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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893

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TORONTO, CANADA, JANUARY 3rd, 1908.

CONTENTS OF THIS ISSUE.

1907 INDEX READY.

Index for Volume 14 (1907) of the Canadian Engineer is now ready. Subscribers desiring copies will kindly drop us a postal to that effect.

PROSPECTIVE.

New Year time, in the business world, is a time of much uncertainty and speculation. With many firms it is the closing of their financial year. A time of review for the past year, a period of planning prospective work, the enlarging of present facilities, the branching into new channels. The cities, towns and counties of our country elect new councils; the electors vote on money by-laws. If the policy of the new year is a policy of retrenchment, the engineer and the contractor will not be in such demand.

Just now there is some uneasiness in the commercial world lest in the immediate future industrial depression should decrease the volume of trade. The tightness in the money market appears to be delaying important works. Laborers in our cities seeking employment add a touch of pathos to the situation. Even in view of the apparent temporary depression, we express the belief that 1908 will see business as brisk, labor as much in demand, as large works undertaken, and as much improvement and expansion outlined as has other years.

The past year has been an active year of railroad construction work. The present year will be just as busy. The Grand Trunk Pacific and Transcontinental Railways have each over a thousand miles either under construction or under contract. This work will be rushed to an early completion.

The Canadian Pacific Railway are preparing for the opening up of new work in Western Canada, where they are determined to hold their supremacy, and to lead in opening up new districts; and in Eastern Canada, where they are seeking a fair share of the business in the more thickly-settled districts and business centres. On grade revision and double-tracking they are expected to open up several sections. This year will see the opening of their new Toronto-Sudbury line.

The Canadian Northern Railway secured at the last session of Parliament permission to build several new lines, and have now location parties in the field.

In canal construction the outlook is not so bright. The Georgian Bay Canal scheme will require more study. The Canadian people are not yet prepared to give it the necessary support. But without new work the completion of the Trent Valley Canal and the improvement and repair of the other systems will employ large forces.

The past year has seen large additions to the population of our towns and cities. The present year must see constructed more complete waterworks systems and more hygienic sewage plants. Each year purer water is demanded; each year it is more difficult to secure. Each year more scientific methods of sewage disposal are required; each year sees it more costly to provide.

Sanitary engineering in Canada is but in its infancy. Our city and town engineers have great opportunities.

The mining industry will not suffer during the coming year. The present temporary depression will have the effect of checking speculation and directing attention to development and production.

The present year will be a year of activity, of development, and of solid growth. A country rich in natural resources, largely free from over-speculation, captained by men of courage and resource, will not be unduly influenced by industrial depression in a neighboring nation.

THE STATUS OF AN ENGINEERS' CLUB.

Engineering must rank high among the professions. The engineer must be a man of skill and judgment; resourceful and courageous; liberally educated and broadly read. Yearly he is in more demand. Problems arise demanding immediate solution, allowing of no time for experiments.

Engineers must prepare themselves for the new opportunities. Books, engineering journals, his own experiences, all assist him, but to supplement these he should be a member of an engineers' club. Not just a member, either, but an active member, alive to the necessities and possibilities of such an organization.

When each member becomes an active force, so will the club.

It will be a social organization providing amusement, recreation, and opportunities for those chats so enjoyed by engineers.

It will be protective, guarding jealously the good name of fellow-members and of the profession—a protection just as potent as any legislative enactment.

It will be stimulative. The success of others will encourage; their presence will enthuse. Difficulties will dwindle before the suggestions of more experienced men. Success related will help others.

It will be an educational organization, with experience as the master, and not such a hard master, either, if you are willing to profit by the experience of others. An exchange of ideas will be good for you—for the other fellow also. The successful engineer is always willing to tell in a modest way, of work accomplished, of difficulties overcome, of experiments carried out.

There is no better clearing house for bright ideas than the engineers' club.

If you are a member of a club not meeting your ideal, perhaps you are not doing your part. If you are a member of a live society, perhaps you know a fellow-engineer who is not. Bring him in.

The remaining winter months should be months of activity, entertainment and profitable discussion for all our engineering societies and clubs.

OF RAILROADS.

The charters for building railways and other purposes which have been procured from Parliament, and under which nothing has been done in the way of construction, would make an interesting tabulation. There are many corporations, for example, empowered to generate electricity at Niagara Falls and given a license to use the waters from the Niagara River. There are railway charters without number, practically covering the same route. In the latter case, their charters are kept alive by "commencing work of construction" within two years. No amount of work is specified. To correct this abuse it is now proposed to require certain percentages of the road to be actually constructed and operated within two, three and four years after date, respectively, under pain of forfeiture. As the law now stands, every new road is to be completed within five years; but in practice the charters are renewed or extended after the five years have expired, although, in fact, the construction has been scarcely commenced, much less completed.

Even if the map of Canada is covered with a network of railways, which have progressed no further than the obtaining of a charter for their construction, those already built and those in course of construction are a sufficient test of the many existing enterprises in Canadian railway realms. It has been suggested that the building of new lines will create such great competition that the prosperity of present companies will soon be seriously impaired. This is evidently the view of him who sees into the future only the length of his arm.

The traffic of our railroads is bound to decrease next year, is the opinion of the London Saturday Review, in stating its views that Canadian railroad shares at 150 are too high. This prediction is opposed to common-sense and facts. The record of railway development in the Dominion is a revelation. Here are a few figures, to June 30th of each year, given:—

	Miles in operation. No.	Passengers carried. No.	Freight carried. Tons.	Gross earnings.
1871	2,695	......	......	$ 14,485,648
1876	5,218	5,544,814	6,331,757	19,358,085
1881	7,331	6,943,671	12,065,323	27,987,509
1886	11,793	9,861,024	15,670,460	33,389,382
1891	13,838	13,222,568	21,753,021	48,192,099
1896	16,270	13,059,023	24,248,294	50,374,295
1901	18,140	18,385,722	36,999,371	72,898,749
1902	18,714	20,679,974	42,376,527	83,666,503
1903	18,988	22,148,742	47,373,417	98,064,527
1904	19,431	23,640,765	48,097,519	100,219,436
1905	20,487	25,288,723	50,893,957	106,467,199
1906	21,353	27,989,782	57,966,713	125,322,865

There is yet the completion of the Grand Trunk Pacific, and also of several minor railroad enterprises. As the steel rail finds its way into new areas, so will those districts sing the song of commerce. A railroad is capable of supporting a big stretch of country; but it must be near enough to industrial centres to be of material assistance. The railroad can create these centres. The man with the brains and a map who directs the course of new tracks does not overlook this fact.

SUPPLY AND DEMAND.

To obtain one single gramme of radium, the total known quantity now in existence, one thousand tons of mineral were required. Scarcity creates value. The extraordinary monetary worth of radium is obvious. Its commercial value will gain, perhaps, only by an increase in supply. Its extreme scarcity makes it as yet but a material for experiments. The man in the laboratory may yet have other things to tell us of it; but honors will fall thickest upon him who locates more than a few milligrammes of radium.

A despatch from Paris states that Professor Bordas, the Director of Laboratories at the French Ministry of Finance, has stated that the total known quantity of pure radium on the surface of the globe does not exceed one gramme, or 15 7-16 grains. This small quantity is divided up among the following people, in the approximate amounts stated, one milligramme being equal to .015 of a grain: Mme. Curie, 15 milligrammes; Sir William Ramsay, 20; Sir William Crookes, 20; Professor d'Arsenoval, 20; Professor Bordas, 10; M. Becquerel, 10; Thomas Edison, 20.

The various medical and scientific institutes in the world possess between them about 30 centigrammes. The Societe des Produits Chimiques has about 30 other centigrammes in stock, and several persons, mostly manufacturers in different countries, possess between them about 20 centigrammes, so that not more than 10 centigrammes may be said to be in the hands of unknown persons.

Radium is extracted by means of a complicated system of washings and chemical reactions. The radium now existing has been entirely extracted from the "pitchblende of Joachimstadt," and it took a thousand tons of mineral to provide the single gramme of radium in existence.

EDITORIAL NOTES.

The new high-pressure system at Winnipeg, under test, gave two hundred pounds pressure in two minutes. The recent discussions revolving around the power plant topic gave twice as much pressure in about two half seconds.

* * * *

The Canadian Pacific Railway might reasonably make a new appointment. "The Official Denier of Rumors" could be his designation. After the Press had almost purchased the Boston and Maine Railroad for the C.P.R., the irresponsible newspaper correspondent is now about to acquire the Chicago and Great Western Railroad for the Canadian Company. The Canadian Pacific Railway will, perhaps, become weary of denying such reports. They do little harm to the Company, while at the same time they afford pocket money for the great imagination.

* * * *

The Canadian Commercial Commissioner for Mexico, Mr. A. W. Donly, in his most instructive report on the commerce of that republic, states that both in Mexico and the southern and western parts of Jalisco there is at present under way a considerable development in copper mining, and, with the port of Manzanillo so conveniently situated, it would be quite feasible to ship either the ores or the copper matte to the British Columbia smelters. As the ores, for the most part, carry a high percentage of copper, they would easily stand the cost of transportation. The output in the immediate future is not likely to be very great, but with the amount of development work now being done, it is certain to be greatly increased in the very near future. Mexico is fast becoming a very important factor in copper production. It has made relatively greater strides in five years in this direction than any other country in the world.

* * * *

With Siberia we usually associate the "salt mines," to which the victims of Russian despotism and autocracy are condemned. The Siberian railway route, in print, does not appeal to the imagination. Apparently, a journey over that road is not the greatest comfort on earth. Canada's commercial representative in Japan has been privileged with a glimpse of the diary of a Yokohama resident, who recently made a trip from that Japanese port to London, via Siberia. One gathers that the Siberian route has nothing to offer in the way of scenic beauties or luxuries of which the Canadian Pacific Railway can boast; but any one pressed for time, and travelling light, is afforded a very quick passage to Europe. Provided only hand baggage is taken, and that one is fairly easy-going, there is little to seriously complain of along the whole route. Of course, there are tiresome delays now and again, great carelessness is displayed in the ventilation of the cars, which are sometimes below freezing point, and again so over-heated as to be unbearable; the visits of customs inspectors are fairly frequent, while the food is served up to suit Russian palates rather than those of Western Europeans. Extraordinary delays and robberies of baggage, too, are frequent. The interminable birch forests, at parts of the journey, are succeeded by long stretches of the most monotonous, uninviting landscape in others; the only bits of fine scenery being encountered near Lake Baikal.

ENGINEERING SOCIETIES.

CANADIAN RAILWAY CLUB.—President, W. D. Robb, G.T.R.; secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, E. A. Evans, Quebec; secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; secretary, F. Page Wilson, Toronto.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. McLea Walbank; secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1908.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, C. B. Smith; secretary, C. M. Canniff, 100 King Street West. Meetings held every Thursday during fall and winter months.

CANADIAN ELECTRICAL ASSOCIATION.—President, R. S. Kelsch, Montreal; secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN MINING INSTITUTE.—413 Dorchester Street West, Montreal. President, Frederick Keffer, Greenwood, B.C.; secretary, H. Mortimer-Lamb.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, R. McColl.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, TORONTO BRANCH:—Louis W. Pratt, Secretary, 123 Bay Street, Toronto

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Frederick R. Hutton; Secretary, Calvin W. Rice. The next monthly meeting will be held at the Society's rooms on January 14th. The subject will be "Car Lighting," the presentations being made by Mr. R. M. Dixon, president of the Safety Car Heating and Lighting System.

APPRECIATION

Below are given extracts from two letters received this week.

From the Assistant Chief Engineer of one of Canada's great railroads:—

"I beg leave to say that it is taken regularly in this office. I think your paper is improving, and wish you continued prosperity."

From an engineer now in his 90th year:—

"I suppose I am quite a stranger to you, as was the Canadian Engineer to me, until the present time. I have read most of this number, (November, 1907), and am much pleased with it. Had I known of such a publication I would have long ago been a subscriber. But from the present time, please to consider me as one, and send it to me."

WITH THE MANUFACTURER.

The "Pittsburg" high-speed vises, manufactured by the Pittsburg Automatic Vise and Tool Company, Pittsburg, Pa., are well represented on the ships of the American Pacific fleet, which started recently on its famous trip. The use of these special type tools as the equipment of ships, is due to the fact that they can be instantly taken from the bench and thrown to one side, out of the way. Another reason is due to their adaptability as a chuck on the drill press, planer, or milling machine, as well as an indispensable tool for bench work, then doing away with extra tools.

The Northern Engineering Works, of Detroit, Mich., report the following sales: A No. 54 Newton cupola for the Standard Pulley Co., of Cincinnati, Ohio; new power station of the Columbia Improvement Co., Seattle, Wash., have procured a 50-ton, three-motor electric crane, as well as cupolas to the Noyes Stone Co., Waterville, Me., and the Progressive Stone Co., of Colorado City.

CORRESPONDENCE

With this issue we open, this, a new department. The department will be just as valuable as engineers and contractors wish to make it. The space is yours, state your difficulty. If we cannot help you some one else can. Short descriptions of new methods, accurate data as to costs, the exposure of antiquated clauses in specifications, anything that will interest you as an engineer will interest your fellow Engineers.—Ed.

THE CALCULATION OF OVERHAUL.

Sir,—In your issue of September 6th, 1907, appeared a description of two graphic methods of calculating overhaul.

Since the method to be used in calculating overhaul depends upon the specifications and their interpretation, I shall, first, state the specification and then give a method which, to my mind, appears suitable for such a case.

Haul: The limit of free haul will be 500 feet. For any haul exceeding 500 feet the contractor shall be paid at the specified price per cubic yard per station.

From the field book one may secure the quantities in each station of cut and fill and prepare the following table:

Station.	Cu. Yds. of Emb.	Cu. Yds. of Exc.	Total to each Sta.
124	....	....	2710
....	880	....	....
125	....	....	1830
....	790	....	....
126	....	....	1040
....	640	....	....
127	....	....	400
....	320	....	....
128	....	....	80
....	80	....	....
129	....	....	....
....	....	60	....
130	....	....	60
....	....	120	....
131	....	....	180
....	....	340	....
132	....	....	520
....	....	920	....
133	....	....	1440
....	....	1290	....
134	....	....	2730

On profile paper plot the cut and fill, and using the grade point as zero plot the diagram, the fill being on one side of the zero line and the cut on the other.

By aid of the scale mark the points where the arms of the diagram are horizontally 500, the limit of free haul, 600, 700, etc., feet apart.

These points so determined will give the stations and fraction of stations containing the yardage hauled one, two, three, etc., stations beyond free haul.

From the diagram we can now secure the number of cubic yards hauled and the distance the material is hauled.

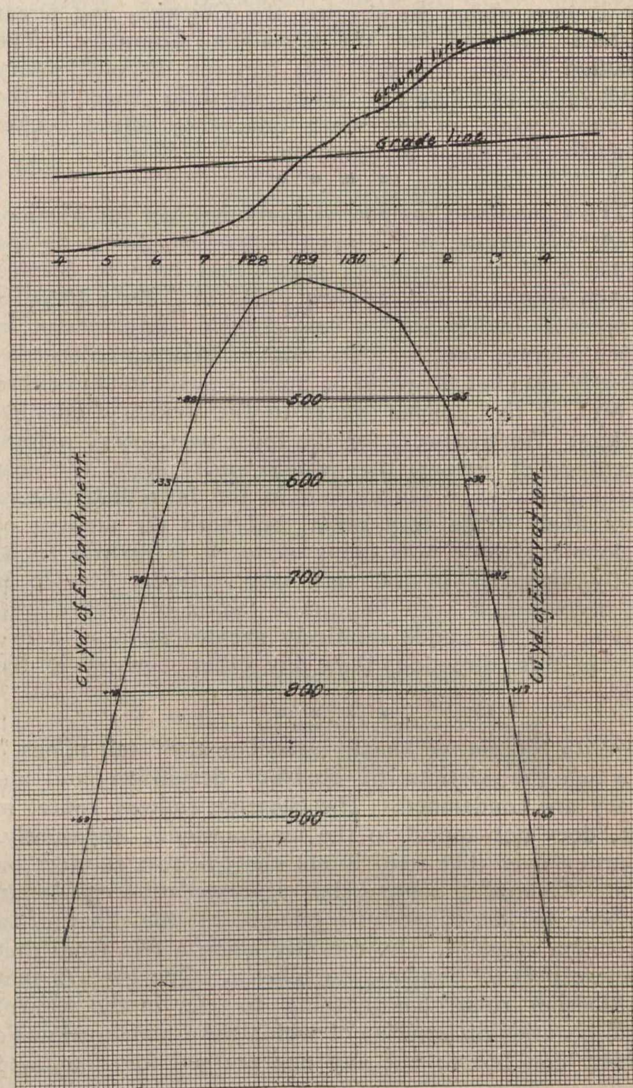
$$\frac{100-85}{100} \times 340 + \frac{33}{100} \times 920 = 354.6 \text{ for one sta.} = 354.6$$

$$\frac{75-33}{100} \times 920 \qquad = 386 \text{ for 2 sta......} = 772.0$$

$$\frac{100-75}{100} \times 920 + \frac{17}{100} \times 1290 = 449.3 \text{ for 3 sta.....} = 1347.9$$

$$2474.5$$

Therefore, cu. yds. of overhaul = 2474.5. The accuracy of this method depends on the correctness of the diagram to scale, and, although a graphic method, I consider it more



accurate than the methods described in the Engineer of September 6th, as it eliminates errors due to the scaling of quantities hauled.

Yours, G. F. R.

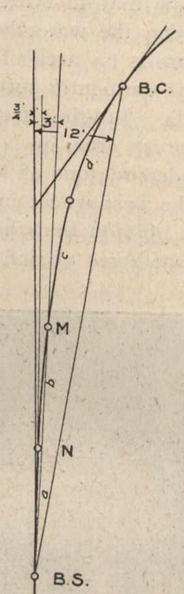
December, 1907.

Railway Spirals.

Sir,—In the lining of transition spirals on trackwork it it is frequently noticed that the spirals do not appear to be true. Looking along the tangent towards the curve the spiral appears to have a shoulder midway on the first chord instead of curving away so gradually as to leave the exact position of the B.S. in doubt. As the only idea in having a spiral is to approach the curve so gradually as to have the rail elevation vary directly with the degree of curve, the effect of the spiral is almost wholly destroyed. To avoid this trouble the spiral is sometimes shortened, but the real trouble is in the ordinate of the first chord.

The spiral used by the C.P.R. on some branches is in length 60 + 60 feet per degree. Let us consider the 1 degree curve with 120 feet of spiral, 2 chords at 60 feet, central angle of 36 min. We wish to ascertain the true middle ordinate of the first chord. The angle deflected for B.C. at B.S. is 36 min. × ⅓ = 12 min., deflection for midway point M is 12 min. × ¼ = 3 min. The point M is distant from tangent sin 3 min. × 60 ft. = .00087 × 60 = .05 ft. or about .64 in., a point midway on chord is then .64 × ½ = .32 in. from tangent. The point N, centre of chord is distant from tangent sin (3 × ¼) min. × 30 ft. = .00022 × 30 ft. = .08 in. The ordinate of the whole chord between B.S. and M is .32 in. — .08 in. = .24 in., or about a quarter of an inch.

The average foreman, thinking of it as a curve gives it an ordinate of perhaps ¾-in., thus throwing the point N actually across the tangent and causing a quite visible kink. It is suggested that the difficulty could be obviated either by



breaking up the first chord into two of thirty feet, or by showing the foreman that the first ordinate is only ¼-in., less than half that of a 1° curve for a shorter chord of fifty feet.

This problem is equally true for the first chords of curves up to about 3° after which a slightly greater ordinate must be allowed, ½ in. for the 4°, ¾ in. for the 5°, 1 in. for the 6°, and so on.

Yours sincerely,
A. C. Oxley.

Height of Arc Lights.

Sir,—I am supervising the installation of an electric light plant, including the wiring of the streets of the town. The consulting electric engineer specified that certain of the arc lights, on the streets should be placed centrally over the poles and in a hood; others hung from brackets, but he has not specified the height the lights shall be above the streets. I would like to know what is the best height to hang these lights so as to avoid the shadow under the light as much as possible.

Yours, Junior.

December 20th, 1907.

Concrete Specifications.

Sir,—The specification for concrete in our work under construction read:—

A mixture of one part cement, three parts sand, and five parts broken stone or gravel, is to be used. Proportions by measure.

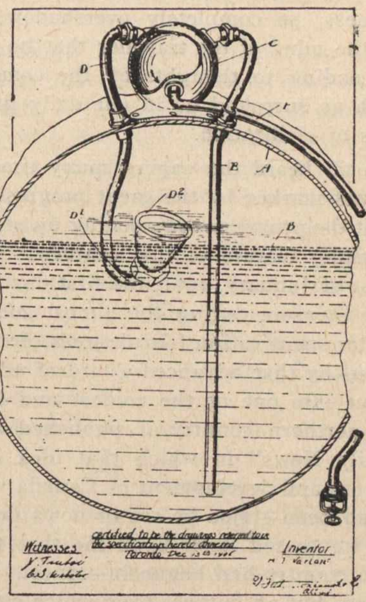
This appears to me a very loose specification, and although I am not myself prepared to improve on it, yet I feel sure there must be a better way of defining the proportions in the mixture. Perhaps some engineer engaged on larger works under other specifications will give his experience.

Yours, Associate.

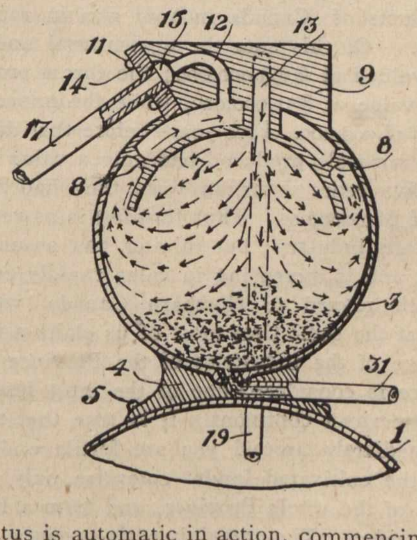
December 5th, 1907.

AUTOMATIC BOILER CLEANER.

This is an improved mechanical device, patent granted to Herbert J. Varlow of Stratford, Ont., Canada. A spherical receptacle is located on or near the top of the boiler. The design of this receptacle differs from any other now in use, having an inner hemispherical shell, suspended within the spherical receptacle, with a pipe leading from the surface of the water in the boiler to the top of the receptacle. Attached to this pipe is a skimmer, the position of which is self-adjusting to the variation of water in the boiler, this being an im-



portant point. Before the scale forming deposits have time to gain sufficient density to sink and adhere to the tubes and shell of the boiler they are collected and carried by the circulation to the receptacle where separation takes place, the deposits fall to the bottom and are drawn off as desired. The water then is carried back to the boiler by another pipe thereby promoting a perfect circulation and equal expansion throughout the entire boiler, which undoubtedly increases the steaming capacity and reduces the fuel consumption.



The apparatus is automatic in action, commencing to operate when the steam pressure in boiler reaches 10 lbs. Many of these cleaners are in active service and giving entire satisfaction. It can be attached to all kinds of boilers, and is especially adapted to those of the locomtive type.

The two great advantages of this device are: first, they are economical and add to the life of a boiler and also save much labour on the part of engineers and firemen.

Mr. Varlow is now in the east with the idea of completing arrangements looking for the manufacture and sale of his invention in this part of Canada.

A PLEA FOR THE DEVELOPMENT OF NORTHERN CANADA.*

By J. B. Tyrrell, Mining Engineer.

Northern Canada as here referred to is doubtless fairly well understood by all as defining that portion of Canada which lies north of the more thickly settled parts of the Province of Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia, and which forms a great land mass stretching for 85 degrees of longtitude across the centre of the North Temperate Zone in the Western Hemisphere. It is a country so vast that even those of us who have made a special study of it know little about it except its immensity, and its vastness so completely overshadows all its other attributes in the mind of the traveller that he has great difficulty in descending to thoughts of the common details of existence such as surround us in our daily life under ordinary conditions of civilization.

You have all heard the saying many times of late that last century was marked by the great progress of the United States but that the progress and opening up of Canada will be the distinguishing feature of this century.

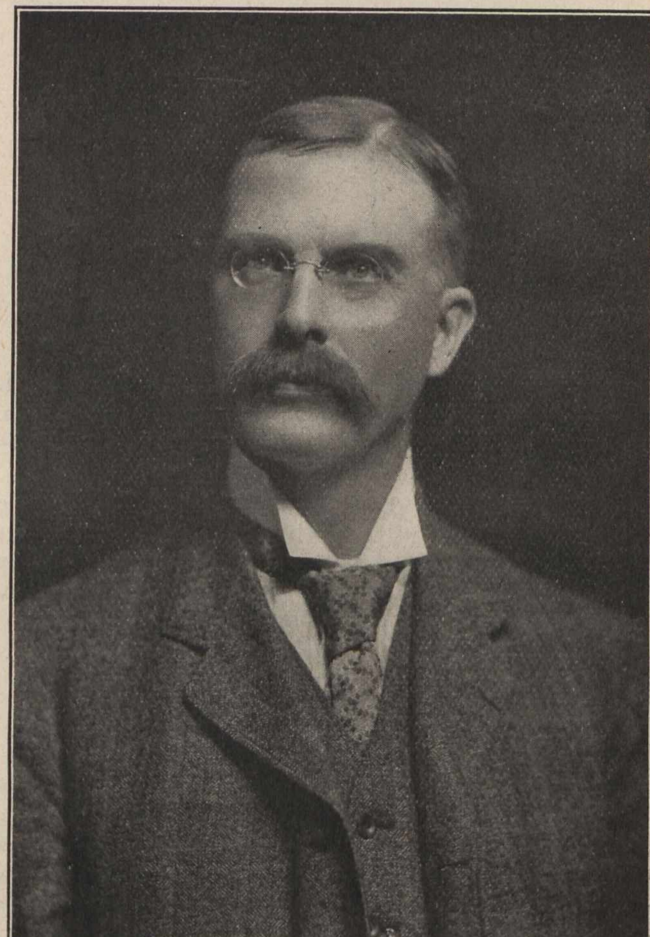
On the 1st of January, 1901, the first day of this century, in the city of Dawson, during the almost sunless days of a very cold winter spent within four degrees of the arctic circle, and surrounded by that advanced guard of adventurous miners thrown out into one of the coldest and least accessible parts of our northern country, I published a letter in the Dawson "Daily News" in which that idea of faith in the coming progress and development of Canada was enunciated. Whether it had been stated before or not I do not know but the idea had impressed itself upon me that the conquest of our own north country had begun in earnest.

Dawson was but an outpost from which civilization would radiate into the surrounding wilderness, and it was but one of many centres which would soon be established by the enterprise of our people. The greatest extent of virgin territory in the world lies in Canada, and before the close of this century we will have learned how to make use of the vast store of natural resources of even the most inhospitable parts of the country.

Let us for a moment consider the value of the products of the whole of Canada at the present time. It is not my intention to weary you with figures and statistics, any of you can look these up in the Census Reports for yourselves, but a few figures may be instructive. The total value of the natural products of Canada in 1901 was in round figures $519,000,000. Of this sum the agricultural and farm products were valued at $393,000,000; the forest products came next with a value of $51,000,000, while the mineral products were worth $48,000,000. Five years before that date, namely, in 1896, the minerals produced had only a value of $20,000,000; while five years later, in 1906, they had reached the large total of $80,000,000. Thus farming is as yet by far our most important industry; but mining has assumed a place second to it, and is increasing in value rapidly every year.

Now with regard to Northern Canada, very little is known, but at the same time most of us claim a fairly accurate knowledge of the industries of the Province of Ontario. This province is considered one of the most fertile parts of the North American continent. It is true that the parts of Ontario immediately around you are fertile and well cultivated, but the cultivated lands comprise only about one-seventh part of the whole Province, and form a fringe along its southern side. The remaining six-sevenths of its area which lies further north is as yet almost undeveloped and hardly comes into your thoughts when you are considering the Province as a whole.

New or Northern Ontario is as yet practically an unbroken and untilled wilderness, except that it has to a considerable extent been stripped of the richest portion of its natural crop, namely, of its forests of white pine. These pine forests, the natural growth of the unbroken soil, yielded many large fortunes to those who had the good judgment to secure them. Fortunes will still be made from the products of the forest; but in our northern country the forest growth is very slow, so that when the land is found capable of being used for other purposes, the forest must needs give way. For instance, we now know that in Northern Ontario, near the Height of Land between the watersheds of the Great Lakes and Hudson Bay, there is an area of 25,000 square miles of rich clay land which is eminently suited to the growth of all the more hardy serials. Judging from the similarity of the vegetation on this forest area in Northern Ontario to the vegetation in the wooded regions of Manitoba, Saskatchewan and Alberta, where the best wheat in the world is grown, I am confidently of the opinion that this great clay belt of the north with its 16,000,000 acres of rich land will, when cleared



J. B. Tyrrell.

and drained, be the wheat growing region of Eastern America. The statement may seem hardly credible, that there is within this Province within a day's journey of us land now lying waste which is capable of producing 150,000,000 bushels of hard wheat every year, but such seems to me to be the case.

On the same day on which this paper was read, Professor R. F. Stupart, Director of the Meteorological Service of Canada, delivered an address before the Canadian Club in Ottawa, in which he is reported to have stated that "From the height of land to James Bay there was nothing in the climatic conditions, at any rate, to prevent the whole great district from being a good agricultural country right up to the shores of James Bay."

I might speak at considerable length of the vast areas of fertile land as yet uncultivated which lie between the eastern border of this Province and the Pacific Ocean, the largest areas of rich unbroken agricultural land in the world. But you have heard of that western country very often of late, and

*Extracts from a paper read before the Canadian Institute of Mining Engineers, Toronto, December 14th, 1907.

anything that I might say here would be tiresome and uninteresting. Only those of you who have travelled through it and have seen it can begin to comprehend its possibilities. We all, however, feel certain of the great agricultural development that is in store for Canada.

My purpose in addressing you was not to dilate on Canada's agricultural greatness. Around and beyond the agricultural land are vast stretches of rocky country which are not suited to the needs of the farmer. Parts of this country will probably be kept for the growth of forest, for the time is at hand when trees will be grown systematically and carefully by the forests, just as hay and grain are now grown by the farmers, and probably the cultivated forests will grow far larger crops of trees than ever grew in the natural forest. But still the development and progress of very much of Northern Canada will depend not so much on what it produces from the surface upwards, but on the valuable minerals that will be dug by miners from beneath the surface.

Now the figures quoted above indicate to some extent the value of what has already been done in the way of unlocking this great treasure-house of nature and taking out the ores and metals that are so necessary for the welfare of mankind. Last year ores and metals to the value of $80,000,000 were recovered. Ten years ago the mineral production of Canada had a value of $20,000,000, a very satisfactory increase in the time.

But let us look at the record of the mining industry in the United States. In the year 1906 the mineral products of the United States had a value of $1,902,000,000, or about twenty-four times as much as the production of Canada in the same year. This gigantic figure should make us very modest in talking about our present mining enterprises, and it shows what we must attain to if we are to claim this century as in any way belonging to us. I believe we can produce as much as the figure last stated before the year A.D. 2000, but you can see that Canada must advance with tremendous strides in the discovery and development of her mineral resources if she is to attain to any such results, and such results are quite unattainable unless the people of this country take a far more general interest in mining than they are doing at the present time.

Probably one-half of the area of Canada is limited to minerals and ores for the production of its wealth, and consequently its progress depends on the discovery and development of these sources of wealth. Such being the case, it becomes the duty of all good Canadians to take an intelligent interest in mining affairs. Probably some of you may say that you do take a great interest in mining, that you own so many shares in such and such mining companies, and that you are very much interested in the market value of your stock; whether the mine will ever pay back the capital invested in it, whether it is producing an adequate quantity of ore to enable it to pay good dividends on what you paid for the stock, or whether the property has to rely entirely on the verbosity and persuasive powers of the brokers to give it value you do not know or do not care so long as the market holds up until you have disposed of your stock at a handsome profit. Now, I want to tell you that in such cases you are not acting as the friends of the mining industry at all. You are introducing into what should be considered an industrial enterprise the worst methods of the real estate agent. In many cases you are piling up on that enterprise a financial burden greater than it is able to bear, and it will sink in consequence. If you wish to be true friends of the mining industry, and considering its vital importance to the welfare of the country, every honest-hearted Canadian must wish to be ranked among its friends, you should devote a certain reasonable amount of time to the study and investigation of the conditions under which the mining industry is carried on, by reading standard books on mining and on the modes of occurrence of ore deposits.

I would suggest that both the Dominion and Provincial Governments be asked to, if possible, introduce and establish Information Bureaus, perhaps in connection with their Geological Surveys, from which information would be freely distributed as to the character of the different parts of the north country or routes of travel through it, the character of the rocks that might be met with in any particular district, the significance of those rocks from a miner's standpoint, and what useful minerals are to be looked for in them. Let this Bureau collect information from the geologists, engineers, surveyors and others who have travelled over and explored the country and put it in such form that it will be accessible and interesting to the general public, and particularly to all persons who may wish to visit any particular locality.

The Government might also make arrangements with the railroads, or possibly the railroads, if asked, would themselves agree to grant fares at very low rates to all who might wish to visit the mining districts or to go out prospecting into any parts of the north country where ores are likely to be found.

I wish strongly to impress upon you the fact that the mining industry must be the staple industry for very large proportions both of this Province and of the Dominion. The Governments who hold the control of that great northern country in trust for the benefit and welfare of the people should see to it that the country is developed along the best possible lines and for the greatest benefit of the people. An Information Bureau should be established which would collect and systematize the knowledge that is now stored away in Government Reports and other places not easily accessible or attractive to the people, and present it to the people in interesting and readable form. Northern Canada is part of the Dominion, and Canadians cannot rid themselves of the responsibility which rests upon them for its proper development.

It is reported that the British Columbia General Contract Company, Limited, one of the largest railway and general construction companies operating in the Province of British Columbia, is in the hands of a receiver. The Company has been carrying on extensive operations during the last year. It is constructing the Cloverdale-Sumas section of the V., V. and E. Railway, and from one hundred to five hundred men have been employed on the work during the past summer.

The Standard Engineering Company, of which W. Almon Hare, B.A.Sc., is chief engineer, has opened an office at 43 Scott Street, Toronto. They are making a specialty of constructing furnaces for heating of steel in all sizes for work such as springs, axles, drop forgings, etc. An installation recently completed by them is that at the Guelph Spring and Axle Company. In connection with their furnaces they are putting in American Underfeed Stokers which are made in nine different sizes to conform to the coal consumption and burn as low as 25 pounds of coal per hour, and as high as 2,000 pounds per hour. They are Canadian manufacturers under license for the Ohio Blower Co., of vertical and horizontal steam separators, "Swartout" cast-iron exhaust heads, and gravity closing ventilators. They are also owners of the Canadian patents of the Angle Chill and Excelsior Brake Shoe.

The Canada Chemical Manufacturing Company have again built a new addition to their Toronto warehouse, so that they now have a frontage of 200 feet on Mill Street, and the buildings run back to the C.P.R. tracks. The two sidings provide ample facilities for unloading tank cars and other carloads. This is the third addition which has been built to the warehouse since the company has located its distributing warehouse in Toronto, but the rapid growth of the sales for acids and chemicals in the district has necessitated this constant enlargement of storage space. For the last couple of years the Toronto sales office, with Mr. Neighorn in charge, has been located in the McKinnon Building; but Mr. Neighorn and his staff are now moving out to the new Mill Street warehouse, where the sales office for Toronto district will be located for the future. The company report that sales of their acids and chemicals so far this year are considerably greater than for any previous year, and that the chemical works at London, as well as their other manufacturing works, are being operated to full capacity in an effort to keep up with the large demand for these products.

CATALOGUES AND CIRCULARS.

Labor Saving Track Appliances.—Cook's Tool Company, of Kalamazoo, send us an illustrated booklet descriptive of modern methods of track maintenance. Size, 6 x 9.

Electrical Appliances.—The Cadiz Electric Company, of Cadiz, Ohio, have issued several pamphlets descriptive of telephones, and accessories. One bulletin describes this company's switch book. Others deal with magnets and coils, batteries, etc.

Mine Cars.—The Kilgour-Peteler Company, of Minneapolis, send us an illustrated catalogue of industrial and mine cars, coal and ore handling machinery, etc., besides specification. A great deal of other valuable information may be found of use for mining purposes. Size 6 x 9, pp. 56.

Air Lift Pumps.—The Canadian Rand Company, with works at Sherbrooke, Quebec, have issued a booklet outlining briefly three systems of pumping by compressed air, giving the leading points of each system. It contains several views of plants where this system is used. Size 3¼ x 5½, pp. 18.

Riveting Machines.—The John F. Allen Company, of New York, describe portable pneumatic percussion and compression riveting machines for practical bridge and railroad work, boiler, tank and stack construction, etc. A great deal of valuable information is given of use to all interested in riveting machines. Size 6 x 9, pp. 32.

Iron Works.—The Marine Iron Works, Chicago, Ill., send us their 1908 supplement to catalogue No. 17. In this catalogue are some of the recent marine products of this company, including marine engines, pumps, hoists, lighting systems, condensing apparatus, launch engines, etc. Size 9 x 6, pp. 16.

Portland Cement.—The Universal Portland Cement Company, of Pittsburg and Chicago, in their bulletin No. 43, describe several interesting forms of concrete construction work. The bulletin contains several photographs of large works of different character, where this company's brand of cement has been used entirely. Size 6 x 9.

Gas and Pumping Machinery.—Messrs. R. D. Wood & Company, Philadelphia, have issued a handsomely-bound catalogue of 175 pages, describing water, gas works appliances, and pumping machinery. The catalogue is prepared in a volume, 9 x 11 inches, and is replete with illustrations, as well as charts, etc. Among these illustrations are a number of full-page cuts. In addition, it contains a great deal of valuable data of interest to municipalities everywhere. The information is so arranged as to be readily referred to, and the compactness of the whole catalogue makes it one of the best received at this office for some time.

Concrete Mixers.—Eureka Machine Company, Lansing, Mich.

A catalogue describing the automatic feeders and measurers and mixing trough. Mixers, either steam, compressed air, gasoline, or electric-driven. Several illustrations. Size, 8 x 11.

Simplex Conduit Erecting and Wiring.—Sheffield-Canadian Engineering Company, Stair Building, Toronto, Ont.

A very full description of the Simplex conduits and fixtures. Various types are described, their adaptability to all conditions. Many illustrations and diagrams. Pages 129; size, 4 x 8.

Castolin.—Sheffield-Canadian Engineering Company, Stair Building, Toronto, Ont.

Castolin, the result of twenty years' research, is a new process for brazing cast-iron. Results of tests are given and several cuts showing the welds in different pieces of machinery. Size, 9 x 11.

Westinghouse Diary, 1908.—Canadian Westinghouse Company, Hamilton, Ont.

A diary of convenient vest-pocket size, neatly bound and prepared. It contains numerous tables of value to electric engineers, and also information of a general character. A complete index makes this information readily available.

BOOKS REVIEWED

Grace's Earthwork Tables. Published by E. and F. N. Spon, 57 Haymarket, London, Eng.; Spon & Chamberlain, 123 Liberty St., New York.

Books of tables we have in plenty, but even yet there is room for more, this book is not required in Canada, however. Too large for field use; too incomplete for office use, but its greatest drawback is the standard of measurement used, the Gunter's chain. For years in Canada the one hundred foot chain has been used on engineering works. Tables prepared to be used with a sixty-six foot chain are useless here. We have not taken the time to look into the accuracy of the tables.

SOCIETY NOTES.

Mr. W. G. Chase, secretary pro tem of the Toronto Section of the American Institute of Electrical Engineers, informs us that a series of very interesting meetings are anticipated after the Christmas vacation, inasmuch as they have promises from President Stott, Past President Charles F. Scott, Manager H. W. Buck, Messrs. D. B. Rushmore, of the Sections Committee, and W. S. Moody, from abroad, to present original papers. Papers have also been promised by Messrs. H. A. Moore and H. W. Price, of the Toronto Section. The Executive hopes that all members will be able to be present on each of these occasions.

NEW INCORPORATIONS.

Quebec.

The Dominion Petroleum Company, Montreal, $150,000. Z. Perreault, E. Donahue, V. Morin, H. Daw, D. McLellan, Montreal.

Ontario.

Bedford Mica Company, Toronto, $100,000. J. E. Day, J. M. Ferguson, E. V. O'Sullivan, Toronto.

Cobalt Shippers, Cobalt, $40,000. J. L. McDougall, Jr., J. M. Hall, T. Kelly, S. Pierce, T. H. Jessop, Haileybury.

T. A. Norris Company, Toronto, $40,000. R. J. McGowan, C. Winfield, J. O. Poole, C. F. Brookes, Toronto.

Industrial Natural Gas Company, Welland, $40,000. T. Coulter, R. Ross, Port Robinson; W. A. Gibb, Hamilton.

Gould Consolidated Mines, Ottawa, $2,000,000. J. Wilson, J. K. Paisley, D. O'Connor, S. Fee, Ottawa.

Canada-Mexico Development Company, Toronto, $200,000. W. D. Gregory, H. F. Gooderham, R. Weir, Toronto.

Brand-Electro-Ozone, Toronto, $100,000. F. B. Filsinger, H. Rose, W. M. Gray, G. Laird, S. Egan, Toronto.

Green-Robin Gold Mines, Toronto, $1,500,000. J. K. Lindsay, M. Macnair, W. Cooke, J. F. Dowley, F. W. Coyne, Toronto.

North American Oil and Gas Company, Niagara Falls, $1,000,000. D. A. Coste, H. D. Symmes, Niagara Falls; J. G. Kerr, J. T. O'Keefe, B. F. Down, Chatham.

Imperial Gas Power Company, Toronto, $100,000. W. B. Hampton, J. Donnelly, W. B. DeGuerre, C. G. Munro, J. W. Lowes, Toronto.

McLaughlin Motor Car Company, Oshawa, $500,000. R. McLaughlin, G. W. McLaughlin, R. S. McLaughlin, and O. Hezzelwood, Oshawa.

Queen City Acetylene Generator Manufacturing Company, Toronto, $40,000. W. H. Kahrs, J. W. McFetridge, H. Rose, and J. H. Watkins, Toronto.

Burnt River Telephone Company, Burnt River, $5,000. W. Fell, J. Hodgson, A. B. Townsend, R. Maconachie, and W. Britnell, Township of Somerville.

Caradoc Ekfrid Telephone Company, Melbourne, $10,000. A. B. McDonald, N. A. Galbraith, J. A. McEwen, Township of Ekfrid; and F. L. Williams, Township of Caradoc.

Lansdowne Rural Telephone Company, Lansdowne, $20,000. W. J. Webster, R. J. Mitchell, O. S. Landon, W. W. Shipman, H. Horton, C. Fredenburg, and G. F. Deane, Lansdowne.

SUCTION GAS PRODUCERS.

W. H. Booth.

So much is being talked at the moment about the suction gas producer, that it might easily be imagined that the suction producer acted upon lines altogether different from other producers, whereas its action in no wise differs from that of all the other plain gas producers. By a plain gas producer is intended to be meant those which work continuously and not intermittently to produce water gas. Water gas is a mixture of hydrogen and carbonic oxide, and is produced by blowing steam through red-hot carbon whereby the steam is split up into hydrogen and oxygen, and the oxygen picks up one atom of carbon. This reaction is endothermic; that is to say, where heat is absorbed by the dissociation of the steam that is produced by the generation of carbonic oxide, and the red-hot carbon is soon cooled and extinguished. Therefore, before the carbon becomes too cold to be active the process is stopped. The gas then produced is turned to waste, the steam is shut off, and the fire is blown with air to a brilliant incandescence, when the cycle of operations is recommenced.

In the plain producer the process is continuous; no more steam is used than can be continuously carried into the producer, and all the nitrogen, which, in the water gas producer is not saved, goes to the gas-holder with the other gases so that plain producer gas is only about one-third combustible and nearly two-thirds nitrogen. In the plain producer the air is driven through by means of a fan. In the suction producer air flows into it by reason of the fact that the engine to be driven draws in its own gas from the pipes which connect it to the producer, and the gaseous contents of the producer are driven forward into these pipes by the atmosphere, which is now enabled to flow into the partially exhausted producer.

The action is as follows: Air entering the producer combines with the first of the fuel it meets and forms CO_2, or carbon dioxide, evolving great heat, and raising the fuel for some distance to a high temperature. As the gas travels upwards through the heated fuel it next combines with a second molecule of carbon, the chemical action being as follows: $CO_2 + C = 2CO$, and where the first oxidation of a pound of carbon to its full oxide produced 14647 units of heat the absorption of another atom of carbon demands 10232 heat units to gasify the carbon, and only produces actual heat to the extent of 4415, so that from the two pounds of carbon which go to produce 4⅔ pounds of carbonic oxide only 8830 heat units are produced in the producer when working perfectly, or without production of CO_2. The heat thus actually produced may be made to evaporate water, and the air which goes to the producer carries with it the vapor thus produced, and a small quantity of water gas is thus generated, so that the final gas produced contains rather less nitrogen, and it contains a moderate percentage of hydrogen, which, in the case of small engines, is useful as a quickener of combustion. The finally escaping heat helps to make hot the cold fuel, and it may even be used to heat the incoming air. So little heat is ultimately rejected that suction producers are claimed to have a thermal efficiency at times as high as 90 per cent.

Of course, the suction producer has a freedom from leakage, which is a desirable quality in a confined space. At the same time, any room containing a suction producer should have good ventilation, preferably by some flue, up which, at some little distance, the gas engine should discharge upwards, and thus keep it warm, so as to ensure an up-draught that will clear the room of any chance gas, while, to ensure the proper up-cast in this flue, a free opening to the room from some other source must be provided to let in air for the producer, or otherwise air will be drawn down the up-cast flue. All suction producers are practically alike. It is essential to their best success that their fuel should be dry, of even size, and of a nature to fall freely, so as not to form cavities. There is much greater risk of air passing by short circuit through the fuel than when the air is blown in under a pressure, and there is a plenum in the producer. The small size of a producer is not, of course, favorable to the free falling of the fuel, for this can arch itself across the chamber, and the over-burden also being small, such arching is less readily crushed in. Within reason, therefore, a producer should be tall, so as to produce downward loading on the fuel, and it should be as narrow as consistent with good working.

The fact that the fuel shrinks as it descends owing to its gradual oxidation is equivalent to rendering a parallel producer taper wider below, for a mass of shrinking fuel cannot so readily wedge itself fast as it descends.

When bituminous fuel is employed many difficulties crop up, and producers for bituminous coal must be varied from the ordinary form, and the coal used must not be excessively bituminous. The aim of designers of producers for such coals has been to drive off the volatile portions of the fuel and compel them to pass through the fire in order to split up the hydrocarbon gases and fix them in a permanent form.

Very large suction gas producers have yet to be made, but there is no special reason to suppose that they would not work perfectly well.

RAILWAY COUPLINGS.

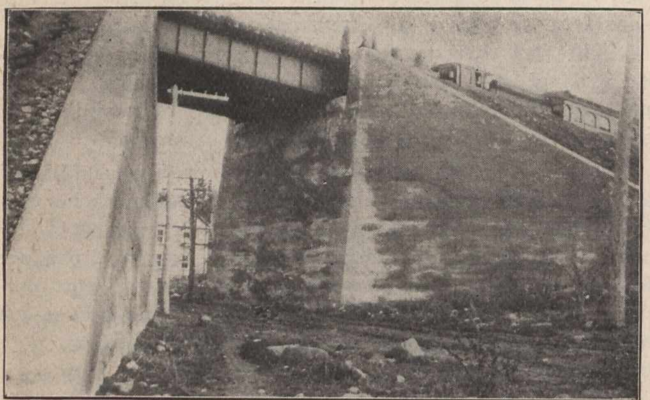
In view of the interest now being taken in automatic couplings for railway wagons, and the fact that a Board of Trade Committee is now dealing with the matter, two exhibits of railway couplers attract notice. The Roche coupler the invention of Mr. D. Roche, of 5 Lammas Park Gardens, Ealing, London, is constructed on the principle of placing the pin on which the hook turns, the recess in which the opposite link rests, and the axis of the drawbar, all in one straight line. The pin and link, being also in a straight line with each other, the pressure on the movable parts is neutralized to such an extent as to permit uncoupling under all conditions of strain. The locking device consists of a rotary pin placed in the crank of a shaft, which shaft is mounted in the drawbar and extends across the vehicle; the rotary pin extends concentrically in a circular slot in the tail of the hook, i.e., the circular slot in the tail of the hook; when the hook is shut, and the rotary pin have the same centre; so that the hook may be said to be doubly pivotted, with the strain on it neutralized. The couplers worked by a side lever about six inches long, the only two positions being "forward" in gear and "backward" out of gear.

The feature of the Coles buffer coupler, is that it is a centre buffer coupler, and thus the side buffers may be done away with. The couplers composed of two oppositely inclined or bevelled jaws or faces adapted to engage, with the corresponding jaws or faces on the next vehicle, and bring them into alignment. At the side of the coupler there is a pivotted locking arm, which, engaging a projection on the other copulers, affects the coupling. The uncoupling gear is a chain leading from underneath the coupler over a sheave under the wagon, and is connected to an arm or lever on the end of a rod which runs to the side of the vehicle. The releasing lever is on opposite corners of the vehicle, so that on both sides there are levers. One lever releases the two vehicles, and both couplings reset themselves automatically ready to re-engage. To effect coupling with a non-automatic vehicle during the transition stage there is a link hanging from the centre of the coupler which the shunter lifts with his stick in the usual way. Another advantage claimed is flexibility, the coupling being provided with two side springs, which, in going round a curve, allow the coupler to give, and when the curve is passed these springs bring the coupler back to its normal position.

The Montreal office of the Canadian Fire Underwriters' Association has just sent out a circular letter calling attention to the defective electric installations in the city as being one of the causes contributing to the heavy fire loss of the city. Accompanying this circular is another giving the schedule of fees to be charged for inspection.

SUBWAY NEAR QUEBEC BRIDGE.

The accompanying view showing concrete retaining walls is that of the subway near the Quebec Bridge. Above may be



Concrete Retaining Wall at Subway Near Quebec Bridge.

seen the excursion train which carried upwards of 100 members of the Canadian Society of Engineers on November 9th, from Montreal to the ruins of the Quebec Bridge.

COMPOSITION OF PORTLAND CEMENT.

Under the title of "Ultimate Composition of Portland Cement," the Chemical Engineer discusses in the May number of that monthly the nature of the combination with each other of the essential elements of this cement and the actual percentage of the various materials found in American Portland cements. The result of these tests is stated as fol lows:—

It may be said that the following represents about the limits of chemical composition met with in freshly made American Portland cements which pass the standard specifications for soundness, setting time and tensiie strength:—

Silica	20—24	per cent.
Alumina	5— 9	"
Iron Oxide	2— 4	"
Lime	60—63.5	"
Sulphur Trioxide	1— 2	"
Sulphur Trioxide	1.5	"

The average is represented by the following:—

Silica	22	per cent.
Alumina	7.5	"
Iron Oxide	2.5	"
Lime	62.0	"
Magnesia	2.5	"
Sulphur Trioxide	1.5	"

The Lehigh Valley cements (made from argillaceous limestone) are characterized by high magnesia, usually between 3 and 3.5 per cent., though occasionally as low as 2.5 per cent. and as high as 4 per cent. They contain about 2.5 per cent. iron oxide and about twice as much silica as iron oxide and alumini combined. In those cements from the western end of the deposit this ratio is somewhat higher, however.

Most of the marl cements are low in magnesia, some of them containing as little as 0.5 per cent. Some of the Michigan marl are high in iron oxide, 3 to 4 per cent. This comes from the clay, or shale, however, and hence is also characteristic of some cements made from limestone and clay or shale. The Alabama cements made from the Selma chalk at Demopolis are high in iron and alumina, published analysis showing 12 to 14 per cent. iron oxide and alumina and only about 20 per cent. silica.

THE CONSTRUCTION OF MACADAMIZED ROADS SUITABLE FOR MODERN TRAFFIC.*

The subject of this paper, namely, the construction of macadamized roads suitable for modern traffic, has been engaging the attention of road engineers and others interested for some considerable time past.

That an improvement in the condition of our highways, excellent as they are in many instances, and eminently suitable for slow-going traffic, is necessary no one can gainsay. In order to withstand the increasing number of heavy and fast-travelling vehicles some radical change must be made in some of the details of present-day practice in road construction.

Road engineers are occasionally considered by some as not keeping up with the times, and that the art of road-making has been lost; but, while not agreeing with these statements, there are notable examples in this country of badly-made and badly-maintained roads, which are absolutely unfit to bear the traffic passing over them Many of these roads will, sooner or later, have to be reconstructed from the foundation.

The financial aspect of the case is a serious one, and the increased demands for money to effect necessary improvements are common everywhere, but, of course, the ratepayer has to be considered. The remedy resolves itself into one of finance, and upon this, as in most matters in county council administration, a firm hand is placed.

The revolution in the nature and amount of the traffic has a great deal to do with the complaints made at the present time. It is difficult to foresee what the effect of any new description of road vehicle will be, but now that these conditions, so far as heavy and fast-travelling motor-cars are concerned, are thoroughly understood, efforts are being made to cope with the difficulty which, while being efficient, may be comparatively economical.

It may be said that the era of bituminous treatment of macadamised roads has been entered upon, and that the methods of construction will give excellent results in regard to wearing capacity, and at the same time get rid of the dust and mud nuisance.

Previous to describing what may be considered the best method of making and maintaining macadam roads suitable for present-day requirements, it may be well to consider some of the items which are factors in construction and maintenance generally.

Foundations.

For all classes of roadway a well-drained, good foundation is a recognized necessity, and on which depends in a great measure the future life of a road and the cost of maintenance. The two great pioneers in road-making—Telford and Macadam—differed in their method of forming a foundation. The hand-set bottoming was employed by Telford, and generally bears his name in specifications when new roads are undertaken. It must be remembered, however, that Telford only applied this form of foundation when he could procure suitable material for the purpose, and in many instances used gravel and other kinds of material obtained locally.

Macadam did not use a hand-set pavement as a foundation, but preferred to make the roadstones forming the roadway of an equal size. In this respect—and it must be borne in mind that it was principally existing roads he was called upon to improve—Macadam generally found sufficient material in the roads, but of a very irregular size. He, as a rule, picked up the whole roadway, reformed the ground, drained the subsoil where necessary, and then applied the old material after being freed of superfluous earth, and broken to a uniform size of about 2-in. cubes. He, however, generally stipulated that the weight of each stone was not to exceed 6 oz.

The writer has in practice adopted a system which may be described as a compromise between the methods set out,

* Extracts from a paper read by Thomas Aitken, M. Inst. C.E., before the Glasgow Association of Students of the Institution of Civil Engineers.

many miles of new roads having been constructed by this method with excellent results. The rough material, after being placed on the formation level of the road, is broken into cubes of from 3 in. to 4 in. in diameter to the requisite depth, generally 9 in. at the centre and 7 in. at the sides. This coating is then consolidated by steam rolling, and a 2-in. layer of sand spread over the surface, partly to fill the interstices and partly to form a cushion for the top metal, or wearing surface. The quality of the stones forming the foundation of a road should be of a good and hard description, and not liable to be affected by frost or heavy wheel traffic. Unfortunately many new roads have been bottomed with soft freestone and with hard core, which, in many cases, means all kinds of rubbish.

It may be of interest to note that some of the roads in certain counties of this country have only a combined depth of material of from 4 in. to 6 in., and, no doubt, this is typical of hundreds of miles of roads in the British Isles. This, no doubt, had been in a great measure brought about on the advent of railways, which drained the roads of their traffic, and, consequently, the drawings by the turnpike system were considerably reduced. The funds of the road trustees were, therefore, such that proper repairs could not be carried out, and the roads suffered in consequence.

It was a common experience during the latter days of the turnpike system, and even up to within a comparatively few years ago, to find the bottoming exposed, and, such as it was, serving the double purpose of foundation and wearing surface. Since the abolition of the tolls a gradual improvement has taken place, but not to the extent, or in proportion to the great advance, made in automobilism and of the increased traffic generally.

Roadstones.

The selection of suitable road metal for repairing roads is of the utmost importance. The essential qualities are hardness, toughness, durability, and the stones should retain a rough surface under traffic. Material, the constituent minerals of which are liable to decompose, or are not chemically stable, should be avoided, as the oxidising influence of air and the solvent action of impure surface water, charged with salts and organic acids, are destructive elements in road maintenance. Hardness and toughness are seldom equally pronounced in roadstones, although there are notable exceptions, such as in basalt and olivine dolerites, the constituent minerals of which are fresh. Good roadstones depend also on the manner in which the mutual arrangement of the component minerals are disposed and the strength of the base or matrix by which these particles are held together.

For the most part road metal prepared from rocks of the basalt, dolerite and andesite family are generally good, although many dolerites are decidedly unsuitable for road purposes. It appears strange that granite, which is so valuable a stone for engineering structures, should be, with a few exceptions, very inferior as roadstones, compared with those already mentioned. This is particularly so in granite, the quartz crystals of which are coarse in structure.

It is generally admitted that it is more economical, where heavy traffic is experienced, to employ the best material procurable for road repairs, even though it has to be brought from a distance and costs more than a local stone of inferior quality.

Many descriptions of materials have been used for road repairs, such as gravel, flints, limestone, ironstone slag, millstone grit, etc., especially in England, but these for the most part are there being superseded and granite of a good quality and basalt, etc., are being substituted.

Binding.

A difference of opinion as to the necessity of using a binding material to assist in consolidating roadstone coatings exists, principally by those who study the road problem closely, but who have not the opportunity of gaining practical experience in such matters.

Telford used small gravel to assist in binding the metalling of new roads, whereas Macadam prohibited the use of any extraneous matter for the purpose, contending that the stones should unite by their own angles. It must be remembered that Macadam, as already stated, was principally engaged in reforming and repairing old roads, and that the greater proportion of the material employed had already done service as metalling. The irregular and large-sized stones were broken to a uniform gauge of about 2 in. in diameter, and, of course, a certain amount of earthy matter would still adhere to the metalling, which, without the addition of any other material, formed at once a sufficient binding to ensure cohesion. The old system of carrying out repairs, namely, by spreading the road metal one stone thick in strips or sheets of from 2 ft. to 6 ft. wide in varying lengths, of which method Macadam had a considerable experience—did not require the application of binding. Few road engineers or surveyors practised binding these patches except under exceptional circumstances. The old roadbed was generally sufficiently soft when the metalling was applied, and the stones became set by the passage of vehicular traffic. During the long process of consolidation of these metal patches by the traffic varying conditions of weather were experienced, frost prevailing for weeks, and sometimes for months, at a time. Under these circumstanecs what occurred was this: the heavy-wheel traffic forced on to the metal patches, and the old surface of the road being hard, the passage, of the vehicle created a grinding action on the stones and considerable abrasion took place. This process not only rounded the edges of the roadstones, but provided indirectly sufficient binding material from the parent roadstones. No doubt this served the purpose of binding the road coatings together admirably, but at the expense of the roadstones; besides, the interlocking of the metalling by reason of the edges of the stones being rounded was deficient. Great trouble was also experienced during subsequent dry weather, as the stones became loose and got scattered over the entire road surface.

This method of repairs was practically the only one pursued till the advent of road-rollers, but the old-fashioned practice is still carried out to a certain extent at the present time.

The modern system of repairing roads is a great advance on past methods, and serves the purpose well where the class of traffic is slow and moderate in amount.

Continuous full width coatings of metal, 3 in. to 4 in. in depth, are spread on to the roads under repair direct from the stonebreakers working in the various quarries. The roadstones, being screened to rid the material of all small and useless stuff, fairly uniform-sized metal is produced. In the consolidation of the coatings by steam rolling a certain amount of suitable material as binding is imperative in order to maintain cohesion between the stones. It is on this, after the metalling has been properly spread, that the success or otherwise of the operation depends. Should large quantities of material of a promiscuous nature be used, then bad results may be looked for, and the process is clearly wrong from a sanitary point of view, and also from an economical standpoint. This is also the means of creating much dust in dry and mud in wet weather, apart from the actual wear of the stones by wheel traffic. Under such circumstances the stones are never brought into intimate contact, and there is no real solidity, while the volume of mud filling the intersticial spaces is considerable. The effect of this is that during summer weather the mud binding dries, and consequently shrinkage takes place. During winter frost expands the large quantity of moisture in the mud and lifts the road surface. In order to fulfil the best conditions of a good roadway it is necessary to apply binding of a light nature, such as loamy sand, and that in small but sufficient quantities, so as to ensure cohesion and a minimum of interstices in the metal coating. Whinstone chippings also make a good binding, and all renewals should be spread with a light covering of these and rolled.

It is the binding, even when the wear-resisting material is employed as roadstones, which makes or mars a macadamised road, and unquestionably admirable results are obtained when the work is scientifically and practically carried out. Nevertheless, the binding material is the weak spot in road construction. A binding or matrix of a viscous or bituminous nature is now, considering the increasing number of self-propelled vehicles, absolutely necessary if the roads are to be constructed for present-day traffic.

The writer has gone into the matter of binding material rather minutely, but feels that this is the crux of the whole question of efficient road-making and maintenance.

Rolling.

Efficient rolling is a matter of great importance; many roads coated with metalling of good quality suffer and become loose when the water in the binding has dried out. The condition to be aimed at is to solidify the coating with a suitable binding applied in small quantities by rolling so as to approximate the original bulk occupied by the material in the solid. All excess binding should be squeezed out by repeated passages of the roller and swept off. This produces a solid crust capable of resisting most effectually the action of ordinary wheel traffic, and containing the least quantity of soluble matter to form mud in wet and dust in dry weather. Steam rollers are made in different weights and used according to the condition of the road to be treated, and the class of material employed for repairs. Consideration also must be given in regard to gas and water mains and other pipes under the roadway, which, in many instances, are quite near the surface, or have but a limited cover. The weight of rollers principally used are 12 and 15 tons; the latter is mostly employed in Scotland, where the roadstones, principally of the igneous type, are generally hard and of good wearing quality. The quantity of metal which can be consolidated in one day by a 15-ton roller varies according to the nature of the stone, class of binding used, efficiency demanded, and the nature and amount of traffic passing over the road where the operations are being carried on. Under favorable conditions 50 to 60 tons of metal can be efficiently consolidated in one day, but this figure may be only 40 tons, and even 30 tons, where many stoppages are occasioned by traffic and on suburban roads. There are many advocates of dry rolling, principally among those who have but a limited experience in such matters. They consider by continually rolling a coat of metalling that it will become solidified without either binding or the application of water. What really takes place is that the stones become abraded and crushed, and a certain amount of binding material thus obtained, which, on the advent of rain, may bring about a tolerably favorable result. By this system of rolling, however, the roadstones are more or less damaged, and are, therefore, rendered practically useless before coming into actual use for sustaining the traffic for which the repairs are carried out. This manner of construction brings about much mud in wet and dust in dry weather.

Macadamised roads properly constructed serve the purpose admirably for most kinds of traffic under normal conditions of weather; that is, a macadamized road is at its best when it contains a small percentage of moisture, the binding under these circumstances has a certain amount of cementitious property. It is, however, the abnormal conditions which have to be overcome; namely, long continued dry weather or a spell of wet weather. In either of the latter conditions considerable brasion of the individual stones takes place immediately below the surface as the binding loses its cementitious properties, which points to the fact that some medium of a tough nature should be employed as a matrix if macadamisd roads are to be improved and made capable of accommodating the new and increasing form of traffic without the accompanying mud and dust nuisance.

A BLOWING GAS ENGINE.

The following complete description of a powerful blowing gas engine in operation at Friendenshutte, near Morganroth, Germany, at the power plant of the Oberschlesische Eisenbahnoedarfs—A.—G. having an output of 1,350 horse-power, a similar unit of 1,500 horse-power being used for driving an electric generator for supplying light and power throughout the plant, should be of interest.

The blowing gas engine is a double-acting tandem engine of the Nurnberg type operating at a speed of 85 revolutions per minute. It is supplied with fuel from the waste blast furnace gases, the same source being utilized for driving the electric generator plant. This high power gas engine operates at somewhat higher speed than the blowing gas engine, making 94 revolutions per minute and driving by direct connection a three phase alternator.

Until recently attempts at designing gas engines for large outputs failed and it was recognized an entirely new design was essential and not merely proportionately increased dimensions of the smaller power gas engines. In addition to special design for high power gas engines, the problem of cleaning the gases has to be solved. The blast furnace gases must be passed through apparatus for removing the dust and the coke oven gases must have the tar and sulphur removed in order that they become suitable for direct use in internal combustion engines. These problems have been solved and high power gas engines are now used successfully for iron and steel works and colliery power plants utilizing these waste gases.

It is remarkable that the high power gas engine did not come into extensive use at an earlier date, when it has been known for years that the gas engine plant is two or three times superior to the steam engine as regards utilization of fuel, and now that it is being largely employed in mining central power stations and power plants of iron and steel plants and collieries, the great economical importance of this serviceable high power motor is being more carefully considered.

Its great value, can be estimated, for instance, where gases are recovered as bye-products from colleries and iron and steel plants, as in Germany alone it is maintained nearly two million brake horse-power can be developed, of which until recently, but an insignificant amount of power had been saved.

It may be of interest to note the great activity in Germany and other European countries, in the past half a decade in the utilization of these waste gases by the modern high power gas engine. One great manufacturing plant alone at Nurnberg, having built 227 great internal combustion units having a combined output of 260,000 horse-power, while of these there are 144 engines using waste gases from iron and steel works aggregating 204,030 horse-power, there are also in colliery mining power plants 37 engines of 34,660 horse-power using waste coke oven gases. Of the above a large number are in operation in electric central stations using suction gases, 40 engines developing 27,550 brake horse-power for this electrical service.

TEST OF 7,500 KW. STEAM TURBINE.

An eight-hour economy test was made on September 1st on a 7,500 kw. Westinghouse-Parsons steam turbine at the Waterside Station of the New York Edison Company. The turbine unit is of the standard Westinghouse construction throughout, and has a maximum rated capacity of 11,250 kw. It was built to operate on 175 lbs. steam pressure, 28 in. vacuum, and 100 deg. superheat. Under these conditions the turbine was guaranteed to have a minimum steam consumption of 15.9 lbs. per kilowatt-hour with a normal speed of 750 revolutions per minute. The electrical efficiency of the generator was guaranteed to be 97.8 per cent., exclusive of friction and windage.

The results of the tests, calculated for the conditions as actually run, were as follows:—

Duration of test	8 hours.
Average steam pressure at throttle	177.5 lbs.
Average superheat at throttle	95.74 deg.
Average vacuum	27.31 in.
Average load on generator	9,830.48 kw.
Average steam consumption	15.15 lbs.

It will be noted that the conditions under which the tests were run were somewhat different from those under which the guarantee was made, and when corrections are made for these differences it shows that the water rate for the turbine was 14.85 lbs. per kilowatt-hour, or 1.05 lbs. less than the guaranteed rate.

CEMENT PLANT FOR MONTREAL.

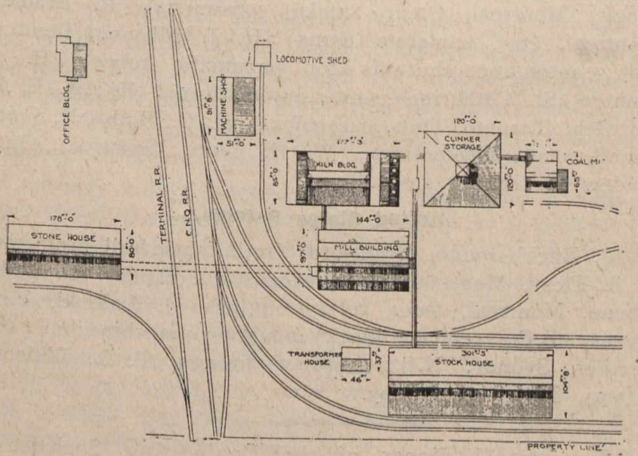
Among the most recent activities in the manufacturing industries of the city of Montreal, is the construction of a large cement plant at Longue Pointe (Island of Montreal), for the Vulcan Portland Cement Company, of Canada, which when completed will have an ultimate capacity of 4,000 barrels daily and will rank with the largest producers of this material in Canada.

This plant now rapidly nearing completion is located on property having a frontage on the St. Lawrence River of 1,200 feet and extending north or inland about two miles. The quarries located near the centre of the property and believed to be inexhaustible, produce an argillaceous limestone of an almost naturally mixed Portland cement character, while the top soil of the property is a very desirable form of clay which can be used in the manufacture of the cement.

Space does not permit of a detailed explanation of the process of manufacture, which is the usual American dry method of handling the raw materials, except that many improvements have been inaugurated and departures made from standard practices, effecting considerable economy in cost of manufacture by reducing manual labor to a minimum.

The principal departures from ordinary practice are the arrangement of apparatus in the stone house and the method of handling and crushing the cement rock. Belt conveyors are used extensively and in a unique manner, connecting the several buildings in such a way that the various stages of production constitute a continuous process from the quarrying of the limestone to the bagging of the finished cement in the packing house.

The plant buildings as shown in the outline plan, consist of a stone house, in which is installed the rock crushing, drying and screening apparatus and large storage bins: a mill building equipped with eight kominuters and ten pebble mills of F. L. Schmidt design, which are used for grinding the raw material and also the clinker: a kiln building in which are installed four Vulcan rotary kilns, 125 feet long by 8 feet in diameter; a clinker storage building, a coal mill, a stock and packing house, having a capacity of 200,000 barrels, a machine shop, a transformer station, and an office building. All foundations for the buildings, machinery, floors and bins are of concrete construction. Main foundations are four feet wide and fifteen feet high, it being necessary to reach a depth



General Plan of Vulcan Portland Cement Company's Plant, Montreal.

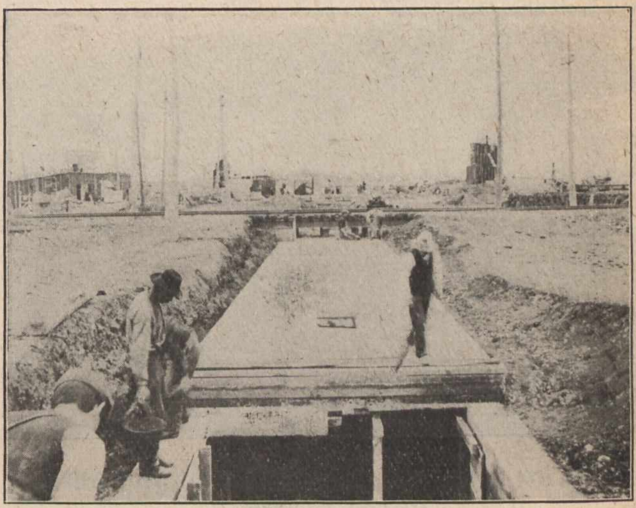
of six feet below ground level in order to place the footings below the frost line.

The superstructure consist of fabricated steel frames, columns and trusses, with corrugated steel sides and roofs except in the case of the stock house which is of reinforced concrete throughout with a composition roof, tending to prevent condensation.

The construction of this reinforced concrete stock house is well worth a detailed description. The design is out of the ordinary. Instead of erecting the building in the usual way, of placing the reinforcing steel in the concrete as the work progressed, an entire structural steel skeleton complete in every detail was erected first, the form work was then set up and the concrete placed around the steel work. This stock house is one of the most complete and permanent structures of its kind on the continent.

As evidence that only the most modern methods of design and construction have been employed throughout, is the fact that the entire plant is to be electrically operated.

Individual motor drive is used wherever feasible and elsewhere the machinery is so grouped, that friction and other losses are reduced to the lowest minimum consistent with a conservative investment, at the same time increasing the general plant operating economies to an extent which places



Belt Conveying Tunnel Between Stone House and Mill Building, Vulcan Portland Cement Co.

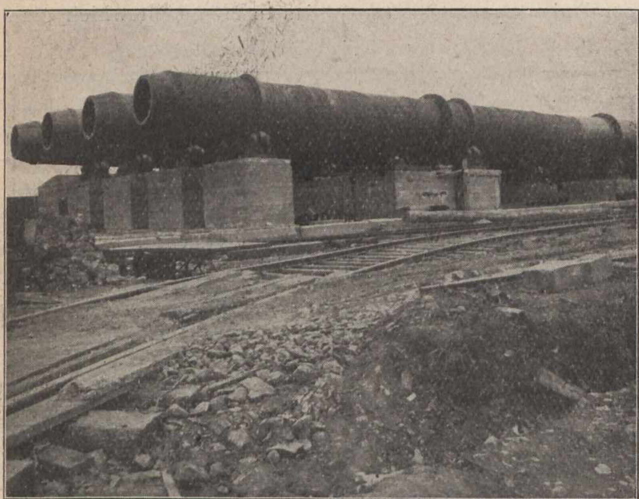
the plant in the foremost rank of cement manufactories similarly operated.

Since it is generally conceded that cement-making machinery is subject to a much greater strain and rougher treatment than that of other industries, it can readily be seen what careful attention must be given, and accurate determinations made, from an engineering point of view, to insure successful operation under such severe conditions.

As regards the electrical operation, three phase alternating current will be taken from the transmission lines of the Shawinigan Water & Power Company, which cross the Vulcan Portland Cement Company's property, transmitted at a pressure of 44,000 volts to a transformer station located at the plant and there reduced through transformers to 440 volts at which pressure the motors will be operated. The Power Co. maintains two separate and distinct high voltage transmission lines which eliminates on the part of the Cement Company the necessity of providing break-down apparatus.

All crushers and dryers in the stone house, as well as the kominuters, tube mills and grinders in the raw material mill, will be driven by individual motor, while the rotary kilns will be operated by a single motor so arranged, that any or all kilns can be driven therefrom. All belt conveyors and coal handling apparatus will also be electrically driven. The motors, ranging in size from 5 horse-power to 150 horse-power are of the well-known slow speed squirrel cage type, except that they are equipped with special dust proof bearings. The total motor installation will aggregate 3,000 horse-power. One of the most interesting features of the plant will be the method of handling, storing and reclaiming the large quantity of coal used for kiln and power purposes.

Requiring a coal low in sulphur and in ash, Pennsylvania slack will be used exclusively, which will be brought in in barges through the Great Lakes and the St. Lawrence River. This necessitates a permanent dock, extending to the ship channel, which will be constructed on the water side property of the Vulcan Portland Cement Company. The dock will carry a mast and gaff outfit with an unloading capacity of 75 tons per hour,—elevating and dumping the coal into a hopper, which in turn feeds a car of an automatic make running on a trestle across the storage area and dumping automatically. The coal is then spread over the storage area by means of a cableway of 800 feet span and consisting of two movable towers capable of assuming any point between the dock and a point 400 feet inland, giving a storage area of approximately 400 x 800 feet. A clam shell bucket of 1½ yards capacity, running on a cable suspended between the towers spreads the coal to a depth of 10 feet. The same cableway is used for reclamation purposes when desired. The coal being carried by cars to the coal mill three quarters of a mile away, where it is in turn passed through the crushers, dryers

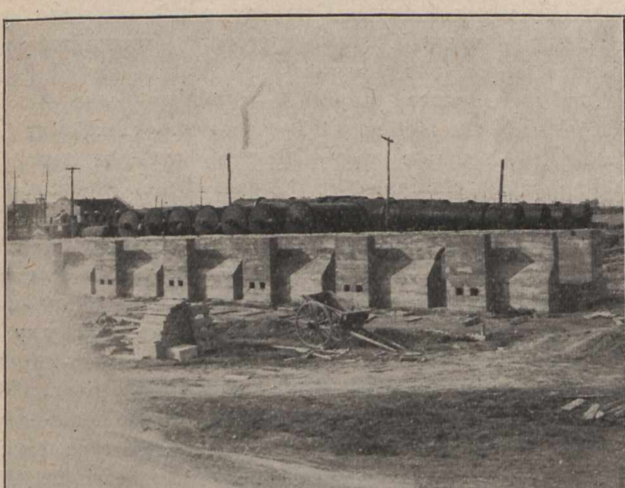


Kilns Set on Concrete Foundations, Vulcan Portland Cement Company.

and ball mills, thence conveyed to the kilns on belt conveyors. It is estimated that 50,000 tons of coal per year will be used, while 40,000 tons will be kept in storage.

The plant is unusually situated as regards transportation facilities, afforded through the agency of the St. Lawrence River, the Canadian Northern Quebec Railway, the Canadian Pacific Railway and the Montreal Terminal Railway, all of which railroads have established side tracks on the Cement Company's property.

The engineering work and most of the construction in connection with the building of the plant has been done by



Ball Mills and Kilns in Position, Vulcan Portland Cement Company.

W. S. Barstow & Company, Inc., of New York, Montreal and Portland, Ore., which company is also building a large cement plant for the Virginia Portland Cement Company, of Fordwick, Va. The Canadian White Company has the contract for the concrete work and erection of structural steel for the Vulcan Portland Cement Company. It is expected that the manufacture of cement for the Canadian market, at the Longue Pointe plant, will begin about January 1st, next. The Wm. G. Hartranft Cement Company, of Montreal, will be the selling agent for the products of this company.

CEMENT FOR PANAMA CANAL.

Investigations have been made by the United States Geological Survey to determine whether suitable materials are available for manufacturing the cement on the Isthmus, and with what economy, since it is estimated that about five million barrels of cement will be required in the building of the Panama Canal, according to the Railway Review, limestone of suitable composition, sufficient in quantity, and within convenient transportation distance, was not found, but there is an abundance of coral rock in the vicinity of Colon. This is a remarkably pure lime carbonate, with a relatively large amount of iron, which it is thought should give the cement a property well calculated to resist the decomposing effects of sea water. The supply of coral rock may be readily obtained either by dredging or by surface excavation from reefs bordering the coast. For argillaceous material mud from the Chagres River or the French Canal, of uniform and desirable composition, and in sufficient quantity, can be obtained and dried under cover. An equally desirable substitute for this is rhyolite tuff, located near the Panama R. R., about 20 miles from the proposed mill site which has been picked at a point about midway between Gatun and Colon. Samples of cement were made from these materials at Allentown, Pa., with excellent results. One sample was made from coral rock and clay, a second from coral and rhyolite tuff, and a third from coral with a mixture of equal parts of clay and rhyolite tuff, with nearly uniform results in three cases. The three kinds of fuel available are coal from the United States, at $4.50 per ton; oil, at 80 cents per barrel; and lignite, in local deposits, to be used with a gas producer. It is thought that, all things considered, coal from the United States would be the most desirable fuel. It is estimated that a plant capable of producing one million barrels of cement per year would cost about $1,500,000.

LIST OF RECENT CANADIAN PATENTS.

Below will be found a list of engineering patents recently granted to Canadian inventors in Canada and the United States. This list comes to us from Featherstonhaugh & Company, of Toronto and Montreal:—

Canadian Patents.

J. F. Ross, Toronto, Ont., sheet metal packings; J. R. Black, Montreal, Que., smoke consumers; E. Bradley, Montreal, Que., concrete dams; H. J. Allison, Trenton, Ont., automatic shut-offs for pneumatic tubes; H. J. Stanton, St. Catharines, Ont., automatic cut-offs; A. E. E. Norwich, Toronto, Ont., car trucks; E. G. Bothwell, Owen Sound, Ont., locomotives; W. H. Quin, Swansea, Ont., sanders for rolling stock.

United States Patents.

P. Buckborough, Brantford, Ont., fabric roll protector; L. A. Desy, Montreal, Que., excavator scrapers; U. Duleschene, Montreal, Que., rotary engines; J. Lalfield, Vancouver, B.C., cement block moulding machine; F. O. Werther, Sydney, N.S., fireproof lining; T. L. Willson, Ottawa, Ont., signal buoy.

The annual dinner of the Engineering Society of Queen's University was held in Grant Hall, Kingston, on the evening of December 6th, and proved to be one of the most successful in its history. Upwards of two hundred and fifty members and guests were present. Principal Gordon spoke of the resources of Canada, and the relation of engineers to this development. He also referred to the loss sustained by Queen's University in Professor Brock's appointment to the position of Deputy Minister of Mines for the Dominion. Mr. J. Butler, Deputy Minister and Chief Engineer for the Department of Railways and Canals, referred briefly to the various Provinces of the Dominion, and to the work done by the Government in aiding the railways and canals. Addresses were also given by Professors Watson, Nicol, C. H. McLeod, and by Messrs. Frank C. Loring, J. B. Tyrrell and others

IMPERMEABLE CONCRETE.

One of the most desirable characteristics of concrete at the present time in connection with its physical resistance to the results of loading is impermeability to water, says the Engineering Record. Although the ultimate compressive resistance of the strongest concrete is far below that of the best natural stones, it is high enough to meet the exacting requirements of masonry in most engineering structures, and its lack of tensile resistance is effectively cured by steel reinforcement. In spite of the fact that its real merits, intrinsically of a high order, have at times been greatly exaggerated and grossly overworked by ignorant and ill-judged advocates, concrete is rapidly becoming one of the most valuable of all our structural materials for engineering purposes, if, indeed, it has not already reached that position. It is employed in many cases where its main function is that of carrying loads, but at the same time where the quality of real impermeability would add greatly to its value. This is not only true in an extended range of engineering structures, such as dams and aqueducts, but also in its application to buildings both en masse and in blocks. If concrete could be given a truly impermeable character its value would be greatly enhanced and its field of usefulness would be even more rapidly extended than at present.

The great obstacle heretofore experienced in making concrete waterproof has been its highly porous character. With the dry mixtures used in times past, the porosity of concrete was excessive and not the least of the many advantages accruing to the use of wet mixtures is the greater solidity or density conferred upon the mass. A wet mixture not only causes all portions of the mass to run together in greater solidity, but it enables the finer materials of the aggregate to flow freely and thoroughly into the spaces between the coarser particles, thus producing a much more nearly continuous and dense interior mass. This means obviously a greatly reduced permeability to water or a much enhanced capacity to resist seepage through it. In fact, if the cement were ground sufficiently fine to enable it and the finest parts of the sand to enter freely into all the interior spaces of the aggregate, a waterproof material under high intensities of pressure would result; but the wettest mixtures which it is possible to use neither eliminate all the air bubbles nor fill all the interior spaces. However much care may be taken in securing a thorough and intimate admixture of the component parts, all porosity is not eliminated and some seepage results under pressure of forty to sixty pounds per square inch or even less.

If suitably mixed concrete could be put under a high pressure before the initial set takes place, so as to squeeze out all air and surplus water, should there be any, in much the same way as molten steel is compressed in order to produce grades of that metal of special value, it is altogether probable that the resulting density would be sufficient to secure essential impermeability under very high heads. This obviously is impossible, but some recent investigations appear to indicate that there may be other simple means of attaining the much-desired quality of impermeability. In a discussion by Mr. Richard H. Gaines of the paper presented to the American Society of Civil Engineers in April of the current year by Messrs. W. B. Fuller and S. E. Thomson, there are set forth some results of tests made to determine the effect of the addition of certain substances on ordinary concrete mixtures. In the search for materials which may enhance the waterproof character of concrete it is clear that none must be used which will prejudice the resistance or durability of the mixture. Mr. Gaines, who is the chemist of the New York Board of Water Supply, shows that the addition of small percentages of alum solution and fine clay to Portland cement mortar and concrete enhances greatly the impermeability of the mixture, and that both compressive and tensile resistances were increased. Although the number of the tests was relatively small and the life of the test specimens was not long enough to settle conclusively such a question as that under consideration, the results obtained show that the line of investigation followed is worthy of being carried further in order to determine just what value may be attached to the mixture of such materials as were employed with the usual proportions of cement, sand, and gravel or broken stone in the manufacture of mortar and concrete.

It has been indicated by tests that, contrary to the former opinions of engineers, the presence of small percentages of fine clay of a suitable character and properly mixed does not necessarily injure the strength of concrete, and it has also been shown that the same mixture may aid in attaining more nearly waterproof qualities. Up to the present time, however, investigations of this kind have not been carried far enough to give quantitative results of sufficient range for practical purposes. It has generally been considered that the effect of fine clay in reducing the porosity of concrete was wholly mechanical, but the modern view of physical chemistry, so to speak, may disclose a different significance to the results of use of fine clay for such a purpose. With the modern wet concrete mixtures, the percentage of the clay is asserted by Mr. Gaines to induce a collodial action which is apparently aided by such a solution as that of alum, so that the result is a modification of the interior mass, tending to eliminate ordinary porosity.

There is nothing new in the employment of an alum solution as well as various soap solutions to afford concrete a certain degree of impermeability to water, but the purpose hitherto has been to produce an impermeable surface rather than an impermeable mass, which the results of Mr. Gaines' experimental work appear to indicate as attainable. The great advantage of securing an impermeable or waterproof mass of concrete over superficial effects is so clear as to need no comment. This observation is especially pertinent to all reinforced concrete work, in which it is of the first importance to protect the steel reinforcement from corrosion. At the present time it is difficult to imagine any greater benefit to be conferred upon all classes of concrete work than to find some simple and effective method of making it waterproof under reasonably high pressures. Such an investigation should also include tests with hydrated lime and the various proprietary waterproofing compounds now extensively used, some of which seem to be giving good results when added to the usual concrete mixtures.

The location of the cement industry in Hastings County is a rocky point three and a half miles east of Belleville, which extends for about a mile into the Bay of Quinte and has a width of about a mile. There are two points which are formed by an indentation of the shore, and which are known locally as Point Ann and Ox Point, the former lying to the westward, and consequently nearer to the city than the other.

On this promontory there is an inexhaustible supply of the best quality of plaster rock, and clay of suitable quality overlies the rock, and is in abundant quantity on the bay shore within a few miles of the valley at places most favourable for shipment.

The mills of the Belleville Portland Cement Company are located on Point Ann. They were put in operation three years ago, with a capacity of 1,000 barrels per day, but the plant has been so greatly enlarged of late that the capacity is now nearly 2,000 barrels per day, and employment is given to about four hundred men.

Half a mile to the eastward, on Ox Point, the Lehigh Cement Company have had an army of men busy on their new plant since early spring, but there is much yet to be done. This plant will have a capacity of 6,000 barrels per day, and the shipping facilities will be admirable, as the works are connected by rail with the Grand Trunk, and extensive wharves have been built out to deep water.

THE NEW RATEAU TURBO-COMPRESSORS.

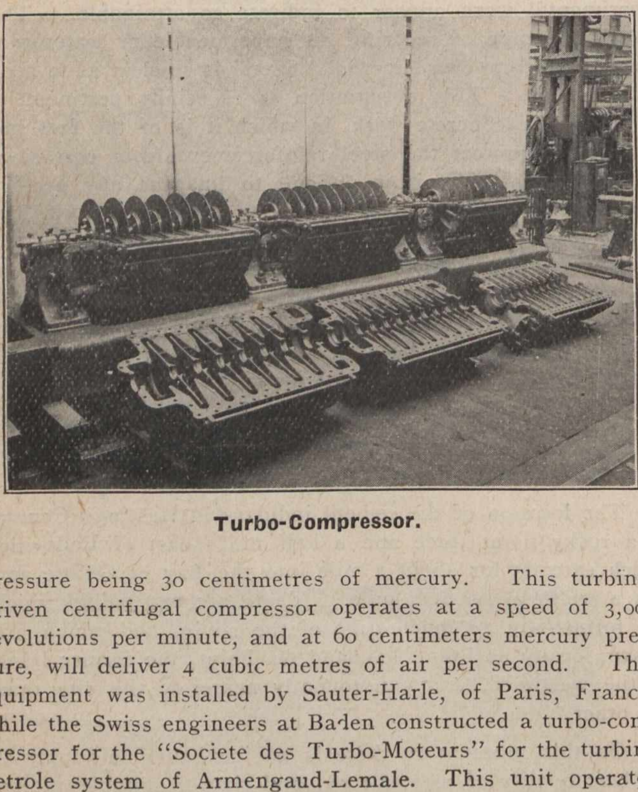
There is great interest at the present time in the new multi-cellular high pressure turbo-compressors on the French Rateau System. These centrifugal compressors have only recently been developed and it is maintained they have shown themselves to be superior to the ordinary compressors of the reciprocating type.

There are many advantages to be gained by the direct connection of the motive power in the form of high and low pressure steam turbines with a satisfactory and efficient rotary compressor. For mining service these units are particularly desirable where compressed air is utilized to advantage for pneumatic drills, air locomotives, mining hoists and other mining machinery operated to advantage by compressed air.

It is also maintained that by not combining the entire power plant in an electric generating and distribution system, the mine is less liable to be completely shut down by any accident to the electric power plant.

In iron and steel plants, the turbo-compressor has also been found useful, a great field being open for these centrifugal blowers for supplying the blast for Bessemer converters. Units of 1,500 horse-power, 2,000 horse-power, and 4,000 horse-power are available, the turbo-compressors supplying air under a pressure of 8 atmospheres. At Baden, Switzerland, Rateau Turbo-Compressors are under construction, and have been installed by Brown, Boveri & Cie, for a number of plants including the Guttehoffnungs hutte, Rheinland, Germany, and the "Ateliers Electriques de Charleroi."

The Rateau Turbo-Compressor at the "Hauts-forneaux de Chasse," in Isere, supplies 7.2 cubic metres per second, the



Turbo-Compressor.

pressure being 30 centimetres of mercury. This turbine-driven centrifugal compressor operates at a speed of 3,000 revolutions per minute, and at 60 centimeters mercury pressure, will deliver 4 cubic metres of air per second. This equipment was installed by Sauter-Harle, of Paris, France, while the Swiss engineers at Baden constructed a turbo-compressor for the "Societe des Turbo-Moteurs" for the turbine petrole system of Armengaud-Lemale. This unit operates at 4,000 revolutions per minute, and supplies 1,100 litres of air per second with an absolute pressure of 5 kilograms per square centimeter.

Among the other important turbo-compressors recently installed by Sauter-Harle & Cie, should be mentioned the plant at the Bethune mines. There is an accumulator at this installation which contains 72,000 lbs. of water and is fed by an intermittently acting hauling engine and ventilating motor, also a continuously working pump motor. It is stated that these three engines supply 6,000 kilograms of steam per hour.

The multicellular high pressure centrifugal compressors are driven by the low pressure turbines taking in 60 cubic metres of air, and delivering it at a pressure of 7 kilograms per square centimeter in absolute value, this proving a most economical plan, in using the waste exhaust steam in low pressure turbines with the air of a steam accumulator.

A turbo-ventilator was installed by Sauter-Harle at the Haut-forneau de Commentry some time ago, which has given good satisfaction, this unit being of 100 horse-power and operating at the very high speed of 15,200 revolutions per minute.

The curves of these turbo-compressors are of particular interest, showing the efficiency to be good and the operation very favorable as compared to the ordinary reciprocating or piston type of compressors.

TRADE INQUIRIES.

The following have been received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S W., England:

Sanitary Appliances.—A North of England firm desires to appoint agents in Canada for their sanitary appliances for domestic and public buildings, and their sewage purification plant.

Fire Bricks.—A Midlands firm makes inquiry concerning the sale in Canada for fire bricks of the best Stourbridge quality.

Iron, Steel, Coal, Etc.—A commission agent in London desires to get into touch with Canadian importing firms connected with the iron, steel, iron ore, coal and shipping trades.

From the City Trade Branch, 73 Basinghall Street, London, E.C.:

Pig Iron, Etc.—A Scottish firm in a position to supply pig iron of all brands and qualities, ferro-manganese, silico-spiegel, spiegeleisen, ferro-silicon, etc.; also Scotch and English fire bricks, would be glad to get into touch with Canadian buyers.

Bearings.—A Canadian company manufacturing a special style of bearing which is particularly adaptable to textile mills wishes to get into communication with some influential Indian firm handling machinery and supplies, which could introduce these appliances to the Indian cotton and jute mills.

Sanitary Tile.—A Montreal firm is open to represent a first-class United Kingdom manufacturer of sanitary tiles.

Steel Plates.—A manufacturers' agent in Quebec is open to represent manufacturers of steel plates of all kinds, and also of steel and cast iron water and gas pipes.

Air Compressors.—An English company manufacturing patented air compressors, as used in engineering works, collieries, mines, etc., seeks a first-class Canadian agent—residing preferably in Montreal or Toronto—who possesses the necessary connection for the introduction of their appliances.

From the Department of Trade and Commerce, Ottawa, Ont.:

Mining Machinery.—A correspondent at Stockholm, Sweden, wishes to secure a purchaser in Canada for an invention for separating copper, nickel and cobalt ore.

Machinery.—A London firm desires to obtain the names of the leading importers of machinery in Canada, who might be interested in their specialties in steam and hand-power laundry and dairy machinery.

Cranes.—A North of England firm manufacturing all kinds of cranes and lifting machinery desires to hear from Canadian importers.

Mica.—A Lancashire firm importing large supplies of mica desires to get into touch with producers and exporters in Canada.

MONTREAL.—There are at present some two thousand men at work on the Davis contract on the Transcontinental, extending 150 miles east of Point Levis. This contract, which was awarded to Messrs. M. P. and J. T. Davis, extends to within about fifty miles of the New Brunswick border line, and runs back about 20 miles from the Intercolonial Railway. About forty per cent. of the work is rock cutting.

CONVERSION OF CHAIN MEASURE.

The following interesting solution for the conversion of Engineer and Gunter Chains, sent to the Canadian Engineer through the courtesy of Mr. W. H. Pretty, Peterboro, might be found useful:—

An Engineer's Chain = 100 feet = 100 links of 1 foot each.
A Gunter's Chain = 66 feet = 100 links of 0.66 foot each.

(*a*) To convert Engineer's Chainage into Gunter's Chainage.

$$\text{One Engineer's Chain} = \frac{100}{66} \text{ Gunter Chain}$$

$$= (1+\tfrac{1}{2}) + \frac{1}{100}(1+\tfrac{1}{2}) + \frac{1}{10000}(1+\tfrac{1}{2}) \text{ \&c. Gunter's Chains}$$

$$= 10^0 (1+\tfrac{1}{2}) + 10^{-2}(1+\tfrac{1}{2}) + 10^{-4}(1+\tfrac{1}{2}) + \text{\&c. Gunter's Chains}$$

Let x = a length in Engineer's Chains

y = the same length in Gunter's Chains

$$\text{then } y = x(1+\tfrac{1}{2}) + \frac{x}{100}(1+\tfrac{1}{2}) + \frac{x}{10000}(1+\tfrac{1}{2}) + \text{\&c.}$$

$$= A_0 + A_2 + A_4 + \text{\&c. (Say)}$$

EXAMPLE—Let x = 256 Chains 35.2 Links = 256 + 35.2.
= 256.352 Chains.

then A_0 = | 256.352
128.176

384.528 = $x(1+\tfrac{1}{2})$.

and $\therefore y$ = | 384.528 .... = A_0
3.84528 .... = A_2
384528 .... = A_4
384528 &c. .... = A_6

388.412117328 + &c.

= 388 Chains 41.2 Links, very nearly, in Gunter's Measure.

The degree of accuracy can be carried to any extent and chosen to meet the quantities dealt with.

(*b*) To convert Gunter's Chainage to Engineer's Chainage.

$$\text{One Gunter's Chain} = \frac{66}{100} \text{ Engineer's Chains.}$$

$$= (\tfrac{1}{2}+\tfrac{1}{10}) + \tfrac{1}{10}(\tfrac{1}{2}+\tfrac{1}{10}) \text{ Engineer's Chains.}$$

$$= 10^0 (\tfrac{1}{2}+\tfrac{1}{10}) + 10^{-1}(\tfrac{1}{2}+\tfrac{1}{10}) \text{ Engineer's Chains.}$$

Let y = a length in Gunter's Chains.

x = the same length in Engineer's Chains.

$$\text{then } x = y(\tfrac{1}{2}+\tfrac{1}{10}) + \frac{y}{10}(\tfrac{1}{2}+\tfrac{1}{10})$$

$$= B_0 + B_1 \text{ (Say)}$$

EXAMPLE—Let y = 388 Chains 41.2 Links = 388 + 41.2
= 388.412 Chains.

then $B_0 = y(\tfrac{1}{2}+\tfrac{1}{10})$ = | 194.206 .... = B_0
38.8412 .... = B_1

233.0472

$\therefore x$ = | 233.0472 .... = B_0
23.30472 .... = B_1

256.35192

= 256 Chains 35.2 Links, very nearly, in Engineer's Measure.

This conversion is absolute and requires only the two terms B_0 and B_1

It is possible that Spokane, Wash., may have a $300,000 concrete bridge. The Spokane River passes through the centre of the city, and the Monroe Street bridge, one of the most important bridge thoroughfares in the city, as well as the longest and probably the highest city bridge in the West, will have to be replaced or repaired. Professor W. H. Burr, bridge expert recently engaged to examine and report on the cost of repairing the present bridge and also on the cost of a new steel structure and a reinforced concrete bridge, has presented his report, which strongly favors the erection of an entirely new bridge. He places the cost of repairing and strengthening the bridge at $185,000. A new steel bridge would cost about $250,000, according to Professor Burr, and a reinforced concrete bridge about $300,000. He recommends the latter as it would be practically permanent and would cost much less for maintenance than a steel structure.

JONES' HIGHWAY BRIDGE, ST. JOHNS, QUEBEC.

An article appeared by Mr. R. Balfour on "Wooden Trestles" in the issue of the Canadian Engineer for November 1st, 1907, in which reference was made to Jones' Highway Bridge over the Richelieu River at St. Johns, Que., a striking example of endurance in wooden structures, built by Mr. R. A. Jones, of St. Johns, in 1827. The following interesting letter, giving in some detail the history, as well as further particulars of this wooden bridge, has been sent to the Canadian Engineer by Mr. W. R. Ryder, a contractor, who came to Montreal from London in 1844. The accompanying illustration appeared in the article by Mr. Balfour, but is of special interest since it shows in some detail the work described by Mr. Ryder.

Editor Canadian Engineer:

I became known to the Hon. R. Jones, who in 1847 consulted me on the "defects" (as he called them) of his bridge. It was then that I made a thorough inspection of his bridge, and continued to do so periodically afterwards, and in the spring of 1863 made a permanent engagement, becoming almost sole manager, which continued until the appointment of the present manager in June 1901.*

The "defects" he complained of, I found to be the vibration and swaying of the bridge in the first place, and at the large span of over 80 feet in the clear, left for rafts to pass through—over which was a King post truss, with the King post much higher than necessary. I found the construction dangerous in consequence of the heavy south winds prevalent in this part of the river Richelieu. The swaying of the bridge was much relieved by placing cross braces under the flooring. I suggested changing the King post truss for a Queen post truss, which was framed and put up by me in 1849, which was a success, and the swaying greatly remedied by laying long tram plates of wide iron (laid in 1864) which greatly saved wear and tear on the bridge, and much assisted vehicle traffic, and to a certain extent, helped swaying.

The bridge, when first built, was not in appearance as it is at the present time. It was built on upright posts, framed into a cap of heavy timber, and a bed sill in the river, with braces put at the end. This I very soon changed, putting the braces on the flat of the posts, with a joint at the head, taking in the cap. The bed sill was a bad plan, being flat on the clay bed of the river, which gave the chance of heavy ice to glide down the stream. Piling would have been better, but piling was not so common in those days as at the present, consequently in the first three years, heavy ice shores made the bridge very crooked in several parts; one part was as much as 6 feet 2 inches down the stream. This took much strength from the bridge and helped the swaying. I wanted Mr. Jones to let me straighten it, but he feared the great work.

The Hon. R. Jones died in January 1874. I pushed again my idea, and his son, one of the present proprietors, consented to my taking up the work, and in the season of 1877 and 1878 I completed it. and the general overhauling of removing trusses, taking out old timbers and replacing with new, and with a new 3-inch pine plank flooring from one end of the bridge to the other.

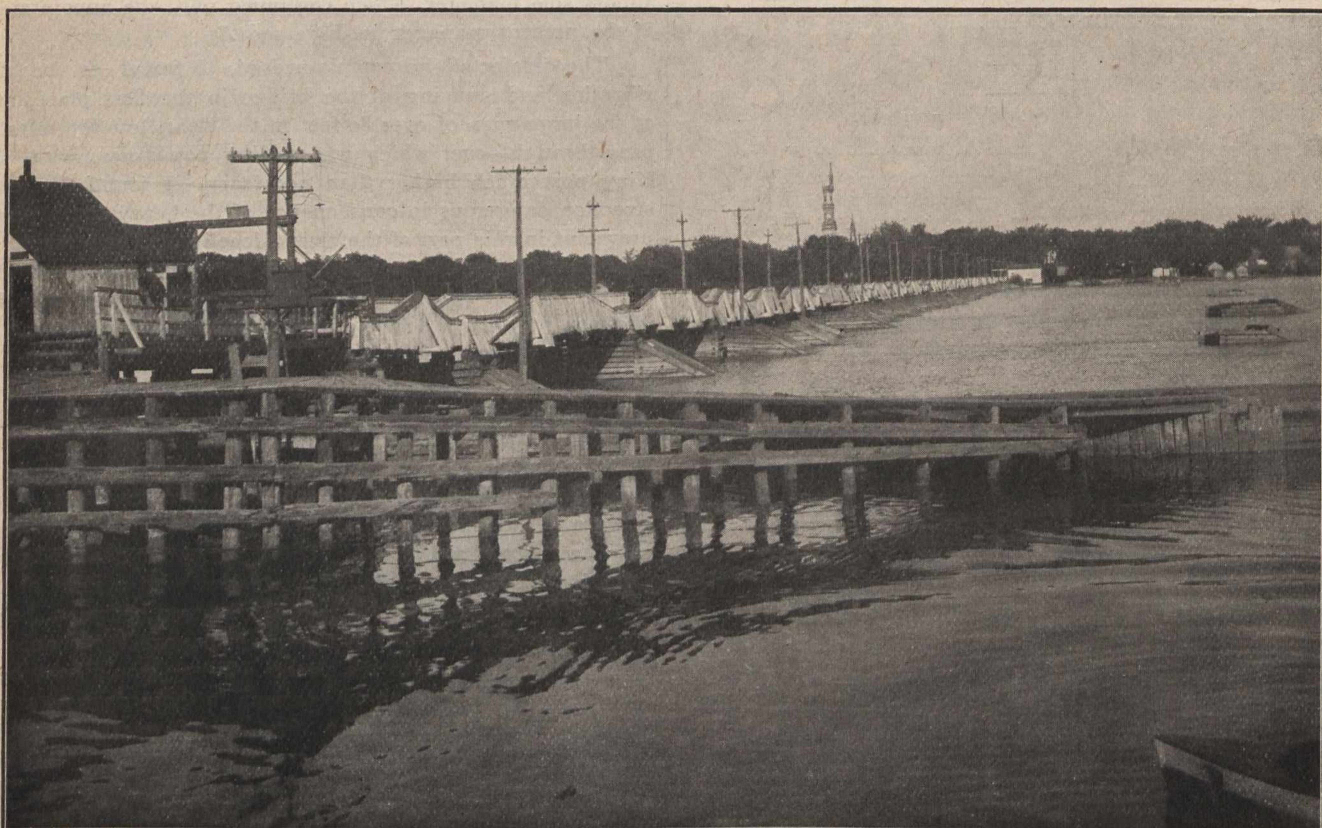
The bridge with its approaches and swing draw over the canal is nearly 1850 ft. long. There are two roadways. There are 21 Queen post trusses over spans of 64 feet and three trusses over the large span of 80 feet. In composing the smaller trusses, two bolts pass through the collar beam and head of rafter and tie beam (1¼-inch iron) form the Queen post, and support a pair of binders, thus dividing the span into three lengths, these support the joists and flooring.

At the conclusion of this extensive work, I made and furnished a detailed report in January 1879, giving every particular to each proprietor. The Hon. R. Jones was not a

* During this long time maintenance of the bridge had been well attended to. A battery of artillery had passed to and fro over it in presence of Col. Pipon and his officers, heavy circuses and general heavy traffic passed over it without any accident ever occurring.

mechanic, as we would understand it, but we must allow that he was a good commonsense mechanic. He knew the value of good timber, and the proper time of the moon, as he believed it, when to cut it from the ridge land, with as little sap as possible. He possessed a large tract of timber land, and it was the work for the carpenter (a perfect broad axeman) to reside in the bush for the winter, prepare it and get it out, and when it was employed he knew the best way to preserve it. Every truss was cased with boards and swing joint and bearing, protected from the weather. The end joints of the capping were laid on drips of 3 x 4 grooved to prevent water and dampness staying there.

I must here remark and use the words of that eminent engineer, Walter Stanley, who had made a very close examination of the bridge, and was a witness in the bridge arbitration and the Quebec Government in 1884, when he said: "I find the bridge of very primitive construction, but the good timber, not spared, well placed and well taken care of, is in good condition—much has been renewed, but much remains at this date as sound as when first used in the construction of the bridge—and in examining the truss over the large span, I find it perfectly sound and good."



Jones' Highway Bridge at St. Johns, Que. Built in 1827.

And this after nearly 60 years of its first construction should alter the opinion expressed in your published article, that "Twenty-five years is the life of a bridge." Such also was expressed by Mr. Peters, a Quebec contractor, during our bridge arbitration in 1884. With reference to the truss over the long span, requiring a tie beam nearly 96 feet long, I would remark that I put it in two thicknesses, with hard wood keys at intervals, which were bolted together. This large span was never used for any but common purposes, and in 1900 was made into two spans. The double tie beam was then sound as ever.

The bridge builders for railways in the present day deserve every excuse in this short lived work, in consequence of the exposure to the weather, and the timber furnished with so much sap left in it.

I have remarked that the bridge when first constructed was on bents, which during the first three years from the building of the bridge had suffered much damage from heavy ice shores, which made the bridge very crooked. From that time crib work of cedar was commenced, built around these bents, and then filled with stones that kept them very solid, but no attention to the straightening of the bridge was given until done by myself in 1877-8.

Much of this crib work has been renewed from the water line; below this it only becomes honeycombed by the rapid stream of the Richelieu River.

Yours truly,
W. M. RYDER.

JOINT TRAFFIC BRIDGE AT EDMONTON.

A high-level bridge, two hundred and fifty feet in height, is the work contemplated by the cities of Strathcona and Edmonton. The second vice-president of the Canadian Pacific, Mr. William Whyte, having conferred with all those interested in the project, has stated that work will be carried on in connection with the substructure of the bridge during the coming winter. This season is the most favorable for the work in hand, owing to the fact that the water in the river is then at its lowest. These municipalities have long desired that a joint traffic and railway bridge be erected, and negotiations have been in progress for several months. At the recent visit of Mr. Whyte it was finally decided to construct the bridge. Under the proposed plan the railway bridge will be below the traffic bridge. On the latter there will be provision for a street car system, with a traffic way on either side. The total cost of the completed structure will, it is said, be in the neighborhood of a million dollars, the railway company paying for the portion used by them and the municipalities and Government interested paying also for the portion used by the general public. The traffic bridge is recognized as a necessity of the situation, and the required appropriations will be made, or have been made. The structure will be the highest building in Western Canada, and will be 2,500 feet in length.

A number of questions in connection with the entrance of the railway into the city were considered by Mr. Whyte and the city council. All the matters were brought to final issue, and all that remains to be done is the engrossing of the agreement.

Speaking of the general progress of the construction of the lines of the company in the West, Mr. Whyte stated that during the past season there had been but one difficulty, and this had been the lack of railway ties. This difficulty would be fully remedied during the present winter, and there would be a full supply of ties for the work of next year. Through traffic to Edmonton would be possible over the new line early next season.

REINFORCED CONCRETE REGULATIONS.

The following are approved regulations of the Bureau of Building Inspection for the City of Philadelphia in regard to the use of reinforced concrete, and are given in the December pamphlet issued by the Association of American Portland Cement Manufacturers:—

The term "reinforced concrete" shall be understood to mean an approved concrete mixture reinforced by steel or iron of any shape, so that the steel or iron will take up all the tensional stresses and assist in the resistance to compression and shear.

Before a permit to erect any reinforced concrete structure is issued, complete specifications and drawings shall be filed with the Bureau of Building Inspection, showing all details of the construction, size, and position of all reinforcing rods, stirrups, etc., and giving the composition and proportions of the concrete.

The execution of the work shall be performed by workmen under the direct supervision of a competent foreman or superintendent.

Reinforced concrete construction will be accepted for fireproof buildings of the first class, if designed as hereinafter prescribed; provided, that the aggregate for such concrete shall be clean, broken, hard stone, or clean graded gravel, together with clean siliceous sand of fine grained gravel; should the concrete be used for flooring between rolled steel beams, clean furnace clinkers entirely free of combustible matter, or suitable seasoned furnace slag may be used; when stone is used with sand gravel it must be of a size to pass through a 1-inch ring, and 25 per cent. of the whole must not be more than one-half the maximum size; and provided further, that the minimum thickness of concrete surrounding the reinforcing members of reinforced concrete beams and girders shall be 2-inch on the bottom and 1½ inch on the sides of the said beams and girders. The minimum thickness of concrete under slab rods shall be 1 inch. All reinforcement in columns to have a minimum protection of 2 inches of concrete.

All the requirements herein specified for the protection of steel and for fire-resisting purposes shall apply to reinforced concrete flooring between rolled steel beams as well as to reinforced concrete beams and to entire structures in reinforced concrete. Any concrete structure or the floor filling in same, reinforced or otherwise, which may be erected on a permanent centering of sheet metal, of metal lathing and curved bars or metal centering of any other form, must be strong enough to carry its load without assistance from the centering, unless the concrete is so applied as to protect the centering as herein specified for metal reinforcement.

Exposed metal centering or exposed metal of any kind will not be considered a factor in the strength of any part of any concrete structure, and a plaster finish applied over the metal shall not be deemed sufficient protection unless applied of sufficient thickness and properly secured, as approved by the Chief of the Bureau of Building Inspection.

All concrete shall be mixed in a mechanical batch mixer to be approved by the Bureau of Building Inspection, except when limited quantities are required or when the condition of the work makes hand mixing preferable; hand mixing to be done only when approved by the Bureau of Building Inspection. In all mixing the material shall be measured for each batch.

When hand mixing is done under the aforesaid limitations, the cement and fine gravel or coarse sand shall be first thoroughly mixed dry and then made into a mortar by gradually adding the proper amount of water. The crushed stone or gravel shall be spread out to a depth not to exceed 6 in. in a tight box or upon a proper floor, and be sprinkled with water as directed, the mortar is then to be evenly spread over the crushed stone, and the whole mass turned over a sufficient number of times, to effect the thorough mixing of the ingredients.

All forms and centering for concrete shall be built plumb and in a substantial manner, made tight so that no part of the concrete mixture will leak out through cracks or holes, or joints, and after completion shall be thoroughly cleaned, removing shavings, chips, pieces of wood and other material, and no debris of any kind shall be permitted to remain in the forms. All forms to be properly supported and braced in a manner to safely sustain the dead load and the load that may be imposed upon them during construction.

The reinforcing steel shall be accurately located in the forms and secured against displacement. Concrete shall be placed immediately after mixing. Whenever fresh concrete joins concrete that is set, or partially set, the surface of the old concrete shall be roughened, cleaned and spread with cement mortar, which mortar shall be mixed in proportions of one of cement to two of sand. Concrete shall not be mixed or deposited in freezing weather, unless precautions are taken to avoid the use of material covered with ice or snow or that are in any other way unfit for use, and that further precautions are taken to prevent the concrete from freezing after being put in place. All forms under concrete so placed to remain until all evidences of frost are absent from the concrete and the natural hardening of the concrete has proceeded to the point of safety.

Concrete laid during hot weather shall be drenched with water twice daily, Sunday included, during the first week. The broken stone, if hot and dry, must be wet before going to the mixer.

The time at which props or shores may safely be removed from under floors and roofs will vary with the condition of the weather, but in no case should they be removed in less than two weeks; provided, that column forms shall not be removed in less than four days; provided further, that the centering from the bottom of slabs and sides of beams and girders may be removed after the concrete has set one week, provided, that the floor has obtained sufficient hardness to sustain the dead weight of the said floor and that no load or weight shall be placed on any portion of the construction where the said centers have been removed.

The concrete for all girders, beams, slabs and columns, shall be mixed in the proportions of one of cement, two of sand or fine gravel, and four of other aggregates as before provided. The concrete used in reinforced concrete-steel construction must be what is usually known as a "wet" mixture. When the concrete is placed in water it must be placed in a semi-dry state.

Only Portland cement shall be permitted in reinforced concrete constructed buildings. All cement shall be tested, in carload lots when so delivered, or in quantities equal to same, and report filed with the Bureau of Building Inspection before using it in the work. Cement failing to meet the requirements of the accelerated test will be rejected.

Soundness, Accelerated Test.—Pats of neat cement will be allowed to harden 24 hours in moist air, and then be submitted to the accelerated test as follows: A pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely-closed vessel, for 3 hours, after which, before the pat cools, it is placed in the boiling water for 5 additional hours.

To pass the accelerated test satisfactorily, the pats shall remain firm and hard, and show no signs of cracking, distortion or disintegration.

Such cements, when tested, shall have a minimum tensile strength as follows:—Neat cement shall, after one day in moist air, develop a tensile strength of at least 150 lb. per square inch; and after one day in air and six days in water shall develop a tensile strength of at least 500 lb. per square inch; and after one day in air and 27 days in water shall develop a tensile strength of at least 600 lb. per square inch. Cement and sand tests composed of one part of cement and three parts of crushed quartz shall, after one day in air and six days in water, develop a tensile strength of at least 175 lb. per square inch, and after one day in air and 27 days in water shall develop a tensile strength of at least 240 lb. per square inch. These and other tests as to fineness, set, etc., made in accordance with the standard method prescribed by the American Society of Civil Engineers, may, from time to time, be required by the Bureau of Building Inspection.

Walls.—Reinforced concrete may be used in place of brick and stone walls, in which cases the thickness may be two-thirds of that required for brick walls.

Concrete walls in such cases must be reinforced in both directions in a manner to meet the approval of the Chief of the Bureau of Building Inspection.

Steel.—All reinforcements used in reinforced concrete shall be of standard grade of structural steel or iron of either grade to meet the "Manufacturers' Standard Specifications," revised February 3, 1903.

Reinforced concrete slabs, beams and girders shall be designed in accordance with the following assumptions and requirements:

(a) The common theory of flexure to be applied to all beams and members resisting bending.

(b) The adhesion between the concrete and the steel is sufficient to make the two materials act together.

(c) The design shall be based on the assumption of a load four times as great as the total load (ordinary dead load plus ordinary live load). (d) The steel to take all the tensile stresses. (e) The stress-strain curve of concrete in compression is a straight line. (f) The ratio of the moduli of elasticity of concrete to steel:

Stone or gravel concrete	1 to 12
Slag concrete	1 to 15
Cinder concrete	1 to 30

The allowable unit transverse stress upon concrete in compression:

Stone or gravel concrete	600 lb. per square inch
Slag concrete	400 lb. per square inch
Cinder concrete	250 lb. per square inch

The allowable unit transverse stress in tension:

Iron	12,000 lb. per square inch
Steel	16,000 lb. per square inch

The allowable unit shearing strength upon concrete:

Stone or gravel concrete	75 lb. per square inch
Slag concrete	50 lb. per square inch
Cinder concrete	25 lb. per square inch

The allowable unit adhesive strength of concrete:

Stone or gravel concrete	50 lb. per square inch
Slag concrete	40 lb. per square inch
Cinder concrete	15 lb. per square inch

The allowable unit stresses upon concrete in direct compression in columns:

Stone or gravel concrete	500 lb. per square inch
Slag concrete	300 lb. per square inch
Cinder concrete	150 lb. per square inch

The allowable unit stress upon hoop columns composed of stone or gravel concrete shall not be over 1,000 lbs. per square inch, figuring the net area of the circle within the hooping. The percentage of longitudinal rods and the spacing of the hoops to be such as to permit the concrete to safely develop the above unit stress with a factor of safety of four.

When steel or iron is in the compression sides of beams the proportion of stress taken by the steel or iron shall be in the ratio of the modulus of elasticity of the steel or iron to the modulus of elasticity of the concrete provided that the rods are well tied with stirrups connecting with the lower rods of the beams; provided, further, that when the rods are used in compression, the approval of the Chief of the Bureau of Building Inspection must be obtained.

In the design of structures involving reinforced concrete beams and girders, as well as slabs, the beams and girders shall be treated as T-beams, with a portion of the slab acting as flange in each case. The portion of the slab that may be used to take compression shall be dependent upon the horizontal shearing stress that may exist in the beam, and in no case shall the slab portion exceed twenty times the thickness of the slab.

All reinforced concrete T-beams must be reinforced against the shearing stress along the plane of junction of the rib and the flange, using stirrups throughout the length of the beam. Where reinforced concrete girders carry reinforced concrete beams, the portion of the floor slab acting as flange to the girder must be reinforced with the bars near the top, at right angles to the girder, to enable it to transmit local loads directly to the girder and not through the beams, thus avoiding an integration of compressive stresses due to simultaneous action as floor slab and girder flange.

In the execution of work in the field, work must be so carried on that the ribs of all girders and beams shall be monolithic with the floor slabs.

In all reinforced concrete structures special care must be taken with the design of joints to provide against local stresses and secondary stresses due to the continuity of the structures.

Shrinkage and thermal stresses shall be provided for by the introduction of steel.

In the determination of bending moments due to the external forces, beams and girders shall be considered as simply supported at the ends, no allowance being made for continuous construction over supports. Floor slabs, when constructed continuously, and when provided with reinforcement at top of slab over the supports, may be treated as continuous beams, the bending moment for uniformly distributed loads being taken at not less than WL-10 in cases of square floor slabs which are reinforced in both directions and supported on all sides, the bending moment may be taken at WL-20; provided, that in floor slabs in juxtaposition to the walls of the building the bending moment shall be considered as WL-8, when reinforced in one direction, and if the floor slab is square and reinforced in both directions, the bending moment shall be taken as WL-16.

When the shearing stresses developed in any part of a reinforced concrete building exceed under the multiplied loads the shearing strength as fixed in this section, a sufficient amount of steel shall be introduced in such a position that the deficiency in the resistance to shear is overcome.

When the safe limit of adhesion between the concrete and steel is exceeded, provision must be made for transmitting the strength of the steel to the concrete.

Reinforced concrete may be used for columns in which the ratio of the length to least side or diameters does not exceed 15. If more than 15 diameters the allowable stress shall be decreased proportionally. Reinforcing rods that are introduced for lateral stresses must be tied together at intervals of not more than the least side or diameter of the columns.

Longitudinal reinforcing rods will not be considered as taking any direct compression.

The contractor must be prepared to make load tests in any portion of a reinforced concrete building within a reasonable time after erection, and as soon as may be required by the Chief of the Bureau of Building Inspection. The tests must show that the construction will contain a load equal to twice the calculated live load without signs of cracks.

Systems of construction differing from the standard already approved and tested, may be required to pass a load, fire and water test.

The Chief of the Bureau of Building Inspection may, from time to time, issue such modifications to these regulations as may be found necessary to conform to modern practice.

The Long Island Railroad will use concrete pile foundations for the new conduit line in the North Shore Yards at Long Island City. The contract has been awarded the Raymond Concrete Pile Company, of Chicago and New York, by J. P. Savage, chief engineer. The conduit, which will be of concrete, will be 1,100 feet long and will carry the feed wires for the electric system. The application of concrete piling to conduit foundations is a novel one, this being the first time such use has been made on a contract of any magnitude. The Abbott-Gamble Company are the general contractors.

STRUCTURAL STEEL VERSUS REINFORCED CONCRETE.

By R. E. W. Hagarty.

Considering that this is one of the first addresses given before the University of Toronto Engineering Society under the new arrangement whereby simultaneous meetings are held by the various "sections" of the Society, I beg to remind you of one of the important reasons for the inauguration of this system. It is, as you know, to establish and encourage free and exhaustive discussion of engineering subjects in the meetings of these distinct branches of applied science, such as the civil and architectural section, to which I have the honor of speaking. In this feature I believe there is a decided advantage. Engineering research may form, in the main, an engineer's life work; consequently, we may assume, possibly, that most of us are students or comparative beginners in the complete understanding of our profession. Considering this, I may, perhaps, presume to address you. For a highly scientific discourse we naturally look to the man of long professional standing and experience. To most of us, however, the liberal discussion of plain engineering conditions has undoubtedly the decided advantage that the mistakes and difficulties of a student are more apt to be appreciated and explained, perhaps, by one who is himself a comparative beginner.

In view of the above, I shall endeavor to enumerate the salient points concerning a subject which I have chosen to call "Structural Steel versus Reinforced Concrete." My aim is merely to compare impartially the relative merits of these two systems of engineering construction.

Just here permit me to say that, owing to the limited nature of this address, no more than a mere outline is advisable. Possibly on this account certain lectures given before the Society have been characterized by vagueness. There may be a slight justification for a misconception of this kind, but, as I have said, lectures cannot properly be other than a synopsis. So much for preliminary remarks by way of introduction.

When an engineering commodity passes the experimental stage and is placed on the market of commercialism, there are several large considerations and severe tests with which it must battle. Theoretical success is fundamental, and especially has this been true in the past few years, when engineering practice has been based on the principles of mechanics, physics, and mathematics. Following this comes a demand for practical possibility. Many designs, like some engineers, are theoretically perfect, but practically impossible; that is, such designs are incapable of erection. However, mere compatibility is a primary condition, and the next requirement embodies practical success in a marked degree. Reinforced concrete, for instance, is just at this stage. Men of great persuasive ability throughout the country are trying to vindicate, by actual use, the practical success of this commodity. The foregoing are some of the considerations referred to. They are, in the main, severe but necessary and beneficial tests. However, there is another test of greater severity than any, one which beginners are apt to neglect, namely, that of financial success.

In the case of the proposed 700 foot span, reinforced concrete arch in New York, the money problem will hardly be considered. But the extreme rareness of any exception to the universal demand for monetary profit proves the unsurpassable importance of the financial test. While this is imperative, there is, however, a very regrettable feature which induces a tendency to skimp design. You are not unmindful of startling examples of this, which have been all too frequent.

The general systems of development of structural materials are similar, and especially in the case of structural steel and reinforced concrete. While enumerating the points of advantage or disadvantage of these respective materials, I would like you to note the bearing of each point on the commercial use and misuse of these commodities. I shall consider, first, structural steel, then proceed to discuss the development of reinforced concrete, and finally its adaptability to certain specific examples.

*From "Applied Science," the official journal of the University of Toronto Engineering Society.

Structural Steel.

Structural steel was originally necessitated by the introduction of railroads about 1839, and its use has steadily increased since that time. It was first used in small culvert spans as beams, and later was applied to the construction of larger bridges. The continued advancement in the use of steel as an engineering material has been due, primarily, to certain physical properties considerably superior to those of any marketable substance to-day.

I. Of these, the first is unit strength, which is exceedingly high in both tension and compression. Merrimen gives the ultimate or maximum strength of structural steel as 60,000 pounds per square inch in both tension and compression. The working stress varies from 12,000 to 22,000. The New York Building Code specifies the following: "All structural steel shall have an ultimate tensile strength of from 54,000 to 64,000 pounds per square inch. Its elastic limit shall not be less than 32,000 pounds per square inch, and a minimum elongation of not less than 20 per cent. in eight inches. Rivet steel shall have an utimate strength of from 50,000 to 58,000 pounds per square inch."

To show a comparison with other materials I beg to quote Merrimen as follows. The values are ultimate compressive strengths in pounds per square inch:—

Brick	3,000
Stone	6,000
Timber	8,000
Structural steel	60,000

I might also add that an approximate average for concrete is 3,000.

Hence, so far as abstract strength is concerned, structural steel is eminent; also considerable uniformity and reliability of strength can be obtained in steel. So strength is an important point for steel.

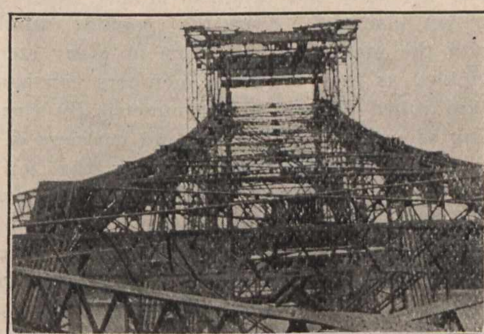


Fig. 1.—Complicated Design.

II. In conjunction with the above comes a property almost equally as great, namely, specific gravity, which is for steel about 7.85, and is remarkably low, considering the high strength value.

The above are two of the most influential reasons for the adoption and continued use of steel. They indicate theoretical and practical possibility.

III. Another property of considerable importance is malleability in mild or structural steel. A specimen of mild steel should, in cold bending, double on itself without rupture. This condition renders practicable rolling the material into standard shapes, such as I's, channels, angles, etc., which are so conveniently and extensively used in structural steel methods of construction.

IV. A fourth property of steel, which also adds to its feasibility, is the low and almost constant coefficient of expansion. The rate of expansion per degree Fahrenheit, according to Kent, is from .00000648 to .00000686. Consequently, accurate calculations with regard to heat expansion are possible. However, it may be well to point out just here that the rate of expansion for concrete is almost the same.

V. The rigidity of steel, as indicated by its modulus of elasticity = 29,000,000 pounds per square inch, is high and comparatively constant up to the elastic limit, while the modulus for concrete is only about 2,000,000, and is not actually constant, making necessary the use of assumptions which, to a greater or less extent, impair the reliability of theoretical reinforced concrete design.

A consideration of the foregoing physical properties of steel accounts for the theoretical and practical possibilities incident with the introduction and continued use of the material. However, its practical success has been due to a series of considerations evinced by practice itself.

I. Of these, the one of greatest importance seems to me to have been the capacity for magnitude of structures designed in structural steel. I refer to large bridges, viaducts, skeleton buildings, etc. The most extensive structures in existence are built of this material; but to definitely impress the huge proportions of what has been at least attempted in steel work kindly permit a few dimensional facts concerning the Quebec Bridge. The structure was of cantilever type, consisting of deck truss approach spans, each 550 feet long; two cantilever arms, each 562½ feet long, and one suspended span 675 feet long, the longest simple truss span ever built. The total central clear span of the bridge from pier to pier was to be 1,800 feet, the longest in the world; while the total length of the bridge was to be 3,220 feet. The depth of the trusses varied from 97 feet at the portals to 315 feet over the main piers; and the height of the peaks of the main post above the river was 400 feet. The clear headway over the high tide was 150 feet, and it was proposed that the new bridge have a clear span of 200 feet in order to permit vessels of the "Mauretania" type to reach Montreal. Magnitude, then, is an important capability possessed by structural steel, which may never be approached by reinforced concrete.

II. In close connection with magnitude comes the possibility for accurate, delicate and complicated design and construction, certainly not attained in any other building commodity yet invented. Even the popular mind is impressed with the marvellous intricacy of many steel structures assembled as they are from members consisting of a few standard rolled shapes, and symmetrically riveted into a fabrication of surprising accuracy and neatness of outline.

The view as shown in Fig. 1 over the top of the south anchor arm of the Quebec Bridge illustrates well this point.

III. Inspection is a potent factor in the safety of structures. Thoroughness in this respect is facilitated to a high degree in the methods employed in steel construction. A large portion of the work is done in the shop of the bridge company who may be the contractors for a certain piece of steel work. Large members are fabricated in the shop and shipped as unit pieces to the place of erection. Individual members weighing as much as 100 tons were used on the Quebec Bridge. It may be easily understood, then, that shop inspection is considerably superior to field inspection, which predominates in reinforced concrete construction. Hence, the inspection of structural steel is decidedly more reliable than is that of the other system.

IV. The same condition that increases the efficiency of steel inspection also necessitates the probability of first class workmanship. Judging even superficially from the nature of shop work its superiority over field work is evident. The systematic concentration of the designing office, the drawing office, the template shop, and the various accessories of the structural workshop, such as electric cranes, pneumatic hoists, high-pressure punching and riveting machines, is bound to induce good workmanship as opposed to the rough-and-ready temporary methods prevailing in the field. This apparency is verified by experience. Years of observation of the manufacture of steel also has its effect on good workmanship.

The prominence of this argument in favor of steel is also well shown by the Quebec Bridge disaster. A professional man viewing the tangled mass of steel which overhangs the south main pier cannot but observe the excellent character of the workmanship which must have been placed in the material for that bridge. The steel overlying that pier, as shown in Fig. 2, has fallen with a tremendous momentum a distance nearly twice as high as the Traders Bank Building, Toronto (nearly 400 feet), and still there appears but little rupture of material or dissembling of parts.

This is, indeed, a wonderful tribute to a condition of almost perfect workmanship which has been attained in structural steel practice.

V. The problem of erection is much simplified by methods of steel work. Members are assembled and erected by derrick or traveller, and are fitted into place with ease and accuracy, and are then bolted or riveted. Hence, ease of erection is another very strong point in favor of structural steel.

From the reasons set forth in the foregoing the extreme and indispensable value of steel in engineering construction is apparent.

Nevertheless we have still to deal with the financial question. With the invention of the Bessemer process the cost of mild steel as used in large quantities was reduced 75 per cent. or more, making the material financially possible. Further, with the closing years of the nineteenth century came a demand for steel which fully doubled the market for this commodity. Conditions imposed on owners of property lying within the business districts of large cities are responsible for the adoption of what is termed the high building. Centralization of business promoted a high increase in land values around these centres, such as the "Heart of Chicago." Consequently a demand for paying investments, and, therefore, for more floor space, led to the erection of the high building, when "skeleton" construction came into vogue. The extensive space occupied by the solid masonry construction was greatly decreased by the structural steel column, and on this account steel became a great financial success.

Fig. 2.—View of Main Pier after drop of nearly 400 feet.

The items, gentlemen, that I have thus far endeavored to enumerate have been decidedly pro structural steel. Within recent years there arose an argument in favor of steel construction which has been more distinctly popular than any, but the fallacy of this very argument forms the connecting link in the evolution of reinforced concrete. I refer to the fireproof question, which will be dealt with later.

Reinforced Concrete.

The durations of existence of structural steel and reinforced concrete are roughly in the proportion of a century to a decade, and all fair considerations of the possibilities of the latter material must take this into account. The process of establishing reinforced concrete has been similar in its stages to that of steel, but the discussion will be somewhat different. Steel has been established by a series of favorable points as mentioned before, and its progress has been repelled by one or two large properties of doubtful economy, fireproofness and durability. These have led to the spontaneous establishment of the newer material, which in reverse, strangely enough, has to battle with the less important, but more numerous considerations which built up structural steel.

Considerable theory has been developed concerning reinforced concrete, such as the formula of Talbot, Hatt, Thacher, and others. These calculations are based on the special ability of concrete to withstand compression, necessitating the use of only a small amount of steel placed in such a way as to assist the concrete in tension. The theory assumes a condition of no slipping of the embedded metal in addition to some assumptions common to both systems of design. The general reliability of concrete as a material is not as good as that of steel, and hence design is affected as regards pure theory. However, most of the manufacturers of steel reinforcement have devised empirical formulae which are founded on theory and which continued use has verified. The Kahn system state that over $22,000,000 worth of reinforced concrete has been designed and constructed according to their system. We may say then that theoretically reinforced concrete is a success.

Resistance to slipping, or the "bond" between steel and concrete is a question of great practical significance. The many patent systems of reinforcement pay more or less attention to this requirement. But the Johnson corrugated bars have been designed with special regard to bond. The surface of the rods is a series of regular indentations, or recesses, hence when a reduction in cross section area of the steel under tension below the elastic limit takes place, bond is preserved. Bond is also strengthened by this method in case of vibration or shock.

With regard to strength representative tests have served to convince even the most conservative that reinforced concrete has beyond doubt the ability to carry load. (See Fig. 3) These experimental tests are substantiated by practical results such as large structures which are actually standing. It is evident then that reinforced concrete is a theoretical and practical possibility.

Just here I wish again to call attention to the perversity of the discussion of these two materials. In general the reasons on account of which structural steel came into vogue

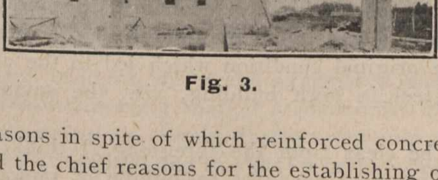


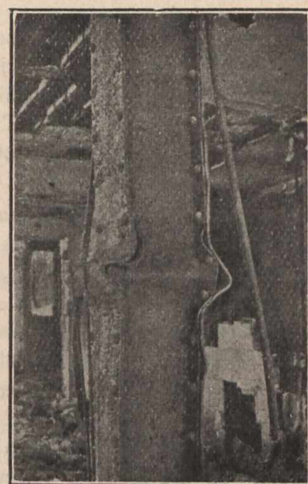
Fig. 3.

are the reasons in spite of which reinforced concrete remains in use, and the chief reasons for the establishing of the latter are the main objections to the former. Hence it is that summing up the points concerning reinforced concrete, I commence where the steel discussion ended, i.e., with the fireproof and durability problems. I should also like you to note that some points for and against steel remain to be evinced by comparison with reinforced concrete.

Points in Favor of Reinforced Concrete.

I.—Probably the most erroneous conception ever acquired by the public was that of the fireproofness of structural steel. Columns of steel in buildings will frequently buckle (Fig. 4), from excessive heat fifteen minutes after the outbreak of a fire, showing their incapability to withstand the flames successfully.

It has been stated that large timber columns of the "slow burning" form of construction are more fireproof than steel. However, to offset this, various forms of fireproof protection for steel have been used. Of these solid porous terra cotta or hollow terra cotta tiles have been extensively applied, but as yet these methods have not proved successful. For example, after the fire in Pittsburg in May, 1897, when the supposedly fireproof steel Horne Buildings were completely destroyed by fire, the salvage of fireproofing was only 16 2-3 per cent. The unsuccessfulness of such protection has been verified by more recent tests, such as the Toronto fire of 1904, and the Baltimore fire. With regard to the latter, Mr. Atkinson, in his expert insurance report, emphatically states, "Terra cotta has failed." The same fact was exemplified by the San Francisco disaster. The steel columns, in many



(Fig. 4).

cases protected by hollow terra cotta tiles, buckled excessively, while reinforced concrete Expanded Metal floors stood well. In addition, experimental fire tests prove the observations of actual fires. Reinforced concrete square columns are not seriously affected, for more than ¼ inches from surface or for more than three inches radially at the corners. It is indeed generally conceded that concrete is the only decidedly fireproof material known which is capable of application to engineering purposes. This argument is worth a host of others, and cannot receive too much attention.

II.—**Durability.**

The durability of concrete and its importance as an argument can also hardly be underestimated. It ranks, I believe, equally with that of fireproofness, and the tests are even more convincing. In Rome can be found to-day a number of examples of concrete constructed over 2,000 years ago. The concrete of the Pantheon dome, the House of Vestals, the Aqueduct of Venus still remains while stone in ancient ruins has long since crumbled away.

The corrosion of steel is well known. Difficulty has been found in obtaining suitable paint even to minimize the powerful oxidizing effect of air on iron surface. However, it is now a well-established fact that steel embedded in concrete is rendered absolutely rust proof. Some writers even maintain that a coating of rust in the steel before placing in the concrete is beneficial. But in any case we may say that durability of concrete reinforced is strangely enough twofold. Both phases, viz., the durability of the concrete itself and that of the embedded steel, are established by an exhaustive set of tests recently completed by Professor Norton, of the Massachusetts Institute of Technology. The only condition the Professor specifies is to "mix wet and mix well." I might add that "the durability of iron embedded in concrete is attested by iron clamps found in the mortar joints in the Pantheon after a period of fully 2,000 years, which were in good condition."

The ultra-importance of these two arguments is evident, However, there are some others worthy of mention.

III.—In direct connection with the above comes the argument which is advanced with impunity by all advocates of reinforced concrete. That is the low cost of maintenance which is practically nil, while the painting of steel and the higher insurance rate on steel structures increases the cost of maintenance of buildings, etc., of this type.

IV.—The monolithic nature of reinforced concrete design is clearly shown to substantially increase efficiency in resisting vibrations such as are caused by machinery or the shock from earthquakes, etc.

Experiments to determine the results of shocks on various floor systems have been carried on recently by the Paris and Orleans Railway Company. Floors of the steel beam and brick arch construction, and of the reinforced concrete system were constructed, using the same live load in the design for both. In proportion to the impacts, the vibrations of the steel beams and brick arch construction to the concrete construction were 20 to 1 in amount and 11 to 1 in time of duration.

V.—From the contractors' stand point, steel for reinforcing can be supplied within a few weeks' notice instead of so many months as is generally the case with structural steel orders. I know of one case where the Trussed Concrete Steel Company supplied an order on two weeks' notice in the busiest season for construction work.

VI.—Noiseless construction is often a matter of practical and commercial consideration. The construction of the Marlborough Blenheim Hotel, Atlantic City, was carried on while guests remained in the older portion of the building. The hotel profits would undoubtedly have been impaired by the noisy riveting of the structural steel erection.

VII.—Concrete when erected is claimed to be soundproof.

The above are a few of the many points advanced in favor of reinforced concrete. In the main, I believe I have shown that this commodity, when fabricated, is decidedly an engineering success. However, unlike steel, most of the disadvantages lie with the construction.

Disadvantages of Reinforced Concrete.

I.—Workmanship.—The greater portion of the construction of reinforced concrete is done in the field. Consequently the tendency is naturally toward less efficient workmanship. On this account the work itself is less reliable, also owing to the difficulties met with in "form building," exact and truly finished workmanship is difficult and unusual.

II.—The contractor is subject to varying local labor conditions, to a large extent. The cost of transporting workmen to various "jobs," which are frequently scattered, is a consideration of important practical bearing.

III.—From the nature of the construction, difficult delay and mistakes in placing the steel reinforcement are evidently liable. Hence the chance for properly executed design is materially lessened.

IV.—The large amount of lumber used during construction greatly increases the possibility of fire. This is especially objectionable in the hearts of cities.

V.—One of the greatest engineering objections is the difficulty of reliable inspection. Much has been said with regard to this phase of the subject, and it will merely be necessary to refer to it as being one of the most flagrant complaints against reinforced concrete. The difficulties of obtaining reliable inspection may be classed, perhaps, as follows:—

(a) Non-uniform testing of cement.
(b) Incompleteness of inspecting the mixing.
(c) Difficulties in placing, etc.

VI.—Every portion of construction has to be moulded, too, exactly in its permanent position. Hence the term "clumsy" construction has been applied. The method of raising the concrete members has been tried but is impractical on account of the excessive weight of the concrete.

We have remaining the discussion of the large question of financial possibility of reinforced concrete. The cost is largely increased, of course, by these constructional conditions. For instance, the cost of placing reinforcement is about $12 per ton of steel. But the all-important item is the cost of "forms." This, I believe, will average over 30 per cent. of the total cost of the concrete in a structure. Certain advocates of reinforced concrete claim that its cost is 25 per cent. less than that of steel. I have in mind a building erected according to the reinforced system, and the contractor lost several thousand dollars by underbidding structural steel. Personally, I believe that the average cost of reinforced concrete is usually a little in advance of steel. Whether or not this extra financial outlay is warranted is entirely a matter of opinion, yet to be shown by the results of more extensive experience.

Adaptability of Reinforced Concrete.

Justification for cost is an important consideration, and may be better discussed by a brief reference to some specific examples.

Bridges.

I.—The fireproof argument hardly applies to bridges. However, durability and resistance to vibration are eminently required, and are attained by the use of reinforced concrete. But "centering" is usually difficult, expensive, and sometimes impossible. Self-support during erection is not feasible, and long span bridges are unusual.

Viaducts.

II.—Reinforced concrete is extremely well adapted to viaducts, which must resist vibration, be fireproof, and durable. The form-work is comparatively simple and uniform, and therefore inexpensive. The size of columns in the substructure is immaterial, also construction is easy since it is mostly executed near the ground in continuous viaducts. Of course the nearer a viaduct tends to become an ordinary bridge, the less do these favorable conditions apply. The above remarks apply more especially to the beam type of viaduct.

III.—Experience has shown reinforced concrete, for the most part, to be well adapted to culvert construction.

IV.—It is well adapted to conduit pipes. The form work is somewhat difficult but is uniform.

V.—For dams, reinforced concrete may be well used since durability is here of so great importance.

VI.—The factory building is one of the very best applications of reinforced concrete on account of the resistance to the vibration of machinery. The size of the columns here is of no special importance, since factories may be built in the outlying districts where land space is of little account, also beauty of construction is not expected in factory buildings.

VII.—Curtain walls of reinforced concrete are objectionable on account of permeating dampness. This may be partially overcome by the Sylvester process which consists of a coating of soap and alum solution.

VIII.—Probably the best application of reinforced concrete is in floor construction, especially for factory buildings or warehouses on account of minimum vibration and great strength.

IX.—Finally, office buildings; these must be fireproof hence the demand for reinforced concrete, but here the financial question is monumental. In the first place the cost of construction is of doubtful economy. Secondly, the size of the columns necessitated by reinforced concrete bring us back to the original condition which led to the adoption of structural steel in high building, viz., the saving of floor space.

It will be clear from the foregoing, I think, that very high buildings must needs be essentially of structural steel. However, with the development of the aesthetical capabilities of reinforced concrete it is quite within the range of practicability that buildings up to 8 or 10 storeys should be erected entirely of reinforced concrete. In this connection the recent invention of a snow-white Portland cement will be significant. The Nottingham Apartment in New York, and the Keuffel and Esser Buildings (Fig. 5), Hoboken, N.J., are recent exploits of this nature.

In the discussion of these few remarks concerning two subjects which have in justice proved to be of live issue among engineers, I have endeavored to maintain absolute impartiality, as previously stated. I would urge you gentlemen to consider the advisability of acquiring this attitude in all references to the comparative merits of structural steel and reinforced concrete. There is, of course, an infinite amount to be said on this vast subject, but I beg leave to conclude my limited remarks with a brief recapitulation of the points set forth.

The introduction of steel was a matter of slow but steady progress throughout nearly the entire nineteenth century. The extreme physical fitness combined with large constructive possibilities and above all the financial success of the material gradually established, a foothold that will probably never be shaken. But the greatest victory was attained by the tremendous tide of popular opinion which staked life and reputation on the supposedly fire resisting qualities of structural steel. This, combined with the other reasons, of course, raised the use of steel to an altitude only measured by the tallest sky-scraper in New York City. As previously shown the fallacy of this same idea was the opening flaw which permitted of the inauguration of the newer material, reinforced concrete; and this commodity strangely enough eminently met the requirements lacking in steel.

Just here, however, it is of keen interest to note that the arguments advanced are reciprocally opposite in the cases of the two respective materials to which feature allusion has already been made. The fireproofness and durability of concrete in opposition to structural steel is evinced by the liberality of the use of reinforced concrete in the rebuilding of San Francisco, while again, the constructional features are exceedingly poor as opposed to the marked appropriateness

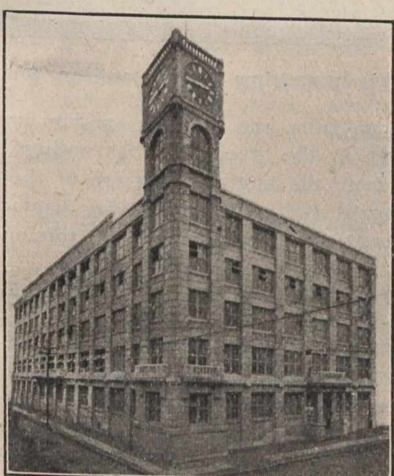


Fig. 5.

of steel work in this connection. We have then a sort of equilibrium of forces acting for and against the two commodities. In brief, the only deficiencies of steel are overcome by concrete and vice versa.

We can all agree, I think, that the points of each material are such that neither arguments may be overlooked. In short, there is a very great deal to be said on both sides. It has seemed to me exceedingly regrettable that there exists at prsent such intense warfare between the devotees of these two engineering commodities. The fight for reinforced concrete has been brilliant, bitter and aggressive, and to-day it remains on the engineering market a commodity of undisputed reputation owing to certain abstract qualities such as fireproofness and durability, and in spite of certain drawbacks which tend to render it unpractical. For instance, very high buildings and large bridges can never be other than essentially structural steel.

On this account I believe that the regrettable warfare will result in a very happy combination of both reinforced concrete and pure structural steel. The dawn of this era seems to be at hand in the new McGaw building of New York. Here the columns consist of laced angles with concrete applied principally as a protective attribute. In this, I think we have the nucleus of a system of construction which will be as near as possible to absolute perfection in spite of the increased original cost, which, by the way, would in the end prove the cheapest. In this connection, floors, beams, and perhaps curtain walls might well be pure reinforced concrete, while roof-trusses, etc., had better remain of structural steel. This combination system, it appears to me will eventually become universal, and might justly be called "Steel-Concrete System" of construction as a combination of the two systems now distinctly separate.

In conclusion, permit me to say that, in view of the above, I consider it the duty of the future engineers of this country to familiarize themselves with the properties and methods of **both** systems of construction if the general conception of "broadmindedness" among engineers is to be maintained.

N. B.—Since delivering this address I should like to express my appreciation of the discussion of these remarks by Mr. Gillespie, Mr. Young, Mr. Chadwick, and others; and also of the kindness of Mr. Redfern, the vice-president of this section.

TORSION METER FOR MEASURING TURBINE AND ENGINE POWER.

By Frank C. Perkins.

For the measuring of power in internal combustion turbine engine and steam turbine work the torsion meter is particularly valuable, as it is impossible with this form of motive power to take indicator cards as with reciprocating engines. By means of this instrument the power developed and transmitted from a steam turbine can be ascertained and accuracy of 99 per cent. obtained in the readings. The instrument has been utilized to great advantage on a number of the turbine steamers, the recording box being placed in the cabin where there is very little noise and the sound of the telephone receiver is distinctly heard. Recording machines also have been devised and installed with a moving strip of paper, a pen which reports the number of revolutions by means of electric contacts, another pen connected with the bridge so as to take the time on the mile and a third pen marking the half seconds from a standard chronometer.

The accompanying illustrations indicate the construction and arrangement of the new torsion indicator constructed at Glasgow, Scotland, by Kelvin and James White, Limited, after designs of Charles Henry Johnson and Archibald Denny. One view shows one of the turbines installed on a turbine steamer, the disc being fixed at one end of the centre shaft; the disc fixed to the remaining shafts and to the other end of the shaft are similar. Two inductors are shown of somewhat different construction of torsion meter, the indicator A consisting of a thin soft iron core wound with insulated wire, and arranged on a base provided for the purpose, while the inductor B is a similar core wound with insulated wire and mounted on a slider on a quadrant shaped guide in such a way that by turning a hand wheel the slider carrying the core may be moved along the guide, either forward or backward as desired.

The telephone receiver is placed in a circuit with the inductors, which are placed beneath a wheel carrying a magnet. In order to take a reading the hand wheel is moved until silence is obtained in the telephone receiver. This adjustment is noted and indicates the amount of torsion of the shaft. The form of torsion meter is intended for low speeds and can be utilized to advantage for measuring the torsion of shafts of vertical or horizontal reciprocating engines.

On account of the uneven turning moment of steam engines the torsion of this kind of shafting varied during a single revolution. For this reason six magnets are utilized on each wheel instead of one, these magnets being equidistant from the circumference of the wheel, and on a different parallel plane, while six separate windings are arranged on each conductor, and a switch is provided by means of which any pair of windings on the two inductors can be simultaneously connected in the circuit with the receiver.

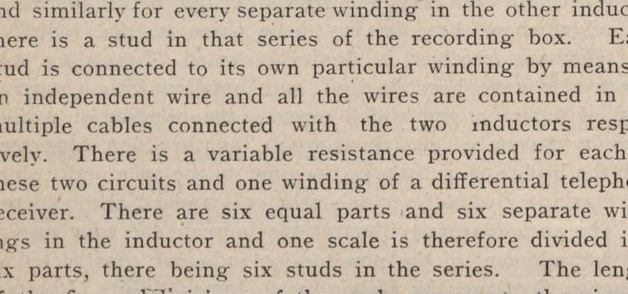
Resistances are arranged for adjusting the strength of the induced current and in this manner the torsion at six different points can be measured easily and therefrom the mean torsion for complete revolution can be noted. It may be stated that on a test with a reciprocating engine which had a turning moment of considerable variation it was noted that with six magnets the greatest error was not over 4 per cent., and when working out a polar diagram of torque the error was not more than 1 per cent. with the magnets suitably arranged on the wheel.

One of the special features noticed in this instrument is the absence of rubbing contact, thus avoiding wear and tear. These instruments are well adapted for work on shipboard, making it possible to take frequent readings of the power and note with accuracy any loss of efficiency. For testing steam turbines they are of great value and have given excellent satisfaction.

Two light wheels are fastened to the shaft at proper distances apart and a permanent magnet mounted on each wheel in such a manner that the projecting pole produces a dense and definite magnetic field at the point by being constructed in the shape of a V. There are two inductors set concentrically with the wheels and the shaft and just below the magnets. Each of these inductors consists of a quadrant shaped piece of soft iron mounted on a gun metal stand provided with leveling screws. A number of separate windings are arranged on each piece of iron, a suitable number of turns per unit of circumferential length of iron being used.

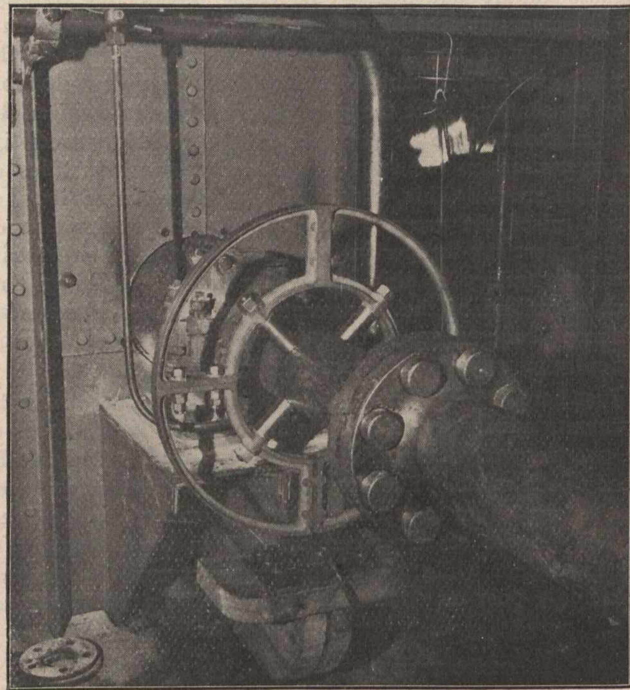
A recording box is used having two series of contact studs which are marked with proper scales and two contact arms, so that electrical connection can be made with any stud of a series and with its contact arm, there being in one series a stud for every separate winding in the one inductor and similarly for every separate winding in the other inductor there is a stud in that series of the recording box. Each stud is connected to its own particular winding by means of an independent wire and all the wires are contained in the multiple cables connected with the two inductors respectively. There is a variable resistance provided for each of these two circuits and one winding of a differential telephone receiver. There are six equal parts and six separate windings in the inductor and one scale is therefore divided into six parts, there being six studs in the series. The length of the five subdivisions of the scale represents the circumferential length occupied by all the windings on the inductor, this being about 0.2 inch, each subdivision being the distance between windings.

There are fourteen equal parts to the other scale, as there are fourteen independent windings on this inductor, and in this series fourteen studs with a distance between windings of 0.02 inch. The inductor at the turbine end of the shaft has its wheel so set that its magnet is above one or the other of the two end windings in the end inductor. When the shaft rotates without transmitting any power, and current of electricity is generated in the end windings of each inductor, these two separate currents traverse their own circuits in passing from the inductor windings to the studs and then through the contact arms and resistances, as well as to the telephone receivers and in returning to the inductors.



Telephonic Receiving—Mechanism of the Torsion Meter.

The receiver windings are so connected that the effects of the independent currents are in opposition and neutralize each other at the receiver when the two current strengths are the same. With the variable resistances the currents can be made equal in strength, and in this manner when the shaft transmits no power and there is no torsion there will be no sound in the receiver. As soon as the shaft begins to transmit power, and there is a twist or torsion there will be a loud ticking sound noted in the receiver, as the currents no longer neutralize each other. It is then necessary to move the contact arm from one stud to another until silence is again obtained in the receiver. By noting the reading opposite the scale the angle of torsion of the shaft will be noted. The scale reading represents the displacement of one magnet with regard to another due to the torsion of the shaft.



Angle-measuring Instrument on Shaft.

WATER-PROOFING CONCRETE.

A paper on water-proofing concrete was read a short time ago at the American Institution of Civil Engineers, and was the result of an investigation carried on by the New York Board of Water Supply in an endeavor to effect improvements in materials and methods of using them in the construction of the new aqueduct for the city, which necessitated a broad study of the composition and testing of cement and concrete. Careful attention was paid to its permeability and methods of water-proofing. Existing methods, says The Engineering Times involve the application of asphalte or other bituminous compounds to the surface, thereby preventing contact between cement and water. Another process consists in the application of washes to the surface with the object of filling up the surface pores with some insoluble compound. Still another method is to mix substances with the cement when it is being made up into concrete. In this process the pores throughout the mass of the concrete are filled with insoluble material. Asphalte and similar compounds are quite impervious to water, and as a result have been used for many years in salt and fresh water. The chief difficulty is that the surface must be dry at the time of application, which is impossible in some classes of work. The durability is questionable, because most of these bituminous substances oxidise, become brittle and porous, and thus break down and become ineffective. In examining the third class of processes absorptive and strength tests were made, and it was found that many of the water-proofing compounds sold were worse than useless. Chemical analysis showed them to consist of inert substances which acted as impermeable septa, interfered with the normal setting of concrete, causing decrease in strength, and actually exerted a negative influence off permeability. Some of the processes were sound in principle, but were too expensive for general use. Some persons state that slaked lime should be added when mixing the concrete, but although it slightly decreases the permeability it reduces the strength of the concrete to an inconvenient extent.

SPECIFICATIONS FOR IRON AND FUEL.*

Methods of Testing Output.

By Richard Moldenke.

Although one often hears of the fine castings produced by the numerous smaller foundries, where specifications and analysis for purchase and sale are disregarded, mention is seldom made of the carloads of castings rejected on account of excessive hardness or internal sponginess. These foundries generally employ standard material, which can be spoiled only through ignorance. In special lines of foundry work, however, and in the large jobbing shops, iron and other supplies are purchased under specification, and are subjected to careful inspection.

Carbon.

A comparatively simple set of specifications for all foundry supplies—pig iron, fuel, fluxes and the newer ferro-alloys—will ensure ample results. Since cast iron is primarily a steel with varying carbon content, carrying large amounts of impurities and mechanically mixed with graphite, it follows that a wide range of metal for casting purposes may be secured by varying the proportions of the impurities and of the combined and free carbon. Thus, a cast iron with but 0.20 per cent. of combined carbon and near 4 per cent. of graphite will really be a "twenty" carbon steel, the graphite merely causing the metal to act like cheese under the tool. The addition of steel scrap to the original mixture—thereby reducing the percentage of graphite without materially altering that of the combined carbon—strengthens the metal, which now, however, will not cut so readily under the tool. Proceeding further, an increase in combined carbon and a reduction in graphite, secured by reducing the silicon, will produce an "eighty" carbon steel, with so little lubrication for the tool as to be too expensive to machine.

In this way by varying the proportions of combined and free carbon, a wide range of metal is obtained, beginning with the soft, weak, easily machined black iron, rich in graphite, running through the gray and mottled grades, and ending in a hard, strong, white iron susceptible only to being ground.

Machinery and Malleable Castings.

Since the relative proportions of combined and free carbon may in a great measure be controlled through the silicon, it is generally sufficient to specify the maximum allowable percentages of sulphur, phosphorus and manganese. Normally blown irons, from reputable blast furnaces, run so uniform in carbon content as to render specification unnecessary. An "off cast" renders itself quickly apparent through the other impurities, and is sold only under its true designation.

For ordinary machinery castings (gray iron) the pig iron used as a part of the charge should contain:—

Sulphur, not more than..............	0.05 per cent.
Phosphorus, not more than........	0.50 per cent.
Manganese, not more than.........	0.80 per cent.
Silicon, from 1.75 per cent. to 2.75 per cent. as specified.	

For malleable castings (white iron) the pig iron used should contain:—

Sulphur, not more than...........	0.04 per cent.
Phosphorus, not more than........	0.225 per cent.
Manganese, not more than.........	0.60 per cent.
Silicon, from 75 per cent. to 1.50 per cent. as	

A variation of 10 per cent. either way from the above figures may be allowed.

Light Castings.

Where light castings are desired, as for stoves and art work, the phosphorous is specified at 1.00 per cent. and over, and the silicon often as high as 3.25 per cent. Similar specifications may be prepared to cover the rest of the thirteen rather distinct grades of cast iron, with their more than forty variations.

To enable foundrymen unacquainted with the metallurgy of cast iron to buy intelligently, the American Society for Testing Materials, through its Committee on Specifications for Foundry Iron, prepared schedules designating the composition of the very deceptive but well-known old grade numbers. Thus, Nos. 1, 2, 3 and 4 are to contain 2.75, 2.25, 1.75 and 1.25 per cent. of silicon, respectively, fracture appearances being disregarded. Sulphur is specified at less than 0.035, 0.045, 0.055 and 0.065 per cent., respectively, when estimated volumetrically, with an allowance of one hundredth more in case the gravimetric method is employed. A variation of 10 per cent. of silicon, either way, from the above figures is allowed; and the sulphur may vary 0.02 per cent. A deficiency of over 10 and under 20 per cent. does not lead to rejection, but entails a penalty of 4 per cent. in price. This is eminently fair, and protects manufacturer and foundryman alike.

In sampling, each car is taken as a unit, and from this one pig is selected out of each four tons. In case of dispute, a pig is selected from each two tons, the loser paying for the additional labor caused by the closer sampling. Drillings from these pigs taken so as to fairly represent the fracture surface, are to be well mixed before analysis.

It is interesting to note that the liberality of these specifications, appealing as it does to the conservatives, is in direct contrast to the severer requirements of the foundryman who buys by specifications of his own.

Fuel for Foundry Work.

Ordinary foundry operations require as fuel anthracite, coke and soft coal, while producer gas, natural gas and oil are employed in the special brass furnaces and the open-hearth for steel and high-grade iron. Necessity for specification is confined to bituminous coal and coke, and in the case of the former only the sulphur, and occasionally the ash, demands attention. The increasing use of the air furnace for the manufacture of high-grade engine castings is leading to a study of the availability of various soft coals; and the United States Geological Survey, through its Advisory Board on Fuels and Structural Materials, has gathered much information, so that specifications for coal and coke for melting purposes may be expected soon. In the meantime, it may be stated that no coal containing more than 2 per cent. of sulphur should be used in the foundry, and, preferably, the amount of this impurity should be limited to 1 per cent. Similarly, the ash should be limited to 10 per cent.

Coke.

The employment of coke demands closer attention to moisture, to the remaining volatile matter, fixed carbon, sulphur, ash, and sometimes phosphorus. Usually, however, the sulphur, ash and fixed carbon are sufficient to give a fair idea of the value of coke, apart from its physical structure, specific gravity, etc. The advent of by-product coke will necessitate closer attention to moisture. Bee-hive coke, when shipped in open cars where it absorbs much moisture, may, through inattention, cause the purchase of from 6 to 10 per cent. of water at coke prices.

Concerning sulphur, there is much to be ascertained; whether its sulphates or its volatile compounds get into the iron, and how. Foundry practice, however, has recognized the fact that a very hot running of the cupola results in less sulphur in the iron. In good coke, the amount of sulphur should not exceed 1.2 per cent.; but, unfortunately, the percentage often runs as high as 2.00. If the coke has a good structure, an average specific gravity, not over 11 per cent. of ash and over 86 per cent. of fixed carbon, it does not matter much whether it be of the "72-hour" or "24-hour" variety. Departure from the normal composition of a coke of any particular region should place the foundry-

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* Presented at the annual meeting of the American Society of Mechanical Engineers.

man on his guard at once, and sometimes the plentiful use of limestone at the right moment may save many castings.

Limestone to be used for fluxing should be as rich as possible in carbonate of lime, for each unit of silica transformed into slag exacts its equivalent of lime and coke. Oyster shells form a most desirable flux, and fluorspar tends to thin the slag.

Ferro-Alloys.

Use of the modern ferro-alloys will eventually be limited to the richer grades. Even to-day 80 per cent. ferro-manganese is demanded; and, while 50 per cent. ferro-silicon is much used, the 75 per cent. grade, or better, is specified by the wideawake foundryman. It is wasteful to employ a rich alloy in the cupola; but in the ladle, removed from the further application of heat, the smaller bulk of the richer alloy causes a smaller reduction in the temperature of the molten iron. For the present, specifications are not required for these alloys, which are made from the best material, and should be low in the undesirable elements, sulphur and phosphorus.

Scrap.

In selecting scrap iron, each foundryman chooses worn-out or broken castings, similar in composition to the proposed product, so that the addition of this scrap to the pig iron mixture does not disturb the calculations.

Beyond the exclusion of burnt or very dirty metal, and of sizes so small as to cause waste in melting or too large to enter the charging door, specifications for scrap iron should be limited to a statement of the class of material wanted—machinery, malleable wheels, pipe, etc.

Weak castings and castings with pin holes or with pockets under the skin, are indicative of the use of burnt metal. Three hundredths of 1 per cent. of oxygen in solution in the iron as an oxide or combination of oxides is, in the case of white irons, sufficient to ruin them completely. The excessive "skulling" of ladles, and other troubles, can be traced to this cause. Thus oxygen in cast iron is far more powerful than even sulphur; yet the action of the former is little understood, and does not lend itself readily to chemical investigation.

Moulding Sand.

In the matter of moulding sands, American foundry practice is far behind that of Germany, or of the rest of Europe. Until the price of our sands has advanced considerably, we shall continue to wet down and mix with a shovel, instead of grinding and sifting and tempering by mechanical means, as in foreign practice. Careful preparation of the sand before it goes to the moulding floors will ensure castings free from surface blemishes. Under present American conditions, attempts to introduce specifications for moulding sands are of doubtful value.

Steel Foundry Conditions.

The absolute necessity, in the case of a successfully operated steel foundry, for the application of specification to all supplies purchased is so well understood that the steel foundry is usually classed with the steel mill, and apart from the foundry. If the acid process is used, or the Bessemer converter, the metal used is a "fancy" pig iron, containing practically only iron, carbon, and the proper manganese and silicon. The basic process allows the use of cheaper material.

The characteristics of the finished product are determined either by testing each article, or by testing to destruction an occasional sample, or by the use of test bars

If the establishment makes finished specialties in iron, ease in machining is the important requirement, and an estimate of this quality may be gained by placing an occasional cast sample disc in the lathe or drill press, the nature of the tests being dictated by the experience of each shop.

Commercial Castings.

Ordinary commercial castings, on the other hand, must be subjected to additional. Castings produced in very large quantity must be tested to destruction, by sample, which, of course, is far beyond the limits of actual service conditions. The remarkable quality of car wheels has resulted from this exacting system of testing.

The foundryman, however, competent, is dependent upon the quality of the iron, for the production of serviceable castings. It is necessary, therefore, in the many cases to which testing to destruction is inapplicable to make a test of a sample form composed of iron identical with that in the casting. To-day, in foundry practice, the foundryman may employ shop test-bars of such size and shape as he chooses. Comparison of the performance of his test-bar with that of the purchaser's test-bar will enable the experienced foundryman to determine the degree of exactness with which he is meeting the requirements.

Standard Tests.

Finding that such a variety of standards prevailed, the American Foundryman's Association and the American Society for Testing Materials, under separate action, but by individual members of each committee, have adopted a set of specifications which embodies the last word on this complex subject. These specifications depart entirely from established procedure.

It has been attempted in these specifications to avoid the introduction of outside influences as far as practicable, and to have the sample represent accurately the iron as it comes from the cupola or the furnace. Hence, the round sample bar is to be of as large size as the limits of commercial testing machines will permit, it is to be poured in a vertical position, to avoid the difference of strength between top and bottom, if poured horizontally; and the mould is to be dried, to ward off the effect of damp sand. The speed of testing is specified, and a regular routine of pouring is to be observed. At the suggestion of Mr. Walter Wood, this bar is called the "arbitration bar," as it is intended for use only in case of dispute between buyer and seller.

The new method of testing, as adopted by the American Society for Testing Materials, is being generally used, and is found to be far superior to the old custom of flat, square bars of small cross section, or the long bars so susceptible of dishonest manipulation. The transverse is best suited to the peculiar nature of cast iron; but on optional tensile test is provided for, at the cost of the party demanding it, although in Germany this latter test is excluded altogether. For further details, the reader is referred to the publications of the two societies mentioned heretofore.

Metallurgy.

The ethics of the cast iron industry has been dependent upon the better understanding of its metallurgy. In times past the foundrymen refused orders to which specifications were attached; and he refused even to provide tentative specifications which might enable the buyer to obtain such iron as he desired to purchase. Now this is changed, and the progressive foundryman welcomes inspection of his methods and tests of his product.

It is to the lasting credit of the foundry that the first demand for specifications came from the foundrymen themselves, through their association, and that they co-operated heartily with the engineer by furnishing information, freely and without reserve. A very friendly feeling between buyer and seller has ensued; for no better evidence of good faith can be given than an invitation to visit freely the shops and the laboratory to inspect manufacture and test. This is the rule to-day, not the exception.

The Canadian Concrete Machinery Company, of Toronto, and the California Artificial Stone Supply Company will give a joint exhibit at the Buffalo Convention of Cement Users.

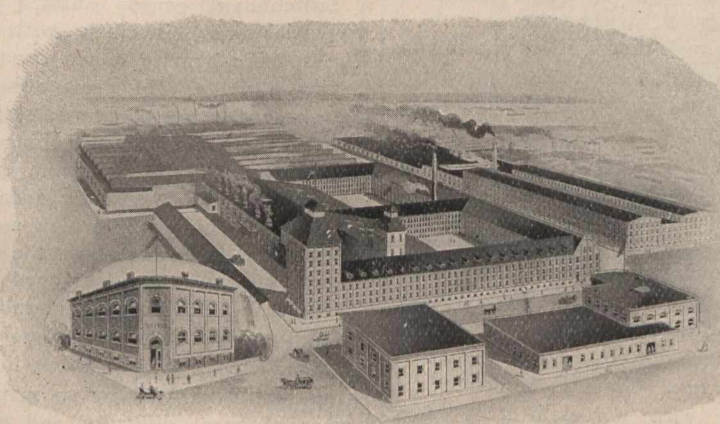
Announcement is made of the removal of the New York offices of the Raymond Concrete Pile Company to 140 Cedar Street, in the new West Street building. The steady increase in the business of the company made the abandonment of the former quarter necessary in order to gain greater floor space.

INCREASING PLANT CAPACITY.

Owing to the important changes that the B. Greening Wire Company, Ltd, of Hamilton and Montreal have made in their premises lately, it is of interest to show a cut of these buildings as they appear to-day. Any one who has seen these works within the last few years, prior to last May, will recognize that a vast improvement has been made. These premises now occupy portions of three separate blocks. The commodious offices, which were built about six years ago, being on the south-west corner of Queen and Napier Street, in which block the firm has erected a netting warehouse and a two-storey carpenter shop, the object being to have all the wood work done in this isolated building so that the lumber yard will be removed from the main buildings.

On the south-west corner of Queen and Peter Streets the firm erected a new weaving mill 260 x 130 feet, and in order to get light to this large building they adopted the saw-toothed roof. Here are installed all the heavy looms from the Napier Street weaving mill, together with several additions, amongst which are the additional screen cloth looms installed this year. It was the intention to remove the old screen cloth plant to this building, but the firm have decided to allow it to remain where it is until after next season's trade, when it is the intention to take the temporary end out of the new weaving mill and build on an addition sufficient to accommodate all of the weaving plant.

The old weaving mill on Napier Street is to be added to the wire mill. The space between the old weaving mill and the wire mill on Napier Street has been built up and the cleaning room for the wire mill reinstalled here. Besides the manufacture of wire, all kinds of wire cloth are made, from the heaviest used for such as locomotive stacks, refuse burners for saw mills, to fine wire cloth for flour mills, to office window blinds, mining purposes, car ventilators, etc. Steel wire chain are made into cattle chains, dog chains, halter chains, tie out chains, and special chains for agricultural implement manufacturers. Wire rope for passenger and freight elevators, derrick, and contractors' use, mining purposes and transmission of power; perforated sheet metal in brass, copper, steel and iron for grist mill machinery, grain cleaning machinery, crimped steel wire, bonding for concrete work, etc., are other products of this company.



Plant of The B. Greening Wire Co., Hamilton, Ont.

MOULDS FOR REINFORCED CONCRETE.

The lack of sound and strong timbering in the temporary work connected with the erection of reinforced concrete structures, says the Engineering Times, is an important impediment to successful construction, and we view with approval the statement that the advisability of employing good timber cannot be too strongly insisted upon. The stability of the whole structure, especially when all parts are moulded together, depends largely on the strength and rigidity of the false-work. Here, as in all other cases where timbering is required, good methods and a somewhat large outlay at the commencement will be found the greatest real economy. The moulds for reinforced concrete work must be stiff and strong enough to bear the weight of the concrete, the ramming, etc., and when supported, the weight of the men and materials, without bulging or vibration. Vibration has a serious effect on the setting of concrete, and in some cases it has been held to be the cause of the complete failure of structures. An authority expresses the opinion that the moulds should be of as simple a character as possible and lend themselves to easy supporting, so that they may be put together, taken to pieces, erected and removed with the minimum amount of labour; standard-sized pieces being employed in building them up, which can be used again and again or easily altered to suit different requirements. Moulds are generally made of timber, which should be carefully selected, and none used that is liable to warp or twist. Much trouble will be avoided if the planks forming the moulds are put together in such a manner that if they swell under the action of the moisture no deformation will occur. In the Ransom system the moulds are frequently made of planks splayed along one of their edges to allow the closing up of the joints, caused by the swelling, without fear of warping. The planks are placed tight against one another, producing a continuous surface; if the humidity swells the timber, the bevelled edge of one plank slides over the square edge of the next, the thickness of the planking is not altered to any great degree, and scarcely any deformation is produced. With square-edged planks and open joints, the opening must be stopped so that the water from the concrete may not drain away carrying some of the concrete with it. Mr. Hennebique now usually makes his moulds with open joints and lines them with coarse canvas, which absorbs the excess of water.

REFUSE DESTRUCTOR FOR THE BOROUGH OF BURY-ST-EDMUNDS.

In the early part of this year the Borough of Bury-St-Edmunds, England, invited tenders for the erection of a refuse destructor. These being duly received they instructed the surveyor, Mr. W. D. Harding, Assoc. M. Inst. C.E., to report on the matter, which he did, this report being unanimously adopted by the council. The council, after giving the matter consideration, decided to accept the offer of Messrs. Heenan & Froude, Limited, of Manchester, Worcester, and London, for the erection of a two cell destructor. The plant which is of the back shovel feed type, will consist of one unit of two cells, combustion chamber, Babcock & Wilcox boiler, fitted with Foster patent superheater regenerator, and fan and engine for forced draught. It will be capable of dealing with 30 tons of refuse per day of 24 hours. The steam raised will be utilized in connection with the electricity generating station, which is situated in close proximity to the proposed site of the refuse destructor.

NOTES ON INSULATION AND INSULATION TESTING.*

By S. M. Hills and T. Germann.

A substance insulates because it is possessed of three distinct properties: Firstly, the ability to stand mechanical and electrical stresses due to the voltage used; secondly, a conductivity such that but a negligibly small current can flow through it and leak away; thirdly, the power to resist chemical action that may be set up by application of the voltage. There is no direct relation between the breakdown E.M.F. and the ohmic resistance of an insulator. A low ohmic resistance usually means a low breakdown test, but the converse is not always true.

A good insulator should fulfil the following general requirements: (1) High disruptive strength; (2) good ohmic resistance; (3) physical properties should remain permanent over a wide range of temperature; (4) must be non-volatile and non-hygroscopic; (5) resist the action of water, acids, and alkalies; (6) fireproof.

No single substance fulfils all these requirements, and various mixtures have been devised in an attempt to produce an insulator possessing the required properties. The density, and, therefore, the molecular composition of the various components, of the mixture is different, and the particles or cells of which they may be conceived as being built up of, can move more freely in some than in others. Since the electrical displacement varies directly with the density, the effect of a mixture is to cause an unequal distribution of pressure in the dielectric. A large number of insulation troubles may be attributed to this phenomenon.

Line Insulation.—In high-voltage distribution, the insulation of the line is a very important matter. There are two substances to choose from, namely, porcelain and glass. Good samples of either will give excellent results up to 5,000 volts, but beyond this figure considerable leakage occurs. Glass often permits of leakage when new, and ages very badly; the surface becomes roughened, moisture and dirt collect until the surface is found to be a tolerably good conductor. Cheap porcelain is often extremely hygroscopic, some makes absorbing 1 to 2 per cent. of moisture. Porcelain for insulating purposes should absorb no moisture and show a brilliant vitreous fracture, which will give no flowing stain with ink. Glass is homogeneous throughout its thickness, but with porcelain it is often found that once the glaze is damaged a porous and practically non-insulating porcelain is revealed. The best substance is to use a thoroughly vitrified porcelain, in which the ordinary glaze is replaced by an actual fusing of the material itself. It is strong, tough, and non-hygroscopic, has very high insulating properties, the surface does not weather, and the insulation is practically permanent. The insulator should be so designed that the extent of surface is as long and narrow as is practicable; also the surface must be initially and continuously highly-insulating.

Oils.—With the increased use of high-voltage distribution a large number of oil-cooled transformers and oil switches are required, and, therefore, the question of insulating oils has received more attention. Each manufacturer has his own pet specification, but the following contains the conditions required in an average specification: (1) The oil should be a pure mineral oil, obtained by the fractional distillation of petroleum, unmixed with any other substance, and without subsequent chemical treatment; (2) flash test must not be less than 180 deg.; (3) evaporation not greater than 2 per cent. after heating for eight hours at 100 deg. C.; (4) must not contain moisture, acid, alkali, or sulphur; (5) must be as clear as possible, fluid, and free from particles of metallic nature. There are two main methods employed in testing the dielectric strength of the oil, namely: (1) Between two spheres submerged in the oil and placed ½ in. apart; (2) between two needle points placed ½ in. apart. The latter method gives a lower value than the former, and since in a transformer or switch many sharp edges, if not points, are met with, the authors favor the use of method 2.

Varnishes, when used in the preparation of insulation, are usually impregnated on cloth, paper, etc. This forms an insulator, the density and electrical displacement of which is not the same in all parts—a very undesirable state of affairs. It is advisable to test the dielectric strength of the varnish when impregnated on paper, at various densities, in order to endeavor to obtain an insulator of somewhat uniform density. The highest dielectric strength will not be obtained by using the highest density varnish, unless the density of the neat varnish happens to be best suited for passing into the pores of the paper.

Ageing and Heating.—Insulation often rapidly deteriorates with age, and it is necessary to store samples of insulation and test them after they have been stored for two or three months. The deterioration is probably due to atmospheric and drying effects, also to the mechanical stresses produced by the rapid alternation of the voltaic stress. Insulation is a bad conductor of electricity, and, therefore, as would be expected, it is a bad conductor of heat—a property which accounts to a large extent for its deterioration with age. The higher the temperature of the insulation the lower the dielectric strength.

Marble.—Marble is largely used for switchboards, and, though preferable to slate on account of its absence from metallic veins, it is not an ideal switchboard material. Marble is one of that class of substances which are always cold, consequently it rapidly condenses moisture, which on a switchboard causes surface leakage. The mechanical properties vary inversely with the electrical properties. The specific gravity has a considerable effect on the properties, e.g.: (1) The greater the specific gravity, the lower the absorption of moisture; (2) the greater the specific gravity, the greater the crushing stress; (3) the greater the specific gravity, the lower the breakdown voltage.

Conclusion.—Practically speaking, there is no piece of electrical machinery in which some insulation is not used, yet but little is known about the subject, nor is the requisite amount of importance assigned to it. Doubtless many of the large firms have a considerable amount of knowledge on the subject, but it is so jealously guarded that the average electrical engineer stands but little chance of obtaining it. Insulation is affected by so many things that testing is a matter of great difficulty and widely different results are obtained, the reason or reasons for this not being definitely known. It is, therefore, imperative that great care should be taken to make tests, which are to be used for comparative purposes, under precisely similar conditions. The study and improvement of insulation demands the attention of the scientific electrican and chemist, not the practical engineer, who considers insulation to be fulfilled by wrapping tape round a conductor.

* Abstract of paper read before the Northampton Institute Engineering Society on Friday, October 25, 1907.

TRADE INQUIRIES.

The following have been received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.:

Chains and Hardware.—An English manufacturer of chains and hardware is desirous of appointing agents in large business centres in Canada.

Machinery.—A London firm wishes to get into touch with Canadian manufacturers of machinery.

Bridges and Structural Steel.—An Ontario firm asks for the names of the leading bridge or structural steel manufacturing concerns in Great Britain.

From the City Trade Branch, 73 Basinghall Street, London, E.C.:—

Storage Batteries.—An English company manufacturing storage batteries wishes to get into touch with Canadian importers.

Lamps.—A London company manufacturing a new incandescent petroleum lamp, which has met with much success, wishes to arrange for its introduction and sale in Canada.

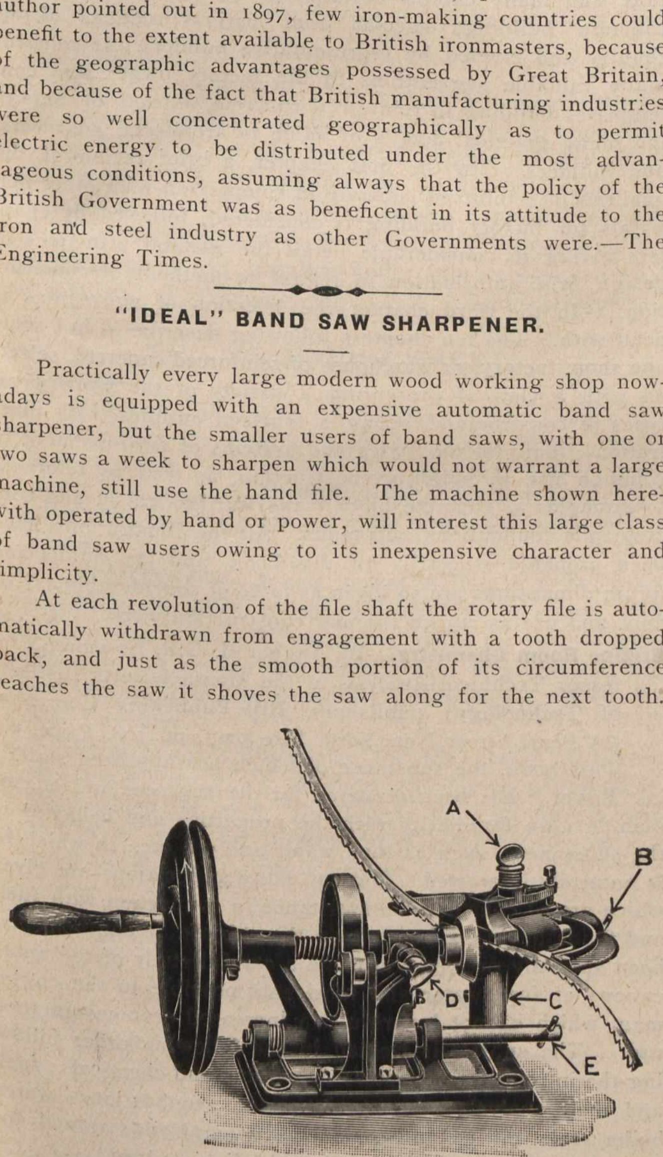
ELECTRICAL POWER FROM BLAST FURNACES.

In the conclusion of the paper on "The Economic Distribution of Electrical Power from Blast Furnaces," which he read at the Vienna meeting of the Iron and Steel Institute, Mr. B. H. Thwaite said that the pooling proposition would financially justify expenditure in apparatus and on technical changes to secure the fullest possible economy in the use of furnace gas in the works. Of course, any available gas from associated coke oven plant, subject to certain mixing operations as would reduce the proportion of hydrocarbon in the combined gases, would be available for the pooling station. The economy resulting from the direct production of power, with a rationally devised plant, had been abundantly proved. A well-designed and built gas-engine, using pure and waterless furnace gas and associated with a high-class electrical generating machine, was claimed to be able to develop the hours of a kilowatt year for 66s. 8d., assuming, of course, that no charge was made for furnace gas. This economic figure of cost to an ironmaster was unapproachable by any other system of power generation, barring water power, which was often located in such awkward if not almost inaccessible positions as to destroy the economic advantages of such power, per se. As the author pointed out in 1897, few iron-making countries could benefit to the extent available to British ironmasters, because of the geographic advantages possessed by Great Britain, and because of the fact that British manufacturing industries were so well concentrated geographically as to permit electric energy to be distributed under the most advantageous conditions, assuming always that the policy of the British Government was as beneficent in its attitude to the iron and steel industry as other Governments were.—The Engineering Times.

"IDEAL" BAND SAW SHARPENER.

Practically every large modern wood working shop nowadays is equipped with an expensive automatic band saw sharpener, but the smaller users of band saws, with one or two saws a week to sharpen which would not warrant a large machine, still use the hand file. The machine shown herewith operated by hand or power, will interest this large class of band saw users owing to its inexpensive character and simplicity.

At each revolution of the file shaft the rotary file is automatically withdrawn from engagement with a tooth dropped back, and just as the smooth portion of its circumference reaches the saw it shoves the saw along for the next tooth.

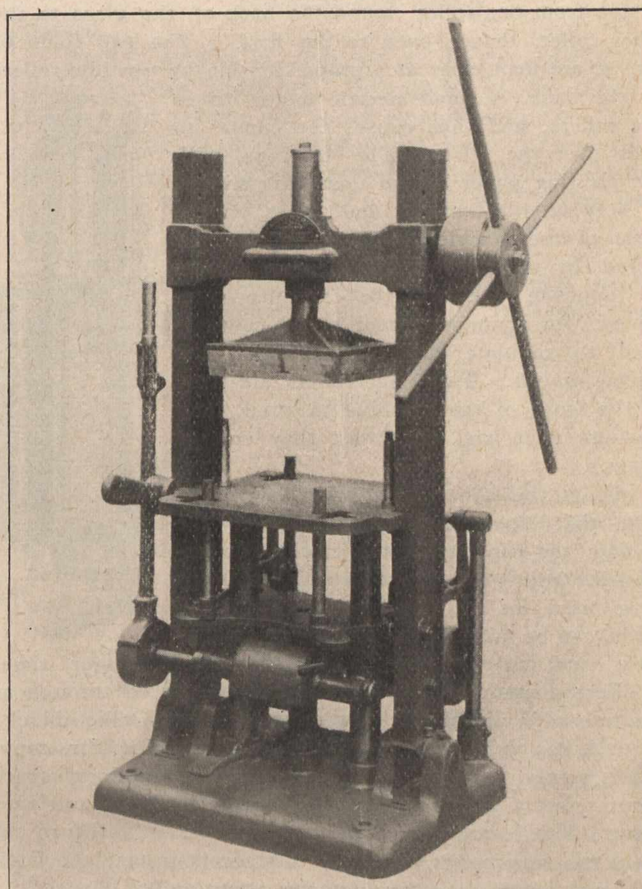


The amount of this movement is regulated according to the size of the saw tooth by the thumb screw. The file only cuts to a certain depth each time and this feature always insures accurate and even teeth.

The construction of the vise makes it possible for a thick weld, and in fact, almost anything but a break to pass through the vise without stopping the machine or injuring a tooth. It is claimed that this machine will save three-fourths or more of the time of hand filing because it is entirely automatic and only requires the time necessary to put in a saw and start the machine.

"COVENTRY" MOULDING MACHINE.

The accompanying view is that of the "Coventry" moulding machine, one of the miscellaneous exhibits at the recent Engineering and Machinery Exhibition held in London. This is an entirely new design of machine, which contains several points of novelty, reference having been made to it in our issue of December 6th. It is claimed that the ramming gear can be worked without exhaustion, and, being free from toggle joints, deep work can be



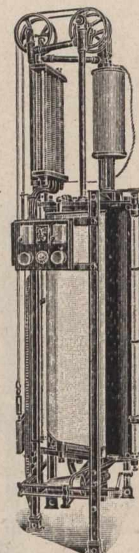
The "Coventry" Patent Moulding Machine.

effectively dealt with. The machine is well made, a perfectly parallel lift is given, and it can easily be operated by an unskilled workman. By the adoption of head gear shown all levers and toggles are done away with, and the machine is thereby not limited to shallow work. The direct squeezing motion allows the operator to easily gauge the amount of pressure he is giving. The lift not only lifts moulds off the pattern, but the moulding-box off the table pins. Two machines were shown working, one using a vibrator and the other a stripping plate.

The National Bridge Company, of Indianapolis, are building a large concrete bridge over the Maumee River, about 12 miles south of Toledo, for the Lima & Toledo Traction Company, the new electric road being built from Lima to Toledo. The new bridge will be 1,120 feet long, and is said to be the longest reinforced concrete railroad bridge in the world. It consists of 12 arches or spans ranging from 70 to 90 feet long, with the centre of the arch 45 feet above the low-water mark. The piers, which are 48 feet long and 12 feet wide at the bottom, and 30 feet long and 10 feet wide at the top, are set in a foundation of solid rock. They are protected from ice gorges by concrete ice-breakers built up stream from the bridge. The concrete is two feet thick at the crown of the arches, and is reinforced by 33 one-inch steel rods stretched across the drum of each arch. The body or inside of the bridge will not be of solid concrete, but will consist of a cushion of earth two feet deep at the top of the arches and 30 feet deep on the piers, inside the shell of concrete.

CONTINUOUS ROTARY ELECTRIC BLUE PRINT MACHINE.

This machine consists chiefly of a vertical semi-cylindrical sheet of glass, over which the tracings slide, and an arc lamp, which is made to travel up and down the axis of the cylinder. As will be gathered from the cut, the sheet of glass is supported by a light metal framework, and its cylindrical form completed by a sheet-iron guard. At each of the vertical edges of the glass a small roller is fixed. An endless band of canvas, of a width equal to the height of the glass, passes from one roller round the back of the glass to the other roller, thence back to the first. The two folds of canvas are kept clear at a proper tension by two idle rollers at the back. A small electric motor drives the rollers, and thus causes the canvas to slide over the glass. The tracings, with the printing paper behind them, are slipped in between the canvas and glass on the right of the machine, and, being dragged round by the canvas, are delivered from the opposite side with the exposure completed. An arrangement of speed cones is used to regulate the rate at which the canvas travels. Two light rollers are fixed to the front of the machine to wind long tracings from and on to as they emerge again.



From the above description it will be seen that, apart from the width of the tracing, the capacity of the machine is unlimited. Prints of great length, such as those used for railway work or in shipyards, can be taken by it as easily as smaller ones, and only require a proportionately longer time.

Ferro-Prussiate (blue) prints can be passed through at the rate of 3 lineal feet per minute. Ferro-Gallic (black) prints take about twice as long. A machine for copying tracings 40 inches wide, occupies a floor space about 2 feet 3 inches square, is about 8 feet high, and uses about 2 B.O.T. units of electricity per hour. It will turn out about 650 square feet of blue prints per hour, and the lamp will run at least a day without attention.

This machine is made in various sizes, up to 54 inches wide, and is manufactured by Leonard Shaw, 39 Victoria Street, Westminster, S. W., England.

GERMAN GOVERNMENT TESTING ESTABLISHMENT.

The Chief Engineer and Surveyor of Lloyd's Register of Shipping has recently paid a visit to the German Government testing establishment at Berlin, and the observations contained in his report are of sufficient interest to call for public attention. The only establishment in England to approach the one at Berlin is the National Physical Laboratory, but useful though this latter is, it does not come near the German establishment in results. There is no doubt that much of the expansion of German industries is due to the assistance given by this national institution. It is equipped with a very powerful testing machine for making tensile or compressive tests up to 500 tons, and there are also numerous other testing machines in constant use each having some special purpose. Among them is a set of twenty machines for testing the effect of fatigue or oft-repeated stresses on different materials. In some of these machines as many as three separate samples can be treated simultaneously. In most of them the tests are made at the normal temperature, but in other the test pieces are enclosed in asbestos lined chambers electrically heated to definite temperatures to ascertain the effect of high temperature upon the mechanical qualities of the materials under investigation. The speed at which the stresses are applied and released is controlled by electrical methods. As an example of the usefulness of this institution, it may be mentioned that the cement industry, which has recently enormously developed in Germany, owes much of its success to researches made at this establishment.

BOOK REVIEWS.

Proceedings of American Water-Works Association for 1907.—By J. M. Diven, Secretary-Treasurer, Charleston, S.C. Size, 6 x 9, pp. 580. Price, $4.

The proceedings of the 27th annual convention of the American Water-Works Association, held at Toronto, June 17th to 21st, has been published in bound form by the secretary of the Association. The work comprises a great deal of information obtainable from no other source than through the Association, and is representative of waterworks development all over America. The knowledge of proper handling of the source of water supply is becoming of growing importance, and no better or conveniently arranged in[illegible] could be found than in the report of this Association. The papers read are well illustrated, and the whole work has been compiled so as to make an exceedingly useful and instructive volume, and a work of reference of value to any waterworks engineer.

Reinforced Concrete in Factory Construction.—Published by the Atlas Portland Cement Company, 30 Broad Street, New York. Size, 7 x 9, pp. 246.

This book contains details of concrete factory construction, and many careful descriptions of typical examples of concrete buildings selected from various sections of the country and erected by representative builders. It contains many valuable suggestions to the factory owner who contemplates building in reinforced concrete, as well as containing many practical details of value to architects, engineers, and builders. In the first chapter, a brief review of the qualities of reinforced concrete in comparison with other materials for factory building is considered, followed by chapters giving in considerable detail the general principles of design, with information in regard to methods of construction. In the third chapter the selection of aggregates is dealt with. The ten chapters following describe in full some one shop, factory, or warehouse of reinforced concrete, selected with a view of presenting a variety of the more usual types of construction. Chapter fourteen outlines, with illustrations, many of the styles and systems of reinforcement in common use in building construction, as well as referring to examples of concrete block walls, surface finish, and concrete pile foundations and tanks. All the illustrations have been prepared especially for this book, and the details and figure dimensions are so given as to be of considerable assistance and use as regard the new construction work.

Engine Room Chemistry.—By August H. Gill, Associate Professor Technical Analysis at the Massachusetts Institute of Technology; publishers, Hill Publishing Company, 505 Pearl Street, New York. Size 5 x 7, pp. 198. Price, $1.

This book, the substance of which has appeared serially in "Power," has been prepared for the engineer and engine man to gain familiarity with the properties and behavior of the substances, such as fuel, water and oil, etc., in which he is naturally interested. A great many suggestions are given which are of considerable assistance in connection with fuels and fluids having a bearing on the subject. The book has been specially prepared to make a careful study of the applications of fuel, water and lubricants possible to the engine man, which cannot but result in increased economy in their use. The subject is treated in the following order following the introductory chapter: Apparatus and chemicals; fuels and their analysis; the regulation of combustion; water, boiler scale, pitting and corrosion; mineral oils; animal and vegetable oils; conclusion and appendix is added.

The fifty-fifth annual meeting of the American Society of Civil Engineers will be held at the house of the Society, No. 220 West 57th Street, New York, on Wednesday and Thursday, January 15th and 16th, 1908. The business meeting will be called to order at ten o'clock on Wednesday morning. The annual reports will be read; officers for the ensuing year elected; members of the Nominating Committee appointed; proposed amendment to the constitution and report of the Special Committee on Rail Sections presented for action, and other business transacted.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

LIGHT, HEAT, AND POWER.

Nova Scotia.

GLACE BAY.—Messrs. A. E. McLean and R. S. Trows- of the Robb Engineering Company, Amherst, are installing the machinery in the new power station of the S. and G.B. Railway at Dominion No. 4.

Calgary.

At a special meeting of the council, held recently, the proposed agreement with the Calgary Power and Transmission Company was discussed, and a decision was reached whereby that Company will supply all the electric current power and energy required by the municipality for five years from date. The proposal of the Alberta Portland Cement Company was turned down, as that company had not fulfilled the requirements in the matter of the necessary deposit.

British Columbia.

VANCOUVER.—The C.P.R. has set aside entirely its steam plant for all its shops here and started up under electric power supplied by the British Columbia Electric Railway Company. The demand for the works, nominally, is 225 horse-power. This is divided among a number of motors, running from 75 horse-power down to 5 horse-power. The electric plant was installed under the supervision of Mr. Chambers, of Winnipeg, the C.P.R.'s electrical expert.

(Contemplated Work.)

Manitoba.

MINNEDOSA.—The Minnedosa Power Company has been granted the right to construct a dam across the Little Saskatchewan River at its outlet at Clear Lake, with the object of maintaining a high-water mark and supplying this town with power for electric light and other purposes.

Alberta.

EDMONTON.—A new power station is to be installed requiring six miles of transmission line at 10,000 volts, 3 wire, 3 phase, 60 cycle, spacing of poles 125 feet, of wires 24 inches. The system will include nine incandescent circuits and two arc light circuits, and a power circuit. R. R. Keely, City Engineer.

EDMONTON.—Contracts for the design and erection of a 2,000 horse-power producer gas engine power plant are to be called for soon. Building to be a reinforced concrete and to be ready for installation of machinery by May 10th, 1908. R. R. Keely, City Engineer.

RAILWAYS—STEAM AND ELECTRIC.

(Contemplated Work.)

Ontario.

EXETER.—The surveyors of the proposed extension of the St. Mary's and Western Ontario branch of the Canadian Pacific Railway have completed the survey to this town.

KEMPTVILLE.—This municipality is considering the advisability of applying for a charter to construct a railway from Kemptville Junction to the Grand Trunk line near South Indian.

WHITNEY.—Contracts probably will be let in the near future for building the extension of the Central Ontario Railway from Maynooth and Lake St. Peter to this point, a distance of about 27 miles. J. D. Evans, chief engineer, Trenton.

British Columbia.

VANCOUVER.—A railway is proposed to be built from Nicola Lake to this place. Incorporation will be sought at the next session of the Legislature. The application is made by Livingstone, Garrett & King, of this city, acting for the new company.

(Contemplated Work.)

Ontario.

PORT ARTHUR.—The Mount McKay and Kakabeka Falls Railway Company will apply to the Legislative Assembly of Ontario for power to build on either the north or south side of the Kaministiquia River. They will also apply for an Act extending the time for the completion of the railway until 30th April, 1912. Messrs. Blake, Lash & Cassells are the company's solicitors.

British Columbia.

VANCOUVER.—The police committee have decided to make an extension to the jail. Mr. W. T. Dalton has submitted plans for the structure.

TENDERS.

New Brunswick.

MONCTON.—Tenders will be received by the Intercolonial Railway until January 7th for the construction of a block of cribwork to fill in a space in the front of the wharf at Mulgrave, N.S. D. Pottinger is general manager, Moncton, N.B.

Ontario.

L'ORIGINAL.—Tenders will be received until January 21st for the construction of an iron highway bridge over the Big Castor River, 120 or 125 feet span. Tenders are also asked for the masonry work required for the Big Castor bridge, concrete or stone. E. A. Johnson, county clerk, for Prescott and Russell, L'Orignal, Ont.

TORONTO.—Tenders will be received by the Board of Control, until January 28th, for a 15,000,000 and 6,000,000 Imperial gallon, triple-expansion vertical engine for the main and high level pumping stations. C. H. Rust is city engineer.

Alberta.

LETHBRIDGE.—Tenders will be received until January 25th for the construction of a brick and stone church for Knox congregation, Lethbridge, as per plans and specifications prepared by J. H. G. Russell, architect. Separate tenders will also be received for the heating and plumbing. E. U. Rylands is chairman of the Board of Managers.

British Columbia.

VANCOUVER.—The civic water committee has decided to call for tenders for the building and laying of the four miles of continuous stave pipe from the Seymour creek intake to the canyon. The material for the pipe will be provided by the city. W. A. Clement is city engineer.

CONTRACTS AWARDED.

British Columbia.

REVELSTOKE.—Three tenders were opened for the erection of city jail. O. W. Abrahamson, W. King & Son, and D. McCarthy. That of O. W. Abrahamson for $3,500 was accepted.

SEWAGE AND WATERWORKS.

Ontario.

GUELPH.—A total balance of $18,196 has been realized by the Waterworks Department, of this city, from the past year's operations, a profit of twelve per cent. on the total capital of $159,000 invested by the city in the waterworks plant. The commissioners have agreed to place $15,748 to the credit of the city, and reserve the sum of $2,448 to form the nucleus of a sinking fund to provide for repairs to the plant in the future.

(Contemplated Work.)

Ontario.

GUELPH.—The following estimates of projected civic works have been presented to the City Council by W. M. Davis, C.E.: Conduit, $67,943; reservoir, $8,418; sand pipe, $22,646; pumping machinery, $16,500. J. G. Lindsay is city engineer.

AYLMER.—This town will construct a ten-inch tile conduit from flowing wells 22,100 feet away for the conveyance of water for the use of this town. Contract for construction of same has not yet been let. Bids will be received at any time. J. Bradley is town clerk.

MARKDALE.—The Town Council is considering installing an up-to-date waterworks system. Engineer Aitken, Toronto, estimates its cost at $19,500 with an annual revenue approaching $2,000.

Alberta.

EDMONTON.—The growth of the city requires a more complete sewerage plant. It is proposed to add septic tanks and filter beds in such a manner that additions can be made in future. R. R. Keely, City Engineer.

British Columbia.

VANCOUVER.—An eight-inch main will be laid shortly at Sixth and Alder Streets. W. A. Clement is city engineer.

BUILDINGS.

Ontario.

WELLAND.—The Page-Hersey Iron Tube and Pipe Company, which has lately built large works here, called the Ontario Iron and Steel Company, is erecting a large additional plant. The furnace building will be two hundred feet long, with wings three hundred and eighty feet long, and a number of other large buildings will be erected. The capital of the company has been increased from $2,000,000 to $3,500,000.

WELLAND.—The Warner-Gibson Company is starting a new factory here. The buildings will be opened shortly. It will manufacture agricultural implements of various kinds.

Manitoba.

WINNIPEG.—An official denial has been issued by the St. Louis Car Company, of St. Louis, Mo., that this Company was looking over a site in Winnipeg for a plant which might be established in this city. It is officially stated that the St. Louis Car Company has not at any time contemplated a Canadian branch.

(Contemplated Work.)

Ontario.

GUELPH.—The Page-Hersey Iron and Tube Company, of this city, intend making extensions to their works here in the near future.

STRATFORD.—An extension will shortly be made to the Loretto Convent here. The new structure will be 45 x 104 feet, and three storeys high. J. S. Russell is the architect.

WHITBY.—The Government intend building a new post office here in the near future.

Saskatchewan.

SASKATOON.—The Imperial Oil Company, of Winnipeg, Man., are contemplating the erection of a warehouse in this city.

SASKATOON.—The Sawyer-Massey Company will erect an office and warehouse here at a cost of $30,000.

Alberta.

LETHBRIDGE.—Mr. G. M. Seaman intends erecting a three-storey brick business block on the property on Round Street. Work probably will be commenced early in the spring.

British Columbia.

VANCOUVER.—At a recent meeting of the Market and Industries Committee the proposal of Mr. Jenkins, of Morrisburg, Ont., to establish a tinplate and galvanized iron factory here was referred back to the chairman to obtain more definite information. The factory would cost from $150,000 to $200,000.

MISCELLANEOUS.

MINING.—Grand Forks.—A settlement between the Granby Company and its miners and smeltermen has been reached, and work has been resumed here and at Phœnix.

STEAMSHIP.—Owen Sound, Ont.—The C.P.R.'s new passenger steamer "Keewatin," which was towed up in halves and put together at Buffalo, arrived here, and will go on the Owen Sound-Fort William route next summer.

TELEPHONE.—Winnipeg, Man.—The Bell Telephone Company has offered to sell out its Manitoba telephone system to the Government for $4,000,000. The Government has sent out expert engineers to look over the Bell Telephone Company's plant and to set a valuation upon it. It is understood that the Government will not, under any consideration pay anything like $4,000,000, but might, if the experts warrant it, pay $3,000,000 to $3,500,000 for the company's plant and equipment in the province.

TELEPHONE.—Edmonton, Alta.—The Government telephone system is now in running order between this city and Lloydminster.

(Contemplated Work.)

DYKE.—Matsqui, B.C.—An auxiliary dyke will be constructed at this point on the Fraser River by the Provincial and Dominion Governments. It will cost about $10,000. Mr. Gamble is chief engineer for the Provincial Government, and Mr. Keefer, engineer for the Dominion Government.

CEMENT INDUSTRY.—High River, Alta.—Arrangements are about complete for the establishment of a cement industry on J. D. O'Neal's farm. The samples sent from Aldersyde to England for Examination have been returned, and the report given is that it is the very best material ever seen for the manufacture of sewer pipes, tile, pottery, and ornamental brick.

PERSONAL.

MR. WILLIAM COTTER, formerly superintendent of the Eastern division of the Grand Trunk Railway, with headquarters in Montreal, has been elected president of the Pere Marquette Railway.

MR. ROBERT R. HEDLEY, Special Commissioner of the Department of Mines of the Dominion Government, is investigating the mineral and metallurgical industry of the four provinces of British Columbia, Alberta, Saskatchewan and Manitoba. He is making a thorough investigation into all the conditions affecting the industry and will report to the department. He has already completed the British Columbia part of his work.

MR. CHAS. OLIVER, M.E., of Hedley, B.C., has completed an inspection of some mica deposits in Northern British Columbia for English interests.

MR. F. W. THOROLD, consulting engineer of Calgary, Alta., has resigned. He will take up independent work at Kelowna, B.C.

MR. G. HALL, assistant superintendent of motive power for the Canadian Pacific, has been appointed superintendent of motive power.

MR. T. C. IRVING, Jr., of the Standard Inspection Bureau, has been appointed secretary of the Toronto Branch of the Canadian Society of Civil Engineers.

MR. E. A. JAMES, former general manager of the C.N.R., is returning to Winnipeg. Rumor connects his name with the chairmanship of the Western section of the Railway Commission, which may be created at the present session of Parliament.

MR. T. H. MASTERSON, who has been superintending the construction of the Moosomin, Sask., waterworks and sewerage system, has returned to Regina.

MR. G. W. THEXTON, of Bowmanville, Ont., has been appointed superintendent of the Goodison Engine Works, of Sarnia, Ont.

MR. W. R. TIFFIN, G.T.R. superintendent at Allandale, Ont., has obtained leave of absence for an indefinite period, owing to ill-health. Mr. P. J. Lynch, assistant superintendent, will be in charge during Mr. Tiffin's absence.

MR. C. W. SPENCER, General Manager of the Mackenzie-Mann eastern lines has resigned. Before going with the Mackenzie-Mann interests Mr. Spencer was General Manager of the K. and P. division of the C.P.R.

PRESIDENT SMITH, of the Diamond Vale Coal Company, has returned to Vancouver, B.C., from a trip to the property of the company, in the Nicola Valley. He reports that active operations are in full swing on the new strike of coal, and that the hoisting of the product of the five-foot vein has now assumed commercial proportions.

MARKET CONDITIONS.

Montreal, January 2nd, 1908.

It would seem that many well-posted people in the United States are of the opinion that the pig iron market has almost, if not quite, reached the bottom and that any resumption of inquiry will immediately result in some advance on present prices. It is reported that the blast furnace output of the United States Steel Corporation was to be reduced to 25 per cent. of its capacity by the end of 1907. This output has been gradually declining for some time past and is now at a low ebb. As practically all other iron producers have made very material reductions in their output, there has been a very small accumulation of unsold stock. Practically all that is now being made is going into consumers' hands. The net result of this drastic action will be that, once confidence in market conditions is restored and inquiries develop, the market will assume a decidedly stronger tone. The railway companies are now starting to specify for steel rails for 1908, and, in fact, some new contracts have already been entered into, it is claimed. It is fully expected that a heavy tonnage in rails will be arranged for within the next few weeks and this should have a decidedly strengthening effect upon Bessemer and other steel-making irons. In the meantime, however, prices on these grades are being well held, with comparatively little movement.

In England, there is practically nothing to remark upon. Business is of a holiday character, over there, and little or no attention will be paid it until after the holidays are all over.

In the local market, inquiries are being received for small lots only, for immediate shipments. These orders are being filled, at around prices quoted, from stocks held here now by dealers. A slight decline has taken place in prices during the past week. A few inquiries for round tonnage of, say, 1,000 tons, have appeared during the past week, but, so far, these have not resulted in business being done. The inquiries were apparently put out with a view of testing the market rather than of doing business. It does not seem, so many think, as though prices would go much lower, so that once purchases begin there will be a rush on the part of a great many customers to place their orders for the year.

Antimony.—The market is steady and dull at 13 to 13½c. per pound.

Bar Iron Steel.—Dealers in Montreal still demand the following figures; though purchases may possibly be made at lower figures: Bar iron, $2.15 per 100 pounds; best refined horse-shoe iron, $2.55, and forged iron, $2.40; mild steel, $2.20 per 100 pounds; sleigh shoe steel, $2.20 for 1 x ⅜-base; tire steel, $2.30 for 1 x ⅜-base; toe calk steel, $2.95; machine steel, iron finish, $2.30.

Boiler Tubes.—Demand for boiler tubes shows little change, being quite dull. Prices are as follows:—Two-inch tubes, 8 to 8¼c.; 2½-inch, 11c.; 3-inch, 12 to 12¼c.; 3½-inch, 15 to 15¼c.; 4-inch, 19¼ to 19½c.

Cement—Canadian and American.—Canadian cement is steady, being still quoted at $1.90 to $2.00 per barrel, in cotton bags, and $2.20 to $2.30 in wood, weights in both cases 350 pounds. There are four bags of 87½ pounds each, net, to a barrel, and 10 cents must be added to the above prices for each bag. Bags in good condition are purchased at 10 cents each. Where paper bags are wanted instead of cotton, the charge is 2½ cents for each, or 10 cents per barrel weight. American cement is steady at $1.10 per 350 pounds, basis Lehigh mills, conditions being the same as in the case of Canadian mills, save that when the cotton bags are returned in good condition, only 7½ cents is allowed for them. American cement sold at $2 to $2.10 on track.

Cement—English and European.—English cement is unchanged at $2 to $2.10 per barrel in jute sacks of 82½ pounds each (including price of sacks) and $2.10 to $2.20 in wood, per 350 pounds, gross. Belgian cement is quoted at $1.75 to $1.90 per barrel, in wood. German is $2.52 to $2.55 per barrel of 400 pounds for Dyckerhoff.

Copper.—The market is weak, but dealers continue to quote 16 to 16½c.

Iron.—Canadian dealers have reduced their prices slightly and they make the claim that they will not accept less than the following for carload lots: Londonderry is only offering for future shipments, and is quoted at $24 f.o.b. Montreal for No. 1. Toronto prices are about $1.25 more. Summerlee iron is arriving, and is quoted at $24 f.o.b. on cars, Montreal, for No. 2 selected, and $25 for No. 1. No. 1 Cleveland is unobtainable at the present time, and Clarence at $20 to $21. Carron special, $24; soft, $23.75, to arrive.

Lead.—The tone of the market for lead is temporarily firmer, but prices are steady at $3.90 to $4 per 100 pounds.

Nails.—The market is steady and demand is dull. Cut nails are quoted at $2.50 and wire at $2.55, base prices.

Pipe—Cast Iron.—The market is next thing to dead. Prices are steady at $36 for 8-inch pipe and larger; $37 for 6-in. pipe, $38 for 5-in., and $39 for 4-in., at the foundry. Gas pipe is quoted at about $1 more than the above.

Pipe, Wrought.—Trade shows a considerable falling off. Quotations and discounts for small lots, screwed and coupled, are as follows: ¼-inch to ⅜-inch, $5.50, with 53 per cent. off for black and 38 per cent. off for galvanized. The discount on the following is 66 per cent. off for black and 56 per cent. off for galvanized: ½-inch, $8.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; and 3-inch, $75.50.

Spikes.—Railway spikes are not in very good demand, $2.60 per 100 pounds, base of 5½ x 9-16 Ship spikes are steady at $3.15 per 100 pounds, base of ⅝ x 10 inch and ⅝ x 12 inch.

Steel Shafting.—At the present time prices are steady at the list, less 25 per cent. Demand is very dull.

Steel Plates.—Demand is quite dull. Prices are steady at $2.75 for 3-16, and $2.50 for ¼ and thicker, in small lots.

Tin.—The market is steady, at 32½ to 33c. per pound. It is possible that even lower figures might be accepted.

Tool Steel.—The situation is fairly active and firm. Base prices are as follows: Jessop's best unannealed, 14½c. per pound, annealed being 15½c.; second grade, 8½c., and high-speed, "Ark," 60c., and "Novo," 65c.; "Conquerer," 55 to 60c.; Sanderson Bros. and Newbould's "Saben," high-speed, 60c.; extra cast tool steel, 14c., and "Colorado" cast tool steel, 8c., base prices. Sanderson's "Rex A" is quoted at 75c. and upward; Self-Hardening, 45c.; Extra, 15c.; Superior, 12c.; and Crucible, 8c.; "Edgar Allan's Air-Hardening," 55 to 65c. per pound.

Zinc.—The market for zinc is weak, demand being on the dull side. Prices are 5½ to 5¾c. per pound, and even less.

* * * *

Toronto, January 2nd, 1908.

During holiday week there is usually but little doing in warehouses, and the present week is no exception. Nor do contractors or builders find this an active time; indeed the builders have been handicapped by the soft weather of several past days. Brickmakers, for instance, and cement dealers find a lull; metals and hardware dealers, too.

The question of future prices of iron and steel construction material is receiving attention. But the mills are for the most part settling up old contracts, and no disposition has been shown just yet to book for future date. More active commercial and industrial conditions are to be expected in the States as recovery from the financial squeeze of late months progresses. Copper, tin, and lead are all showing improvement since our last. Tin had quite a spurt during the week; prices went up in New York. Lead is no longer weak, prices abroad having stiffened. Copper is fairly sure to recover when activity in the States returns.

Dealers in machinery cannot be called busy at the moment, but a time is about at hand when they may expect activity; switches, pumps, batteries, coils, will soon be asked for in the gas engine department; other machinery will be less immediately called for. But the feeling is buoyant and indicates confidence in good business early in the New Year.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—Quiet at 11½ to 13c.

Bar Iron.—$2.30, base, from stock to the wholesale dealer. A moderate supply on hand.

Boiler Heads.—25c. per 100 pounds advance on boiler plate.

Boiler Plates.—¼-inch and heavier, $2.50. Supply probably adequate and quotations still firm.

Boiler Tubes.—Lap-welded steel, 1¼-in., 10c.; 1½-in., 9c. per foot; 2-in., $9.10; 2¼-in., $10.85; 2½-in., $12; 3-in., $13.50; 3½-in., $16.75; 4-in., $21 per 100 ft. There is no reduction in price.

Bricks.—Common structural $10 per thousand, as before, and the demand fairly brisk. Same may be said of red and buff pressed, which are worth $18 at Don Valley Works.

Cement.—Star brand, Toronto, 1,000 barrel lots, $2.25 per barrel, 350 pounds net, including bags, or $1.85 ex-package, small lots cost $2.10 warehouse, $2.15 delivered. National and Lakefield prices are identical; English, Anchor, $3 per barrel in wood. Demand has relaxed.

Fire Bricks.—In steady request; English, $32 to $35; Scotch, $30 to $35; American, $25 to $40 per 1,000.

Galvanized Sheets—Apollo Gauge.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.25; 12-14-gauge, $3.35; 16, 18, 20, $3.50; 22-24, $3.70; 26, $3.95; 28, $4.37½; 29 or 10¾, $4.70 per 100 lb.

Ingot Copper.—Market shows improvement, feeling firmer. Our quotation is 15 to 16⅜c.

Lead.—Quite a change in the situation, prices abroad on upward grade, 4½c. now the local price.

Nails.—Wire, $2.55 base; cut, $2.70; spikes, $3.15. Supply moderate.

Pig Iron.—Summerlee No. 1, always in demand, generally for small lots, quotes now, nominally, $27; Glengarnock, $26.50; No. 2, $26; Cleveland, No. 1, $23.50, $24; Clarence, No. 3, procurable in Montreal, price here $23 to $24.

Steel Rails.—80-lb., $35 to $38 per ton.

Sheet Steel.—In moderate supply; 10-gauge, $2.65; 12-gauge, $2.75.

American Bessemer.—Fourteen-gauge, $2.65; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.85; 26-gauge, $2.95; 28-gauge, $3.20.

Tank Plate.—3-16-in., $2.65; Tees, $2.90 to $3 per 100 pounds; angles, 1¼ by 3-16 and larger, $2.75 to $3. Extras for smaller sizes.

Tin.—Price has advanced in New York. We still quote 31 to 32c. here.

Tool Steel.—Jowitt's special pink label, 10½c. per pound; Capital, 12c.; Conqueror, highspeed, 70c. base.

Wrought Steam and Water Pipe.—Trade prices per 100 feet are: Black, ¼ and ⅜-in., $2.59; ½-in., $2.89; ¾-in., $3.90; 1-in., $5.60; 1¼-in., $7.65; 1½-in., $9.18; 2-in., $12.24; 2½-in., $22.15; 3-in., $30.00. Galvanized, ¼ and ⅜-in., $3.41; ½-in., $3.74; ¾-in., $5.06; 1-in., $7.26; 1¼-in., $9.90; 1½-in., $11.88; 2-in., $15.84; 3½-in., black, $39.00; 4-in., $42.85. Prices firm but unchanged, stock light.

Zinc.—Has participated slightly, in the improved feeling in other metals. Toronto, slab, $5.50; sheet, $7.50.

NEW INCORPORATIONS.

Ontario.

Lewis & Smith, Toronto, $100,000. H. Lewis, H. W. Wilcox, C. M. Doolittle, T. C. Haslett, A. L. Scott, Hamilton.

Crown Gypsum Company, Cayuga, $100,000. J. P. Fell, G. L. Lovejoy, J. T. Mullany, Buffalo; J. A. Murphy, Cayuga.

The Automatic Vending Company, London, $50,000. G. H. Townsend, Smithville; S. W. Trusler, Camlachie; W. L. Trusler, Toronto.

Electric Securities Company, Toronto, $300,000. A. M. Manson, J. M. Langstaff, D. J. Cowan, J. A. Goudy, C. L. Corin, Toronto.

Princeton and Drumbo Telephone Company, Princeton, $20,000. F. J. Daniel, W. H. Wells, T. Conway, W. Courtney, Princeton.

Nova Scotia Cement and Plaster Company, Toronto, $100,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, H. Chambers, M. Coates, Toronto.

Dereham Telephone Company, Bowmansville, $30,000. R. W. Hawkins, I. Harris, J. W. Hopkins, S. A. Freeman, H. Minshall, K. E. Freeman, Township of Dereham.