much used as a text book, the statement is made that sulphate of lime quickens the setting time of cements. The theory that plaster of Paris, being a quick setting material, imparts this property to what it is mixed with, seems plausible, but is denied by experiment. Why this is true seems so far to be unknown. The conclusion is also indicated that an unusually high tensile strength at an early period is a suspicious rather than a meritorious circumstance. In this connection, however, it should be remembered that almost all investigations in connection with cements have been and are being made by chemists in the employ of various cement manufacturing companies, and the information gained by each is carefully guarded by their employers as part of their stock in trade, not to be imparted to their rivals or customers. The benefits of the impartial and independent investigations of the properties of the constituents of asphalt pavements, as carried on by the city laboratories of Washington, Brooklyn and others, are well known and appreciated by the members of this society, and similar work and publications from the same sources on cement would be equally valuable. The competition among manufacturers to produce cements of high tensile strength has, I believe, deceived engineers into raising their requirements to correspond, until the danger line has been passed. One city has been raising the standard each year for a number of years, and parades this before the world as a virtue; but the manufacturer simply winks the other eye and produces a cement to correspond. The composition of cements and method of production are not now so different from ten years ago that a cement honestly and naturally made from the same rock and clay as then will now show double the tensile strength legitimately.

Authorities, what few there are, are much at variance about the amount of sulphate of lime permissible in Portland cements before injury is worked, one insisting on a limit of 1½ per cent., while another claims that 8 per cent. is allowable, with various other opinion in between, until the practicing engineer feels pretty much at sea in the matter. He is probably safe in adopting the minimum requirement, but with the risk of ruling out many good cements which overstep that limit, for it is possible that a safe amount in one cement might be injurious to another. But the worst feature is in the capacity of the sulphate to conceal bad qualities in cements totally disconnected with the sulphate itself. The question that confronts him is, where shall he take his stand, and what can he do to protect himself and his work? What benefit is it for him to undertake a tedious and possibly expensive quantitative analysis of each sample, if a permissible limit cannot be decided upon, beyond which rejection shall be obligatory? It might be suggested that the minimum proportion of sulphate of lime allowed should not be so great as to prevent "blowing" under the boiling water test, if the cement be so constituted as to fail under this test. This rule would seem to place the limit at about 2 per cent., and it might well be less.

If it would be possible to decide this point, and then prescribe one or more tests that would be adequate, easily performed and inexpensive, certainly a great stride forward would be made toward insuring good work of reliable duration. But as the matter now stands, such tests as it is now customary to prescribe in specifications, fail to assure the engineer sufficient guaranty that his work will endure the test of time and the elements. The idea of a rough and ready test for sulphate and carbonate of lime has taken form out of some of our laboratory experiments, and may briefly be stated as follows:

After first trying the boiling test (for if the cement fails under this it is rejected by the terms of the specifications anyway), dissolve a portion of the sample in diluted hydro-chloric acid, when, if carbonate of lime be present, a strong effervescence of carbonic acid gas will take place; and as the carbonate should never be present in any good cement, sufficient grounds for rejection are found at once. The solution should be perfect, though it need not be absolutely clear; and if there be a residue on the bottom of the glass there is a strong suspicion of adulteration. If, however, nothing suspicious be found so far, the solution may be filtered and boiled, and a small quantity of barium chloride added, which will, if sulphate of lime be present, cause a precipitate which can be taken as a measure of the sulphate for comparative purposes. In order to have a standard for comparison let a competent chemist take a sample of cement known to be reliable and accurately determine the percentage of calcic sulphate, if any, and then add enough to bring it up to the allowable limit, say 2 per cent. Then the quantity of the precipitate under barium chloride may be preserved by sealing the beaker; and if all future tests are made with the same quantity by weight of cement in the same size of beaker, a visual comparison can be made with the prepared standard close enough for practical purposes.

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