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MISSING

The Canadian Engineer

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ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893

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TORONTO, CANADA, NOVEMBER 1st, 1907.

CONTENTS OF THIS ISSUE.

COALITE, A SUPERIOR FUEL TO COAL.

A new fuel, the use of which is claimed to be more advantageous than coal, is being put on the English market under the name of "Coalite." It has been given much publicity in the columns of British journals.

It is claimed that this fuel will burn under any ordinary conditions without emitting smoky gases, and that it has a higher heat efficiency than the best Welsh steam coal. We have had several enquiries asking for information regarding this new fuel, and for the benefit of those, and many others who will doubtless be interested, the following particulars, taken from the London Standard are given:—

"Coalite is obtained by the distillation of bituminus coal of any size or quality, and the process consists in carbonizing such coals for a period of eight hours in flat, rectangular retorts, ten feet in length, which are placed vertically in a gas-fired furnace, the temperature of which is kept at 800 degrees F., a temperature which just shows a dull red glow when shaded from strong light. These retorts being filled, the swelling of the coal on heating causes a considerable pressure, and results in the formation of a product of good density, while the low temperature prevents the whole of the volatile matter from being expelled, and yields a substance which, although it has a superficial resemblance to coke, differs widely from it in many important points. Each retort takes 15 cwt. of coal at a charge, and yields approximately 11 cwt. of coalite, but this varies with the composition of the coal used, so that, although in most cases the yield is 70 per cent. of the coal taken, it may be slightly higher or lower.

"The temperature at which coalite is formed is nothing comparable with the white heat to which ordinary gas retorts are subjected, with the result that the constituents of which illuminating gas is composed remain behind in coalite to an extraordinary extent. The presence of so great a proportion of the gaseous elements of coal also secures the easy ignition of the fuel and its burning with a gentle flame; while the removal of the superfluous volatile elements deprives it absolutely of the power of emitting smoke at any time during its combustion."

A smokeless fuel that will even compare in value to bituminous coal is much to be desired, especially in view of the stringent laws that are being passed in almost every large city for the prevention of smoke. If this new fuel is all that is claimed for it consumers will welcome its speedy advent. Not only will it be possible to use it for manufacturing and domestic purposes, but also under locomotives, the smoke from which is very noxious, particularly where much shunting is done within or near the city limits.

Professor Vivian B. Lewes, of the Royal Naval College, Greenwich, has made some exhaustive tests with "Coalite," and his report on same contains some very interesting figures. According to the report, "Coalite" has a heating value of 13,500 B.T.U. per pound. That of bituminous coal averages 14,800 B.T.U. These figures would lead one to believe that coal is superior to "Coalite," but it is claimed that it is not, owing to the fact that on combustion most of the calorific value of "Coalite" is converted into heat. Exhaustive tests have shown that about 50 per cent. only of the calorific value of coal can be obtained from it. On this basis, taking coal with a heating value of 14,800 B.T.U., only about 7,500 B.T.U. can be utilized, while 13,000 is available in the "Coalite." It has been shown by test that a fire of "Coalite" radiates 1.56 times as much heat as a coal fire of the same size, and from a heat-producing standpoint the "Coalite" fire was much more steady. These figures are more or less convincing, but it is hard to see how coal from which some of the volatile matter has been extracted, can compare in value with the original article.

In the manufacture of "Coalite" there are several by-products, among which is a spirit that can be used as a motor fuel, a fuel that can be sold at a much lower price than either gasoline or petrol. It is estimated that in treating 3,000,000 tons of coal about 7,500,000 gallons of benzol, naphtha, etc., are obtained, and a large percentage of this is suitable for use in motors.

As already noted, we have received several enquiries asking about this new fuel, and no doubt many of our readers, whether interested in the fuel question or not, appreciate the foregoing particulars.

THE FAILURE OF THE BRIDGE AT QUEBEC.

On another page we publish a letter dealing with the Quebec Bridge disaster. So much has already been said about this matter that it seems almost futile to say any more. There is one point in this letter, however, that attention may be drawn to, and that is that when any large engineering work is to be undertaken Canadian engineers are more or less ignored. According to the report of the investigating Commission, the best bridge engineers in the United States were engaged to design and erect this bridge. Such being the case, then, the product of the best effort of these men was a bridge that fell down. To say that the disaster was purely accident is not correct. If it is, the science of engineering is not an exact one, which it must necessarily be. As has already been stated in these columns, someone has blundered, and the blunderer is one of the best engineers in the United States.

According to Sir Wilfrid Laurier, the Quebec Bridge when rebuilt is to be a national structure. It will be paid for by the people of this country. This being the case, the opportunity for the Canadian engineer to show what he can do is at hand. Canadian money should be paid to Canadians for Canadian effort, especially if the result of that effort is as good, if not better, than that of a foreign competitor. In this instance Canadian engineers cannot do worse. They can do better.

EDITORIAL NOTES.

The Canadian Engineer has now completed arrangements whereby it will be personally represented in Great Britain by A. Webster at Chancery Lane, London, E.C. Mr. Webster will always be glad to answer any and all questions re advertising and subscribing, and we trust our many friends in Great Britain will make free use of the office.

* * * *

Unfortunately the name of the author of the paper entitled, "Specifications for Steel Forgings, Steel Castings, and Steel Boiler Plates," read before the American Society of Mechanical Engineers, and reprinted on page 391 of this issue, was omitted. The omission was noted before the last form went to press, and we are pleased to be able to make the correction in this issue. This very valuable paper was prepared and read by Mr. William R. Webster, of Philadelphia.

* * * *

At the Engineers' Club of Toronto, on Thursday last, one speaker gave as his views regarding the cause of the Quebec Bridge collapse information that had apparently been taken from the columns of this journal. The figures given were exactly the same, and in many instances the exact language was quoted. During the meeting Engineering News and the Engineering Record were quoted, and due credit was given. No credit was given to the Canadian Engineer, which was more liberally quoted than either of the other two. The information given in these columns is "boiled" down and made as concise as possible, in order that it may be read quickly by engineers, most of whom are very busy men, and have not got time to read long-winded articles. The Canadian Engineer has taken its stand in this important matter along with other technical journals, and, therefore, should be given credit. We hear on every hand the slogan, "Made in Canada" and "Canada for Canadians." Why not another, "The Canadian technical press for Canadian engineers?"

* * * *

In view of the recent reports to the effect that the Westinghouse Machine Company had made application for a receivership, the following letter, dated October 26th, from the receivers will go far towards allaying any misapprehensions that clients of the company have been under:—

"The undersigned desire to assure the clients of the Westinghouse Machine Company and all others interested, that there should be no occasion for apprehension because of the Company's application for a receivership.

"This action was deliberately and thoughtfully taken as a sensible and logical measure for conserving the interests of the customers, creditors, and stockholders of a solvent institution which is doing a large and profitable trade.

"From such examination of its affairs as the receivers have been able to make in the short time during which they have been in charge of the property it would appear that the Westinghouse Machine Company has been suffering from nothing more serious than a rapidly-growing and profitable business. This has necessitated the employment of considerable borrowed capital and credit throughout the country, the sudden withdrawal of which would have seriously interfered with the manufacturing operations of the Company.

"There has not been even a momentary pause in the operations of the Company, and the personnel remains the same as heretofore. There will be no departure from the general policy that has hitherto obtained in the conduct of the business, and the receivers will, during their incumbency, spare no pains to foster and maintain the cordial relations that have always existed between the Westinghouse Machine Company and its customers."

WM. MCCONWAY,
W. H. DONNER, } Receivers.
E. E. KELLER,

MACHINERY EXPORTS TO AUSTRALASIA.

The exports of machinery from Canada to Australasia in 1906, were as follows:—

Gas and oil engines	£642
Other engines	38
Boilers and pumps	1,509
Printing machinery	3,511
Sewing machines	53
Typewriters	1,584
Machine tools	197

A decrease of £1,747 as compared with 1905. The total imports of machinery in 1906 were £2,118,352.

The American Waterworks Association has published the minutes of proceedings of the twenty-seventh annual convention, held at Toronto from June 17th to 21st, 1907, in book form. Besides containing the proceedings of this convention, it contains a full list of officers and members, and the specifications for cast iron pipe and the discussion thereon.

WOODEN RAILWAY TRESTLES.

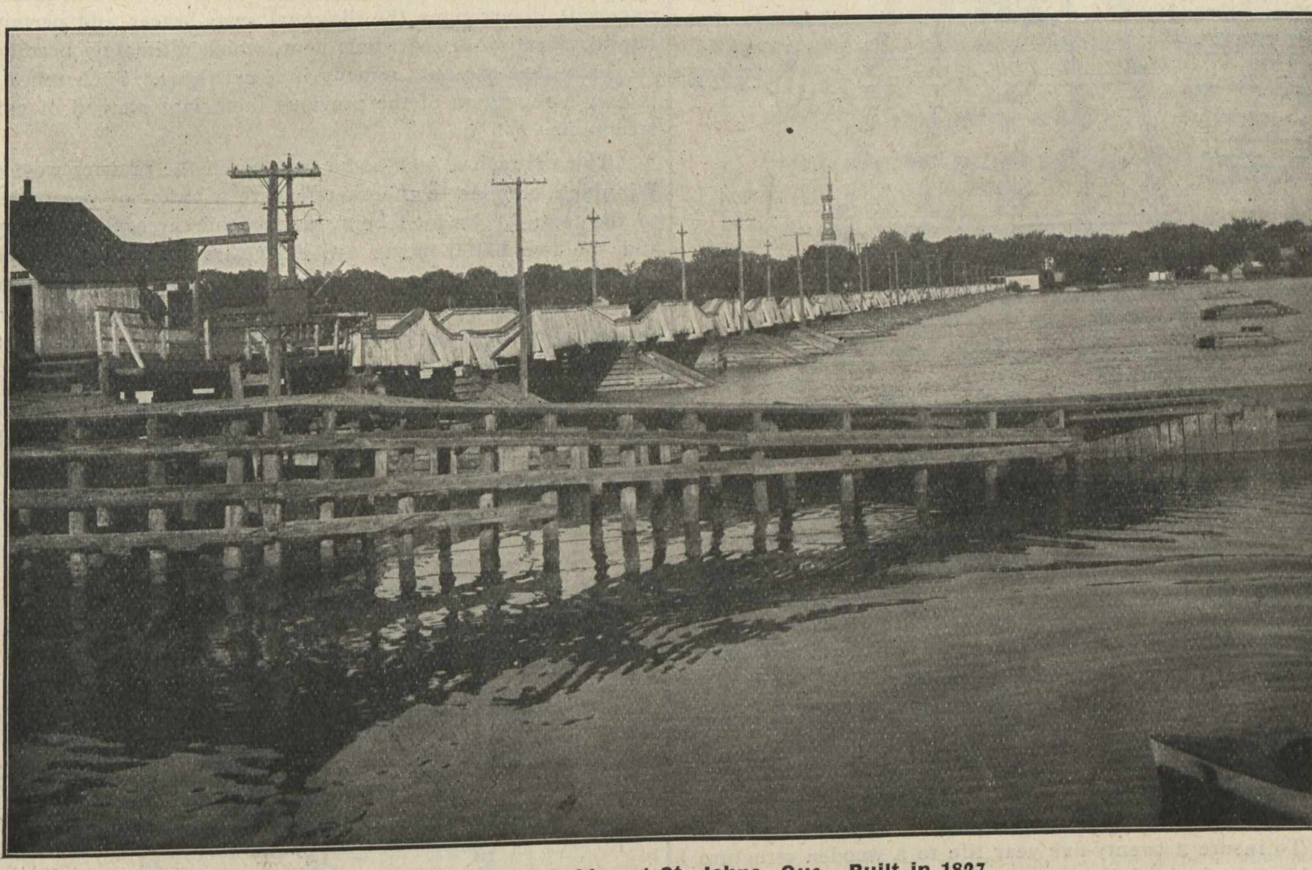
By R. Balfour.

The advantage of railway trestles constructed of timber, are not generally appreciated by railway corporations or governments, principally for the reason that their life is restricted to within eight to fifteen years, and the cause for this short life may be found in faulty design and construction. If railway timber trestles were properly designed and carefully constructed their life might safely be placed at twenty-five years as a minimum. As an example of their maximum endurance, I might refer to Jones' Highway Bridge over the Richelieu River at St. Johns, Quebec. This bridge was built entirely of timber in 1827. The superstructure is still in use, but the upper portion of the cribwork in the piers was renewed in 1904. This bridge stood, without renewal, for seventy-seven years, and the greater portion of the structure is still in use, and apparently as sound to-day as it was when erected, eighty years ago.

It appears strange indeed that corporations and governments spend hundreds of thousands of dollars in timber work, and the function of the batter posts was to brace the bent. In the ordinary steel trestle of to-day there is no plumb post, the load is carried directly on the batter posts. With this development and improved method of structure with respect to steel and iron, there has been no corresponding advance in the design of a wooden trestle bent. We are using the same design our forefathers used fifty or sixty years ago.

If the late Mr. Jones, of St. Johns, Quebec, who was neither a bridge builder nor an engineer, could design and erect in 1827 a wooden bridge, which sustained the heavy traffic of the early freighting and stage coaching between Montreal, Boston, and New York, and which, three years ago was sound, without renewals, except flooring, it appears of importance to ask the engineering profession of Canada, why the wooden trestles built ten years ago, are to-day rickety and dangerous to such a degree that the problem is, will they sustain another year's traffic?

This leads to the inquiry—wherein has there been failure to improve the design of wooden structures, which in consequence of such faulty design are weak, after ten years' usage, to the danger point.



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

in these days of advanced ideas in other branches of mechanics, following faulty designs, with the result that in ten years the outlay must be duplicated, whereas their timber trestles might be made almost as durable as steel, and far less expensive.

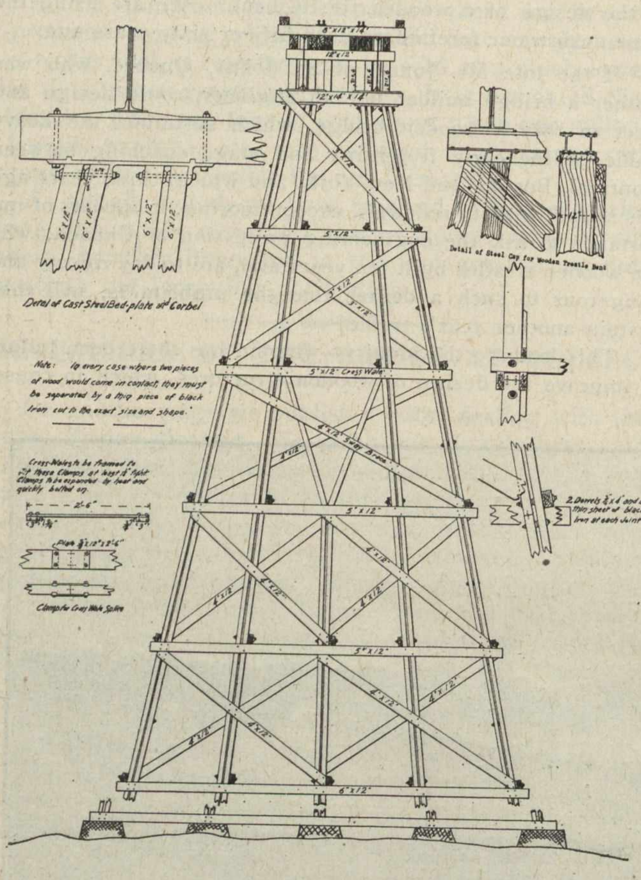
The designing of timber structures during the past twenty years has not received the studious and intelligent consideration of engineers the subject merited. The writer remembers that thirty years ago it was a common remark of bridge men that the timber trestle was practically a thing of the past, and general attention was directed to the steel and iron form of structure. For years past the inventive genius of bridge engineers has been confined to the development of designs in steel and iron to the exclusion of any improvement in the wooden structure.

Thirty years ago the design of timber trestles was as far advanced as it is to-day. That design involved at least two plumb posts and two batter posts. The plumb posts were so constructed that they inevitably had to carry the load,

An examination of wooden timber structures will disclose the fact that the load is carried on vertical posts, and that batter posts were introduced to keep the bent erect. This I believe to be a wrong principle, as it permits of lateral movement. If the batter posts carried the weight as they do on steel structures, there would be no initial lateral movement. As at present constructed, little or no strain comes on the batter posts until some lateral movement occurs to the whole bent, and then the danger has accrued, for the sway-bracing is distorted and weakened, and a general break-down of the entire structure is a matter of time.

This is not all. The batter posts are not placed in a position to do effective service, they have a batter of only two inches to the foot, instead of at least three inches to the foot, in a windy country such as that now being crossed by the Grand Trunk Pacific, west of Winnipeg. Yet in the case of wooden structures in this system they are being constructed to-day with all the defects outlined in this article and are liable to the same fate as their predecessors.

Another defect is that one bent is piled on the top of another with cap sills intervening between the posts of each bent, subjecting the fibres of the cap sill to the crushing effects of the weight above. This principle is wrong, the weight should be sustained end wood on end wood from the foundation to the top. The side wood contracts and expands in response to changes of climate so that one day it



may be higher or lower than another, owing to the swelling or shrinking of the wood which is being crushed side-wise.

Yet another objectionable feature of modern wooden structures is that the cap sills alluded to above, are spliced underneath the main cap sill with a short piece of 12 x 12. It is decidedly unwise to have two pieces of timbers, one directly over the other, on the same plane, as this permits water to enter between the joints of the two pieces and the result is decay. All these defects have a tendency to shorten the life of the structure.

If these structures were properly designed and built, they would be perfectly safe at least for twenty-five years, with ordinary care and the occasional renewal of faulty material.

To insure a twenty-five year life to a wooden structure I would carry the load directly on two pairs of batter posts. On the windy or prairie section, I would give the outer posts a batter of three inches to the foot, and the inner posts a batter of an inch and a half to the foot. In bents up to one hundred feet in height I would have each post consist of two pieces 6 x 12 inches. I would divide the bent into bays every fifteen feet of height. At these bays I would have cross-wales 6 x 12 inches, one on each side of the bent. Diagonally between them I would have sway-braces 4 x 12 inches, as shown on plan.

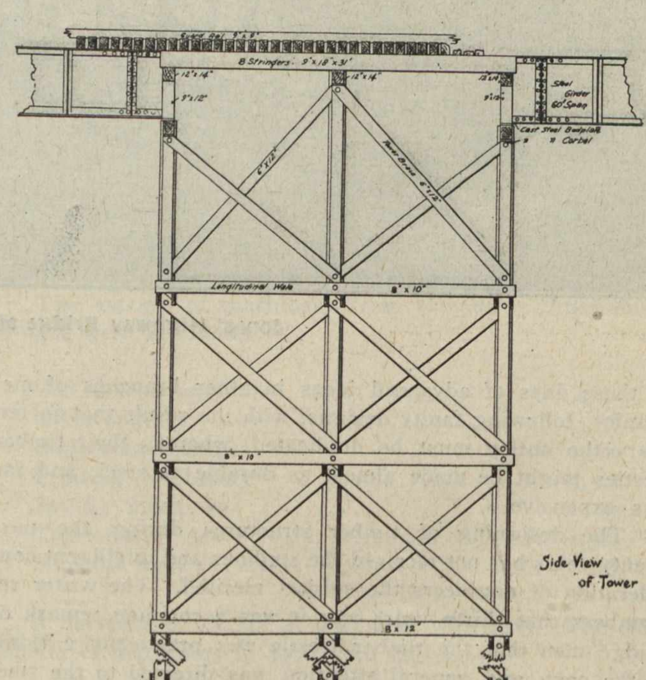
I would have no end wood crushing into side wood at a strain greater than one hundred pounds to the square inch. Each post piece should be thirty feet in length, with joint in the middle of its mate piece as shown on plan. In the designs of these structures I would impose an arbitrary rule that no two pieces of wood should come in contact, I would interpose a thin sheet of black iron. Where steel girders are used instead of wooden stringers, I would have a cast steel bed plate rest on top of the cap to distribute the load along end wise of the cap to obviate unduly crushing the cap sidewise of the grain. Underneath the cap I would place a cast steel corbel to distribute the strain due from the weight crushing down on the end wood of the posts—see detail in plan, cast steel plate and corbel.

For the ordinary rough and ready style of foundations, viz.; piles of any old kind of pile timber picked up along the right of way, and hammered into the mud and cut off—I would substitute the following:—I would have every bent resting on concrete pedestals. On the top of these I would place a piece of iron, either rolled or cast, for the end wood of the posts to rest on directly, without the interposition of a sill.

The ordinary railway trestle in a timber country, as a rule, is rushed through without any attention being given to design, or the slightest care as to foundations. Piles are procured from the neighborhood and driven a few feet below the surface, a sill is placed on top of these piles and posts erected from the sill, then two, three and in some cases four bents are carried on this sill, one above the other, the sill being sustained by the piles. The result is a flexible, yielding, unstable foundation. The sill is subject to almost daily wetting and drying. In its wet condition it is crushed together by the weight of the posts, and when dry it shrinks. The wood is spongy and soft at times, and allows of a vertical movement throughout the whole bent. This vertical movement (occasioned by the rebound of the sill after the load is removed) disarranges the diagonal sway-braces and permits lateral vibration of the whole bent, which ultimately becomes so shaky that the only remedy is a new bent. Such renewal is only a repetition of the previous inefficient method of construction.

The writer has seen some trestles on the prairies west of Winnipeg, similar to the sketch, with a batter of two inches to the foot. The load being carried on three plumb posts, and the two batter posts are evidently intended as braces with a batter of only two inches to the foot. Ten years from now these trestles will be a source of anxiety and annoyance to the railway company operating the line, and of danger to the travelling public.

As the greater portion of the material will have to be procured from British Columbia, from which point the freight rates are excessive, the timber should be planed and sized before shipping as the saved freight would about equal the labor of planing and sizing. Seasoned lumber is not neces-



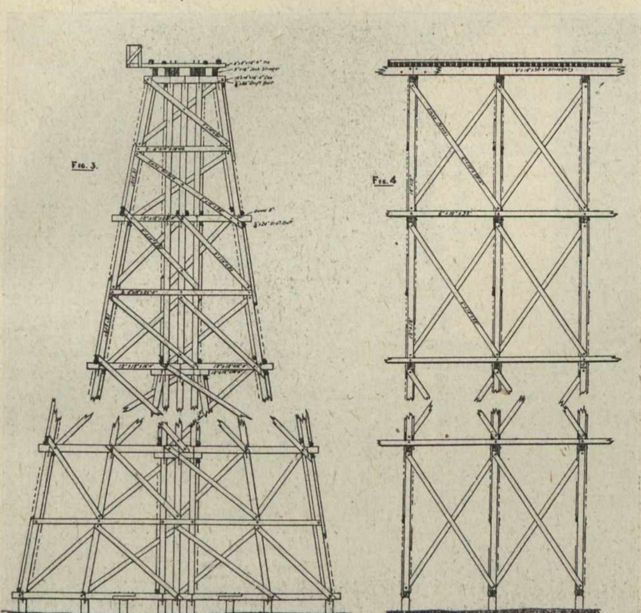
sary as whenever two pieces of wood would otherwise come in contact, a piece of thin black sheet iron is introduced. The oxidization of this iron furnishes paint, which preserves the timber. We now have a structure which is perfectly painted in all unexposed places. After the structure has stood a year, and is thoroughly seasoned, the exposed surface should be painted with fire-proof paint, or white-washed with lime, or a mixture such as the United States Government use in their lighthouses.

From personal observation during an experience of thirty-five years, the writer has come to the conclusion that the safe working load, sidewise on hard pine, should be taken at one hundred pounds per square inch, in a moist climate, and varying in proportion to the dryness of the climate from that to two hundred pounds, or even two hundred and fifty pounds per square inch, in very dry countries.

In actual practice the strain is often five hundred to one thousand pounds per square inch. An important consideration is facilities for renewals, the bridge should be designed with sufficient strength so that the pieces in each bent can be removed one at a time and another substituted, without interrupting traffic.

Figs. 1 and 2 are submitted as general plans for trestles up to or over one hundred feet in height. According to this plan there are no stresses on the side wood great enough to destroy the fibre. It is so designed that it can be removed piece by piece and it is intended that all the timber on the structure shall be planed and painted.

Fig. 3 represents a general plan of a wooden trestle as generally built. This style has a batter of two inches to the foot (one in six). It has intermediate cap sills and sill. Notwithstanding that this plan is faulty in many details, it has the approval of two great corporations in Canada. It has not



Front Elevation. Side Elevation.

sufficient spread to carry the great loads that are expected to go over it. Locomotives weighing one hundred tons, and with a high centre of gravity, are expected to run over these structures at fifty miles an hour. The swaying or oscillation of these locomotives on a trestle one hundred feet in height will be terrific, owing to the peculiar design of the structure. The strain on the side wood of the sills and the cap sills will be sufficient to crush the life out of the wood between the upper and lower posts, owing to the shrinkage and swelling of the cap sills in wet and dry weather, as explained above.

Fig. 1 shows a side view of the proposed bents in the writer's design up to one hundred feet in height. The size of the posts are to be 6 x 12 inches, and the longitudinal wales (end view—shown in Fig. 1 in detail A) should be 8 x 10 inches and thirty-two feet long. Where two pieces of the posts butt on to each other, two dowels ¾ x 4 inches are used (see detail A and B), and a piece of black sheet iron of about 24 B. W. gauge, cut 6 x 12 inches and inserted between the ends of the two pieces of the posts. Detail C shows a corbel under the cap to which the posts are fastened, and also a cast steel bed plate on which the steel girder rests. Detail D shows splicing of the cross-wales when they become too long to be furnished in the complete length.

Fig. 2 shows a side view of tower to carry steel girders with 9 x 18-inch stringers over the tower. The tower braces are to be 6 x 12 inches throughout until the tower exceeds one hundred feet, and the longitudinal wales to be 8 x 10 inches. The ties on this plan are shown 8 x 12 inches, but if greater economy is desired the 9 x 18-inch stringers over the tower might be kept four inches higher, and 8 x 12-inch ties used over the steel girder.

The Department of Railways and Canals of Canada issues specifications for steel and iron bridges, but I do not know of any specification governing timber trestles, although nearly all our western railways are carried over gulches on timber trestles when the railways are first built.

As the Government of Canada contributes generously to the construction of railways, and as the safety of the public patronizing them is in the care of this Department, it appears of the first importance that stringent specifications should be adopted in regard to the style of the structure, as well as the material used therein. Canadian railway development is only in its infancy, and as there is an abundance of timber, undoubtedly in the development of railway systems a great amount of timber will be consumed both for temporary and permanent use, and whereas timber can be procured quickly; and to secure steel involves great delay, there is no doubt that timber will be the material largely used for many years to come.

It appears desirable that plans of trestle bents with all their bracing and foundations, and superstructure whether of wood or steel should be prepared by the Department of Railways and Canals, and it should be made imperative that all railways receiving Government assistance should follow these plans.

MACHINERY INDUSTRY IN JAPAN.

A tabulated statement, prepared by the Japan Chronicle, and incorporated in the report of the commercial agent for that country, shows the growth of the machinery industry in that country since 1896. The table* follows:—

	Steam Engines.	Electric Dynamos.	Locomotive Engines.
1896	818,241	14,094	1,620,768
1897	1,308,173	167,628	4,235,617
1898	697,173	91,414	4,282,502
1899	327,144	12,566	1,968,374
1900	773,255	309,195	1,089,209
1901	1,095,906	388,716	1,749,408
1902		473,084	12,114,323
1903	989,873	836,653	2,267,472
1904	1,710,914	1,266,186	2,291,327
1905	2,633,033	2,455,424	2,466,561
1906	2,162,123	1,408,315	1,659,951

	Lathes.	Others and Total.
1896	73,538	12,944,669
1897	192,672	22,347,432
1898	243,863	21,114,104
1899	331,070	9,561,246
1900	231,405	13,930,302
1901	709,103	16,738,947
1902	473,084	12,114,325
1903	178,109	13,213,072
1904	827,615	14,757,884
1905	3,349,617	27,954,226
1906	1,120,405	27,040,554

At the end of 1900 246,000 was the aggregate horse-power industrially employed, and, according to the commercial agent, it is now about 300,000. This figure is not very large, but the amount of power used has quadrupled during the past ten years, and it is expected that the ratio of increase will continue.

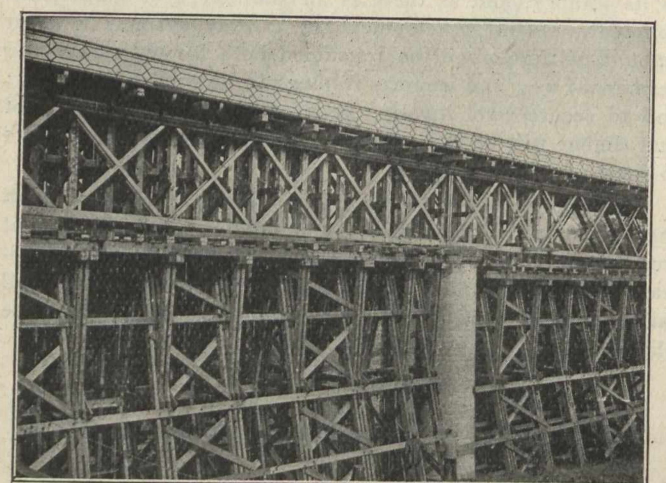
* The figures are given in yens, the unit being equal to 49.8 cents.

REPLACING OF GAUNLESS VIADUCT

By John H. Devey.*

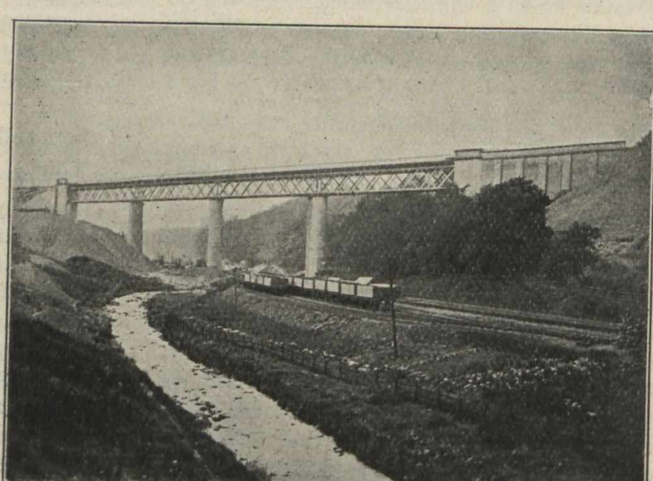
The Gaunless Viaduct is situated between the villages of Cockfield and Evenwood, in the county of Durham, England, on the Bishop Auckland and Barnard Castle branch of the North-Eastern Railway, and formed part of the old Stockton and Darlington Railway, which company owned the famous engine, the "Rocket," now mounted on Darlington platform, which engine was built by George Stephenson, and at one time ran on this branch of the system.

Gaunless Viaduct was designed and built by George Bouch, the brother of Sir Thomas Bouch, builder of the ill-fated Tay Bridge, about 1847. It is composed of four iron spans of continuous joint.



Gaunless Viaduct, showing Brick Pier and completed Trestle Work.

It was on the Stockton and Darlington Railway that the first iron bridge at West Auckland was built, and which was replaced by steel girders in 1904. Gaunless Viaduct was built for a double track on abutments and piers composed of firebrick, but the double track was not laid till the section, Barnard Castle to West Auckland, was double-tracked, and, as the girders were found to be too light for present-day engines and loads, it was deemed necessary to renew them. The centre pier was 66 feet from ground level to top of bed-stone (piers 9 feet in diameter, bed-stones 11 feet). The piers and abutments were in a very satisfactory condition, and it was found necessary to renew only the bed-stones (re-laid with scrap granite) and repair and point the piers and abutments, the estimate for which was £500.



Gaunless Viaduct.

It was at first intended to build an entirely new viaduct and divert the tracks in order that the mineral traffic to the north would not be interfered with during the construction of the work. However, owing to the fact that piers and abutments, which were sunk through 40 feet of shale and coal, were in a good state of preservation, and, as the whole district was undermined by colliery workings, which would make it extremely difficult to get as good a foundation, and, as notice had been filed that were new piers and abutments sunk there would be a danger of the workings being flooded by the River Gaunless, which runs beneath the viaduct, and if such were the case the company would be liable for damages, it was decided to utilize the old piers and abutments. Although these workings had been abandoned for many years, an old shaft at the side of the viaduct was opened up as soon as we started operations. To overcome these difficulties, that is, keep the traffic going and at the same time renovate piers, abutments and bed-stones as well as replace the girders, it was decided to construct a trestle viaduct on the site occupied by the existing viaduct to accommodate the traffic.

Gaunless Viaduct.—Plan of Trestle Work.

The trestles were built as shown by photographs and drawing reproduced herewith, and it was decided so far as possible to have a standard height of trestle, but this was only possible in two out of the four spans, because in the one case the viaduct was on a grade of 1 in 264, and the ground fell rapidly to the first pier at either end of the viaduct.

A standard length of trestle was used in the two centre bays, placed on concrete foundations. In the two end bays as many trestles as possible were built of the same height and placed on subsidiary trestles of various heights, also placed on a concrete foundation.

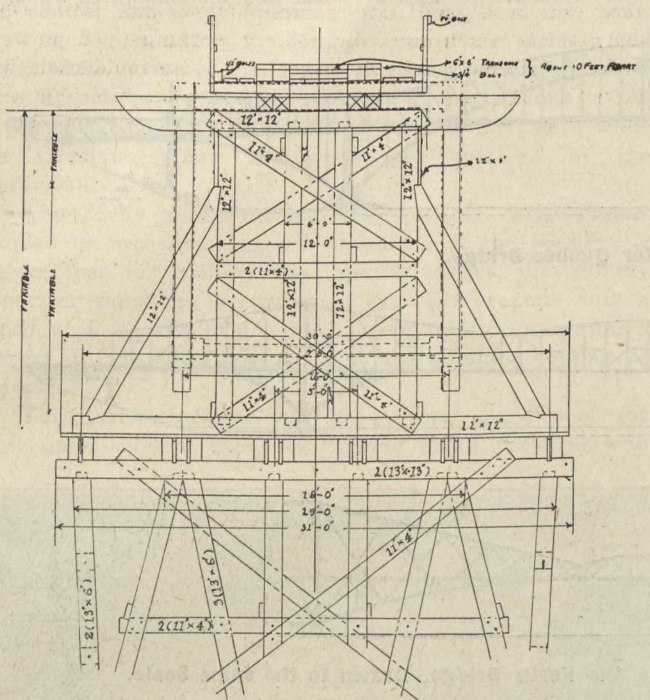
Now, in order to take the grade on the viaduct, the under trestles were constructed with a level top from end to end, and on these trestles stringers were placed, and on that decking; these upper trestles were of variable height. The main trestles were 66 feet high, and upper trestles 19

* Assistant engineer on the work.

feet high, and the distance from rail level to ground was 90 feet at the highest point.

Now, as the lower trestles were 12 feet from centre to centre and upper trestles placed 4 feet apart, it was decided to place stringers on top of the main trestles, and to place decking on these stringers in order to distribute the weight.

Another branch railway ran under the viaduct and made the arrangement of the trestles at this point very difficult. No scaffolding was used during the process of erection. The trestles were fitted together under the



Transverse Section, showing Standard Trestle.

viaduct, one end being kept higher than the other during construction in order to facilitate the raising of same. The trestles when completed were raised by means of pulley and cable, the pulley being placed on the girders of existing viaduct, and rope being carried from trestle over pulley to a locomotive, and the engine started up the grade, and the trestles were carried up, one by one, and then laid close together, and afterwards spaced by means of two steam cranes on top of old viaduct, the trestle being slung at end of the jibs of the two cranes. All the timber used was sawn to a true cross-section, the method of half-timbers being employed.

THE QUEBEC BRIDGE.

By Alfred J. Roewade.*

Speculation as to the cause of the Bridge collapse seems now to have a tendency to settle down to a discussion of details and shop practice. The doubts in regard to the appropriateness of the general design being forgot. This induces me to ask your hospitality for an effort to revive the last question named.

My personal impression of the bridge design has, from the first look at it, been that it was proportionally too low, too flat and stretched to give the proper impression of strength for a span of that length. Yet as I, from merely practical investigations on other lines, know it to be too near the water line to serve its purpose properly, knew that it would act as a barrier to navigation, and gave public utterances to this my belief, I thought to have done my duty. The terrible fate, however, which so soon after struck the bridge while building, has revised my first impressions. Being habitually accustomed to judge designs according to their architectural appearance and to believe in demands requiring that all such structures should be built on lines which were able to impress the eye with the appearance of strength, not only indicating the ability to carry the load imposed upon it, but to do this with ease, I must confess that the Quebec Bridge design, to me looked as if it would be unable to carry itself, let alone the live load of the traffic for which was to be built. The collapse has given a terrible confirmation to my suspicions and made me regret not having mentioned this side of the problem in time.

I know from experiencing the stubbornness reigning in the bridge engineer's office in regard to architectural demands, of experiencing how everything is ruled by shop practices and how impossible it is to make a bridge engineer listen to appeals in that line. With his mind perverted by onesided shop methods and details innumerable, he regards any criticism as to looks and appearances as crankish and ridiculous, while he at the same time admits that foreign bridge work is superior to the American in regard to appearance. He finds himself bound by the spell of common practice and knows that with few exceptions, the great men of his profession have become such by sacrificing the maxims of architecture for those of economy, and he does not want to go against the tide of professional opinion. The Quebec Bridge design is not among the worst examples, yet it shows the characteristic style developed in the bridge factory, and if we will compare it with that of the Forth Bridge, of which it is a modification, we will see how the strong monumental lines and general character of the prototype is wiped out, and no new or characteristic lines created to replace them. There is no doubt in my mind that if that particular member of the structure, which was found to show weakness before the collapse, had not shown this some other member would have done so, and the result thus have been the same. The strain diagram and all the calculations and figures may be in strict accordance with the developed practice, yet the collapse has proved that the calculations were applied to a faulty design and built on air. This being my belief I do not hesitate saying that awful as the price has been the experience will be worth it, if the profession takes heed of the warning and henceforth provides satisfactory designs for works of such immense importance.

The Quebec Bridge when built will be a truly national monument. It will be the main gateway of the Dominion, through which the official passage between the old and the new world is to come and go. Would it not be appropriate to make this gateway appear true to its character? Should not a design be found which without words could proclaim the free intercourse and hospitality, and should not that other design, which, to give it its right character, appears as a backyard fence with an opening left to crawl through, be discarded? It will, if used again, in order to prevent a second catastrophe, have to be strengthened so much that its economical features thereby will vanish, and the main reason for its existence thus cease to exist.

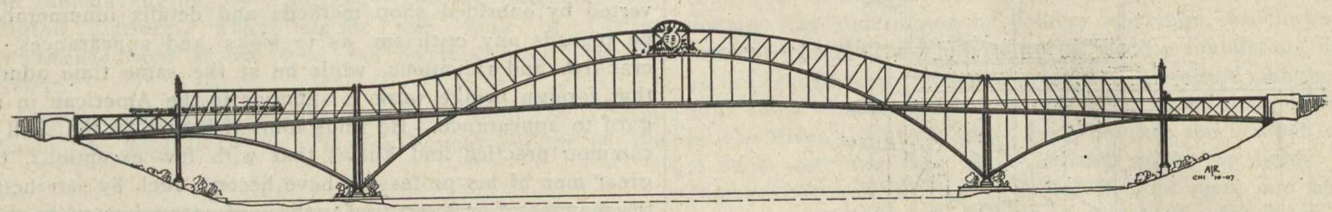
Whatever our opinion as to the value of the American style of bridge design may be, when this is compared to European examples, it must be remembered that both are the results of natural conditions. A new country is a problem and an old country is a study. We are living in a new country where everything has to be built from the bottom; and the vastness of it furthermore makes the task so enormous. Where the old country has one bridge to build we have a thousand and no time to deliberate on single cases and their consequences or relation to surroundings. While these are fixed in Europe and while they have plenty of time, we have to go ahead with the speed of the electric flash, and while we bridge a river in the wilderness today, this bridge may tomorrow be located in the middle of a busy city. Yet we must not forget that the effects of these different ways of doing things inevitably leads to different results. The enormous press of business has led us to adopt shop methods as governing the work—we had no choice—and blinded us to the demands of rational designs. This has produced the style of bridge building we are practicing to-day, a style which in its character has all the marks of **temporariness.** While on the other hand the more leisurely way in which they work out their bridge designs in Europe naturally tends toward **permanency** of the structures.

A consequence of our ways and their practical successes is that the designer imagines his work superior to that of his

*Consulting Engineer, Chicago, Illinois.

European colleagues, because it is cheaper and speedier of erection. He does not stop to think of the difference between temporary and permanent structures. Though he sees that his work from the day it is delivered as finished also is delivered to decay and that it, with few exceptions, is treated with indifference both of owners and of the public; though he knows that not one per cent. of the bridges in existence are treated with the respect due to permanent structures, maintained and improved in surroundings as the time goes by; yet as there is no time left for deliberations, he goes on employing the current designs and methods on structures, which, according to importance, purpose and location, ought to be regarded from a different view point and treated as structures aimed at the greatest possible permanency, for he knows that cheapness and quickness of constructing are important factors in the considerations.

It ought to be as evident to the engineer as it is to the civic student either of whom in these matters takes his task seriously, that we cannot keep on this way. As the first structures are replaced by second and second by third, and as the country gradually is getting permanently settled, we must distinguish between its East and West, must find time to consider auxiliary reasons and relations, in those older parts, to structures which according to their purpose and importance must be treated as permanent, and must make the shop methods yield to the more important architectural demands. There must be a general design expressing the proper strength, a rational design, before details are considered or shop drawings worked out, there must be harmony between sub and superstructure and between these and the surroundings. In short we must hereafter take a stand which will prevent designs of the class to which that of the Quebec bridge belongs from solely being prepared within the confines of the factory.



Proposed Design for Quebec Bridge.

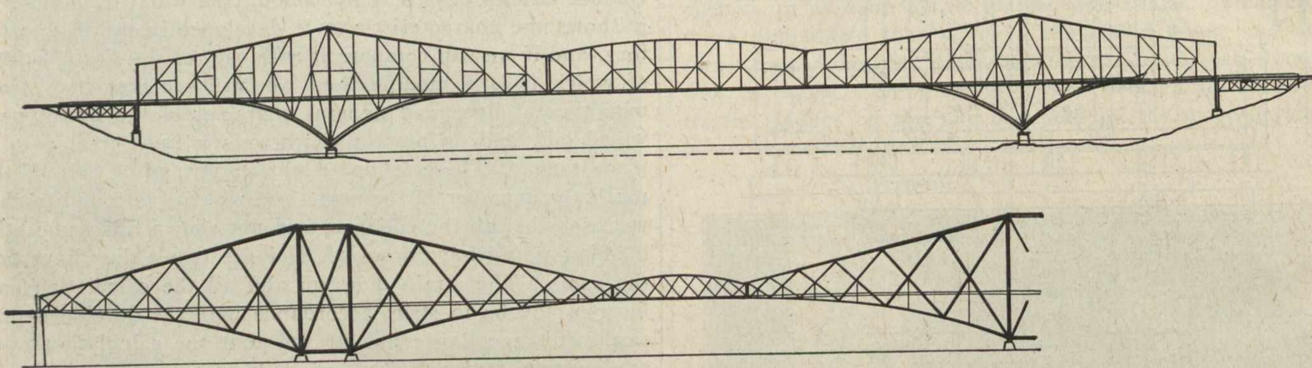


Diagram of the Quebec Bridge and its prototype, the Forth Bridge, Drawn to the same Scale.

It is necessary to state this plainly so that everybody can comprehend it, so that a public policy can be formed, to be followed in such cases, for the responsibility for failures does not entirely fall on the engineer. The authorities who accept the design have their past to carry, so have committees judging the designs, and so have members of the profession who for the sake of colleague or good fellowship feelings acquiesce in weak designs or abstain from timely criticism.

OBITUARY.

FRANK B. POLSON, president and general manager of the Polson Iron Works, Limited, Toronto, passed away quite suddenly on Monday, the 28th ult. Born at Port Hope, Ont., February 10th, 1858. Mr. Polson was the son of William Polson, who was mechanical superintendent of the Grand Junction Railway at Belleville before he founded the present business in conjunction with his son. The deceased after completing his studies entered the engineering profession, first in the service of the Cobourg & Peterboro' Railway and Mining Company. Leaving the position of mechanical superintendent of the Victoria Railway at Lindsay in 1883 he joined his father in the founding of the Polson Iron Works. He was a member of the Engineers' Club of New York and a member of the Canadian Society of Civil Engineers. It is of interest here to state that the first steel steamship ever built in the Dominion, the "Manitoba," for the C. P. R., was constructed by the firm.

Discussing the extensive use of concrete in construction, an authority says:—

"Not only in great office buildings and immense factories, but in hotels, dwellings, and in every other form of construction work, concrete is everywhere coming into use. The creation of the Portland cement industry as a result of this form of construction is one of the wonders of the industrial world. In 1880 the total output of Portland cement in the United States was 42,000 barrels; last year it was 34,000,000 barrels, or 800 times as much. And yet the growth of the cement industry has in no way hampered or interfered with the growth of the iron industry. On the contrary, but for the creation of this new industry the construction development of the country would have been halted, or else we would have had an absolute iron and steel famine.

"There is no likelihood that the development of cement in the future will be other than an aid to the expansion of the iron and steel industry, for the latter is growing with as great rapidity as capital and labor can be found adequate to utilize our ore and coal resources. But as we seem to be standing just at the threshold of a still further expansion of world-importance in iron and steel, with a world-wide expansion of every line of human activity, so we seem to be but at the beginning of a development of the cement industry, which, while the rate of growth cannot, of course, continue at the same great percentage of increase as for the last quarter of a century, will, at least, in all probability, continue as great in the actual figures of advance as of late years. As late as 1900 the total cement production of the country was only 8,400,000 barrels. The next year it jumped to 12,700,000 barrels, followed in 1902 by a gain of nearly 5,000,000 barrels, and reaching in 1903 an output of 22,300,000 barrels, from which there was an advance in 1905 to 24,000,000 barrels.

GERMAN AND FRENCH STEAM TURBINE STATIONS.

By Frank C. Perkins.

In Germany, as well as in France, the high power steam turbine is being largely utilized for central stations supplying current for light and power.

The accompanying illustration, Fig. 1, shows a most interesting steam turbine unit of the Zoelly type in operation at the central station at Muhlhausen i. Th. Germany, while drawing Fig. 2, shows the arrangement of the turbines and boiler plant of one of the largest and most thoroughly up-to-date French power stations of modern construction. The latter plant is located on the Seine River at St. Denis, while the German station is owned and operated by the municipality.

The Zoelly steam turbine noted in Fig. 1 is directly coupled to two direct current machines of the Siemens & Halske type for railway and lighting service, the railway generator supplying a current of 550 volts pressure with a capacity of 105 kw., while the lighting dynamo generates a current of 250 volts pressure, and has a normal output of 300 kws.

This turbo-generator unit has a total capacity of 405 kws. under normal load, the turbine being provided with steam at 7½ atmospheres, it was constructed at Zurich, Switzerland, by Escher, Weiss & Co., and the steam consumption is said to be as low as 6.81 kgs. per horse-power hour, or 10.41 kgs. per kilowatt hour, with an output of 463.3 kws., or 707.6 horse-power. The speed is 3,020 revolutions per minute, with a temperature of 170.5 degrees C., for the steam vacuum of 91.7 per cent. being utilized. With a load of 232.5 horse-power, or 132.2 kws., the steam consumption was found to be 8.04 kgs. per horse-power hour, and 14.15 kgs. per kw. hour.

The French steam turbine plant located at St. Denis on the Seine River, as shown by the accompanying drawing. This plant is owned and operated by the Compagnie Generale de Railways et d'Electricite, formerly Compagnie Russe-Francaise. The steam turbines are of the Parsons type constructed by Brown, Boveri & Co., of Baden, Switzerland, and are of 5,000 kw. capacity each under normal load, and capable of a maximum output of 6,000 kw.

The station is equipped with mechanical coal transporters having a capacity of 80 tons of fuel per hour, and the boiler house is equipped with Green economizers, Babcock & Wilcox boilers, and superheaters of the latter type.

The plant complete will include ten turbine units and sixty boilers, of which seven units will supply 3-phase current of 10,250 volts pressure, and a frequency of 25 cycles per second, while three of the units will generate two-phase current having a frequency of 42 periods per second and a pressure of 6,150 volts.

The boiler room has twenty Babcock & Wilcox boilers, each having a heating surface of 420 square meters, with a pressure of sixteen atmospheres, while twenty Green economizers will be used, having a total heating surface of 160 square meters. The twenty Babcock & Wilcox superheaters each have a heating surface of 172 square meters, with a temperature of 350 degrees Centigrade. The total capacity of these steam generators is from 165,000 to 206,000 kg. of steam per hour. The auxiliary apparatus includes two triplex plunger pumps of the piston type, and two electrically-driven centrifugal pumps, each operated by an 80 horse-power motor, together with four reservoirs each having a capacity of 125 cubic meters.

The St. Denis electric station of the Societe d'Electricite De Paris is equipped with four turbo-alternators, each operating at a speed of 750 revolutions per minute, and having a maximum output of 11,500 horse-power. These four units first installed supply a current of 25 cycles per second, and a pressure of 10,250 volts, the normal output being 5,000 kw. for each unit, and the maximum capacity, 6,000 kw. Each unit which is of the Brown-Boveri-Parsons type is 14.5 meters long, 3.5 meters high, and 4.15 meters wide. It is stated that the fuel consumption is 6.8 kg. of steam at 12 atmospheres and 300 degrees C. There are four condensers of the surface type, each supplied with water by a centrifugal pump of 120 horse-power, and an air pump operated by a 70 horse-power electric motor.

For supplying continuous current, a turbo-generator is provided consisting of a 300 kw. direct-current machine,

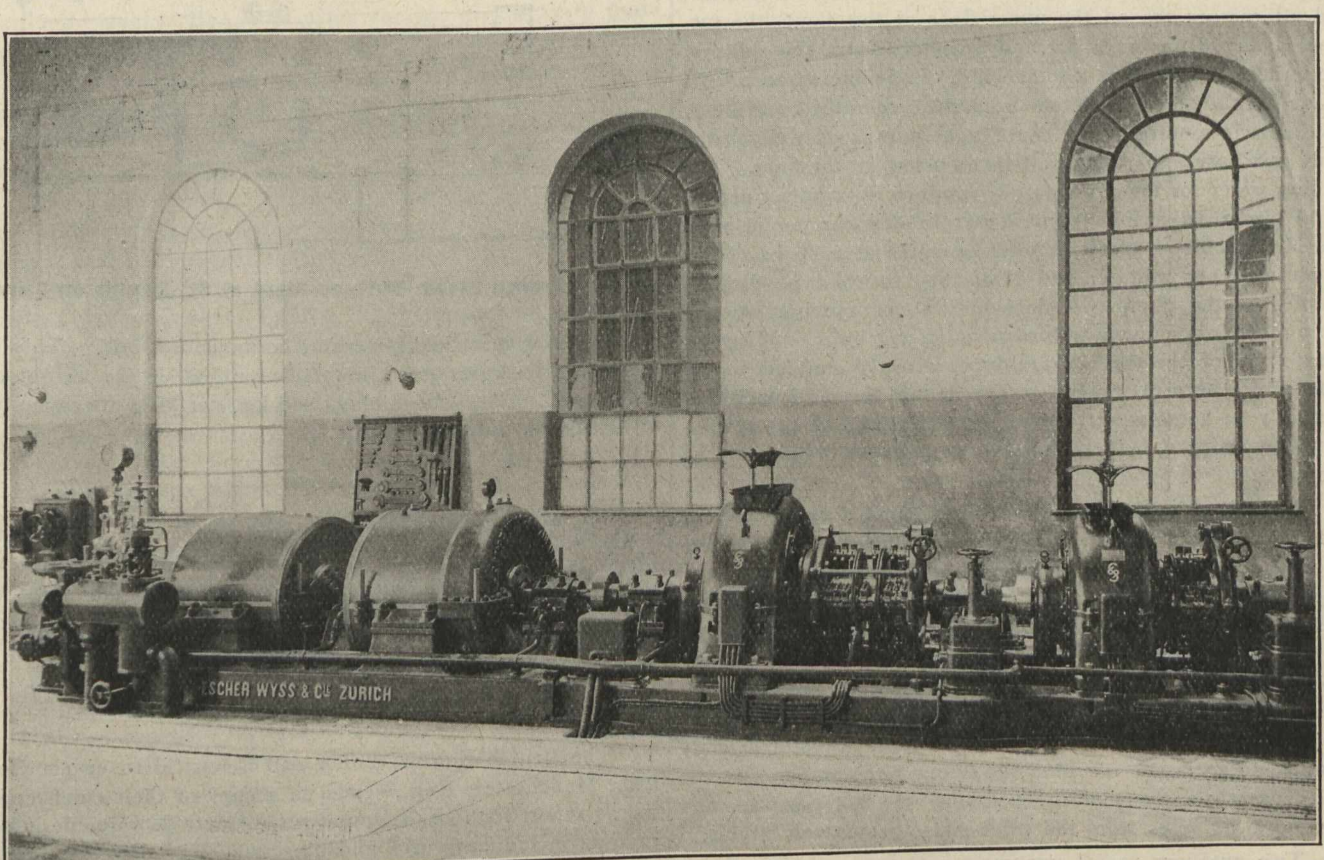


Fig. 1.—Zoelly Steam Turbine, Directly Coupled to Lighting and Railway Generators in the Muhlhausen Central Station.

operating at a speed of 2,700 revolutions per minute, and supplying a current of 230 volts pressure. The direct-current installation also includes two motor generators of 375 kw. each, the motors being of the three-phased type operating from the 10,250 volts circuit, with a frequency of 25 cycles per second, and the dynamos delivering a continuous current of 230 volts. A storage battery equipment has also been provided consisting of 126 elements, each having a capacity of 1,300 ampere hours, with a one hour discharge.

The transforming equipment includes four machines, each consisting of a synchronous motor of 1,500 kw. capacity, operating at a speed of 500 revolutions per minute, and driving two direct-current machines of 750 kw. each, the continuous current being supplied at a pressure of 500 volts. The current is distributed from the switchboard by means of 48 armored cables. Two of the above-mentioned synchronous motors of 1,500 kilowatts each will be supplied with a three-phase current of a frequency of 25 cycles per second, and 10,250 volts, and the others with a two-phase current of 6,150 volts, and a frequency of 42 periods per second. The two direct current dynamos of 750 kilowatts each driven by the 1,500 kilowatt motor, in each set supplies a direct-current of 550 volts for use on the electric railway lines.

As noted by the accompanying most interesting drawing of this station of St. Denis, on the Seine River, the turbines and alternators are on the upper floor of the plant, the turbine being 8 meters apart and 6 meters from the sides of the building, which has a total width of 20 meters and a total inside height of 12.25 meters from the generator room floor. The electric motors of the centrifugal pumps as well as the other auxiliary apparatus are located below on the floor. The cooling water for the condenser is supplied by a Sulzer centrifugal pump delivering 35 cubic meters of water per minute. The direct current electric motor operates at a speed of 310 revolutions per minute, and is of the vertical type directly coupled to the pump. It developes about 130 horse-power taking 470 amperes at a pressure of 220 volts. The air pumps are of the three-piston type, directly coupled to ten pole direct current motors. The motor has a capacity of normally 54 horse-power, operating at a speed of 225 revolutions per minute, and taking 195 amperes at a pressure of 220 volts.

A small switchboard is located at C, and a gallery is provided leading to the switchboard building which has five floors, the cables entering the lower floor at D from the generators, and leaving the building from M. The high tension oil switches are located in compartments E, F, J, and K, for alternators and feeders, while the rheostats are installed in compartment G, and the controlling apparatus on the top floor or gallery at H. The two transformer groups of 375 kilowatts each, consist of a synchronous motor directly coupled to an 8-pole machine supplying 1,700 amperes at 220 volts pressure, the motor developing 540 horse-power, and taking 36 amperes from the three-phase 10,500 volt circuit.

Two auxiliary motor generator sets are provided of 110 horse-power capacity, consisting of a direct-current motor and a direct-current generator for use as booster sets in connection with charging the 126 cells of storage battery of 1,300 ampere hours capacity. These dynamos are capable of supplying a continuous current of 600 amperes at a pressure varying from 0 to 120 volts.

This is a most interesting steam turbine station representing as it does the latest design of power plant using this form of prime mover as installed on the Continent of Europe.

This steam turbine station is one of the very largest in Europe, having an ultimate capacity of nearly 100,000 horse-power, or from 60,000 to 70,000 kilowatts when completely installed. The St. Denis station on the River Seine is thoroughly up-to-date, and shows the latest development in steam turbine plant design.

It will be noted that there are three boiler rooms provided in the plans, each equipped with 20 boilers. The coal is conveyed from the boats to three storage plants consisting of four coal bunkers of a capacity of 12,000 tons, by automatic transportating apparatus. The 5,000-6,000 kilowatts turbo-alternators used in this plant are arranged in groups of four, and are guaranteed to have a coal consumption not exceeding .863 kg. per kilowatt hour.

The turbines weigh about 50 tons, and the pumps, condensers and piping about 60 tons, while the total weight of

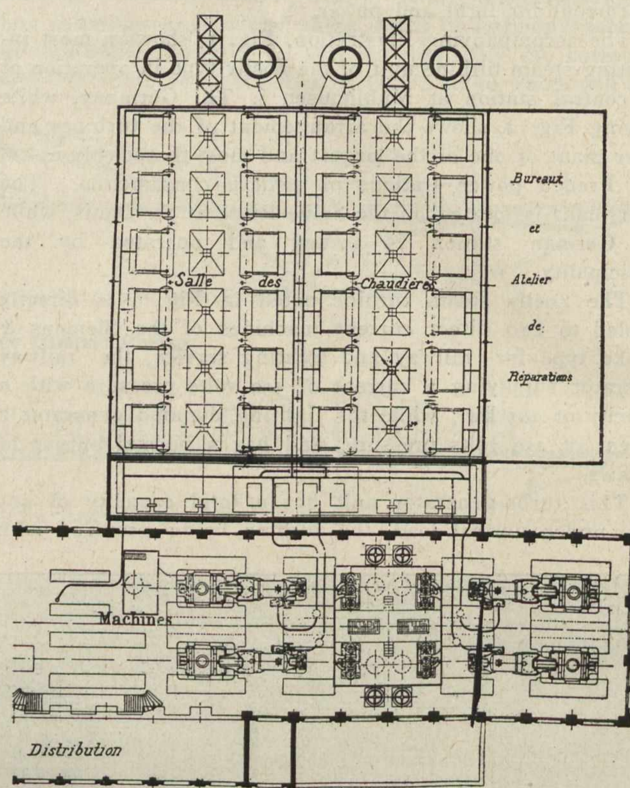


Fig. 2.—French Steam Turbine Plant at St. Dennis on Seine.

the unit with electrical generator is about 200 tons. This is about 40 kilograms per kilowatt output, while the weight of a Corliss Engine Unit is about 200 kg. per kilowatt capacity, or nearly six times as much.

The first battleship of the United States Navy to be propelled by turbine engines is now in course of construction at the Fore River Shipbuilding Yards. The British seem to have been the pioneers in the matter of applying this new propelling force to naval and mercantile marine uses.

The British Engine, Boiler and Electrical Insurance Co., Ltd., Manchester, Eng., sends us a copy of their chief engineer's report for 1906. It contains considerable valuable information, including figures and diagrams. The data are admirably classified, and will prove interesting reading for all who have to do with machinery. The report shows that boiler explosions, and breakdowns of engines, and electrical machinery, are due to natural deterioration, malconstruction, and maltreatment. They are principally the natural consequence of defects which have not been seen because they have not been looked for, or of wear and tear that has not been remedied in time. The actual condition of a boiler can only be ascended by a thorough examination, and in the case of engines, electrical plant, and lifts it is essential that all parts should be periodically opened out for detailed inspection. As far as is reasonably possible every part should be examined, since any part may be defective and thus lead to failure. On boilers, a satisfactory hydrostatic test, and on electrical plant a high insulation test, are not alone sufficient to ensure safety and freedom from breakdowns. Dust (especially if mixed with oil) and damp are the greatest enemies of electrical plant. The air gaps on modern electrical machines are cut so fine that the wear in the bearing brasses requires very careful watching—serious damage may result from a revolving part coming in contact with a fixed part.

REGULATION AND CONTROL OF CONCRETE CONSTRUCTION.*

By E. S. Larned, C.E.

The rapid changes and developments during the past five or six years in municipal works, railroad construction, terminal improvements and rapid transit, and in building construction for manufacturing, mercantile and residential uses, have furnished the theme for many contributions to engineering and cement publications, and are strikingly reflected in the wonderful expansion of the Portland cement industry; the production during 1906 of 45,610,822 barrels showing an increase of 438 per cent. over the output of 1900, and about 26 per cent. increase over the previous year, 1905.

The manufacturer of Portland cement is now confronted with a situation both gratifying and alarming—his product is growing in favour, nevertheless, he is in danger of serious injury, only temporary, to be sure, but none the less real, from the friends and advocates of his product, some of whom, in their zeal, inexperience and unlimited confidence, attempt the impossible, or perhaps are quite impossible in the attempt, however legitimate.

The extent of public interest at this time in cement construction cannot be measured by the present output of our Portland cement mills, and when the known desire to build in cement comes to be fully realized on the part of our laboring classes, artisans, clerks, and farmers, this vast army of home-seekers and home-makers, the output of the cement mills must show a further increase that will dwarf even the present handsome figures.

The great problem confronting us now is to properly and adequately meet, foster and encourage this widespread interest and yet not permit it to grow beyond a safe control; by this I mean that every effort should be made to avoid and prevent the mistakes, failures and disappointments that surely attend undue haste and want of preparation in the way of proper design, intelligent supervision and employment of trained and experienced men. All this has been found necessary to avoid failure in the use of other materials of construction, then why not in the use of the plastic material?

It will not add to the cost of construction in cement to effect this, but rather result in economies through greater efficiency and better progress alone. The same proportion of unskilled or common labour may be used, only we should seek to train and improve it, and always keep it under competent supervision in constant attendance.

The general public—architects, engineers, and contractors—must be brought to recognize the fact that while cement in concrete construction is a very important element, nevertheless, the other materials with which it is combined and the manner of mixing and placing the materials and the forms to contain them are also of prime importance, and should be submitted to the same inspection, preliminary tests and approval of competent authority as may usually be required of the cement.

The proportion of sand to cement should never be fixed in advance of sufficient knowledge of the character and quality of sand available for the work in hand; if this be found inconvenient or seemingly impractical, then the proportions should be open to easy adjustment and should be provided for in advance in the contract. Available and proposed sand should always be tested and compared with some recognized standard before use.

The public demand for cement construction cannot be met at this time, not for want of cement, but because we have relatively so few builders and contractors qualified by experience to undertake this class of work; and showing the cumulative effect of such condition, this fact has in a large measure prevented architects from designing in concrete and urging its adoption for residential uses.

A most promising and encouraging feature in the industry, however, is the organization of construction companies, officered by engineers and experienced contractors, who are making a specialty of concrete work, and it is perfectly reasonable to expect that their efforts will result in further improvements and economies in ways and means, also in the appearance and quality of finished exposed surfaces; a field affording great possibilities and much promise already.

In the flush of their first successes, however, let these companies pause and consider the danger of allowing their work to grow beyond their capacity to properly direct and control.

The cement industry cannot rest satisfied with a national interest in the product at this time, but must create even a broader confidence by the encouragement of prudent and rational safeguards, lest their omission be followed by unfair and discriminating restrictions on the part of local municipal building commissions.

Trade jealousies are keen and alert, and every failure or disappointment in concrete construction, however infrequent or unimportant, is amplified and accentuated.

It was thought at first that this publicity would seriously retard the progress of the new industry; but not so, and this fact can only be taken as further evidence of the wonderful vitality of this form of construction. It has also come to be generally known and admitted, as a result of rigid and thorough investigation, that each instance of failure has been the result of ignorance or criminal carelessness, and almost without exception, has occurred during construction. Is any material of construction proof against such causes?

The scores upon scores of splendid examples of concrete construction, in all departments of engineering work, and among all classes of buildings, leave no room for doubt of its success from the standpoint of adaptability, appearance, economy, and durability, under conditions of exposure that no other material now used in construction can so successfully and economically meet.

The greatest economy and best results structurally and architecturally, however, cannot be obtained, except by competent design and intelligent sympathetic treatment of outline and texture, with due regard to environment, exposure and available materials composing the aggregate, of which we have an endless variety, by selection and combination; and then the work of construction must have the equivalent in intelligent and honest supervision that any reputable job receives; in fact, it might have even more and still cost less than is represented in the person of the boss carpenter, boss brickmason, general foreman, sub-foreman and superintendent, all of whom are in constant attendance.

No other department of the cement industry has so felt the need of standard specifications and uniform instructions as we find in the manufacture of cement blocks.

There is to-day a large and growing demand for this material, and its general and almost unlimited use is only retarded by lack of confidence on the part of architects, builders and resident owners who see only the wretched results that attend the efforts of the misinformed and inexperienced, and overlook the splendid possibilities of this form of construction in the hands of skilled and experienced operators.

In considering the requirements that cement blocks should meet as a structural material, we must take into account the use in which they are to be put.

We have in brick classification, the term cotta brick, mud brick and dry pressed face brick, and the hard burned medium and light common brick; all of which find extensive and legitimate use, and yet vary widely in strength, fireproof qualities and appearance.

The granites, limestones, sandstones and marbles are generally accepted in first-class construction, and yet differ greatly in weather and fire resisting qualities.

Lumber, of course, is very combustible, and yet the different varieties show marked contrast in strength, dura-

* Paper read before the Association of American Portland Cement Manufacturers.

bility and fire-resisting qualities, and we have to learn of any municipal requirements stipulating the kind of lumber for building construction.

With these facts in mind, is it not fair to ask that some latitude be granted in the manufacture and use of cement blocks?

If an owner in most localities chooses to build the outside walls of his factory or residence of light burned common brick, showing an absorption of 30 per cent. water who is there to say no? In fact, the average so-called hard burned brick will absorb from 20 to 22 per cent. water and will pass muster under most municipal and architects' requirements; yet our leading municipal specifications require that cement blocks shall not exceed 15 per cent. absorption, regardless of the use to which they are put.

Cement blocks may properly be used in substitution of other materials for:

1. Foundations
2. Exterior and superstructure walls carrying weight.
3. Curtain walls, exterior and interior.
4. Fire walls and partitions.
5. Veneering.
6. Retaining Walls.
7. Cornice, trim and ornamental work.
8. Filler blocks for floor slabs.
9. Chimney flues, etc., etc.

In this variety of work it is at once seen that uniformity and the highest quality are not required.

Experience in the use of other materials has taught us to recognize practically without repeated or preliminary tests, the quality of most material for which cement blocks are substituted, and this fact alone gives them an advantage over the newer material.

Commercial, local, and natural causes are, however, calling for the more extensive use of cement blocks; this demand will increase as our manufacturers of cement blocks gain experience, and by the encouragement and observance of rational building requirements. It is of prime importance to every city and town in this country, having a building code, that they should recognize and include cement blocks as a building material.

The writer, as chairman of the Committee on Tests of Cement and Cement Products of the National Association of Cement Users, recommended in his report, last January, that a Specification Committee be appointed by the Association to draw up a standard specification and uniform instructions covering the manufacture of cement blocks, with the hope that this form, when prepared, might be offered to all the cities and leading towns in the United States for adoption.

As a basis upon which to consider the standard specification and uniform instructions, my suggestions included the following, in part:—

Cement.—Only a true high-grade Portland cement, meeting the requirements and tests of the standard specifications of the American Society for Testing Materials shall be used in the manufacture of cement blocks for building construction.

Unit of Measurement.—The barrel of Portland cement shall weigh 380 pounds net, either in barrels or sub-divisions thereof, made up of cloth or paper bags, and a cubic foot of cement packed as received from the manufacturer, shall be called 100 pounds or the equivalent of 3.8 cubic feet per barrel. Cement shall be gauged or measured either in the original package as received from the manufacturer, or may be weighed and so proportioned; but under no circumstances shall it be measured loose in bulk, for the reason that when so measured it increases in volume from 20 to 33 per cent., resulting in a deficiency of cement.

Proportions.—Owing to the different values of natural sand or fine crusher screenings for use in mortar mixtures, due not only to its mean effective size, but also to its physical characteristics, it is difficult to do more in a general specification than fix the maximum proportions of good sand that may be added to cement.

Sand, or the fine aggregate, shall be suitable, silicious material passing the one-fourth inch mesh sieve, and containing not over ten per cent. of clean, unobjectionable material passing the No. 100 sieve. A marked difference will be found in the value of different sands for use in cement mortar. This is influenced by the form, size, and relative roughness of the surface of the sand grains, and the impurities, if any, contained. Only clean, sharp, and gritty sand, graduated in size from fine to coarse and free from impurities, can be depended upon for the best results. Soil, earth, clay, and fine "dead" sand are injurious to sand, and at times extremely dangerous; particularly in dry and semi-wet mortars, and they also materially retard the hardening of the cement. An unknown or doubtful sand should be carefully tested before use to determine its value as a mortar ingredient. Screenings from crushed trap rock, granite, hard limestone and gravel stones are generally better than bank sand, river sand or beach sand in Portland cement mortars (but not so when used with natural cement, unless the very fine material be excluded).

So-called clean, but very fine sand, has caused much trouble in cement work, and should always be avoided, or if impossible to obtain better, the proportion of cement should be increased. Stone screenings and sharp, coarse sand may be mixed with good results, and this mixture offers some advantages, particularly in making sand-cement blocks.

For foundations or superstructure walls exposed to weather, carrying not over five tons per square foot, the maximum proportions shall not exceed four parts sand to one part cement. This proportion, however, requires extreme care in mixing for uniform strength and will not produce water-tight blocks. We recommend for general work not over three parts sand, if well graded, to one part cement, and the further addition of from two to four parts of clean gravel stones passing the three-fourths inch sieve and retained on a one-fourth inch mesh sieve, or clean screened broken stone of the same sizes. These proportions, with proper materials and due care in making and curing, will produce blocks capable of offering a resistance to crushing of from 1,500 to 2,500 pounds per square inch at twenty-eight days.

(For the best fireproof qualities limestone screenings or broken sizes should be excluded, but otherwise are all right for use.)

Where greater strength is desired, particularly at short periods, from two to six weeks, we recommend the proportions of one part cement, two parts sand, and from one and one-half to three parts gravel of broken stone of sizes above given. Blocks made of cement, sand and stone are stronger, denser, and consequently more waterproof than if made of cement and sand only, and are more economical in the quantity of cement used.

Mixing.—The importance of an intimate and thorough mix cannot be overestimated. The sand and cement should first be perfectly mixed dry and the water added carefully and slowly in proper proportions, and thoroughly worked into and throughout the resultant mortar; the moistened gravel or broken stone may then be added either by spreading same uniformity over the mortar or spreading the mortar uniformly over the stones, and then the whole mass shall be vigorously mixed together until the coarse aggregate is thoroughly incorporated with and distributed throughout the mortar.

We recommend mechanical mixing wherever possible, but believe in the thorough mixing of cement and sand dry before the addition of water; this insures a better distribution of the cement throughout the sand, particularly for mortar used in machine made blocks of a semi-wet consistency. For fine materials, such as used in cement blocks, it is necessary that the mechanical mixer be provided with knives, blades or other contrivances to thoroughly break up the mass, vigorously mix the same and prevent balling or caking.

Curing.—This is a most important step in the process of manufacture. second only to the proportioning, mixing and moulding, and if not properly done will result either in great injury to or complete ruin of the blocks. Blocks shall be kept moist by thorough and frequent sprinkling, or other suitable methods, under cover, protected from dry heat or wind currents for at least seven days. After removal from the curing shed, they shall be handled with extreme care, and at intervals of one or two days shall be thoroughly wet by hose sprinkling or other convenient methods. We recommend curing in an atmosphere thoroughly impregnated with steam. The method serves to supply needed moisture, prevent evaporation, and in some measure accelerates the hardening of the blocks.

We view with distrust, in the present knowledge of the chemistry of cement, any artificial, patented or mysterious methods of effecting the quick hardening of cement blocks or other cement products. If such method be proposed it should be thoroughly investigated by competent authority before use.

Time of Curing.—This is also most important in its effect upon the industry, and is directly and vitally influenced by the following conditions:—

1. Quality, quantity and setting properties of the cement used.
2. Quality, size and quantity of the sand or fine aggregate used.
3. Amount and temperature of water used.
4. Degree of thoroughness with which the mixture is made.
5. Method of curing, weather conditions and temperature.
6. Density of the block as effected by the method and thoroughness of tamping or pressure applied.

Before fixing the minimum permissible time required in curing and ageing blocks, it is well to consider the important effect of additions of sand upon the tensile strength of cement mortar.

The following tabulation has been interpolated from the diagram of cement mortar tests prepared by Mr. W. Purvis Taylor, of the Philadelphia Municipal Laboratories.

The results of the neat tests and the 1 to 3 mortar tests (i.e., one part cement to 3 parts crushed quartz, by weight) are averaged from over 100,000 tests, while the other results are based on from 300 to 500 tests.

Tensile strength in lbs. per square inch of Portland cement:—

Proportions	dys. 7	dys 28	mos. 2	mos. 3	mos. 4	mos. 6	mos. 12
Neat cement....	710	768	760	740	732	758	768
1 to 1 mortar...	590	692	690	680	680	685	695
1 to 2 "	370	458	460	455	453	458	460
1 to 3 "	208	300	310	310	310	310	308
1 to 4 "	130	210	230	230	230	232	232
1 to 5 "	80	150	185	195	195	195	197

It must also be kept in mind that these results are obtained under practically uniform and theoretically correct conditions, in the amount of water used. thoroughness of mixing and moulding and storage of samples until tested.

Comparing the results at 28 days, it is apparent that the 1 to 5 mortar has only 71 per cent. of the strength of the 1 to 4 mortar, and but 50 per cent. of the strength of a 1 to 3 mortar. The 1 to 4 mortar has but 70 per cent. of the strength of a 1 to 3 mortar and 46 per cent. of the strength of a 1 to 2 mortar.

The ratio of compressive strength to tensile strength is not quite constant for all periods of time, and for the several mixtures above given; but the compressive strength, or resistance to crushing per square inch, may be approximately obtained by multiplying the tensile strength given in the above table by the constant six (6). (Note. This would increase with the age of the mortar, and would be greater for good gravel or stone concrete than for the clear mortar of which a given concrete is made.)

In fixing the minimum time required for curing and ageing blocks before use, due regard should be given to the proportions used. It is manifestly wrong in principle to require as long a period for a 1 to 2 or a 1 to 3 block as might seem necessary for a 1 to 4 or a 1 to 5 block, and it is obviously unsafe to attempt to use a block of lean proportions in as short a time as a rich mixture would gain the necessary strength.

This might be supposed to be met by fixing the minimum resistance to crushing of blocks (of all compositions); but it must be kept in mind that a very small percentage of the blocks used are tested, by reason of the expense, inconvenience, or lack of facilities.

The required minimum resistance to crushing of first-class blocks used for exterior and bearing walls should not be imposed upon blocks for minor and less important uses.

Marking.—All cement blocks should be stamped (in process of making), showing name of manufacturer, date (day, month, and year) made, and composition of proportions used. The place of manufacture, methods and materials should also be open to inspection by representative of the Building Department, the architect, engineer, or individual buyer.

There are good commercial reasons for permitting and encouraging this, as it would at once create confidence and add to the reputation of the block offered. No honest and progressive manufacturer would object. Quality and appearance will at once create a market for cement blocks at profitable prices, in most any location, and all this is of easy attainment.

Let the intending manufacturer of machine-made blocks remember that the machine is simply a mechanical convenience, and it remains for him to use proper materials, correct and accurate methods of proportioning, mixing, moulding, and curing, to study and meet the demands of the building trade, and keep abreast and a little in advance of the other fellow in this progressive age.

Frank Hedley, general manager of the Interborough Company, of New York, has invented and patented a device which he believes will prevent the telescoping of cars in train wrecks. The device is being attached to all of the new cars of the Interborough Company as fast as they are turned out of the shops. Most all of the telescoping of cars is due to the fact that the front of the rear car is liable to climb up on the rear platform of the car ahead, and thus can go right through the woodwork with which the upper portion of the car is usually constructed. Mr. Hedley's invention is an attachment adapted to be secured to the end of a car or car platform which has three prongs or projections on its outer surface. When two cars come together these prongs on the platforms interlock and the car is prevented from rising above the platform of the one it strikes. It costs little to put it on a new car.

The following table gives the production of the chief minerals, including Kauri-gum, of New Zealand, for the year ending December 31st, 1906:—

	Quantity.	Value.
Gold, ounces	563,843	£2,270,904
Silver, ounces	1,390,536	143,572
Manganese ore, tons	16	40
Mixed minerals, tons	1,297	18,241
Colonial coal exported, tons	141,641	122,614
Colonial coal used in New Zealand, tons	1,587,895	793,948
Kauri-gum, tons	9,154	522,486
Coke, tons	5	6
Total		£3,871,811

The total increase over the year 1905 was £249,025.

Mr. W. A. Verner, of Brantford, president of the company which has taken over the Grand Valley Railway, the Brantford City Railway, and the Ingersoll and Woodstock Railway, has outlined his plans as follows:—Numerous extensions to the Brantford city service, extension of the Grand Valley road to Galt, an extension to St. George, via Blue Lake, extension from Brantford to Port Dover, via Simcoe, an extension to Woodstock and an extension from Ingersoll to London

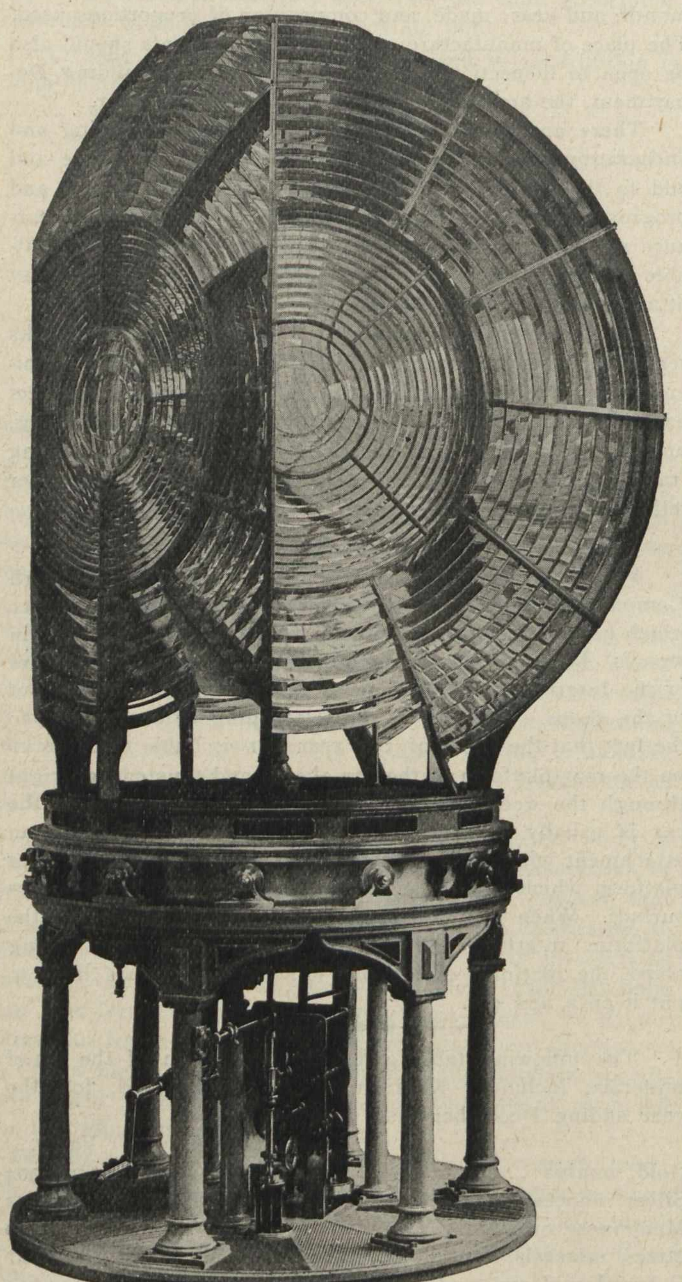
ENGINEERING NEWS FROM GREAT BRITAIN.

(From Our Special Correspondent.)

London, Oct. 8, 1907,

The Quebec Bridge Disaster.

The calamitous disaster to the Quebec Bridge has naturally evoked a good deal of comment in engineering circles over here, coupled with much theorising as to the probable cause of the occurrence. This latter of course, is of little value, for it seems very probable that the true cause will be discovered at the official enquiry. Our contemporary the Engineer states: "The catastrophe has been called the greatest engineering accident ever known. It has happened after a century of rich experience in iron bridge building, and at a time when the production of steel has been brought to a degree of uniformity and trustworthiness incomparably greater than that of any other building material, wood, brick, stone, or concrete. Moreover, the design of the Quebec Bridge contains no novelty, but a type has been chosen which has been proved by common consent to be the most suitable for bridges of very large span, on account of its simplicity in respect of erection as well as of the calculation of the strength of its parts. Errors in these respects are therefore easily avoided, and, taking into account the importance of the work—having the largest span ever attempted—which must have incited those concerned, engineer, manufacturer and builder, to make every effort to ensure success, it is inconceivable how errors could have passed such as might be avoided by other members of the profession. This, from our point of view, is the most distressing aspect of the accident, and under this impression we tender our sincere sympathy to our colleagues over the ocean."



Strumble Head Light.

Strumble Head Light.

The following is a description of the new Strumble Head light, supplied by Messrs. Chance Bros., of Birmingham, to Trinity House, to the designs of Mr. G. Matthews, engineer-in-chief, to be erected in a new lighthouse at Strumble Head, Pembrokeshire. The optical apparatus consists of 4 panels of 920 m/m (36¼") focal distance, i.e., 2 panels of 76 degrees horizontal angle, with a dioptric of 40 degrees horizontal x 100 degrees vertical angle x 1,000 m/m (39⅜") focal distance. From each panel there emerges a flash or beam of light, of which the intensity is equal to 400,000 candles. The effect of the dioptric mirror is to reflect the whole of the light falling on it from the lamp, and to return it so as to reinforce the light passing through the panels of 76 degrees. The character of the light will be four flashes in quick succession every 15 seconds, thus:—Flash 0.28 seconds, eclipse 2.00 second flash 0.28 seconds, eclipse 2.00 seconds, flash 0.28 seconds, eclipse 2.00 seconds, flash 0.28 seconds, eclipse 7.88 seconds. Total period (one revolution) 15 seconds. The focal plane of the light will be 148 feet above high water spring tides, and the light will be visible in clear weather for a distance of 18½ miles, this being the limit of vision due to the height of apparatus above the sea. The weight of the lenses, with table, etc., which revolve in a bath of mercury, is 4½ tons. The whole is revolved by clockwork driven by a falling weight of 9 cwts. The lamp or burner uses vaporised oil, with an incandescent mantle. This is the system now in general use for lighthouse work. The above will be placed in a lantern of 14 feet diameter of the Trinity House type, with helical framing and domed roof.

British Railway Accidents in 1906.

The annual report of the Board of Trade upon British railways and accidents during 1906 states that the total length of railways in the United Kingdom at the end of that year was 23,063 miles. The greater portion of this mileage consisted of two or more lines of rails. The total track mileage, i.e., single lines, was 38,886 without sidings, and 52,902 with sidings. Within the year 1,169 persons were killed and 7,212 injured by accidents due to the running of trains or the movement of railway vehicles. The average figures for the previous ten years were 1,144 and 6,631 respectively. The year was again remarkable for the number of fatalities to passengers in train accidents; indeed, more were killed in this way than in any year since 1889; but it should be observed that 56 out of a total of 58 deaths were attributable to three accidents. The number of railway servants killed and injured in train accidents were 12 and 140 respectively. The corresponding averages for the previous 30 years were 12 killed and 127 injured. The Board of Trade express regret that there has been an increase in the number of fatal and non-fatal accidents to railway men over those of the previous year. It is probable, however, that the increase is largely due to the exceptional activity in goods traffic, and the consequent high pressure at which all railway work had to be conducted during the year 1906. It is to be noted in this connection that while the train mileage shows an increase of 3¼ per cent. there is reason to believe that the shunting mileage, of which no record can be kept, has increased still more largely, and it is in shunting that accidents are most apt to occur.

Electric Traction by "Surface Contact" in London.

No tramway authority in the world can be beset by such difficulties as is the London County Council. Having been given the complete ownership and responsibility of the working of the London tramway system, obstruction meets it at almost every turn. The Council early realized the error made originally in binding itself unconditionally to the conduit system, especially when many unforeseen expenses continually cropped up in connection with the removal of existing cables and pipes to accommodate the trenching for the conduit. In a very short time the more reasonable policy was adopted of using the conduit system at all busy centres, and the overhead system in the outlying parts. The borough councils, in the possession of a veto foolishly given a few years ago by the County Council, as to the choice of system in their particular districts, at first cavilled a good deal, but one by one they have given in to the views of the County Council. The Stepney Borough Council, however, remained steadfast in its objection to the overhead system, and after years of negotiation the G.B. surface contact system, was agreed upon as a way out of the difficulty. The County Council were thus pardonably to be excused if they considered the matter settled, but it was not to be so. Outside the London boundary there are a number of other tramway systems upon the trolley system each of which is anxious to have through running into London. Therefore, immediately the agreement with Stepney was made known, protests were made by these authorities to the Board of Trade that the adoption of the surface contact system would interfere with any idea of through running which was so essential to the well-being of the travelling public. On the face of it, however, practical difficulties did not appear to exist, for cars could very easily be equipped for both systems and so preserve the continuity. I am pleased to say that the Board of Trade have been advised to this end, and yesterday gave its decision to grant the London County Council the necessary official sanction to adopt the surface contact system proposed. The last move of the opposing councils is to urge for a conference of the authorities concerned.

New Home Office Electrical Regulations.

Within the past month the Home Office has issued a code of regulations for application to all buildings coming within the scope of the Factory Acts, which are to be complied with in respect to the use of electricity. The details of these regulations are not of supreme interest here, being of more or less local application, but it is to be noted that the most strenuous opposition is being offered to them on the ground that they are of such a character as to restrict the use of electricity in buildings of this nature. The main point is that if these regulations come into force, two sets of regulations will have to be obeyed, for there already exist a similar set issued many years ago by the Board of Trade, and, not unnaturally, the two, in some respects clash. Central station engineers and supply authorities generally are doing their best to organise a campaign in the responsible technical press in order to bring about drastic alterations. As a matter of fact, a period of one month is allowed within which objections to the regulations may be lodged, the original set published being only in draft form. Electrical engineers rightly feel that the industry is being very badly treated at the hands of the legislature. In the first place, the original electric lighting acts passed in 1882 and 1888 have never been revised, notwithstanding the great strides which have been made since those days, whilst the Tramway Act of 1870 passed in the days when mechanical traction on roads in any form was unknown, is to-day the measure controlling electric tramway traction. Repeated efforts have been made to have these Acts of Parliament brought up to date whilst the first move made by a Government department within recent years suggests a method of regulation which may hamper the industry still further.

Threatened Railway Strike.

The industrial world generally in Great Britain is just now contemplating with anything but an easy mind, the possibility of a more or less complete railway strike, which if carried out, would have a most paralyzing effect upon trade. The position has arisen in this way. For more than a year the Amalgamated Society of Railway Servants, which has more than one representative in Parliament, has been asking the railway companies to acknowledge them as the accredited mediators between the companies and the men in respect of all grievances. This the directors of the majority of the railway companies have steadfastly refused to agree to, and something approaching negotiation has gone on until at the present time the men are being ballotted as to whether or not they shall support the demands of their society in a practical manner by ceasing work. There is much to be said on both sides especially in a more or less democratic country such as England is supposed to be, but the men have somewhat alienated themselves from public sympathy by the intimation that they have a large number of grievances. The directors, and a good portion of the public, foresee, that once the principle of recognition of the society is granted, there will be no great lapse of time before reforms will be demanded, and in the present state of traffic economics it is difficult to see where any considerable concessions can be made. The situation is a serious one but a definite result will doubtless be arrived at before my next notes are despatched.

Suggested Union of Electrical Interests.

The present depressed condition of the British electrical industry is too well known to need dilating upon. With the object of finding a remedy for the present state of things the proposal has been made that a union of electrical interests should be formed whose members should be everyone who is interested in electricity, either as shareholder, employer, consulting engineer, manufacturer or employee. The union will start without any political bias and with neutrality as regards municipal trading and such like matters. The proposed procedure is, when sufficient subscribers have been enlisted, to classify the subscribers according to the branches of the industry in which they are specially interested, and to ask each branch to elect one or two members of a provisional council. There will be a subscription of 2s. 6d. annually. It will be seen that a good many details have yet to be settled, and I fear that a much more definite programme will have to be prepared to induce a large membership.

A Dynamometer Car.

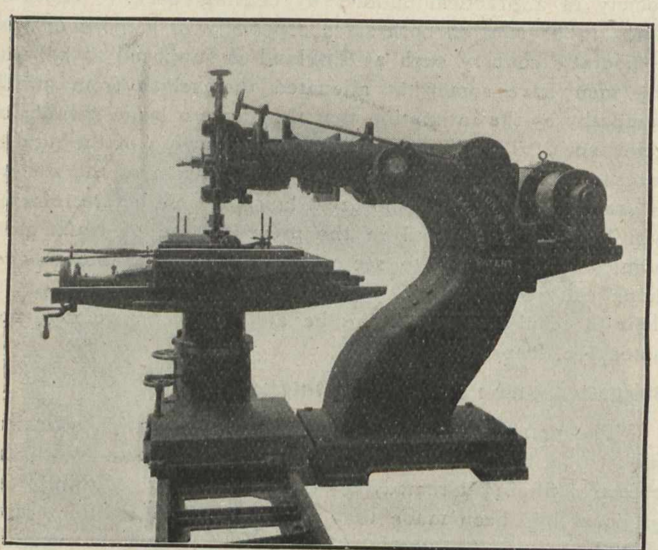
There has recently been constructed for the North Eastern Railway Company a dynamometer car for the purpose of testing locomotives and rolling stock. The object aimed at in having this car constructed is to obtain information which will be valuable in connection with present day demands for greater speed and generally to secure increased efficiency. By the aid of electro-magnetic pens the draw bar pull is graphically shown. Other measurements which can be taken are the wind pressure, the pressure in the steam chest, and brake tests including the pressure in the brake cylinder and so on. I believe this is the first instance of such a car being built here.

ENGINEERING AND MACHINERY EXHIBITION, LONDON.

(From Our London Correspondent.)

The Engineering and Machinery Exhibition now in progress at Olympia, London, is the immediate outcome of a similar exhibition held in the autumn of 1906, and which was admittedly a great success. The feature of the previous show was an exceptional showing of machine tools. So pronounced and definite was this that the Advisory Committee, after the close of the exhibition, expressed regret that, while the tool section was splendidly represented, more of the larger engineering firms did not avail themselves of such a favorable opportunity of demonstrating the progress of British manufactures during recent years. It was, therefore, with the avowed object of remedying this defect that another show was organized this year, for I understand that the present organizers, at any rate, intend to allow a period of some years to elapse before they will undertake to organize a similar exhibition in London.

The present exhibition occupies a far larger area than its predecessor, and, although the heavy engineering trades are not as fully represented as could have been wished, there is a marked increase in the number of such exhibits, and it is pleasing to note that a large proportion are British firms. Nearly one hundred firms who were not exhibiting in 1906 are present. The exhibition is again under the



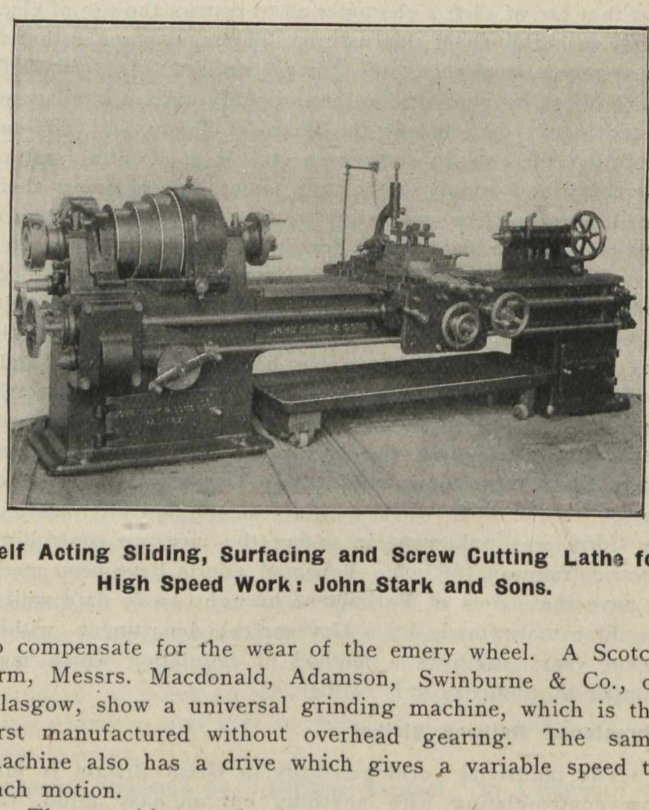
Mechanical Woodworker: Wadkin and Company, Leicester.

patronage of a large number of the leading gentlemen in the diplomatic, scientific, and commercial world, while the Advisory Committee is composed of representative gentlemen associated with the great engineering institutions and the largest engineering concerns. For instance, Sir Alexander Kennedy, F.R.S., is the president of the exhibition, with Sir Alexander Binnie as vice-president. On the Advisory Committee are such names as W. H. Allen, of Messrs. W. H. Allen, Son & Co.; Mr. W. Beardmore, of Messrs. W. Beardmore & Co.; Mr. Dugald Clerk, the gas engine and patent expert; Mr. Mark Robinson, of Messrs. Willans & Robinson; the Hon. C. A. Parsons, and a host of others.

In extenuation of the fact that once again the main attention of visitors to the exhibition is focussed upon the machine tool exhibits, it must be stated that in aiming at gathering together at Olympia a representative engineering exhibition, using the word engineering in its broadest sense, the organizers really seek to do the impossible, both physically and from other points of view. In the first place, no showground exists which would be capable of accommodating such an exhibition, whilst in the second case an important factor which must be present to the minds of the organizers is the fact that there are so many exhibitions which are held at short intervals for the various branches of the engineering trades, that, to be hidden away, so to speak, in a medley of stands which are arranged in no order or classification, can hardly appeal to a business engineering firm. One could point to half a dozen specialized exhibitions where the manufacturer of a particular class of machinery can stage his goods with the certain knowledge that the only people who will visit the building will be those directly interested in what he makes. Therefore, it can easily be seen that this alone will always militate against the possibilty of a representative engineering exhibition—again speaking in the broadest sense—even if it were desirable.

Having stated that the machine tools are really the **piece de resistance** of the exhibition, I will deal with them at once. In looking around at the methods of driving, one is struck with the gradual supersession of shafting and belt-driving by the direct drive by electric motor. Naturally, under the conditions prevailing in an exhibition, each machine is more conveniently driven by an individual motor, but to what extent this reveals the tendency of opinion as to driving singly or in groups is problematical. The majority of the machines are driven by electric motors through chains, but there were one or two notable examples in which the motors were built into the framework of the machine tool itself. The development of the motor car industry in Great Britain within the past few years has been responsible for the evolution of many new types of machine tools. Messrs. Drummond Bros., of Guildford, who make a specialty of small lathes and such like, show one designed for motor repairing. These lathes are fitted with a novel form of slide rest, in the design of which is incorporated a large boring carriage. The loosening of one nut allows the upper fitted with slots, converting the tool from a lathe to a slide to be entirely removed, leaving a truly surfaced table regular boring machine for such work as cylinder reboring, rebushing, gear cases, etc. The firm also show a very heavy 9-in. centre high-speed steel lathe, which is said to be the most powerful of its size yet made, and has some special points. The exhibits on the stand of Messrs. Charles Churchill & Co., of London, illustrate the gradual evolution of the principal machine tools from the original idea embodied in the crude revolving spindle of the primitive lathe. Two examples of the turning lathe, one being a typical example of modern practice, and the other an antique specimen, showing a comparatively early stage of the evolutionary process. This latter machine eloquently suggests the mechanical limitations by which our predecessors were handicapped, and from an archæological point of view is of quite as much interest as the well-designed high-speed lathe by Ernault. The majority of the machines on this stand, however, are American importations, which your readers will probably have other means of becoming acquainted with.

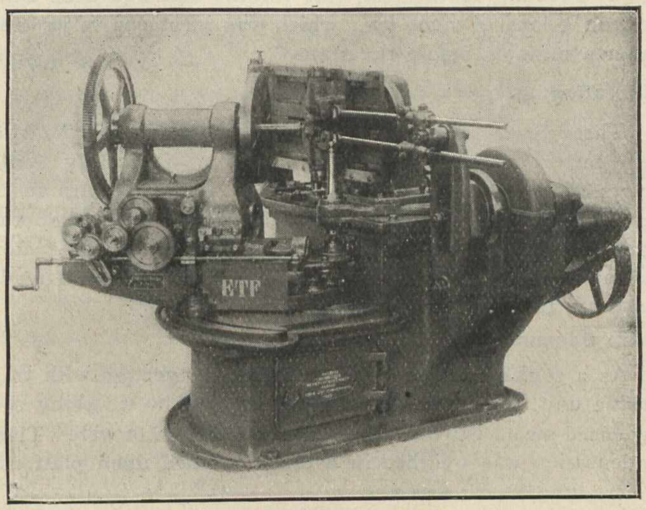
There are quite a number of machines exhibited by Messrs. H. W. Ward & Co., of Birmingham, in which there are special features. Thus there is a 12-in. centre all-gear combination turret lathe, specially designed to obtain the maximum output with the new high-speed steels. The headstock is of the all-gear type, and has treble-gear, driving direct on to the chuck-ring, thus avoiding all strains on the neck of the spindle due to the drive. A 9-in. centre chucking lathe, with all-gear headstock, has its main drive by Hele-Shaw clutch; a 8-in. centre friction-geared capstan lathe has a friction-geared headstock operated by toggle clutches on the main spindle, whilst a 6-in. by 6-in. automatic bush-grinding machine has as its special feature a swing-up work headstock to facilitate gauging. The machine is self-contained, and has an automatic feed, which can be set to grind any diameter, there being a micrometer adjustment



Self Acting Sliding, Surfacing and Screw Cutting Lathe for High Speed Work: John Stark and Sons.

to compensate for the wear of the emery wheel. A Scotch firm, Messrs. Macdonald, Adamson, Swinburne & Co., of Glasgow, show a universal grinding machine, which is the first manufactured without overhead gearing. The same machine also has a drive which gives a variable speed to each motion.

The machine tool department of Messrs. Burton, Griffiths & Co., of London, have staged as comprehensive a display of machines as could be wished for, and it is impossible to more than briefly note their chief characteristics. A special feature of the "Pittler" universal turret lathe is the method of mounting the turret, which carries sixteen tools altogether, thus providing for a large number of operations without necessitating changing tools; there is also an automatic threading lathe, which only requires an attendant for putting in and taking out the work. The "Whitcomb-Blaisdell" "second belt" planing machine, which planes 2 ft. by 2 ft. by 6 ft. long, is fitted with a leather belt for connecting the high-speed driving shaft to the gear



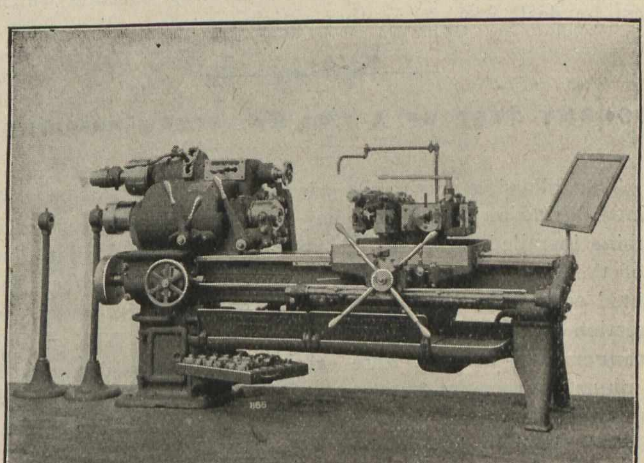
Gear Planer, Zimmerman.

operating the table rack, thus doing away with a train of gearing and its attendant noise and liability to set up vibration, which would show upon the finished surface of the work. The very quiet and smooth reversal of the table on this machine is very noticeable. Messrs. John Lang & Sons, Johnstone, near Glasgow, have on view a 30-in. wing surfacing and boring lathe fitted with a patent variable speed-drive and speed-changing mechanism. The bed of the lathe has a plate covering upper surface, so as to prevent the cuttings from falling on the working surfaces. Special attention may be directed to the surfacing feed; as the tool travels towards the centre the lathe automatically increases in speed, and thereby keeps the cutting speed of the tool practically constant.

Some wood-working machines exhibited by Messrs. Wadkin & Co., of Leicester, show special features of construction which make them particularly applicable to the numerous and ever-varying details of pattern work. For this class of work there is a patent mechanical woodworker which has universal motions to the cutter-head and the table, and both are provided with quick and fine positive feed motions. The spindle being carried (absolutely free from vibration) in the revoluble head of an overhanging arm, the cutter spindle can work in any angular position between the vertical and horizontal. The cutter spindle, moreover, has a reversing motion and is free to slide independently of any movement of the head. The work supporting table is so mounted as to move freely with longitudinal and cross motions. It can be raised and lowered, and will move through a complete circle horizontally. The turning of the table and swivelling of the head can be instantly effected and the motion of the spindle can be reversed when working in any position. Amongst other machines shown by this firm is a wood skiver, which, being driven by power, will take a much longer cut than a hand machine, and leaves the operator with both hands to feed and manipulate the work. The knives are of the usual kind, and automatically move to and fro the whole length of the machine, but they can also be regulated to take a long or short cut from either fence as required, being actuated by a shaft continuously revolving in one direction. A circular saw bench shows good features of design, and is provided with an improved vertical adjustment of the table. A corner lock-jointing or square dovetailing machine also commands attention, principally from the fact that its design is in direct opposition to the old-fashioned system of laboriously arranging and clamping down and cutting a number of pieces at one time. The work is fed singly to the cutters, and is actually cut and finished as fast as it can be fed.

Among the heavier British lathes should be mentioned a combination turret lathe by Messrs. Alfred Herbert, Limited, of Coventry. This has been specially designed for dealing with heavy chucking work, but may also be employed upon bar work. The machine, as seen, has a powerful headstock, which is provided with duplex back gear and quadruple friction clutches, which are operated by two levers in front of the headstock. This arrangement enables nine speeds to be instantly obtained at any time without shifting the belt upon the cone pulley. The spindle is exceptionally large, enabling 5½-in. diameter bars to pass through. The saddle is fitted with patent chasing mechanism so arranged that when the nut is put into gear with the leader the tool is simultaneously moved into its cutting position, and when the nut is withdrawn from the lever the tool is automatically withwrawn from its work. Another tool shown by this firm is the No. 2 hexagon turret lathe, in which some notable improvements have been introduced to adapt the lathe for use with modern cutting tools of high-speed steel. The machine is fitted with patent single pulley head. Sixteen spindle speeds are obtainable forward or reverse, arranged in geometrical progression. Patent dial feed motion is fitted. To obtain any feed, the dial is rotated until the number corresponding to the required feed comes opposite the point. The feed rack which actuates the turret is inverted, so that chips cannot get in. A new and interesting tool is in use upon this machine, this being a new patent roller steady tool, which is easily set, and in which the cutter does not require to be forged. Among a number of other interesting machines shown are a Newall universal grinding machine and a vertical milling and profiling machine.

Yet another British firm of machine tool makers deserving of special mention are Messrs. John Stirk & Sons, of Halifax. An electrically driven high-speed radial drilling machine, 3 ft. 6 in. radius, has balanced spindle and reversing motion for tapping. The spindle is 2½ in. diameter, and is bored to receive a No. 5 Morse taper shank. It is carried in a bush, which revolves in phospher bronze bearings. The main driving wheel is placed near to the lower bearing, so as to drive the spindle as near to the work as possible, and the spindle is placed close into the arm, so that the twisting stress on the arm is kept down to a low limit. The carriage rests on flat surfaces on the arm, and



Hexagon Turret Lathe: Alfred Herbert and Company.

may be conveniently locked in position by a handle at the right-hand end of the carriage. A vertical handle on the left of the carriage operates a clutch, which causes the spindle to be driven through single gear at a quick speed, or through double gear at a slow speed. Another lever on the right-hand operates a reversing motion, having positive clutches of a special design, so that the motion of the spindle may be stopped, started, or reversed without shock while the spindle is running at high speeds. There are four positive feeds to the spindle, viz., 1-32, 1-48, 1-72, and 1-105 per revolution of spindle, and these are operated by means of a small crank handle at the left of the carriage. The spindle has a rack-feed, and is balanced. The worm wheel has a lever so that it may be disengaged and leave the spindle free to follow a tap when tapping. A further movement of this lever throws a quick motion into gear, so that the one-hand wheel, which is used for a fine adjustment of the spindle, may also move the spindle quickly up or down. The arm rests on a ball-bearing, and may be elevated, if required, for a distance of 12 in. The machine is driven through a belt running at a constant speed, and through a gear-box, giving nine changes of speed, operated by two handles. The spindle has thus eighteen changes of speed, ranging in geometrical progression from 630 down to 20 revolutions per minute. All these changes can be made instantly without moving the belt on to the loose pulley, and without shock. When the two handles on the gear-box are in a vertical position, the driving is at the lowest speed, and driving takes place through a silent pawl arrangement. When the levers are moved either to the right or left, clutches are operated, and quicker running wheels come into gear, and the pawls working in the slower running wheels are automatically disengaged, and run idly without any click or noise. The driving pulleys are 10 in. diameter, receive a 3½-in. belt, and run at 625 revolutions per minute. Under testing conditions the machine has been driven by a 30 horse-power motor to thoroughly test the driving power and stiffness of the machine. It has sent a 1-in. diameter drill through mild steel 3½ inches thick at the rate of 8 inches per minute, and through castiron 3 inches thick at the rate of 12 inches per minute. These were the limits of the drills and not of the machine. The weight of the machine is 3¾ tons.

A patent electrically driven 30-in. vertical boring and turning mill has the armature of the motor built into the body of machine (not motor attached). The special features of the high-speed pattern 8-in. self-acting sliding, surfacing and screw-cutting lathe are that the headstock and bedplate are in one, and the large spindle diameter and hole through to take 3-in. bars.

On another stand this firm show a 12-in. special pattern abnormal high-speed lathe in operation driven by a 35 horse-power direct attached motor. The headstock is of the all-gear type, giving sixteen changes of speed. This lathe will take a cut ½-in. deep, ⅛-in. feed at 70 to 80 feet per minute, removing material at the rate of over ten hundredweight per hour.

There are a number of other interesting exhibits which must be dealt with in another article.

ECONOMY TEST OF A 7,000 KW. STEAM TURBINE.

The following data comprise the principal results obtained during an 8-hour economy test on September 1st, of a turbine installed earlier in the year at Waterside Station No. 2 of the New York Edison Company. This test was conducted entirely by the New York Edison Company, under the direction of Mr. J. P. Sparrow, Chief Engineer. The various arrangements therefor, were carried out in accordance with a mutual agreement between builder and operator, entered into previous to the test, and the results, as herein given, were obtained by independent computation.

The turbine unit tested, is of a standard Westinghouse construction. It has a maximum rated capacity of 11,250 kw., and was built to operate on 175 lbs. steam pressure, 28 inches vacuum and 100° superheat. Under these conditions the turbine unit was guaranteed to have a minimum steam consumption of 15.9 lbs. per kw. hour at the generator terminals, with a normal speed of 750 r.p.m. Incidentally the electrical efficiency of the generator was guaranteed to be 97.8 per cent., exclusive of friction and windage, at a load corresponding to that sustained during the test. The results of the tests, detailed below, show an economy about 7.5 per cent. better than the guarantee.

METHODS OF CONDUCTING THE TEST.

Load.

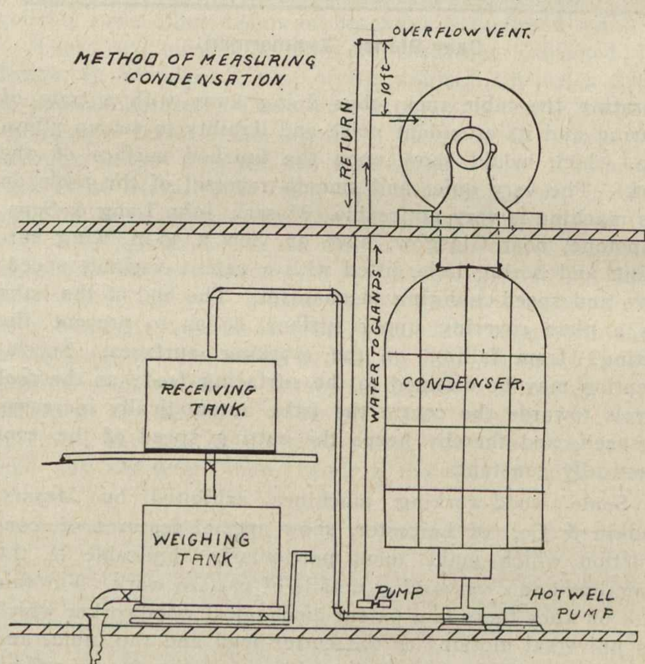
During the test period, No. 2 Waterside Station sustained practically all of the 25-cycle load on the system, of which the unit under test carried practically 70 per cent., the remainder by the other turbine units in the station. This load was maintained as constant as possible by remote control of the turbine governor by the switchboard operator. Between the first and the last hours of the test, the maximum variation in load was held within 4 per cent. above and below mean. Previous to the test, this turbine unit had been running on a load of 7,000 kw., which was increased to its test load ten minutes before the start.

Calibration.

Three-phase electrical load was measured by the two watt meter method, using two Weston indicating watt meters of the standard laboratory type. These instruments were calibrated at the New York Electrical Testing Laboratories immediately before and after the test. Power factor was maintained substantially at unity, and all electrical readings were taken at one-minute intervals.

Steam Consumption.

As a surface condenser was used in connection with this turbine unit, the water rate was determined by weighing the condensed steam delivered from the condenser hot well. This condensation was weighed in a tank mounted upon platform



scales, with a reservoir above large enough to hold the condensation accumulating between each weighing, as shown in the accompanying illustration. These weighings of 12,000 to 13,000 lbs. each, were made at intervals of five minutes.

Gland Leakage.

By the loop method of connecting the gland water supply, the necessity for correcting condensation by an amount equivalent to the weight of the gland water used, is avoided. It will be noted that continuous gland water circuit is used entirely outside of the weighing apparatus, and that all overflow from the standpipe returns to the hot well delivery.

Condenser Leakage.

As the circulating water is quite salt, any condenser leakage may immediately be detected by the salinity of the condensed steam, which should be pure distilled water. On this account, condenser leakage was determined entirely by chemical analysis, employing the silver-nitrate test with a suitable color indicator. This method proved extremely sensitive, and possessed a decided advantage over the ordinary method of weighing the leakage accumulating during a definite period when the condenser is idle and under full vacuum. As samples of circulating water and condensed steam could be taken at the same time, this method made it possible to discover any change in the rate of condenser leakage taking place during the test, while the method of weighing, above described, provides only an average result during the period.

Hot Well Correction.

In this condensing plant, the delivery of hot well pump is automatically controlled by a float valve in the interior of the hot well. This maintains the water level therein at a practically constant point, and hence no correction had to be made for difference in level of water in the hot well before and after the test.

Steam Supply.

Steam pressures and temperatures were determined close to the turbine throttle. As usual, the degree of superheat was obtained by subtracting from the actual steam temperature the temperature of saturated steam at the corresponding pressure carried at the time. All gauges and thermometers were calibrated previous to the test of the United States Testing Bureau. It will be noted that both pressure and superheat were somewhat below the guarantee.

Vacuum.

Vacuum was measured directly at the turbine exhaust by means of a mercury column with a barometer alongside for reducing to standard barometer—30 inches. This also obviated the necessity of temperature correction between the two mercury columns. During the test, the vacuum was not maintained quite up to normal.

RESULTS OF TESTS.

The following data represents the results of the tests. calculated for the conditions as actually run—i.e., for internal errors only:—

Duration of test—9.30 a.m. to 5.30 p.m.

Average steam pressure at throttle, lbs. per square inch gauge	177.5
Average superheat at throttle, degrees F....	95.74
" vacuum (referred to 30″ barom.) in. Hg.	27.31
Average load on generator, kw............	9,830.48
" steam consumption, as tested, lbs. per kw. hour	15.15

Test Correction.

Owing to the departure, during the test, from specific operating conditions upon which guarantees were based, it was necessary to correct the observed results by the following amounts:—

Pressure (2.5 lbs. high) correction, 0.25 per cent; vacuum (0.69 inch low) correction, 1.84 per cent., superheat (4.26° low) correction, .29 per cent.

These corrections were mutually agreed upon previous to the test as representative of this type of turbine. When applied to the observed steam consumption given above, the following results, representing contract conditions, are obtained:—

Average corrected water rate during 8-hour test, 14.85 lbs. per kw. hour.

Guaranteed water rate, 15.9 lbs. per kw. hour.

Log.

The load was considerably lower during the first and last hours than during the main part of the test. Neglecting, therefore, these two hours and considering only the six-hour period from 10.30 a.m. to 4.30 p.m., the results are as follows:—

Average corrected water rate, six hours.....	14.8 lbs. per kw. hour
Equivalent water rate ..	10.65 lbs. per bhp. hour
Equivalent water rate ..	9.8 lbs. per ihp. hour

The two latter quantities are determined by applying conversion factor for generator efficiency and for internal losses.

In connection with these tests, a noteworthy agreement exists between the results noted and those previously obtained from tests of machines similar in design installed in the Manhattan Station of the Interboro Rapid Transit Company, New York, and the Long Island City Station of the Pennsylvania Railroad. At the same loads, and with equivalent operating conditions, the performance of the machines is almost identical. These economic results, while not exceeding in actual steam consumption the best records of European practice, yet are extremely good in view of the moderate operating conditions under which the test was conducted. In fact, they represent the best results that have yet been obtained by any turbine under the conditions named.

SPECIFICATIONS FOR STEEL FORGINGS, STEEL CASTINGS AND STEEL BOILER PLATES.*

1. At the request of the Secretary, I am submitting as a matter of information to this Society, the specifications for Steel Castings, Forgings, and Boiler Plate of the American Section of the International Association for Testing Materials. These specifications were prepared by their Committee No. 1, and as "proposed specifications," they have been widely discussed during the past two years. At the annual meeting of the American Section, in June last, at Niagara, these specifications were adopted as their standards, but no attempt has been made to put them in general use.

2. The course which has been followed with the rail specifications will be pursued with these. The rail specifications were brought up for discussion by the "Committee on Rail" of the American Railway Engineering and Maintenance of Way Association at their annual meeting in Chicago, March, 1901, and at their annual meeting this year, were adopted with some important modifications. The next step will be to refer these modifications to Committee No. 1 of the American Section, who will report on the same at their annual meeting at Atlantic City, June 12, 13 and 14, when the modifications will no doubt be accepted. All the members of the other committees, or interested members of the other societies, who have considered these specifications, will be invited to be present, and take part in the discussion. In this way a good representative standard rail specification will be obtained.

3. With this explanation, these specifications are offered for consideration and discussion. In order to bring out a good discussion on each of these specifications, other members of Committee No. 1 will write short papers bearing on the most important points.

4. The subject is one of the greatest importance to all. and I know of no set of men who are more interested than our members, in securing good, sound, reliable steel castings, forgings, and boiler plates. I trust that the discussion will result in a committee being appointed on specifications, in order that the American Society of Mechanical Engineers may do its part of the work, and assert its influence in putting into final shape these specifications for general use in this country. In work of this kind one society can be of great service to another without any actual connection between them.

STANDARD SPECIFICATIONS FOR STEEL FORGINGS.

Process of Manufacture.

1. Steel for forgings may be made by the open-hearth, crucible, or Bessemer process.

Chemical Properties.

2. There will be four classes of steel forgings which shall conform to the following limits in chemical composition:

	Forgings of soft or low, carbon steel. Per cent.	Forgings of carbon steel, not annealed. Per cent.	Forgings of carbon steel, oil tempered or annealed. Per cent.	Forgings of nickel steel, oil tempered or annealed. Per cent.
Phosphorus shall not exceed..	0.10	0.06	0.04	0.04
Sulphur " " " ..	0.10	0.06	0.04	0.04
Nickel " " " ..	——	——	——	3.00—4.00

*Read before the American Society of Mechanical Engineers.

PHYSICAL PROPERTIES.

Tensile Tests.

3. The minimum physical qualities required of the different sized forgings of each class shall be as follows:—

Tensile strength. Pounds per sq. inch.	Yield point. Pounds per sq. inch.	Elongation in 2 inches. Per cent.	Contraction of area. Per cent.	
				Soft Steel or Low Carbon Steel.
58,000	29,000	28	35	For solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.
				Carbon Steel Not Annealed.
75,000	37,500	18	30	For solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.
	Elastic limit			Carbon Steel Annealed.
80,000	40,000	22	35	For solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.
75,000	37,500	23	35	For solid forgings, no diameter to exceed 20 inches or thickness of section 15 inches.
70,000	35,000	24	30	For solid forgings, over 20 inches diameter.
				Carbon Steel, Oil Tempered.
90,000	55,000	20	45	For solid or hollow forgings, no diameter or thickness of section to exceed 3 inches.
Tensile strength. Pounds per sq. inch.	Elastic limit. Pounds per sq. inch.	Elongation in 2 inches. Per cent.	Contraction of area. Per cent.	
				Carbon Steel, Oil Tempered.
85,000	50,000	22	45	For solid forgings of rectangular sections not exceeding 6 inches in thickness, or hollow forgings, the walls of which do not exceed 6 inches in thickness.
80,000	45,000	23	40	For solid forgings of rectangular sections not exceeding 10 inches in thickness, or hollow forgings, the walls of which do not exceed 10 inches in thickness.
				Nickel Steel, Annealed.
80,000	50,000	25	45	For solid or hollow forgings, no diameter or thickness of section to exceed 10 inches.
80,000	45,000	25	45	For solid forgings, no diameter to exceed 20 inches or thickness of section 15 inches.
80,000	45,000	24	40	For solid forgings, over 20 inches diameter.
				Nickel Steel, Oil Tempered.
95,000	65,000	21	50	For solid or hollow forgings, no diameter or thickness of section to exceed 3 inches.
90,000	60,000	22	50	For solid forgings of rectangular sections not exceeding 6 inches in thickness, or hollow forgings, the walls of which do not exceed 6 inches in thickness.
85,000	55,000	24	45	For solid forgings of rectangular sections not exceeding 10 inches in thickness, or hollow forgings, the walls of which do not exceed 10 inches in thickness.

Bending Test.

4. A specimen one inch by one-half inch (1 inch x ½ inch) shall bend cold 180 degrees without fracture on outside of bent portion, as follows:—

Around a diameter of one-half inch, for forgings of soft steel.

Around a diameter of one and one-half inches, for forgings of carbon steel not annealed.

Around a diameter of one and one-half inches, for forgings of carbon steel annealed, if twenty inches in diameter or over.

Around a diameter of one inch, for forgings of carbon steel annealed, if under twenty inches diameter.

Around a diameter of one inch, for forgings of carbon steel oil-tempered.

Around a diameter of one-half inch, for forgings of nickel steel annealed.

Around a diameter of one inch for forgings of nickel steel oil-tempered.

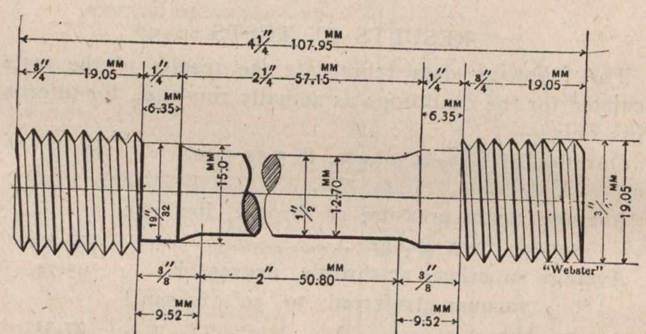
TEST PIECES AND METHODS OF TESTING.

Test Specimen for Tensile Test.

5. The standard turned test specimen, one-half inch (½ inch) diameter and two inch (2 inch) gauged length, shall be used to determine the physical properties specified in paragraph No. 3. It is shown in the following sketch:—

Number and Location of Tensile Specimens.

6. The number and location of test specimens to be taken from a melt, blow, or a forging, shall depend upon its character and importance, and must, therefore, be regulated by individual cases. The test specimens shall be cut cold from the forging or full-sized prolongation of same parallel to the axis of the forging, and half way between the centre and outside, the specimens to be longitudinal, i.e., the length of the specimen to correspond with the direction in which the metal is most drawn out or worked. When forgings have



large ends or collars, the test specimens shall be taken from a prolongation of the same diameter or section as that of the forging back of the large end or collar. In the case of hollow shafting, either forged or bored, the specimens shall be taken within the finished section prolonged, half way between the inner and outer surface of the wall of the forging.

Test Specimen for Bending.

7. The specimen for bending test one-half inch (1 inch x ½-inch) shall be cut as specified in paragraph No. 6. The bending test may be made by pressure or by blows.

Yield Point.

8. The yield point specified in paragraph No. 3 shall be determined by the careful observation of the drop of the beam, or halt in the gauge of the testing machine.

Elastic Limit.

9. The elastic limit specified in paragraph No. 3 shall be determined by means of an extensometer, which is to be attached to the test specimen in such manner as to show the change in rate of extension under uniform rate of loading, and will be taken at that point where the proportionality changes.

Samples for Chemical Analysis.

10. Turnings from the tensile specimen, or drillings from the bending specimen, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in chemical composition specified in paragraph No. 2.

Finish.

11. Forgings shall be free from cracks, flaws, seams or other injurious imperfections, and shall conform to dimensions shown on drawings furnished by the purchaser, and be made and finished in a workmanlike manner.

Inspection.

12. The inspection representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

STANDARD SPECIFICATIONS FOR STEEL CASTINGS.

Process of Manufacture.

1. Steel for castings may be made by the open-hearth, crucible or Bessemer process. Castings to be annealed or unannealed as specified.

CHEMICAL PROPERTIES.

Ordinary Castings.

2. Ordinary castings, those in which no physical requirements are specified, shall not contain over 0.40 per cent. of carbon, nor over 0.08 per cent. of phosphorus.

Tested Castings.

3. Castings which are subjected to physical test shall not contain over 0.05 per cent. of phosphorus, nor over 0.05 per cent. of sulphur.

PHYSICAL PROPERTIES.

Tensile Tests.

4. Tested castings shall be of three classes:—"hard," "medium," and "soft." The minimum physical qualities required in each class shall be as follows:—

	Hard castings.	Medium castings.	Soft castings.
Tensile strength, pounds per square inch	85,000	70,000	60.000
Yield point, pounds per sq. in. ..	38,250	31,500	27,000
Elongation, per cent. in two inches	15	18	22
Contraction of area, per cent. ..	20	25	30
Tensile strength, pounds per sq. inch. .	85,000	70,000	

Drop Test.

5. A test to destruction may be substituted for the tensile test, in the case of small or unimportant castings, by selecting three castings from a lot. This test shall show the material to be ductile and free from injurious defects, and suitable for the purpose intended. A lot shall consist of all castings from the same melt or blow, annealed in the same furnace charge.

Percussive Test.

6. Large castings are to be suspended and hammered all over. No cracks, flaws, defects, nor weakness shall appear after such treatment.

Bending Test.

7. A specimen one inch by one-half inch (1 inch x ½ inch) shall bend cold around a diameter of one inch (1 inch) without fracture on outside of bent portion, through an angle of 120 degrees for "soft" castings, and 90 degrees for "medium" castings.

TEST PIECES AND METHODS OF TESTING.

Test Specimen for Tensile Test.

8. The standard turned test specimen, one-half inch (½ inch) diameter and two-inch (2 inch) gauged length, shall be used to determine the physical properties specified in paragraph No. 4. It is shown in the following sketch:—

Number and Location of Tensile Specimens.

9. The number of standard test specimens shall depend upon the character and importance of the castings. A test piece shall be cut cold from a coupon to be moulded and cast on some portion of one or more castings from each melt or blow, or from the sink-heads (in case of sufficient size are used). The coupon or sink-head must receive the same treatment as the casting or castings, before the specimen is cut out, and before the coupon or sink-head is removed from the casting.

Test Specimen for Bending.

10. One specimen for bending test one inch by one-half inch (1 inch x ½ inch) shall be cut cold from the coupon or sinkhead of the casting or castings as specified in paragraph No. 9. The bending test may be made by pressure or by blows.

Yield Point.

11. The yield point specified in paragraph No. 4 shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

Sample for Chemical Analysis.

12. Turnings from the tensile specimen, drillings from the bending specimen, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in phosphorus and sulphur specified in paragraphs Nos. 2 and 3.

Finish.

13. Castings shall be true to pattern, free from blemishes, flaws, or shrinkage cracks. Bearing surfaces shall be solid, and no porosity shall be allowed in positions where the resistance and value of the casting for the purpose intended, will be seriously affected thereby.

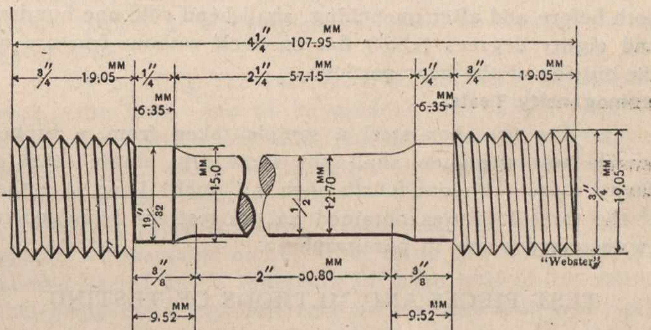
Inspection.

14. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture prior to shipment.

STANDARD SPECIFICATIONS FOR OPEN-HEARTH BOILER PLATE.

Process of Manufacture.

1. Steel shall be made by the open-hearth process.



Chemical Properties.

2. There shall be three classes of open-hearth boiler plate and rivet steel, namely:—"Flange or boiler steel, fire box steel and extra soft steel," which shall conform to the following limits in chemical composition:—

	Flange or boiler steel, per cent.	Fire box steel, per cent.	Extra soft steel, per cent.
Phosphorus shall not exceed	Acid 0.06 Basic 0.04	Acid 0.04 Basic 0.03	0.04
Sulphur shall not exceed.	0.05	0.04	0.04
Manganese	0.30 to 0.60	0.30 to 0.50	0.30 to 0.50

Boiler Rivet Steel.

3. Steel for boiler rivets shall be of the extra soft class specified in paragraphs Nos. 2 and 4.

PHYSICAL PROPERTIES.

Tensile Tests.

4. The three classes of open-hearth boiler plate and rivet steel, namely; flange or boiler steel, fire box steel and extra soft steel, shall conform to the following physical qualities:—

	Flange or boiler steel.	Fire box steel.	Extra soft steel.
Tensile strength, pounds per square inch	55,000 to 65,000	52,000 to 62,000	45,000 to 55,000
Yield point, in pounds per square inch shall not be less than	½ T. S.	½ T. S.	½ T. S.
Elongation, per cent. in eight inches shall not be less than	25	26	28

Modifications in elongation for thin and thick material.

5. For material less than five-sixteenth inch (5-16 inch), and more than three-fourths inch (¾ inch) in thickness, the

following modifications shall be made in the requirements for elongation:—

(a) For each increase of one-eighth inch (⅛ inch), in thickness above three-fourths inch (¾ inch), a deduction of one per cent. (1%) shall be made from the specified elongation.

(b) For each decrease of one-sixteenth inch (1-16 inch) in thickness below five-sixteenths inch (5-16 inch) a deduction of two and one-half per cent. (2½%) shall be made from the specified elongation.

Bending Tests.

6. The three classes of open-hearth, boiler plate and rivet steel shall conform to the following bending tests; and for this purpose the test specimen shall be one and one-half inches (1½ inch) wide if possible, and for all material three-fourths inch (¾ inch) or less in thickness the test specimen shall be of the same thickness as that of the finished material from which it is cut; but for material more than three-fourths inch (¾ inch) thick, the bending test specimen may be one-half inch (½ inch) thick:

Rivet rounds shall be tested of full size as rolled.

(c) Test specimens cut from the rolled material as specified above shall be subjected to a cold bending test, and also to a quenched bending test. The cold bending test shall be made on the material in the condition in which it is to be used, and prior to the quenched bending test, the specimen shall be heated to a light cherry-red as seen in the dark and quenched in water, the temperature of which is between 80 degrees and 90 degrees Fahrenheit.

(d) Flange or boiler steel, fire box steel and rivet steel, both before and after quenching, shall bend cold one hundred and eighty degrees (180°) flat on itself without fracture on the outside of the bent portion.

Homogeneity Tests.

7. For fire box steel a sample taken from a broken tensile test specimen shall not show any single seam or cavity more than one-fourth inch (¼ inch) long in either of the three fractures obtained on the test for homogeneity as described below in paragraph 12.

TEST PIECES AND METHODS OF TESTING.

Test Specimen for Tensile Test.

8. The standard test specimen of eight (8 inch) gauged length, shall be used to determine the physical properties specified in paragraphs Nos. 4 and 5. The standard shape of the test specimen for sheared plates shall be as shown by the following sketch:

For other material the test specimen may be the same as for sheared plates, or it may be planed or turned parallel throughout its entire length and, in all cases where possible, two opposite sides of the test specimens shall be the rolled surfaces. Rivet rounds and small rolled bars shall be tested to full size as rolled.

Number of Tensile Tests.

9. One tensile test specimen will be furnished from each plate as it is rolled, and two tensile test specimens will be furnished from each melt of rivet rounds. In case any one of these develops flaws or breaks outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor.

Test Specimens for Bending.

10. For material three-fourths inch (¾ inch) or less in thickness, the bending test specimen shall have the natural rolled surface on two opposite sides. The bending test specimens cut from plates shall be one and one-half inches (1½ inches) wide, and for material more than three-fourths (¾ inch) thick the bending test specimens may be one-half (½ inch) thick. The sheared edges of bending test specimens may be milled or planed. The bending test specimens for rivet rounds shall be of full sie as rolled. The bending test may be made by pressure or by blows.

Number of Bending Tests.

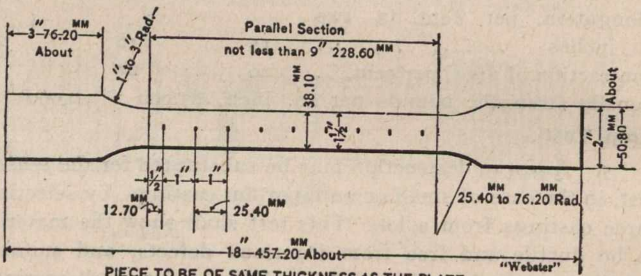
11. One cold bending specimen and one quenched bending specimen will be furnished from each plate as it is rolled. Two cold bending specimens and two quenched bending specimens will be furnished from each melt of rivet rounds. The homogeneity test for fire box steel shall be made on one of the broken tensile test specimens.

Homogeneity Tests for Fire Box Steel.

12. The homogeneity test for fire box steel is made as follows:—A portion of the broken tensile test specimen is either nicked with a chisel or grooved on a machine, transversely about a sixteenth of an inch (1-16 inch) deep, in three places about two inches (2 inches) apart. The first groove should be made on one side, two inches (2 inches) from the square end of the specimen; the second, two inches (2 inches) from it on the opposite side; and the third, two inches (2 inches) from the last, and on the opposite side from it. The test specimen is then put in a vise, with the first groove about a quarter of an inch (¼ inch) above the jaws, care being taken to hold it firmly. The projecting end of the test specimen is then broken off by means of a hammer, a number of light blows being used, and the bending being away from the groove. The specimen is broken at the other two grooves in the same way. The object of this treatment is to open and render visible to the eye any seams due to failure to weld up, or to foreign interposed matter, or cavities due to gas bubbles in the ingot. After rupture, one side of each fracture is examined, a pocket lens being used if necessary, and the length of the seams and cavities is determined.

Yield Point.

13. For the purpose of this specification, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.



PIECE TO BE OF SAME THICKNESS AS THE PLATE.

Sample for Chemical Analysis.

14. In order to determine if the material conforms to the chemical limitations prescribed in paragraph No. 2 herein, analysis shall be made of drillings taken from a small test ingot. An additional check analysis may be made from a tensile specimen of each melt used on an order, other than in locomotive fire box steel. In the case of locomotive fire box steel, a check analysis may be made from the tensile specimen from each plate as rolled.

Variation in Weight.

15. The variation in cross section or weight of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations:—

(e) Plates 12½ pounds per square foot or heavier, up to 100 inches wide, when ordered to weight, shall not average more than 2½ per cent. variation above or 2½ per cent. below theoretical weight. When 100 inches wide and over, 10 per per cent. above or 5 per cent. below the theoretical weight.

(f) Plates under 12½ pounds per square foot, when ordered to weight, shall not average a greater variation than the following:—

Up to 75 inches wide, 2½ per cent. above or 2½ per cent. below the theoretical weight. 75 inches wide up to 100 inches wide, 5 per cent. above or 3 per cent. below the theoretical weight. When 100 inches wide and over, 100 per cent. above or 3 per cent. below the theoretical weight.

(g) For all plates ordered to gauge, there will be permitted an average excess of weight over that corresponding to the dimensions on the order equal in amount to that specified in the following table:—

Table of Allowances for Overweight for Rectangular Plates When Ordered to Gauge.

Plates will be considered up to gauge if measuring not over 1-100-inch less than the ordered gauge.

The weight of one cubic inch of rolled steel is assumed to be 0.2833 pound.

Plates ¼-inch and over in thickness.

Thickness of plate.	Width of plate. Up to 75 in.	75 to 100 in.	Over 100 in.
Inch.	Per cent.	Per cent.	Per cent.
¼	10	14	18
5-16	8	12	16
⅜	7	10	13
7-16	6	8	10
½	5	7	9
9-16	4½	6½	8½
⅝	4	6	8
Over ⅝	3½	5	6½

Plates Under ¼-inch in Thickness.

Thickness of plate.	Width of plate. Up to 50 in.	50 in. and above.
Inch.	Per cent.	Per cent.
⅛ up to 5-32	10	15
5-32 " 3-16	8½	12½
3-16 " ¼	7	10

Finish.

16. All finished material shall be free from injurious surface defects and laminations, and must have a workmanlike finish.

Branding.

17. Every finished piece of steel shall be stamped with the melt number, and each plate, and the coupon or test specimen cut from it, shall be stamped with a separate identifying mark or number. Rivet steel may be shipped in bundles securely wired together with the melt number on a metal tag attached.

Inspection.

18. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

THE WATER POWERS OF PERU.

Mr. Emil Guarini, professor of physical and electrical science at the Escuela de Artes y Oficios, Lima, Peru, sends us some particulars of Peruvian water powers and their development. He says that the present developments are insignificant, being limited to 1,000 horse-power installation, furnishing light and power to Arequipa, and a very modest private lighting plant in the Tambo Valley.

At Mollendo there is no power plant of any description. The Peruvian Corporation is about to install a steam plant to furnish power for industrial purposes and harbour work during the day, and for public lighting at night. The high cost of fuel and the uninterrupted demand for a power during the 24 hours, however, make the advantages of a water-power installation apparent.

In the immediate vicinity of Mollendo, in the Tambo Valley, there are a number of small streams capable of developing several hundred horse-power, which can be easily utilized and transmitted electrically. The supply of power available from this source is so much greater than any demand in sight for it at Mollendo, that a primitive wooden water-wheel of local manufacture, in connection with a dynamo and a few kilometres of copper wire, would amply suffice for present requirements, and would represent a great saving in first cost and in operating expense over the proposed steam plant. The utilization of the city's water supply to operate a wheel before entering the distributing mains suggests an alternative source of power.

Mollendo gets its water from the mountains at an elevation of 2,300 metres above sea level, whence it is conveyed a distance of 140 kilometres through pipes, 20 centimetres in diameter at a velocity of 20 litres per second, according to chief engineer Bustamante y Raneda, in his recent report and project for increasing the water supply of Mollendo. Friction losses would average 5 millimetres per metre of pipe, or 700 metres for the entire distance, not including loss of head from short turns, bend and angles.

On the basis of 1 horse-power = 175 kilogramme metres, net available, and allowing 75 per cent. as the efficiency of the wheel, the theoretical available power would be 320 horse.

In practice, however, this result could not be obtained for two reasons: first, because the present pipe line could not resist the attendant pressure of 219 atmospheres, and second, because the entire theoretical head is not available owing to the fact that the line is sectioned off in several separate reservoirs at different levels, serving to supply intermediate towns and villages, and also to relieve the pressure on the line.

The power problem would consequently have to be solved by either of the following methods: 1. By installing a water-wheel and alternating-generator set at the mouth of each reservoir, feeding a single cable carrying the current to Mollendo and furnishing power to different localities on the way. Under existing conditions, at least 250 horse-power could be delivered in this manner at Mollendo, during 24 hours, supplying 3,000 standard 16-candle-power lamps = 48,000 candle power, or 3,000 special-filament 32-candle-power lamps = 96,000 candle-power.

This output could be further increased by installing a storage battery at Mollendo, which could be charged during the daytime.

2. By building two reservoirs at Mollendo, at different levels; the lower one to be used as the supply reservoir proper for distribution, and the other as a water-power storage basin, which would empty into the lower reservoir during lighting hours.

Under present conditions, each reservoir would have a capacity of 900 cubic metres (that being the capacity of the existing basin) and a difference of mean level of 220 metres (that being the actual difference between the Mollendo reservoir and the last section basin). This would give a flow of 10 litres per second for 24 hours, or 40 litres per second for 6 hours, or an equivalent of 88 actual horse-power, sufficient to supply 1,000 special 32-candle-power incandescent lamps for six hours, which would be fully adequate for the immediate needs of the little town of Mollendo.

The Tambo Valley abounds in small water-powers, which could be easily developed to supply power to run the machinery in the sugar mills that dot the valley, during the day, and to light the many estates and farms, at night.

To-day, the only application of these natural forces is to be found on a plantation, where a miniature electric-lighting plant is run by a very primitive and inadequate water wheel of native design.

At Arequipa, the "Sociedad Electrica de Arequipa" owns and operates a hydro-electric central station at a place called Charcani, about 11 kilometres from the town, the motive power for which is supplied by the Chile River, with a maximum capacity of 1,000 horse-power. Current will be delivered at Arequipa over a three-phase line, at 5,400 volts, for power and lighting purposes, as soon as the installation is completed.

The intake flume, about 1,300 metres long, has a capacity 4 cubic metres per second. With an available head of 26.5 metres, it is possible to develop a theoretical force of 1,413.33 horse-power and at actual output at the water-wheel shaft of about 1,060 horse-power. The original equipment consists of two turbines consuming 865 litres of water per second, and developing 248 horse-power each, or a total of 496 horse-power. Each wheel operates a single-phase, alternating-current, 50-cycle, 5,400 volt generator.

The high-tension current is carried over an eight-wire line into Arequipa, a distance of 12,500 metres, where it is converted to 110 volts at a sub-station, through sixteen static transformers of capacities varying between 2 and 20 kilowatts.

Arequipa to-day uses ten 1,000-candle-power arc lamps, and 4,391 incandescent lamps of different ratings, aggregating 77,972 candle-power. The lighting service is, however, most unsatisfactory, owing to the insufficiency of the present equipment to meet requirements. As a result, the streets are half the time in the dark, and complaints from private subscribers are constant—the company being unable to support the current contracted for and give satisfactory service, on the one hand, and the consumer trying to get even with the company, on the other, by using lamps on their circuits of double the rating that they are entitled to, in an effort to get a modicum of brilliancy.

The Sociedad Electrica de Arequipa, it must be admitted, is now installing an additional 500-horse-power equipment which should suffice for present requirements, although, as a matter of fact, an entirely new hydro-electric plant would be advisable in order to bring the light and power service up to the standard expected in a first-class city of the importance of Arequipa.

Another source of supply should be the Chile River which is amply capable of furnishing all the motive power necessary for the purpose, representing, as it does, a colossal hydraulic force, hitherto overlooked.

Mr. Habich, director of the Technical School of Lima, in an article published in the bulletin of the Mines of Peru, in its issue of July 31, 1901, pointed out that Peru, with its rivers descending from elevations of 3,000 to 4,000, and 5,000 metres, possessed incalculable sources of power, and showed that the Rimac River alone was capable of developing at least 100,000 horse-power.

Returning to the River Chile itself, and basing calculations from a point a little above the location of the present station at Charcani, about 3,000 metres above sea level. It is estimated that this stream carries a volume of water of 6 cubic metres per second, equal to a theoretical force of 240,000 horse-power. By properly damming the Chile between Charcani and sea level it would be easy to develop a minimum effective power of 100,000 to 120,000 horse-power.

The objection to such a scheme would be the fact that the water thus taken from the stream could only be used for irrigation after passing through the water-wheels, which, if installed at sea level, would render such utilization impossible, whereas the Peruvian Government is unequivocally opposed to the granting of any water rights whatever that would interfere with its plans for increased irrigation facilities. In the eastern part of Peru there is such an abundance of water that this restriction does not obtain, but on the seaboard it is necessary either to utilize the higher levels of the streams (up in the mountains), or to have recourse to partial and successive developments so as not to interfere with irrigation. For the specific case of Arequipa, the latter plan is the most practical.

By lowering the location of the present plant about 400 metres, it would be a simple matter to increase the head from the 26 metres now available, to at least 100 metres. This would in no wise prejudice irrigation, as there are no lands whatever under cultivation between the present and the proposed locations of the plant.

By lengthening the present flume or ditch, a force of 4,000 horse-power could be developed, while by building a new flume of sufficient capacity to carry the 6 cubic metres of which the Chile River disposes, a force of 6,000 horse-power could be obtained.

With such a supply of electrical energy available, the electrification of the railroads of southern Peru would follow in due course, either totally or partially, creating a large market for power.

The Peruvian Southern Railroad operates 359 kilometres of road over an average grade of 1.3 per cent., between Mollendo, which is at sea level, and Crucero Alto, the highest point on the line, at an altitude of 4.840 metres.

Allowing 33⅓ per cent. for losses from all sources, which is excessive, the remaining 4,000 horse-power available would suffice to move five trains of 70 tons each at a speed of 36 kilometres per hour, which is far in excess of present or ultimate traffic demands on the road, especially if tri-phase traction operation is adopted, when the returning cars on the down grade, instead of consuming, would on the contrary generate additional current, the motors being converted into generators. The total mileage of the road is not beyond the limit of economical electrical operation over high transmission lines, at the present day.

The next and by far the most important source of water-power supply of Peru, points out the hardy pioneer, is Lake Titicaca, lying 3,800 metres above the level of the sea, with a surface area of 6,600 square kilometres, and an average depth of 20 metres.

Lake Titicaca, as is well-known, is an isolated basin into which a great number of rivers empty. The outlet of this basin is the River Desaguadero, which discharges its waters into Pampa Aullagas, where they are lost through evaporation and filtration. There is a popular belief that a subterranean stream continues and discharges into the sea, but scientific investigations have failed to substantiate the theory and it appears certain that this water is absorbed only by evaporation and filtration. The fact remains however, that the Desaguadero River before entering the Pampa Aullagas carries a volume of 100 cubic metres of water per second, whereas the stream that serves as outlet to this lake has a volume of only 1 cubic metre per second. It is therefore evident that the greater part of the waters of the affluents of Lake Titicaca are lost through evaporation and filtration between the two lakes and the Desaguadero River.

The proportion of this loss due to evaporation returns in a measure to the drainage basin of Lake Titicaca in the form of rain, contributing in part only to the cycle here outlined.

Therefore, the project hereafter suggested contemplates exclusively the utilization of the water actually wasted by filtration in Pampa Aullagas.

For various reasons, and especially for the purpose of utilizing this water for irrigation after leaving the turbines, it is desirable to have this water fall over the Pacific slope. Lake Titicaca lies in a hollow, surrounded on all sides by an unbroken ridge of mountains, ranging from 250 to 800 metres in height, presenting a formidable engineering problem which can be overcome by only two solutions; either tunnelling through the mountain, or pumping the water up and over the lowest practicable eminence.

The distance from Lake Titicaca to the Pacific Ocean, as the crow flies, is 250 kilometres.

According to surveys, the shortest practicable tunnel that could be bored through this natural barrier to the nearest valley, would be between 35 and 40 miles long; this, while entailing an enormous cost, would greatly shorten the transmission line.

As regards the alternative plan of pumping the water over the side of the mountains, it should be called to mind that the highest point on the ridge immediately encircling the lake is Crucero Alto, at an elevation of 4,600 metres, or about 800 metres above the level of the lake. In the event of an actual undertaking of such an enterprise, a much lower point would of course be determined upon, after proper surveys; but for the purpose of demonstrating its feasibility, Crucero Alto will be selected as the peak to which the water must be raised, and furthermore, the pipe line will be assumed to follow the tracks of the Peruvian Southern Railroad (a very much longer and more circuitous route than would be taken in practice), a total distance of 524 kilometres.

To raise 100 cubic metres of water one metre in one second requires 1,000 horse-power with good pumps. The difference in levels between the surface of the lake and Crucero Alto being 800 metres, a force of 1,900 x 800 = 1,520,000 horse-power would be necessary.

At first sight this figure appears appalling, but it will be shown hereafter that the available supply of power for the pumping station would be far in excess of this amount.

100 cubic metres of water under a head of 4,600 metres represent a theoretical force of 6,133,333 horse-power which,

after deducting 1,520,000 horse-power consumed at the pumping station, would still have a theoretical supply of 4,613,333 horse-power to dispose of.

Assuming the penstock to be built of a number of pipes, each 1 metre in diameter and carrying a volume of 628.3 litres of water at a velocity of 0.8 metres per second, loss of head may be estimated at 1 metre per kilometre, or 524 metres for the entire line, equal to 698,666 horse-power to be deducted.

Further, allowing 1,914,667 horse-power for losses from all sources, in the turbines, generators, etc. (which is extremely liberal), a net surplus of 2,000,000 horse-power of electrical energy would be left available for sale.

The plan above provides for the driving of the pumps by the electrical energy generated by their own initial action, but it must of course be understood that steam is contemplated as the original motive power at the pumping station. For example, a pumping station would first have to be installed on the edge of Lake Titicaca, at a suitable point such as Puno, driven by steam, with a capacity sufficient to force 1 cubic metre per second to a height of 800 metres. Such a pump would consume 1,520 horse-power to perform the work.

The water would be pumped into a reservoir at Crucero Alto, from which it would fall by gravity to sea level, where it would develop, as above shown, an actual net force of 35,000 horse-power of electrical energy, or more than double the power required to drive the pump at Titicaca. After supplying this power to the first pump, there would be a reserve force of 20,000 horse-power left, which could be used to drive a second pump, and so on successively, until, with adequate capacity in the Crucero Alto reservoir, one hundred pumps could be kept in automatic operation, delivering a net total of 35,000 — 15,000 x 100 = 2,000,000 horse-power, as above demonstrated.

The market for this supply of power would be in its application to the electrification of present steam roads and the operation of new electric properties, mining and agricultural industries, public and private lighting, the manufacture of carbide calcium at the coal mines, the operation of overhead conveying cables which are in general use in Peru, and for heating, household, and general power purposes.

THE QUEBEC BRIDGE FAILURE.

Referring to Mr. C. A. P. Turner's articles on the Quebec Bridge Failure, which appeared in the Canadian Engineer fo October 18th (page 387) a correspondent writes us as follows:—

The bridge could not fall otherwise than vertically unless its fall was resisted by a force greater than its own. Gravity was the force drawing it down vertically, the sole resistance was the atmosphere which in this case was practically nil. Any of the older men of the Phoenix Bridge Company's staff would gladly substantiate this statement authoritatively. No Canadian engineer has had enough experience in spilling bridges to speak authoritatively on this subject.

Mr. Turner speaks truly and wisely when he states that the design of the Quebec Bridge was an "effort" to produce a structure that "would 'approach' the perfection of the bridge builder's art." "The best possible" bridge will have to be obtained or this failure will be duplicated. Examination of the wrecked structure is about as useful in determining the cause of failure as examining last year's cornstalks in an attempt to determine the quantity of last year's corn crop. Engineers must be able to tell from plan and specification exactly what the structure will be, and do, or engineering is a delusion or worse. The writer has every reason to know that the science of engineering is well nigh an exact science, and that the engineer can establish his conclusions and inferences with certainty and mathematically prove his position to coincide with natural law. The general design of the Quebec Bridge was but little at fault, and the bridge might safely be reconstructed on the same general design except that a few of the important parts of the structure would have to be made in a radically different manner, while the method of erection requires equally radical treatment.

This bridge failure has not been useless, for it emphasizes the fact so well known to such past masters of engineering as Stevenson, Fairbairn, Arrol, Brunell, and some others, all of whom were first-class practical workmen, that the full value of technical training cannot be realized except by putting the knowledge so obtained to serviceable use in the office, and combining both with practical common sense obtained in the school of experience, by observation and study of fundamental principles. Besides possessing the above qualifications no mere consulting engineer should be entrusted with the construction and erection of so important an undertaking unless he could and did personally supervise the erection, daily and continuously. The importance and truth of this assertion is clearly established by the successful erection of the Brooklyn and East River bridges. At the former the late eminent engineer, C. C. Martin, visited the work daily, and it may be said that Mr. Buck smoked all over the East River bridge, inspecting and smoking with equal continuity and ability.

Again one might here ask is the habit of dropping bridges and other structures becoming chronic with the American company entrusted with the building and installation of the bridge at Quebec. A careful consideration, review, and answer to this question might (it should) cause those entrusted with, and responsible to the country for, its cost to see that it is high time that Canadian engineers were consulted, not only as to its design, but its erection, and all other details. One incontrovertible statement in favour of the Canadian engineer is that he never dropped anything during erection as big as the Quebec Bridge, or any other kind of structure as often as United States engineers have. Indeed had the supervision and design, manufacture and erection of this bridge been entrusted to Canadian engineers their everlasting noisiness would have stood them in good stead, which in turn would have prevented this unpardonable blunder, as well as the ever lamentable sacrifice of about eighty useful lives.

The writer is strongly of the opinion that Mr. Turner is too magnanimous in his splendid article, when loss of prestige to the engineering profession is admitted, if he means to include Canadian and British engineers. In none of these has the habit of dropping bridges during erection become chronic. We have lately learned that another blunder has developed in a United States tunnel which will cost half a million dollars to rectify. Is the engineer across the International boundary suffering from brain storm? This is a question which merits the attention of the Canadian taxpayer as well as his representative. The former will suffer in money loss in this lamentable and unnecessary blunder, while the latter will be held accountable for it.

AUSTRALIAN TARIFFS.

We have just received through Mr. D. H. Ross, Commercial Agent of Australia, a copy of the revised Australian tariff. The following items, taken from it, are those that will interest those engaged in the iron and steel industry in Canada:—

Tariff Items.	General Tariff.	Produce or Manufactures of the United Kingdom.
Iron, plate and sheet, viz.:—		
(a) Corrugated galvanized, ad val.	25 p.c.	20 p.c.
(b) Galvanized not corrugated, and corrugated not galvanized, ad val	20 p.c.	15 p.c.
Cutlery of all kinds, n.e.i., ad val....	20 p.c.	15 p.c.
Nails, viz.:—		
(a) Horseshoe nails, per cwt.....	8s. 3d.	7s. 6d.
(b) Brads (including moulders' and glaziers'); picture nails; raildogs or brobs; spikes; staples, n.e.i.; tacks, n.e.i.; wire and other nails, n.e.i., per cwt.	5s. 6d.	5s.

Engines (including traction and portable), n.e.i.; turbines; winches, n.e.i.; boilers, n.e.i.; pumps, windmills, ad val.	30 p.c.	25 p.c.
Machinery and parts thereof, viz.;—		
Steam engine indicators and recorders, etc.	10 p.c.	Free.
Machinery and machines, and machine tools, n.e.i., viz.:—		
Machines, n.e.i., used in the tanning of hides and skins, etc., ad val.	25 p.c.	20 p.c.
Mixed metalware and plated ware, n.e.i., ad val.	30 p.c.	25 p.c.
Manufactures of metal, n.e.i., ad val.	30 p.c.	25 p.c.
Saws, n.e.i., ad val.	25 p.c.	20 p.c.
Mining engines and machinery, n.e.i., ad val.	35 p.c.	25 p.c.
Wire cloth, wire gauze	5 p.c.	Free.
Wire, n.e.i.	10 p.c.	Free.

The following are some items which come into operation on dates to be fixed by proclamation, and exempt from duty in the meantime. Proclamation to issue so soon as it is certified to Parliament by the Minister that the manufacture to which the proclamation refers has been sufficiently established in the Commonwealth:—

Tariff Items.	General Tariff.	Produce or Manufactures of the United Kingdom.
Iron and steel—		
(a) Scrap iron and steel and pig iron, ad val.	12½ p.c.	
(b) Ingots, blooms, slabs, billets, puddled bars and loops, or like crude manufactures, less finished than iron or steel bars, but more advanced than pig iron (except castings), ad val.	12½ p.c.	
(c) Bar, rod, angle, tee, sheet and plate (plain), wire and hoop, ad val.	12½ p.c.	
(d) Machinery, machines and parts— Mowers, reapers, and reapers and binders, ad val.	17½ p.c.	
(e) Iron and steel tubes and pipes, not dutiable under Division VI., ad val.	12½ p.c.	
(f) Spelter, ad val.	10½ p.c.	

The following are some of the items which come into operation on dates to be fixed by proclamation and subject to the duties specified in the previous division, in the meantime proclamation to issue so soon as the duties specified in the previous division have been brought into operation:—

Tariff Items.	General Tariff.	Produce or Manufactures of the United Kingdom.
Iron, plate and sheet, viz.:—		
(a) Corrugated galvanized, ad val.	30 p.c.	25 p.c.
(b) Galvanized not corrugated, and corrugated not galvanized, ad val.	25 p.c.	20 p.c.
Portland cement, plaster of Paris, and other like preparations having magnesia or sulphate of lime as a basis; also gypsum, per cwt.	1s.	9d.
Carbide of calcium	10 p.c.	Free.
Timber, viz.:—		
(a) Timber, undressed, n.e.i., in size of 12 x 6 in. (or its equivalent) and over, per 100 super. ft.	1s. 6d.	
(b) Timber, undressed, n.e.i., in sizes of 7 x 2½ in. (or its equivalent) and upwards, and less than 12 x 6 in. (or its equivalent), per 100 super. ft.	2s.	
Timber, undressed, n.e.i., in sizes less than 7 x 2½ in. (or its equivalent) including door stocks, per 100 super. ft.	2s. 6d.	
Timber, dressed, n.e.i., per 100 super ft.	3s.	
Shingles, per M.	3s.	
Staves, dressed or partly dressed, but not shaped, per 100	2s. 6d.	
Logs, not sawn	Free.	
Staves, undressed	Free.	
Tool handles, unattached, ad val.	20 p.c.	
Bicycles, tricycles and similar vehicles, n.e.i., and frames thereof, whether wholly or partly finished, each	£5 5s.	£5
(Whichever rate returns the higher duty), or ad val.	30 p.c.	25 p.c.
Children's cycles, ad val.	25 p.c.	20 p.c.
Motor cycles, tricycles and similar vehicles, n.e.i., and frames thereof, whether partly or wholly finished, ad val.	£10 10s.	£10
(Whichever rate returns the higher duty), or ad val.	30 p.c.	25 p.c.
Coke, per ton	4s.	
Rope, cordage and twines, n.e.i., including cordage with metal core, macrame twines, fleece thread, brushmakers' and mattress twine, saddlers' twines, roping, seaming, sewing and shop twines, and coir fenders, halters, and other articles manufactured from cord or twine, ad val.	25 p.c.	
Reaper and binder twine and yarn, 2 cwt.	5s.	
Explosives, viz.:—		
Cartridges, n.e.i., ad val.	30 p.c.	20 p.c.

ENGINEERS' CLUB OF TORONTO.

On Thursday evening, the 24th inst., a discussion of more than usual interest took place at the Engineers' Club of Toronto, the subject being the "Collapse of the Quebec Bridge." The discussion was opened by Mr. John S. Fielding, who compared the designs and general dimensions of the Quebec bridge with those of other large bridges, including the "Forth." A comparison of these designs will be found on another page of this issue. Mr. Fielding stated that the weak point of any bridge is in the compression members. These, he said, are necessarily made of soft steel, which in a compression member is pretty unreliable material, and nobody can tell how near a member is to being loaded to its total capacity. Mr. Fielding also expressed himself as believing that American engineers take too great chances. The idea of glory in building a very large span ran away with them.

Other speakers made some very interesting comparisons between the Quebec bridge and the Forth bridge, all of which went to show that the latter was of much heavier construction, taking into consideration the load it was designed to carry, and that the details of the design were much superior to those in the Quebec bridge.

One of the members present laid particular stress on the design of lower chord A 9 L, to the failure of which the accident, up to the present time, has largely been charged. The speaker dealt with this phase of the question at some length, and gave very minutely the salient features of Mr. C. A. P. Turner's article, which was published in the Engineer of October 18th.

The meeting was a very successful one, although no definite conclusions were arrived at.

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.

Ontario.

PORT ARTHUR.—Messrs. Smith, Kerry and Chace have been instructed by this city to draw up plans for the development of 30,000 horse-power on Dog Lake at Silver Falls, about twenty-five miles from this city.

HAMILTON.—Explanatory tables of the new electric light rates, which are to come into force here, have been prepared by the company, and are now available. There will be no residential flat rate, while for commercial lighting there is to be a combined flat rate and meter rate.

TORONTO.—At a recent meeting of the International Waterways Commission held here the question of damming the Rainy River at a point below Fort Francis for the purpose of generating power was discussed. The Dominion Government has commenced important works on the river for the purpose of rendering this navigable to large vessels.

TORONTO.—Arrangements have been made by Smith, Kerry & Chace to take charge of the commencement of the development of a large power plant for the city of Port Arthur. This plant will be located twenty-five miles northwest of the city on the Kaministiquia River at Silver Falls. The ultimate capacity of the works will be 30,000 horse-power, the probable present development being in the neighborhood of 6,000 horse-power.

Manitoba.

PORTAGE LA PRAIRIE.—The directors of the Central Electric Light Co. have decided to expend $35,000 on enlarging the power plant. The company offers to double the number of street lamps if the town will extend the street lighting contract. A. Doum is Chief Engineer.

MUNICIPAL.

Ontario.

WELLINGTON.—A deputation from this county has asked the Government to give financial assistance toward the completion of the West Luther drain and to send an engineer to the scene of the work. Already the drainage scheme, which will improve 100,000 acres of land, has meant an expenditure of $11,000. It is probable that a Government engineer will be instructed to inspect the works.

CAMPBELLFORD.—A by-law to expend $50,000 to develop a municipal electric power plant at Middle Falls was voted on, on the 26th inst., and carried by 296 to 11.

MARKHAM.—Three by-laws for local improvements were carried here on the 22nd inst.: Granolithic walks, $3,000; extension to electric light plant, $3,000; a new bridge over the Rouge River, $3,000. M. White is town clerk.

Quebec.

MONTREAL.—The Fire Committee of this city have decided to enter action against seven manufacturers and others who have not obeyed the smoke by-laws.

New Brunswick.

DOMINION.—Plans and estimates in connection with the new water system for this town are completed, and will be presented before the council. It is hoped that the laying of the main pipe line will be completed before the winter.

Manitoba.

WINNIPEG.—A project is on foot to supply Tofield with water from a spring two miles out. The estimated cost will be in the neighborhood of $20,000.

BRANDON.—A by-law may be submitted to the ratepayers providing for the acquiring of a large depot for the city crushing plant, dump, and trenching machine. The by-law may be submitted at the time of the civic elections in December.

SWAN RIVER.—The question of water supply for the town received some attention at the hands of the board, and a committee was appointed to wait on the municipal council and urge upon that body the necessity of placing a good force pump in the well on the corner of Main and Fifth Avenue.

Alberta.

EDMONTON.—The city council is considering a proposition to purchase the franchise of the Strathcona Street Railway system, as it is thought that the two systems can be operated more cheaply as one concern.

EDMONTON.—Applications have been made from the American-Canadian Oil Co. for franchises to lay pipes for gas into both this city and Strathcona.

British Columbia.

DAWSON.—About $140,000 will be appropriated this year for public roads and bridges, according to the recommendation of the public Works Committee.

INDUSTRIAL.

Ontario.

SAULT STE. MARIE.—The steel plant here was closed down for a couple of days owing to a shortage of pig iron.

TORONTO.—The works of the James Morrison Brass Manufacturing Company were damaged by fire to the extent of $2,300 recently.

FLESHERTON.—The tunnel through the mountain at Eugenia Falls has been conducted to a successful finish. The contractors are Messrs. Rowan & Elliott, of St. Catharines. The tunnel is 967 feet long by 9 feet wide and 8 feet 6 inches high.

OTTAWA.—It is announced that the Montreal, Ottawa and Georgian Bay Canal Company will apply at the coming session of Parliament for legislation extending the time for the commencement and completion of the canal. It is understood the company is prepared to go ahead if the Government will guarantee the bonds in return for Government control of the rates to be charged on the canal when completed. A most interesting account of this proposed work appeared in the "Canadian Engineer" of April 5th, 1907, written by H. K. Wicksteed, C.E., to which readers are referred.

TORONTO.—The 59th annual report of the Consumers' Gas Company has been published. The output for the year ended September 30th amounted to 1,773,588,000 cubic feet, an increase of 235,770,000 cubic feet, over the previous year. During the year nineteen miles of new mains were laid, as compared with sixteen miles the year before. The total mileage is now 337 and 5,189 new services have been placed. The gas rentals for 1907 came to $1,229,585.11, as compared with $1,136,884.80 for 1906, an increase of $92,700.31. The amount of the profit and loss account for 1907 was $523,666.67, while in 1903 it was $513,000. The balance carried down in 1907 is $455,360.49, and in 1906 $509,952. The amount written off in the past year on the plant and buildings renewal fund was $199,689.30, and in 1906 the amount was $179,653. In the statement just issued the "gas accounts receivable" come to $215,955, and last year these amounted to $191,000. Owing to unexpected delays the new works will not be completed till next season. To meet the expenditure on new works and extensions the company will offer for sale at public auction on December 12th 9,000 shares of new stock of a par value of $450,000.

Prince Edward Island.

CHARLOTTETOWN.—Considerable improvements are now under way here preparatory to the installation of the new telephone equipment. New buildings are to be erected, a power plant and a complete equipment installed.

Foreign.

The new foundry of R. Hoe & Co., of New York, has been equipped with three ten-ton electric travelling cranes, each of about 56 ft. span; also with a No. 72 Newten cupola. These were furnished by the Northern Engineering Works, Detroit, Mich.

DULUTH, MINN.—The new foundry of the Clyde Iron Works will be operated by alternating current motors and will be equipped with two ten-ton and one fifteen-ton electric travelling cranes of about 40 ft. span, equipped with alternating current motors, furnished by the Northern Engineering Works, of Detroit, Mich.

PHILADELPHIA, PA.—In the presence of the members of the Quebec Bridge Commission a steel eye bar, 30 feet long, 14 inches wide, and two inches thick, was subjected to a strain of 882 tons in the testing department of the Phoenix Iron Company at Phoenixville. The bar was similar to those used in the structure of the bridge at Quebec.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

CHATHAM.—The officials of the Chatham, Wallaceburg & Lake Erie Railroad have decided to cross the Michigan Central Railroad tracks at Charing Cross by means of a subway.

CHATHAM.—The officials of the Chatham, Wallaceburg and Lake Erie Railroad have decided to cross the Michigan Central Railroad tracks at Charing Cross by means of a subway.

PORT ARTHUR.—Extensive operations will be commenced in connection with the C.N.R. terminals here early in the spring, according to Mr. M. H. McLeod, general superintendent of the road.

NIAGARA FALLS.—It is probable that work will be begun shortly on the construction of the Toronto and Niagara Railway and Transmission Line between Falls View and a point on the Niagara, St. Catharines and Toronto Railway, near Stamford Station.

OTTAWA.—The city has decided to agree to the terms of the G. T. R. in connection with the building of the proposed hotel and terminal station. The building will cost $2,500,000, and the fixed assessment on the hotel for fifteen years will be $500,000, and on the station $150,000.

Quebec.

MONTREAL.—C. P. R. earnings for the month of September were $6,423,452, working expenses $4,272,099, net profits $2,151,353. The net profits for the same month last year were $2,437,931.

Manitoba.

WINNIPEG.—It is expected that the grading on the extension of the Canadian Northern Railway from Rossburn to Russell, a distance of twenty-five miles will be ready for the rails in the cause of a few weeks.

Alberta.

EDMONTON.—According to Mr. C. Schreiber, Government Engineer of the Grand Trunk Pacific Railway, tenders will be called for the construction of the line from Edmonton to the Yellowstone Pass in a short time.

British Columbia.

GOLDEN.—The contractors for the driving of tunnels on the main line of the C.P.R., between Field and Hector, have started operations. Grading preparatory to doing the rock work on several miles of lines has commenced.

PERSONAL.

MR. M. S. BLAIKLOCK has been appointed engineer, maintenance of way of the Grand Trunk Railway, with office at Montreal, Que.

MR. WM. MACKENZIE is on his way to Europe, where he will endeavor to find out what position financiers take regarding the Canadian Northern.

MR. H. E. WHITTENBERGER has been appointed superintendent, Eastern Division of the Grand Trunk Railway system, with office at Montreal, Que.

MISCELLANEOUS.

Under this heading in our issue of October 18th, we stated that tenders for the construction of a cement wall at Chatham, Ont., would be received at the office of H. J. Lamb, Resident Engineer, London. We should have said that plans and specifications could be seen at London, but tenders would be received at Department of Public Works, Ottawa, until November 4th.

Ontario.

TORONTO.—Tenders will be received by E. Coatsworth, Chairman Board of Control, until Tuesday, November 12th, for the supply and erection of the superstructure of Riverdale Park Steel Footbridge. (Advertised Canadian Engineer).

COLBORNE.—The Public Works Department has awarded the contract for the construction of the new dock at Colborne, to Kastrer & Porter, of Wiarton, the lowest tenderers.

COBALT.—The shipments of Cobalt ore for the weeks ending October 26th were as follows: Buffalo, 60,000 pounds; La Rose, 309,538 pounds; Trethewey, 64,680 pounds. The shipments since January 1st total 10,261 tons.

Manitoba.

CARMAN.—Tenders will be received until November 8th, 1907, by H. J. Burton, Chairman of the Board of Works, Carman, for the construction of a 90-ft. span Pratt Truss Steel Bridge, with 18-ft. roadway and concrete abutments, over the Boyne River.

British Columbia.

GRAND FORKS.—It is reported that representatives of Mr. F. A. Heinze, of Butte, Mon., are negotiating for the building of a smelter, near the McKinley mine. They are trying to purchase enough properties to keep the smelter supplied.

Foreign.

CUYAHOGA.—H. H. North, engineer of construction of the Lake Shore and Michigan Southern Railway has awarded the contract for the concrete piles for the footings of the Cuyahoga viaduct of the Cleveland Shore Line Road to the Raymond Concrete Pile Company, of Chicago, and New York.

SOCIETY NOTES.

The fifty-fourth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building at 29 West 39th Street, New York, December 3rd to 6th, 1907. Symposiums on foundry practice, giving the experiences of prominent men in that work, have been arranged. The specific heat of superheated steam will be taken up, a very important and exhaustive work by a Professor of Engineering at Cornell will be presented. The utilization of low grade fuels in gas producers, combustion control in gas engines, tests of producer gas engines, etc., will be given a session. Other live topics, such as industrial education, power transmission by friction driving, cylinder port velocities, etc., will be discussed. All of these subjects have been treated by prominent engineers of Europe and America, professors of our universities, and men eminent in the particular work of which they write. The committee have on hand an interesting excursion for Wednesday afternoon, December 4th, and an address in the evening which will be especially enjoyable.

CANADIAN AGENT WANTED.

One of our English advertisers, handling a line of air-compressors, commercial vehicles, wood-working tools, and high-speed oil engines, is anxious to get into touch with someone in Canada willing to push such lines. Those interested may secure further information by addressing "Oil Engine," care of the Canadian Engineer.

TRADE INQUIRIES.

From the Superintendent of Commercial Agencies, Enquiries Branch, the Department of Trade and Commerce, Ottawa.

Firebricks, fireclay, quartz, etc.—A Tyneside firm asks for Canadian purchasers of firebricks, fireclay, quartz, etc.

Pig lead, lead pipe, etc.—A Tyneside firm asks for purchasers of pig lead, lead pipe, refined red lead, orange lead, milled lead, mould shot, patent shot, and similar lead manufactures.

Building or architectural specialty.—A firm which has been established to push the sale of Canadian manufactured goods in a large industrial centre, desires to hear from any firms producing a specialty suitable for the building, architectural or other trades, who may be anxious to open up an export trade with Great Britain.

Alloy type metals.—Leeds firm making high-class alloy type metals asks for Canadian buyers of these goods.

Agents for iron and steel.—A London firm dealing in all classes of iron and steel material is open to consider applications from agents in Canada where they desire to be represented.

Cutlery and electro-plated goods.—A Sheffield firm manufacturing cutlery and electro-plated goods desires to be brought into touch with Canadian importers in these lines.

Machine augers, etc.—Sheffield firm manufacturing all kinds of machine augers, machine and wagon builders' bits, inquires for Canadian purchasers.

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

A company in Victoria, British Columbia, would be pleased to get into correspondence with United Kingdom manufacturers of motors, wishing to do business in that part of the Dominion.

A company in Halifax, Nova Scotia, is in a position to undertake the sale of Portland cement and other builders' materials.

NEW INCORPORATIONS.

Ontario.

Queen City Foundry, Toronto, $40,000; E. Gillespie, W. C. Burt, J. W. Clark, R. G. Smythe, Toronto.

Glengarry Cobalt Mines Company, Haileybury, $600,000; J. P. Grace, J. J. Johnson, A. N. Asselin, L. A. Roy, Montreal.

Larder Gold Reefs Company, Ottawa, $40,000; W. A. Allan, S. H. Fleming, H. W. Chamberlain, A. W. Ault, Ottawa.

Tate Accumulation Company of Canada, Toronto, $500,000; A. O. Tate, J. C. Stewart, F. A. Drake, A. C. Macdonell, W. W. Sloan, Toronto.

The Independence Larder Lake Gold Mines, Toronto, $4,000,000; W. S. Russell, F. Law, W. A. Abendroth, R. R. Tighe, J. H. Tighe, D. Drover, Toronto.

Dominion National Smoke Consumer Company, Hamilton, $50,000; N. R. Han, Medina, New York; E. C. Tanner, H. R. McKinney, Bradford, Pa.; A. R. Whyte, F. H. Whyte, Hamilton.

Quebec.

Ahern Safe Company, Montreal, $75,000; R. N. Ahern, A. Ahern, W. J. Ahern.

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, 33 Melinda Street, Toronto.

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

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.

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. Business and Sectional Meetings will be held for the month of October as follows: October 17th, General Section Meeting; October 24th, Business.

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. Business and Sectional Meetings will be held for the month of November as follows:—November 7th, Electrical Section Meeting; November 14th, Mechanical Section Meeting; November 21st, Mining Section Meeting.

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

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—3 West 39th Street, New York. President, Frederick R. Hutton; secretary, Calvin W. Rice.

IMPORTANT WATER POWER CASE.

On the 18th inst., Judge Barker gave an important judgment in the Equity Court at St. John, N.B., with regard to the case of Brown vs. the Bathurst Electric and Water Power Company. Judgment was given for the plaintiff on all points claimed.

As we hope to give in a later issue a full account of this case, (which will have far-reaching effect throughout the Dominion), we now give merely a brief resume.

The defendant company obtained incorporation in 1904, and proceeded to erect works on the Tetagouche River for the purpose of supplying electric light to the town of Bathurst.

Mr. Brown, who owned and operated a grist and carding water-power mill lower down the waterway, claimed that the operations carried on by the Bathurst Electric Light Company were prejudicial to his interests. After appealing to the Legislature, a government engineer was instructed to report upon the justice of Mr. Brown's claims. No relief was obtained by Mr. Brown, and action was taken for relief and redress; with, as mentioned above, complete success. The features of interest in connection with the case will be dealt with further in an early issue.

His Honour ordered an injunction restraining the defendant company from making an unreasonable use of the Tetagouche River, the injunction to come into force on January 1st, 1908, and gave the complainant his damages.

MARKET CONDITIONS.

Toronto, October 30th.

By reason of the approaching Thanksgiving holiday, this report is prepared on Wednesday instead of Thursday. Some slackening in building activity is noticeable, except in directions where contracts already taken are in progress. Plumbers and steamfitters, though busy as a rule, are unable to get out the volume of work they formerly did because of the lack of skilled labor, the strike keeping a number of men idle. In structural steel, cement, stone and brick, there is not so much work offering as this time last year; indeed it may be said that the building trade is slackening off almost all over. This is true in the States as well. Prices in some directions are therefore less stiff, though not quotably lower.

In hardware and metals there is much movement. Bar iron is steady in price and in the small sizes in fairly good supply; the larger sizes are more scarce; the demand normal. The demand for wrought steam and water pipe continues active, and it is scarce, especially ⅜-in., 1¼-in., and 2-in. black; ½-in. and 2-in. galvanized. Shelf goods are active, and the usual fall stock additions are being made all over the list. No changes fall to be made in quotations.

Reports from some Canadian towns and cities are to the effect that men are being laid off at factories here and there, and the Canada Foundry Company have shortened one at least of its departments. But it is not possible to argue from this that general reduction is in progress. In fact the activity is remarkably well maintained.

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

American-Bessemer Sheet Steel.—14-gauge, $2.70; 17, 18, and 20 gauge, $2.80; 22 and 24 gauge, $2.90; 26 gauge, $3; 28 gauge, $3.25.

Antimony.—The London market is not very strong; we now quote 13 to 13½c. here.

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

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

Boiler Plates.—¼-inch and heavier, $2.50. Supply limited, 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.; stocks here are moderate.

Bricks.—Common structural $10 per thousand, as before, and as much in demand as ever. Same may be said of red and buff pressed, which are worth $18 at Don Valley works. Terra cotta lining very active.

Cement.—Star brand, $1.95 per barrel, f.o.b., Kingston, National, $1.95 per barrel, Toronto, in car lots; retail price, $2.15; English, Anchor, $3 per barrel in wood. The mills are still full of orders.

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

Ingot Copper.—The market is still demoralized. The slump has caused dire trouble in many quarters. Price here is down to 14c.

Lead.—Demand less strong; goods scarce for immediate delivery; no change in price here; price same as before reported in United States markets.

Nails.—Wire, $2.55 base; cut, $2.75; spikes, $2.75. A fair supply on hand; prices steady.

Pig Iron.—Summerlee No. 1, to arrive, steadily in demand but hard to obtain, still quotes, 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.—Firm, 10 gauge, $2.70; 12 gauge, $2.80; in moderate supply.

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.

Tin.—Market off in sympathy with copper. We quote 38 to 39c.

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. In galvanized ½-in., and in black 2-in., are at a premium; 3 and 4-in. black are also scarce.

Zinc.—Sheet zinc, a moderate business doing at steady prices. Toronto, slab, $6.25; sheet, $8.

CATALOGUES AND CIRCULARS.

Consulting Engineers.—The Traylor Engineering Company send us a calendar card for this month, on the back of which is given the "Treatment of Mercury and Amalgam."

Engines and Accessories.—The Atlas Engine Works, of Indianapolis, builders of engines and boilers, have issued a Bulletin No. 137, descriptive of their splash-oiling, single-valve engine, designed for direct connection to electric generators, and for classes of work requiring high rotative speed. Size, 8 x 10, pp. 8.

The Navy Bulletin.—A booklet which should prove exceedingly useful to everyone who sells electric motors or motor-driven machinery to the Navy Department has just been issued by the Cutler-Hammer Manufacturing Co., of Milwaukee, makers of electric controlling devices. This company for many years has made a special study of Navy Department requirements, and in the booklet just issued full descriptions, illustrations, dimension diagrams, and shipping weights are given on starting panels, speed-regulating panels, machine tool controllers, resistances, circuit-breaker panels, etc.

Expanded Metals.—The Expanded Metal and Fireproofing Company, Limited, 100 King Street West, Toronto. "Steelcrete" is the very appropriate name given to the expanded metal system of concrete construction. Anyone who is interested in reinforced concrete will find this catalogue very interesting and valuable. It contains many illustrations of buildings in Canada and the United States in which expanded metal has been used, together with much information regarding reinforced concrete. Size, 8 x 5, pp. 176.

Metallic Packing.—The H. W. Johns-Manville Company, of New York, have issued catalogue No. 110 dealing with Morris Metallic Packing. Size 7 x 4½, pp. 12.

Recording Indicators and Testing Instruments.—A catalogue has been issued by Dobbie McInnes Ltd., of Glasgow, dealing with their "McInnes-Dobbie" Indicators. A great many different types are shown in a neatly arranged catalogue of 46 pages. Pamphlets descriptive of their Cipollina Continuous Double Diagram Indicator, "Sellers" Portable Dynamometer, Explosion and Pressure recorders; and Speedometers have also reached our office.

Trucks.—Mussens Limited have issued a pamphlet descriptive of railroad, warehouse, and other styles of trucks.

Switch and Cut-Outs.—A pamphlet has been issued by the Canadian General Electric Company dealing with combined switch and plug cut-outs.

Engines.—A catalogue has been issued by Belliss & Morcom, of Birmingham, England, and a circular on the Belliss Engine in Canada, dealing with electric light, power, traction, and mill-driving engines. It is a well illustrated catalogue, and shows views of patent self-lubricating, quick-revolution engines, either direct belt or rope drive Laurie & Lamb, Montreal, are the Canadian agents, and the following are some of the installations completed in Canada:—Paton Manufacturing Company, Sherbrooke; Chatham Gas Company, Chatham; Dominion Bridge Company, Lachine; Canadian Locomotive Company, Kingston; Dominion Textile Company, St. Henry; Frost & Wood, Smith Falls. Size 8½ x 11, pp. 47.

Metallic Value of Ores.—A pamphlet No. 10 has been issued by the Traylor Engineering Company, New York, dealing with the composition, per cent. of metal and specific gravity of ores.

Oil Engines.—The Canada Foundry Company, Canadian agents for the "Blackstone" oil engines, have issued a catalogue giving full particulars of these engines. Size, 3 x 6, pp. 16.

Electrical Supplies.—The Canadian Westinghouse Company, Hamilton, Ont., have issued circulars descriptive of regulating and reversing controllers for crane and hoisting purposes, multiple alternating and direct arc lamps and motors for alternating and direct current circuits.

TENDERS CALLED FOR.

NOTICE TO CONTRACTORS.

TENDER FOR RIVERDALE PARK STEEL FOOTBRIDGE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, November 12, 1907, for the supply and erection of the superstructure of the above bridge.

Envelopes containing tenders must be plainly marked on the outside as to the contents.

Parties tendering must submit a drawing fully dimensioned as to size of members, etc., of the bridge they propose to supply. Drawings of the existing bridge and specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

The usual conditions relating to tendering as prescribed by the city by-laws must be strictly complied with or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

E. COATSWORTH (Mayor).
Chairman Board of Control.

City Hall, Toronto, October 25th, 1907.

Sealed Tenders addressed to the undersigned, and endorsed "Tender for Alterations and Additions to the Post Office Building, Toronto, Ont.", will be received at this office until **Tuesday, November 5, 1907,** inclusively, for alterations and additions to the P.O. Building, Toronto, Ont.

Plans and specifications can be seen and forms of tender obtained at this Department and at the office of Mr. Thos. A. Hastings, Clerk of Works, P.W.D., Custom House, Toronto, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed form supplied, and signed with their actual signatures.

Each tender must be accompanied by an accepted cheque on a chartered bank, made payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or if he fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By Order,
FRED. GELINAS,
Secretary.

Department of Public Works,
Ottawa, October 18, 1907.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.

NEW PUBLICATIONS.

Gas Producers.—A catalogue issued by the Will Power Gas Company, of Rochester, N.Y., deals with their suction gas producers. This catalogue contains several illustrations. Size 7 x 9, pp. 22.

Lathes.—Niles-Bement-Pond Company, New York, has issued an exceedingly attractive catalogue dealing with their Pond rigid turret lathe. Size 6 x 9, pp. 43.

Mining Machinery.—Westinghouse Electric Manufacturing Company, Pittsburg, Pa., have issued their industrial series No. 13,002 treating of electric machinery for the operation of Mexican mines. Size 6 x 9, pp. 38.

Filtration.—The Greer Filter Company, Philadelphia, Pa., have issued an attractive catalogue descriptive of water softening plants, gravity filters, and pressure filters for municipal and industrial purposes. Size 6 x 9½, pp. 47.

Wheelbarrows.—Mussens Limited, Montreal, have issued a pamphlet descriptive of the different varieties of barrows handled by this company.

Oil Engines.—De La Vergne Machine Company, New York, N.Y. A lucid illustrated description of a two cycle vertical oil engine, using either fuel oil or kerosene, is given in this pamphlet. Size 4 x 9, pp. 8.

The Currents in Belle Isle Strait, from investigations of the tidal and current survey in the seasons of 1894 and 1906. By W. Bell Dawson, M.A., D.Sc., engineer-in-charge. Published by the Department of Marine and Fisheries. Ottawa, Ont. Size, 6½ x 9¾, pp. 43.

Water Softening.—The Kennicott Water Softener Company, of Chicago, have issued a splendid catalogue descriptive of water softening plants. This catalogue contains many illustrations of plants throughout the Continent, and is an exceptionally attractive production. It is 9 x 12, and contains 68 pages.

MINERAL RESOURCES OF NEW ZEALAND.

PART VIII.

The resistance to the passage of an air-current through the above system will evidently be less than through an airway 6 ft. × 3 ft. 6 in., say, 12,000 ft. in length. The generosity of this hypothetical length will insure that the power shall be sufficient to deal with any exceptional atmospheric conditions.

$A = 6 \times 3.5 = 21$ square feet.

$S = (2 \times 6 + 2 \times 3.5) \times 12{,}000 = 208{,}000$ square feet.

$$V = \frac{4{,}000}{21 \times 1{,}000} = 0.187 \text{ thousands of feet per minute.}$$

$k = 0.0217$.

p = pressure in pounds per square foot to set up the desired current.

$$p = \frac{k S V^2}{A} = \frac{0.0217 \times 208{,}000 \times 0.187 \times 0.187}{21}$$

$= 8.25$ lb. (nearly),

$$\text{and theoretical horse-power required} = \frac{8.25 \times 4{,}000}{33{,}000} = 1.$$

A Blackman fan to do the work could be landed in the colony for £110. A water-motor capable of driving it with a head of 80 feet would be included in this price. A steam engine combination would cost the same.*

A Hayes fan of rough-and-ready construction could be put up—according to the inventor—for a ten-pound note. In most mining districts small engines capable of driving this could be picked up cheaply, and the compressed air supplied to the mine could be used as the motive power. Such a combination, however, could not be expected to show a high efficiency. Let the efficiency of the fan be 40 per cent., and that of the engine 25 per cent., then 10 horse-power will be required at the compressor. Assuming steam to be the power used for driving the latter, and a consumption of 2½ lb. coal per b.h.p., we have extra coal

$$\text{consumption due to fan } \frac{2\tfrac{1}{2} \times 10 \times 24}{2{,}240} \text{ tons per day, or}$$

slightly over a quarter of a ton. The price of coal at the mine in question is 8s. 6d. per ton, so that the cost of running fan and engine will be: Coal, 2s. 2d. per diem; oil, waste, etc., 2s. per diem; total, 4s. 2d. per diem. If water-power be used, the cost will be even less. Put briefly, it may be said, without fear of challenge, that it would take less to run the fan than to operate one machine drill.†

Second, as to the forcing of portions of the main current into dead ends. Wabner‡ shows that a jet which will itself discharge 8 cubic feet into the atmosphere at a pressure of 45 lb. per square inch will, if turned into a pipe 2 in. in diameter connected with the main airway, and not more than 35 ft. long—deliver 220 cubic feet per minute. A jet sufficient to pass 50 cubic feet will, if similarly fixed into a 6 in. pipe, deliver 1,500 cubic feet through 35 cubic feet of piping, 800 cubic feet through 200 ft. of pipe, and 500 cubic feet through 350 ft.; that is to say, if we assume the extreme case of two machine drills working at a distance of 350 ft. from a main airway, the quantity of compressed air which would be required to insure the blind heading being properly ventilated would be less than two-thirds of that required to run one drill.

If compressed air is used, however, in the ordinary wasteful way, and to the extent which some managers would have one believe, then enough air is blown to waste to run five additional drills. All that is necessary is to fit air-pipes of light, galvanized iron, which can be fixed by means of small dogs to the cap and one leg of every third or fourth set. A small attachment could be soldered into one length, consisting of a short piece of small pipe bent in line with the main pipe, with a suitable connection to the compressed-air pipe-line. This 6 in. pipe could be carried to within 20 ft. of the face in perfect safety.

* The W. G. is rather high for this type of fan.

† A ten-drill compressor requires 130 i.h.p.

‡ "Mine Ventilation," pp. 132-34, q.v.

The Economic Value of Pure Air, etc.

A shareholder in a quartz mine of any size should take steps at the earliest possible opportunity to make himself acquainted with the conditions under which his employees are working. He should make an informal but thorough inspection of his property, going into every blind working, and bearing a hand at whatever is going on there. He would find that he seemed to tire very quickly, and perspired profusely. He might contract a violent headache; at the least, he would feel generally most uncomfortable. He would probably be told that his discomfort was due to the fact that he "is not used to it," but if he had any common-sense at all he would realize one reason why quartz miners do less work than their brothers and cousins above ground. Is it not more than reasonable to suppose that if given pure air miners would have a larger individual output? This much he would be able to see for himself; possibly, also, he would note that men cannot do good work with blunt tools, or with no tools at all, and that much time may be lost by men who have to wait till some particular implement comes in turn to their hands. As regards anæmia—the effect of which on a man's work need not be enlarged upon—and silicosis, he had better apply to some local medical man for information.

A Possible Secondary Effect of Improvements in Ventilation.

Quartz miners actually work shorter hours than any other class in this country. They spend forty-six hours per week on their employer's premises, but from this must be deducted at the least half an hour per day for "crib" (lunch). The usual procedure is to fire a round of holes and to take "crib" while the "smoke" is clearing away. They are usually slow in returning to the face, and the thirty minutes often spins out to forty-five. They have good reason for their slowness, too, for even after that lapse of time the atmosphere in the face is frequently very foul.

As a matter of fact, the hypothetical forty-three hours is still further whittled down by the time spent in going to and returning from the face. This is provided for by legislation, and the reason is that quartz mining as carried on at present is a most unhealthy occupation, and it is not too much to expect that, if the work is made as healthy as that of, say, a bushman employed at a sawmill, the quartz miner will be prepared to put in a full eight hours at the face.*

One obstacle to the discontinuance of this system of paying men for eating their meals is the fact that most mines are worked in two or three shifts. In many cases this could be avoided, and a large majority of the men put on "all day shift." At some mines the change has been made. It is known to all miners that more work is done on day-shift than on any other. The reason for this is rather obscure, but the fact is well established, and the point is certainly worth noting by a shareholder who takes an interest in the economical working of the mine in which his money is invested.

Treatment of Employees.

It is most essential for economical working that goodwill should prevail between mine-owners and men. A miner who is well disposed can, in certain cases, save his employers many a pound by spreading bagging before shooting down the stone, and he can frequently economize with explosives and stores generally. He can also effect a considerable saving by preventing the loss of tools by being buried up by filling in the stopes or underfoot in the levels. As already touched upon, he can note and report every trifling change in the nature of the stone. He can refuse to shield incompetents and loafers, in addition to himself achieving a maximum output.

Working contractors supply their own explosives and candles, and find they can pay their wages-men 1s. a day over ordinary rates. In some cases they even pay more, but clauses are sometimes inserted in the contracts prohibiting this.

* See also C.

(To be Continued.)