Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- ☐ Coloured covers/ Couverture de couleur
- ☐ Covers damaged/ Couverture endommagée
- ☐ Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- ☐ Cover title missing/ Le titre de couverture manque
- ☐ Coloured maps/ Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- ☐ Coloured pages/ Pages de couleur
- ☐ Pages damaged/ Pages endommagées
- ☐ Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Pages detached/ Pages détachées
- ☑ Showthrough/ Transparence
- ☐ Quality of print varies/ Qualité inégale de l'impression
- ☑ Bound with other material/ Relié avec d'autres documents
- ☑ Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- ☐ Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- ☑ Continuous pagination/ Pagination continue
- ☐ Includes index(es)/ Comprend un (des) index

Title on header taken from:/ Le titre de l'en-tête provient:

- ☐ Title page of issue/ Page de titre de la livraison
- ☐ Caption of issue/ Titre de départ de la livraison
- ☐ Masthead/ Générique (périodiques) de la livraison
- ☐ Additional comments:/ Commentaires supplémentaires:

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
☐		☐		☐		☐		☐		☑	

The Canadian Engineer

VOL. III.—No. 10. TORONTO, FEBRUARY, 1896. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, *MARINE AND SANITARY ENGINEER; THE MANUFACTURER*, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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

OFFICES—62 Church Street, Toronto, and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers.
E. B. BIGGAR
R. R. SAMUEL
Address—Fraser Building, MONTREAL, QUE.

Toronto Telephone, 1392. Montreal Telephone, 2589.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto office.

CONTENTS OF THIS NUMBER:

THE ENGINEER OF TO-DAY.*

BY ST. GEORGE BOSWELL, M.I. C.E., CHIEF ENGINEER TO QUEBEC HARBOR COMMISSION.

The field of civil engineering has extended, I need hardly say, to a great extent within the last 15 or 20 years, and, as a consequence, more is required of the individual members of the profession than was the case formerly. This applies with particular force to engineering in Canada, where there is an immense territory awaiting development, which must be accomplished largely by the labors of the civil engineer. He will be called on to determine the best means of conveying the products of the country to the markets of the world, and his solution of the problem must be such as will enable the producers to compete on favorable terms with their competitors in other parts of the world where, in many instances, owing to the cheapness of labor, the cost of production is less than it is in this country. Grain, for instance, must be carried from the North-West Provinces at a rate that will allow it to compete in European markets with that produced in Egypt or India, where the cost of production is considerably less.

The necessity for a cheaper means of transportation than can be furnished at present by the railroads is already being felt, and has given rise to an agitation for the establishment of a deep waterway between the great lakes and the seaboard.

There is every reason to believe that Canada is as well endowed with natural advantages and resources as is any other part of the world, and it only remains for these resources to be ascertained and properly developed to place this country in a foremost position as a great producing nation.

It is to the civil engineer that the public must look to obtain a just appreciation of countries' possibilities, and for the means by which they may best be taken advantage of. And, in order that he may fully meet the expectations of the public in this respect, the engineer must be familiar with the geographical features of the country forming the field of his labors, and conversant with all the possibilities and defects of the existing means of communication.

He must also be well informed as to the facilities possessed by other countries for the transportation and handling of their products, and be sufficiently posted in mercantile matters and requirements to be able to determine the intrinsic value of schemes for transport on a purely business basis, and form a correct judgment—here a knowledge of similar engineering works in other parts of the world, with their commercial aspects, is essential.

Comparatively new subjects also demand the study of the engineer. The tendency of the population to concentrate in cities is steadily increasing, one cause for this probably being the introduction of agricultural machinery and the carrying on of farming on, as it were, wholesale principles, by large companies, thus cheapening the cost of certain farm products to such an extent as to drive the small farmer, with little or no command of capital, out of the business. However this may be, the fact remains that the population is centering in the cities, where also the principal wealth is accumulating, and with this increase of population and wealth in the cities comes the demand for better civic arrangements, in, amongst other matters, sanitary affairs, inter-communication—the electric railway taking the place of the horse car—and lighting, thus giving rise to two almost new departments in civil engineering, viz., sanitary and electrical.

When I speak of civil engineering I mean civil in contradistinction to military engineering, *i.e.*, all engineering connected with the development and advancement of civilization, whether railroad, hydraulic, mechanical, sanitary, electrical, or any of the other sub-divisions into which civil engineering may be divided.

Now one of the first questions that naturally presents itself to the beginner is how best to prepare himself for the practice of the particular branch of engineering he has selected as the most likely one to allow full scope to his natural abilities or bent. He has during his college career acquired, it will be assumed, a more or less complete theoretical knowledge of civil engineering in its broad sense as covered by a full course in a well-equipped engineering college. He looks over the field of his future labors and determines to devote himself either to railroad, electrical, sanitary or some other department of engineering, as the case may be. It so happens, however, we will say, that he can find no opening in the particular branch selected. Should he then await his time or take advantage

* A paper read before the Applied Science Graduates' Society of McGill University, and published exclusively in THE CANADIAN ENGINEER.

of the first opportunity for employment as an engineer that presents itself?

The answer to this question is, I take it, to be found in a knowledge of how intimately connected are all the various branches of engineering, and over what a wide field of practical experience an engineer must work before he can hope to excel in any one specialty.

The young engineer should, therefore, I consider, take, no matter what his inclination may be, the first opening that offers in whatever line of engineering the opportunity occurs.

If he starts out by supposing that because he has in his mind to become a mechanical engineer, he therefore does not require a practical knowledge of hydraulics, or that because he intends to make a specialty of electrical engineering, he may be indifferent to railway practice, would be to begin life with a very mistaken idea of what is expected of an engineer of eminence in any one department of engineering.

The engineer with an established reputation as a specialist, is undoubtedly more familiar with his particular branch of the subject; but he must, to have obtained prominence in this, have a more or less comprehensive and practical knowledge of all others. So that the engineer who says within himself, "I have no room or use for any engineering experience outside my own specialty which I may be placed in a position of acquiring," makes a great mistake, as the want of knowledge in any one subject will surely be felt sooner or later. He must be sufficiently master of his profession in all its phases to be able, at least, to deal with all ordinary problems. You have only to consider some of the larger engineering works of the present day, to perceive, that for their inception and successful execution, they call for the display of engineering knowledge in all subjects of a high order.

Apart from exceptional works, the railroad engineer, so called, in the higher offices is brought into contact with electric work in block signalling, car lighting and haulage, with mechanical problems in storage of grain, handling of freight, movable bridges, etc.

Again, a city engineer in the larger cities is constantly called on to decide questions involving railroad practice and construction, electric lighting and traction, sanitary matters, water supply, and various other problems, embracing the whole field of engineering. It would only be a repetition were I to mention, in detail, other departments of engineering, as the same thing applies to all; to be successful in any one branch, a more or less intimate knowledge of them all is needed. When the engineer has acquired this, it will then be in order for him to select his specialty, should his inclination urge him to do so. But the probability is that when he has reached this stage he will already have been forced by circumstances into the more direct pursuit of some special subject.

In what I have just said I have no wish or intention, by magnifying the needful attainments of a thoroughly competent engineer, to intimidate or discourage anyone feeling within himself an inability to master so comprehensive a subject, from persevering. But I do wish to caution anyone against the fallacy of the belief that because he is tolerably conversant with some one of the subdivisions into which engineering is divided, he is therefore a finished engineer. An engineer, in this respect, is like a city, and should never be finished. But, again, few men actively engaged in the practice of their profession can keep in touch with or fully up in the progress of engineering in all the various departments with which they do not happen to be, at the time, immediately concerned. They must, as a consequence, expect to get somewhat rusty in some subjects. To overcome this difficulty, and as the next best thing to having any desired information, is the knowledge of where it is to be had; the engineer should, with this object in view, keep an index of all important articles on engineering matters he comes across, with a brief summary of their scope or contents, so that when suddenly called upon to consider any question, he may know just where to go for the most recent information on the subject. Such an index will be found, I think, of more use than any to be obtained in print, for it will recall, at least to some extent, the article, and enable the user to decide more readily than he otherwise could which to select as being most likely to meet his wants.

Having acquired all the requisite professional knowledge, the engineer may yet lack the power of applying it to advantage; this want of power is, however, to some extent, constitutional. The engineer requires, above almost anything else, to be endowed with a strong ingredient of common sense, without which all his theoretical and practical engineering knowledge will be of very little service to him. I do not say that common sense is not needed in all walks of life, but that it is more necessary in engineering than in some other professions or callings. The lawyer has, in most cases, precedent to follow, and fixed rules to guide him in the conduct of his affairs. The doctor has a tolerably exact science to rely upon, with a definite course laid down for him to follow in specific cases. Engineering, however, is not an exact science except in assumed cases or under assumed conditions, but as the conditions are never exactly alike in any two cases, in actual fact the engineer has no definite guide to follow, but must use his own judgment in selecting and applying theory to facts as he finds them, and it is here that the pure theorist or the young and inexperienced engineer is apt to go astray, and be led to conclusions which an experienced man would at once condemn as unsound. And this is not the fault of the theory, which may be all right, but in its wrong application due to a want of the common sense or practical experience needed to adapt the theoretical considerations to the case in point. Possessing a wide knowledge of his profession, with the discernment to make the best practical use of his knowledge, the engineer may yet lack some of the elements essential to a successful career. When I say successful I do not mean the mere getting of money; he may succeed in doing this and yet be no credit to his profession.

The engineer is subjected to peculiar and insidious temptations to deviate almost unconsciously from the strict paths of integrity, and I think it only fair to the younger members just entering into the active pursuit of their profession to caution them as to the character of these dangers. From the outset of his career the engineer is frequently placed in a p sition where he is called upon to measure and inspect contract work. He finds after a time that although trying to do his duty conscientiously, he is apparently forgotten, and that others less zealous and competent than he feels himself to be, are preferred before him; he soon perceives that the more fortunate ones possess "friends at court," or in other words, backing; he knows that his exact measurements and strict interpretation of the specifications, which it has been vainly urged upon him was not

in accordance with the established custom on such works, have given offence to influential parties. He finds himself in an isolated position, an Ishmael, his hand against every man, and every man's hand against him.

The young engineer so situated is apt to become discouraged and wearied with well doing. He finds the place too straight for him and becomes somewhat less exacting; his position becomes improved, his merits are recognized, he advances with others, everything moves along smoothly, and the young man's eyes gradually close to many things which, in his early zeal, would have met with condemnation.

"Facilis descensus Averni."

When the young engineer has learnt to look for advancement to the good-will of contractors, or to the favor of interested politicians, his usefulness is gone. What I have just said is not intended as a reflection on either contractors or politicians, individually, but merely that they are the classes of men from which an engineer should accept no favors, for he will, sooner or later, be placed in a position where he will be expected to requite them. The engineer may, however, err in the other direction, and look on the contractor as his natural enemy. Now, this is an altogether mistaken view of the case. The engineer is the arbitrator or judge between the contractor and the parties for whom he is doing the work, and he must be as careful to give justice to one as to the other.

A specification is, I may say, generally gotten up, not solely as a guidance to an honest contractor in his work, but also as an instrument wherewith a dishonest man may be held in check and coerced into doing good work, and, as such, is in many cases of so stringent a character that a literal interpretation of it would ruin a contractor, or cause a work to exceed all reasonable bounds in cost. The engineer must be guided by the spirit of the specification, when dealing with a contractor evidently prepared to carry out his undertaking conscientiously, and is not justified in harassing him with unnecessary conditions, which may be perfectly in accord with the literal meaning of the specification, but which do not, in any way, increase the value or quality of the work and are of no benefit to the employer, but put the contractor to useless expense. It must be remembered that a contractor undertaking a large work assumes a great financial responsibility, and is entitled to every consideration, so that if the supervising engineer can in any way assist him without detriment to the work under his charge, he should in all fairness do so, without any wish for or expectation of reward. Again, the engineer is frequently the custodian of secret information connected with industrial enterprises, or projected works, the possession of which would be of great financial assistance to outside parties. In this position it is not unlikely that he will be approached with a view to the obtaining from him of information intended only for his immediate employers. I need hardly say that any approach in this direction is to be immediately and distinctly repelled. Opportunities of the above kind for crooked dealing are perhaps more numerous in engineering than in most other businesses, but it is not against these manifest digressions from the path of rectitude that I wish to caution you, as here the right and wrong are plain to any man, but against insidious methods employed at first with, perhaps, no sinister motives or on any definite plan, but which eventually, if not withstood and repelled from the first, will be sure sooner or later to render the person against whom they are employed an engineer in name only, in reality a tool in the hands of the first individual requiring, and able to pay for, subservient service.

The demands on a civil engineer increase with the advance of a nation to a higher degree of civilization, and to meet these demands something more is required than a purely professional knowledge. He must be a good man of business, with a faculty for expressing himself in all matters in a clear and concise manner, and must possess self-reliance and confidence in his own ability, without which he cannot hope to inspire confidence in others. Self-reliance is, in fact, a most essential qualification of the engineer.

Most professions appeal to individual interests. The sick man procures the best medical advice he can obtain. The man involved in legal difficulties retains the best lawyer his means will allow—these matters touch his individual interests; with the engineer the case is different; his services are, comparatively speaking, seldom required in wholly private affairs; he is more often called upon to design or supervise works involving the expenditure of public money or funds of incorporated companies. Here a more or less lavish expenditure does not very keenly affect the individual, and so does not interest him to the same extent as do his private affairs, and the result of this is that the control of works of this kind frequently gets into the hands of parties who hope to benefit thereby, in some way, during their execution. They are anxious to direct matters in such a way as to meet the ends which they have in view, and for this purpose suggest, it may be, alterations in the design or arrangements for carrying out the work to the engineer-in-charge. He will, in this way, receive a mass of gratuitous advice backed up with a considerable amount of pressure. If he is a young man, and perhaps a little diffident as to his infallibility, he may be influenced by the pretended friendly advice of men older than himself, with known experience.

This will invariably lead him into difficulties and teach him, when too late, that there can be only *one* engineer, and that if he does not feel competent to fulfil the duties devolving on the position, his best course is to resign—rather than allow himself to be guided by the advice of interested parties. With a determination to reject, on principle, favors from those with whom he may have business relations, no matter, seemingly, how well intended, and with sufficient self-reliance to dispense with unsolicited advice and rely solely on his own judgment in engineering matters, the engineer will be equipped with at least two attributes essential to the effective discharge of his duties, and whether his career is eventually crowned with financial success or otherwise, he will, at least, at its termination have the satisfaction of knowing that he has made use of the talents committed to his charge to the best of his ability.

To the young man fresh from college, where apart from the subjects, interesting in themselves, requiring his study and consideration, he has been impelled forward by the rivalry of numerous competitors, and has to some extent worked in the full light of others' observation, when his labors and zeal were manifest, and met with more or less immediate reward, the routine of an engineer's office, and the apparently trivial duties apportioned to him in the first few years of his practice,

may and will, no doubt, in many cases, be found irksome. He must, however, remember that no matter how trivial his employment may seem to be, the precept of "whatever your hand findeth to do, do it with all your might," is one which applies to the young engineer with peculiar force, for accuracy in detail is a most essential faculty to cultivate. An illustration of this may be found in a recent number of the *Engineering News* (December 19, 1895), where, in a report on an anticipated deficiency of supply by an almost-completed new water-main for Newark, N.J., the engineer, Mr. Herschel, states that although the pipe in question was in accordance with the most reliable hydraulic formulæ, correctly proportioned to deliver the required quantity of water, it will not do so, as he has ascertained since designing the pipe that all the formulæ for the discharge of long pipes published during the last fourteen years are inaccurate, as they are based upon experiments made to ascertain the actual discharge of a long pipe at Rochester in 1877. The discharge from this pipe, it now appears, was so loosely recorded as to render the result quite unreliable, and, as a consequence, all formulæ based upon it. The duty of recording the height of water in the reservoir at stated intervals was, apparently, too trivial a matter for the person assigned to the task; the result, however, of his neglect has been far-reaching. Secluded from public observation and working in the shade of obscurity, with the knowledge perhaps that others are obtaining the credit for his achievements, the beginner must yet continue to discharge his duties faithfully, in the full assurance that his opportunity will come. Then prepared in every way for the higher responsibilities of his profession, he may avail himself of that "tide in the affairs of man which, taken at the flood, leads on to fortune," and emerging from the obscurity of his early surroundings, assume the position which his ability and his application entitle him to receive.

THE CANADIAN PIG IRON INDUSTRY.

BY GEO. E. DRUMMOND, MONTREAL.

To review the young and growing Canadian iron industry, without "taking stock" of rival markets, is an impossibility in these days of close competition. The American iron masters especially must be reckoned with, for they have succeeded in displacing the iron and steel producers of Great Britain in the Canadian market, and have now narrowed down the fight for supremacy to a question of the product of American labor as against the product of Canadian labor. The British iron masters frankly admit that they are out of the fight in so far as the trade of Western Canada is concerned. The splendid equipment of the American furnaces, together with their close proximity to the Canadian market, puts the Scotch and English furnace men at a great disadvantage, and it is an acknowledged fact that the competition for the iron trade of Canada must now and for the future be solely and alone between American and Canadian producers. It has been said that our neighbors to the south "want the earth," and if one is to judge by the opinion of so eminent an American authority as Mr. Andrew Carnegie, it would seem that in so far as the Canadian iron market is concerned, they imagine they have it. Mr. Carnegie, in a glowing article recently contributed to the "40th Anniversary" number of the *Iron Age*, in writing of the Iron Producers of the United States, of which body [illegible]ell be termed "King," says, they "have become the largest and best disciplined and most effective army of iron masters in the world. They have wrested their home market from the grasp of the foreigner, they supply the Canadian market upon equal terms with him, and are beginning to conquer territory which never before was theirs."

The "foreigner" referred to so aggressively by Mr. Carnegie is the British ironmaster, for no other competitor of consequence, aside from the Canadian, ever fought for the iron trade of these British North American provinces. It is quite true that the British makers have been driven out of the greatest and most desirable portion of the market, and they have been driven out, to a large extent, by American makers. In that Mr. Carnegie is right. Our Canadian ocean steamship owners can bear testimony to this by the consequent loss of tonnage for their steamers plying between British and Canadian ports. The British ironmaster has passed away, probably never to be reinstated, in so far as the Western Canadian market (the greatest we possess) is concerned, but Mr. Carnegie is mistaken if he imagines that American ironmasters are left in sole possession of the field. If he will glance at the statistics of the imports of pig iron into Canada, *versus* the domestic production for the fiscal year ending 1893-4, he will be convinced that Canadian-made pig iron is making a steady and sure headway. Quoting from a late number of the *Canadian Manufacturer*, in which figures taken from official sources are given, the increase of output from Canadian furnaces for the fiscal year ending June, 1894, was 200 per cent. over that of the fiscal year ending June, 1891 (three years).

The period of 1893-4 marked an epoch in the history of the Canadian iron industry, because the domestic production for that year, 62,522 tons, meant that Canadian workmen were producing from purely Canadian material 58 per cent. of all the pig iron consumed in the country. The official statistical year book gives the percentage of home-produced iron to the total consumed as 45.4 per cent., but this is incorrect, inasmuch as the imports group together the following material: pig iron, iron Kentledge, scrap iron, and steel, giving the total as 75,275 tons. The total quantity of iron imported for that year was 45,282 tons, the Canadian iron exceeding the importations by 17,240 tons. The statistics down to the close of the last fiscal year, June, 1895, will show (the ebb and flow of trade being allowed for) a proportionate steady advance, and this will still be more marked in the coming year, when it is probable that the output of the new coke furnace at Hamilton, Ont., will be sufficiently large to replace what is now imported from the United States, and to a very large extent may be calculated upon to do so. The *Canadian Manufacturer* places the value of the pig iron production of 1893-4 at $965,968.77, and when it is considered that almost nine-tenths of this has been paid out for labor to Canadian workmen, the value of the industry will perhaps be better appreciated. A continued encouragement of the industry will mean that Canadion pig iron will yet form a base for many articles of finished iron and steel not now produced in this country. It has been well said that the production of pig iron is one of the best tests of a country's metallurgical greatness. This has been particularly true of Great Britain and the United States. If so, then the statistics referred to above evidence the fact that Canada is on the "right track." The Dominion may rank low as yet in the scale of iron-producing

countries; but she is on record along with such nations as Great Britain, the United States, Germany, France, Sweden, Russia, Austria and Spain, and the Canadian percentage of the world's output, though small, is steadily increasing, and must increase if the industry is encouraged as the circumstances of the case demand.

THE AMERICAN TRADE.

Eighteen hundred and ninety-five has been a year of surprises. As one authority puts it, "1895 iron was like a sandwich, the meat, or best part of it, was in the middle." Opened badly, surprisingly good during the summer and autumn months, and surprisingly bad at the close. On the whole, however, a year fairly prosperous, and with few, if any, failures of importance attending its operations. In this respect an improvement on 1894, and a marked contrast to 1893. As an evidence of the great fluctuation of price during the year, Bessemer pig iron was quoted at $10, at Pittsburgh, equal to $9.35 at Valley furnace, in the early part of the year. Later on in the season, this iron went up to $17.50 at Pittsburg; but receded again before the close of the year to $11 per ton. On some lines of finished goods, the prices advanced fully 100 per cent., but again receded. While the actual figures of the output of pig iron in the United States to the close of the year have not yet been compiled, it will aggregate almost, if not quite 9,500,000 tons, and 1896 opens with the enormous output of almost one million tons of pig iron a month, and with but a very light demand for steel and finished material. This would not seem to be an encouraging position of affairs, yet it is safe to say that the actual conditions are quite as favorable as they were along in the summer and autumn of last year, when buyers were "tumbling over one another" in their anxiety to get orders filled. The great railways and other large corporations have not by any means supplied their legitimate wants. Speculators have "rushed" the market during 1895, and are carrying stocks to-day which were purchased at fairly high prices. The legitimate buyers, at least the larger ones, notably among the railways, have held back; but they must come into the market sooner or later, and there is good ground for believing that even the present immense output will not be, at least for some little time to come, too great for the legitimate demands of the country, when the unsettling war scare, combined with the drawbacks of a Presidential year, have permitted trade to settle down into ordinary grooves.

Natural conditions will all tend more or less to keep prices steady through the coming year. With advanced prices on ore and coke, Bessemer pig cannot be made for $10, or anything like it. Labor is 30 per cent. higher than it was a year ago, and it is now costing more to make iron than it did last season. It is, therefore, probable that the present low prices are more or less temporary. The *New York Journal of Commerce* says that the ore shipments of the lakes have been about one-third greater than the previous year, and they have exceeded by more than 10 per cent. the shipments of the banner year, 1892. A significant feature is that ever since 1892 a surplus of about two and a half millions tons of ore has been lying on the docks, while now the supplies are down to a point that there are fears of an ore famine, and prices have advanced accordingly. The Mesaba mines commenced shipping in 1892, but the amount that year was nominal. In 1893 there was a considerable shipment, and this was tripled in 1894, but the shipment of four million tons in 1895 has a good deal more than doubled the shipments of the previous year. It is notable that at the beginning of last season only 10 mines in the Mesaba range contemplated making shipments, but at the close of the year 22 mines were in operation, and a dozen more are making arrangements to ship as soon as spring opens. While it is apparent to outsiders that there will be sufficient ore for all practical purposes, still the conditions point to the price of ore being well maintained throughout 1896.

GREAT BRITAIN.

It is too early yet to give full returns of the British output for 1895. The production of pig iron, however, for the first half of 1895 was 3,721,870 tons, which is at the rate of 7,443,740 gross tons, against a production in 1894 of 7,427,342 tons. It will be seen that the output in the United States shows a steady and marked increase over that of the rival market, Great Britain. In marked contrast with the excited fluctuations of the American iron market during the past year, the course of Scotch pig iron has been of an extremely placid and uneventful description. Opening at 41s. 7d., with a quiet market, Scotch warrants closed at the end of 1895 at 45s. 7d., without any special features of interest. The price at which they opened at the beginning of the year was very low, and the market gradually recovered during the spring and early summer, until in the month of September, when the American boom was at its height, they reached the high figure of 48s. 10d., which, however, was maintained for only a short time. Prices then began to settle again and they continued gradually to recede until the close of the year, when 45s. 7d., as we have stated, was the ruling price. It was expected at one time during the course of the year that the Scotch and English markets would follow the lead of the American, but the collapse of the boom on this side of the Atlantic effectually stopped this.

Another incident happened to further depress the buoyant feeling which was prevalent in Scotland during the month of September, and that was the unfortunate trouble that arose in the shipbuilding yards on the Clyde, and also at Belfast and in England in connection with the wages of the shipbuilding hands. A large quantity of tonnage was placed in the latter part of 1895, and it was expected that the Scotch and English shipbuilding yards would be fully employed, and the demand for steel would thus be considerably increased. The disputes, however, between the shipbuilders and their employés has undoubtedly sent a large quantity of this tonnage to foreign shipbuilding yards, and consequently the large demand for steel which was expected has not developed. It is understood that these disputes have now been satisfactorily settled, and it is not expected that the prices will decline further than they are at present. The fluctuations in the warrants market are, of course, largely of a speculative character, and are often due more to condition of the money market and other outside causes than to any special increase or decline in the demand for pig iron for consumption. In order therefore to judge of the actual condition of the consumptive pig iron market it is necessary to look at the figures of Scotch shipping brands, such as "Summerlee," "Coltness," "Calder," "Gartsherrie," etc. In looking at the prices of those brands, the extremely placid nature of the market during the past year is especially noticeable. No. 1 "Summerlee" was quoted f.o.b. Glasgow, in January, 1895, at 52s. 6d., and the quotation at the

close of the year was 51s. The lowest price quoted during the year was 50s. on several occasions, while the highest was during the months of September and October, when 53s. was asked, and possibly a little higher may have been the ruling price for a short time, but the margin of fluctuation during the whole year was never greater than 3s. 6d., or under $1 per ton. This is rather different from the course of the American market, for the same grade of pig iron, such as is made in Northern Ohio, No. 2 American Scotch, was sold as low as $9.25 at the furnace, while during the boom it went as high as $14.50, showing a margin of fluctuation of over $5 per ton on this grade. The figures in connection with the production, consumption and exportation of British iron have not come to hand, but it is safe to say that British production during 1895 will not fall short of the previous year, and will approximate the figures mentioned above. Statistics show a great falling off in the imports of pig iron from Great Britain, as compared with the United States. The returns for the fiscal year ending June 30th, 1895, show importations of 33,944 net tons, of which only 6,346 tons came from Great Britain, while 27,550 tons are credited to the United States. The year 1894 was certainly a most exceptional one, as the iron market in the United States was at the very depths of its depression, and sales of American iron were made at prices very much below the average cost of previous years, and without doubt below the actual cost of production. Now that matters have been somewhat more equalized, it is expected that the British iron master will be better able to compete for a portion of the Canadian trade with their American rivals than during the past year, and particularly in the Montreal and Eastern seaboard markets. With the advent of the new Hamilton furnace, the Canadian iron industry will make it more and more difficult for British and American producers to take any portion of the Canadian trade, beyond what little iron may for a time seem necessary for mixtures. In course of time even this moderate market will be lost to the foreign producers. Cleveland iron import returns, issued at Middlesboro, England, show an increase of stocks of 4,000 tons for November. There may have been previously uninterrupted decreases since April. The production was 245,000 tons, 120,000 tons being Cleveland iron, and the remainder hematite, etc. The total stock of Cleveland iron is 271,000 tons, 93 furnaces in blast—one increase. The total stocks 12 months since were 200,000 tons. The condition of affairs at the close of the year will probably remain relatively the same, the stocks being greater than they were a year ago.

GERMANY.

The German production for the first ten months of 1895 was 4,788,571 metric tons, as against production for a similar period in 1894 of 4,579,180 tons, an increase in production of 209,391 metric tons.

CANADA.

It is an acknowledged fact that a time of depression in the United States is nearly always followed (generally speaking, a year later,) by a period of dull times throughout Canada; 1895 has been no exception to this general rule, but thanks to the moderate dividing wall afforded by our system of protection to native enterprises, we have been preserved from any such panic as the markets of the neighboring republic experienced in 1894, and the solid financial condition of Canada has been the subject of favorable discussion in the money markets of the world. This has been true of all important Canadian industrial enterprises. In the iron department our operations have been carried on upon a safe basis. Most of the furnace companies have restricted themselves during the year to comparatively short campaigns, being wise enough to suit the output to the times. In the face of this the record for 1895 is creditable, and now starting the new year 1896 with comparatively light stocks at the various furnaces, and with a knowledge that the new 200-ton per day Hamilton furnace can be depended upon for the coming year, it is safe to predict that 1896 will prove the banner year of the iron industry in Canada, so far as the past and present is concerned, and the beginning of a new and more vigorous existence in the metallurgical history of our country.

The record of the various Canadian furnaces during 1895 is as follows:—

NOVA SCOTIA STEEL CO., NEW GLASGOW AND FERRONA, N.S.

Coke pig iron made	19,410 tons,	1,440 lbs.
Ore charged	38,783 "	1,520 "
Fuel "	28,110 "	1,560 "
Flux "	16,304 "	1,920 "
Labor employed in steel works	450 men.	
" " in ore production	100 "	
" " in furnace work	250 "	
	800 "	

This company manufactures all grades of agricultural implement steel, forgings, etc., the basis of which is very largely Ferrona iron, made from Canadian ore, so that the utmost possible amount of labor is secured to the country in the special lines now made by this company.

LONDONDERRY IRON CO., LTD.

Coke pig iron made	17,744 tons,	320 lbs.
Ore charged	41,557 "	1,200 "
Fuel " Coke	25,264 "	1,920 "
" " Coal	3,088 "	1,920 "
Cast iron water and gas pipe produced	2,110 "	160 "

Average number of men employed, 425.
Furnace output of 1895, campaign, 8 months.
Pipe foundry campaign, 7 months.

It is a notable fact that the tariff revision of session 1894, by which a duty (on a sliding scale) was imposed on wrought scrap iron, has already resulted in the Londonderry Iron Co. making contracts with Canadian manufacturers of bar iron, which is enabling them to start up their rolling mills. The work is just commencing in this department and will afford steady employment to a large number of Canadians.

CANADA IRON FURNACE CO., LIMITED.

Charcoal iron produced in 1895, in a campaign of nine months:

Charcoal pig iron made	6,598 tons, 420 lbs.
Charcoal consumed	654,361 bushels.
Ore consumed	16 203 tons.
Limestone consumed	1,500 tons, 417 lbs.

Average number of men employed, 600.

It may be explained that the operations of this company, involving the work in bog and lake iron ores, and the making of wood for charcoal, extend over a considerable territory. The labor is largely drawn from the farming class, and is, therefore, naturally of a more or less intermittent nature, which accounts somewhat for the large number of men employed. A portion of the output of the furnace is used for the manufacture of the highest class of railway car wheels, in the company's auxiliary works at Lachine, Que., and St. Thomas, Ont.; where a further staff, at each works, of about 150 men are employed, and with few exceptions every railway line in Canada is now using the

Canada Iron Furnace Co.'s metal as the basis of their work for standard car wheels. It will also be gratifying to Canadians to know that the high quality of this metal, as shown by its great strength and splendid chilling qualities, has so far attracted the attention of foreign engineers that the company have been enabled to open up a foreign trade during the past year, and are now shipping their iron regularly into the Pittsburg market, where it is used for very special qualities of work. In addition to this, important shipments have recently been made from Radnor Forges to the European market. While this trade is not a large one as yet, it proves that the quality of the iron made in Canada is unsurpassed, and is another reason why we should carefully build up our national industry.

DRUMMONDVILLE.

The campaign was short, but the output will be about the same as 1894. The whole of the production of this furnace is used in manufacture of car wheels at the company's works in Montreal. The campaign is always more or less regulated by the requirements of the car wheel department.

PICTOU CHARCOAL IRON CO., BRIDGEVILLE, N.S.

The returns of output have not yet been filed, but a very notable point in connection with these works is that the company are just on the point of installing a steel converting plant, and will use the largest portion of their material in that way, finishing it into the highest quality of agricultural implement steel for the home market. This is a striking illustration of the effect of the Dominion Act of 1894, which provided for the payment of a bounty of $2 per ton on all steel billets manufactured in Canada from Canadian pig iron.

THE HAMILTON IRON AND STEEL CO.

The new furnace, with the capacity of 100 tons per day, goes into blast immediately. At the start a large proportion of this company's ore will be the product of American mines, but they look to the Act of the Legislature of Ontario, session 1894 (which provided for the payment of $1 per ton on the pig metal product of iron ore, raised or smelted in the province of Ontario), to bring about an almost immediate development of the mines of the province. In the meantime the Hamilton Iron and Steel Co. will naturally have to waive claim to the Dominion bounty of $2 per ton, so that it is entirely in their interest to push forward the exploration and development of Ontario mines, and thus give the real benefit of the industry to Canadian labor. Under present circumstances, Ontario not possessing coal mines, and the question of economical transportation and handling of Lower Province coal being as yet unsolved, the Hamilton Iron and Steel Co. will have to use American fuel, which unfortunately means that one-half of the labor benefit of the industry will go to a rival market. Under these circumstances the Dominion Government will probably restrict the Federal bounty to a sum proportionate to the amount of Canadian labor employed in the industry; this as a protection to the coal miners and charcoal burners of the other provinces.

(*Concluded in next issue.*)

IT is estimated that if the trolley railway plants were run by the latest style of oil gas-engines, a brake horse-power could be generated by ¾ lb. of coal per hour, which is less than half what can be done by the best triple expansion engines now in use. There are firms who are now prepared to take contracts, guaranteeing the result continuously.

For THE CANADIAN ENGINEER.

A CANADIAN MOTOR-VEHICLE CONTEST.

BY ARTHUR W. WHITE, LONDON, ONT.

Glancing through the different scientific papers one sees considerable discussion and argument about motor vehicles. Some, probably through selfish motives, publish what they designate a "conservative article," and in some instances an editorial dealing with the question. The articles referred to are inconsistent in the extreme, and the only inference to be taken from them is that their writers are not ready for the advent of motor vehicles; by all means be conservative, but do not allow personal advantages to be the motive. Among the best methods, in the writer's opinion, for pushing this good thing along in Canada, public trials and tests stand well to the fore. New York is agitating one, France and Germany will hold a number next summer. The last issue of the London (England) *Engineer* contains full prize list and conditions of a competition for one thousand guineas. The present English law prohibits a self-propelled vehicle from travelling more than four or six miles per hour, and places further restrictions on this manner of travelling, enough to make a race impossible without special act of parliament, or a revision of turnpike laws, which changes are now being agitated. There seems to be a difference of opinion as to whether a race could be run in Canada without the same steps being taken. Should this be the case would it not be advisable to obtain permission before a Canadian race takes place, otherwise the contestants or promoters of the trial could be held responsible for damages arising from frightened horses, etc.

That a Canadian race should take place goes without saying. We must keep up with the times. If there are no public-spirited men who can afford to offer sufficient inducements, in the shape of prize money forthcoming, the race can be arranged in other ways. In Ontario we have two large fall exhibitions, the Industrial of Toronto and the Western of London. Either of these should be able to make a paying investment of a motor-vehicle contest; it certainly would be a drawing attraction, more instructive, more entertaining, better advertised and more in keeping with an Industrial Exhibition than balloon ascensions, high diving, second-class contortionists and acrobatic entertainments and wild-west and Arab shows, comprised mostly of toughs from the slums of large cities, who hire a few horses, dress in exaggerated costumes, shout and discharge fire arms. Half the amount of money paid for this sort of thing would make a purse sufficient to induce others besides Canadians to compete. It would make an exhibition industrial in reality, as well as in name. It would stimulate Canadian inventors as the Chicago race did United States inventors. Previous to the advertising of this race motor-vehicles were almost unknown in the United States. Over five hundred applications for patents, covering motor-vehicles and parts thereof, were made during the time intervening between the first notice and the consummation of the race. If five hundred of our best thinkers started to think, it would mean more for Canada than one can imagine. Motor-vehicles are only in their infancy. There is room for great improvement and competitive tests are among the best methods for their improvement. Preliminary tests, from which the judges could decide the points of internal friction, design, construction, ease of handling, finish, etc., could be held the first four or five days of

the exhibitions in a building provided for this exhibit. Processions could be given daily in the ring, and a final race, starting in the ring, encircling it once or twice, thence to a point twenty or thirty miles into the country and return, to finish by again going round the ring. Manufacturers would enter a contest of this kind as much for advertisement as for the prize money, and should, in the writer's opinion, be willing to pay a reasonable entrance fee. There is no reason why both London and Toronto should not include a motor-vehicle contest in their attractions and prize lists, and it is to be hoped that the directors of these exhibitions will give it due consideration. London can offer exceptionally good accommodation. A race from the city to Lucan or Strathroy would be an ideal run : roads that are good in all weathers, with grades just enough to give a good test, and plenty of villages along the route for frequent relay stations. The vehicles might be divided into two classes, one class for electric motor vehicles and another for carriages driven by internal combustion engines and other small motors, that carry their fuel in small receptacles, enabling them to take enough for the complete trip. The former might show up to good advantage in preliminary tests, processions and short trips, but, as has been proven by previous races, the latter could make the best time in a long road race. Should these few rambling remarks, or any personal assistance, be of any value to exhibition directors or private individuals with a desire to further the advancement of this industry in Canada, the writer will be more than pleased. One thing is certain, the motor-vehicle has come to stay, and our country should, as usual, be well to the front in the improvement and manufacture of them.

MUNICIPAL CONTROL OF STREET CAR, WATER AND GAS PLANT.

The city of Glasgow, Scotland, owns and operates its street car plant. Thirty-nine per cent. of the fares in that city average one cent per journey, and the average of all fares is below two cents. The cars are run by horses, yet a large profit on the investment is realized by the municipality. All authorities agree that horses are more expensive than electric traction. When the city took possession of the plant, as they were empowered to do, the company refused to sell their horses to them ; 3,000 horses were required to operate the plant, and these had to be purchased wherever they could be got. Some of these horses were diseased, and in consequence 1,500 were laid off sick, the city being put to great expense in caring for and replacing them. To harass the municipality the old company put on a line of busses operated by their old horses and ran them at low fares, carrying on a fierce competition. The municipality, however, took no notice of this and kept on their way, reducing the hours of labor for their men, supplying them with uniforms and improving their plant, and established a reduction in the fares of 33 per cent. in spite of their misfortunes, opposition and expense in reorganization. They realized a profit the first year of $111,000, one-third of which was set aside to cover depreciation, one-third to cover improvements, and $40,000 given to the city for the reduction of municipal taxation.

In the city of Liverpool, England, and Berlin, Germany, the street car fares are two cents per trip. On the Liverpool elevated railway, double-track dock line, seven miles in length, the fare is four cents inside and three cents outside, with lower fares morning and evening for workmen. The Liverpool surface tramway's rails are level with streets, there being no obstruction whatever from curb to curb ; the car wheel flanges run in a narrow groove, so that the most delicate buggy wheels are in no danger of being caught. The average fare on all the tramroads owned by companies in Great Britain does not exceed three cents per trip. In most of the cities the tracks are deflected to the side-walks at all stopping places, allowing the passengers to get out without encountering the mud and danger of crowded streets.

Notwithstanding the great cost of the Liverpool elevated electric railway—it being built practically regardless of expense to insure a first-class line in every respect—the passenger fares are stated to be 45 per cent. over the running expenses. This line runs its cars practically without noise or vibration, there being no gearing either on the motors or the axles. The motors are attached direct to the axles by a sleeve of larger inside diameter than the axle, to allow it play. This sleeve is attached to armature and drives the axle by a sliding coupling, which does away with great wear of the gears, as used in America, as also the noise, rattle and vibration common to geared motors. In the city of Berlin the elevated roads are operated by the state. On these a yearly ticket is sold for $4.50 to go in and out of the city, a distance out of five miles, as many times in the day of each year as the holder desires, a possible daily average of ten miles for one cent. These roads are making a clear profit of forty per cent. on their passenger traffic, without reference to their light freight and other sources of revenue.

Budapest, the capital of Hungary, has a very successful surface electric railway, with no trolleys or wires in sight, the electric connections being below the surface. The rails are as in Liverpool, Glasgow and other British cities, level with the street. The fares are two and a half cents per trip, on which a very large profit over expenditure is realized. The foregoing statements give about the general average of receipts and expenditures in European cities.

The capital of the Union Traction Company in the city of New York is set down to the credit of the company as being $139,000,000. The whole of the tracks in the control of this company, including power houses, cars, motors, overhead systems, etc., did not cost more than $27,000,000, including street paving, etc. It could be duplicated for this amount of money. The actual investment did not exceed $20,000,000 at the outside. The franchise is capitalized at $119,000,000, or six times the total value of the plant. What is this but wholesale robbery of the people ?

The city of New York should have six-sevenths of the profit shown in this, and the company one-seventh, instead of the whole of it, this being the proportion that the city and the company contributed to the realization of the profit. This matter is now occupying the attention of the cities of San Francisco, Chicago, Detroit, Philadelphia and Boston, in all of which three-cent fares are demanded, or municipal control of the roads.

The city of Toronto bought its street-car system in 1891 and operated it for six months. In that time it realized a profit of $25,000 per month. Yet by some means a company got possession of this valuable franchise for $8,000 per month less than was actually realized by the city for the six months that it ran the railway. Since that time a new power plant has been put in and the road run by electricity. It is well known

to those conversant with this subject that electric propulsion costs scarcely more than one-half that of horses, so that the profit at the present time, allowing for interest and depreciation of the plant, must be greatly above what it was when run by horses, with less than one-half the passenger travel of the present time.

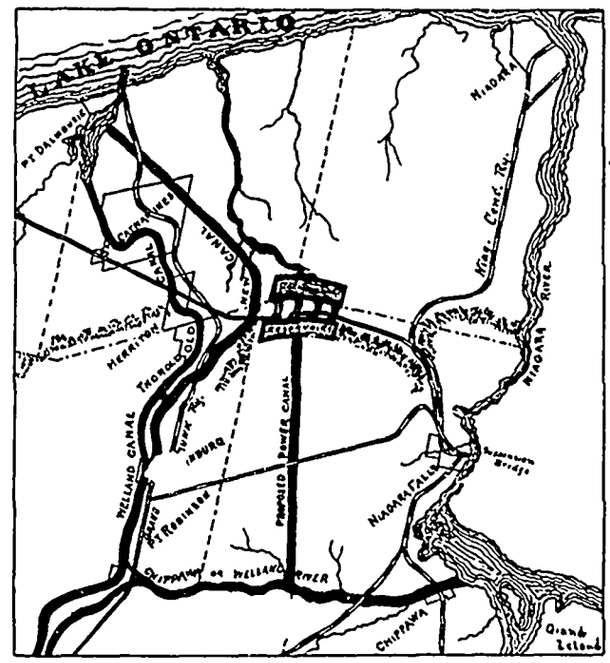
It has been stated that municipal control in these matters would put the public works under the hands of politicians or designing men. There is no reason why this should be the case on this continent any more than in European cities. There has been no ground for suspicion that the public works of Glasgow, Belfast, Portsmouth or other cities in England, Scotland or Ireland, were controlled by boodlers. Toronto, Hamilton, Kingston, London and other cities in Canada own the city waterworks, and we know that there never has been a serious complaint of this kind with regard to that service. In each case the water works are a large source of profit to these cities. If these works are under city control and yield a large revenue by being so, why should not the same result be achieved with other works, such as city transportation and lighting?

The history of civilization has largely consisted in transforming antagonisms into co-operations, and partial co-operations into complete co-operation. Then this co-operation should assume larger and larger groups until they become a government function managed by the public for the benefit of all. This applies to all municipal requirements in general demand. So long as the work is done by private companies whose business it is to make large dividends for themselves and the companies they represent, so long will the interests of the public be subordinated to individual interests and profit. It makes no difference whether the companies hold by lease or ownership, their aims and efforts will be the same. Let the men who manage the works be the agents of the people and responsible to the people. There is no way for the people to get the full value of what the city has made valuable except by owning and operating public works.

THE WELLAND POWER AND SUPPLY COMPANY, LIMITED, CAPITAL $5,000,000.

BY J. H. KILLEY, HAMILTON.

This company, recently formed, with head office in St. Catharines, Ont., proposes to tap the Welland River at five miles from its entrance into the Niagara River, at or near Chippewa. This river has an average width of 120 ft. by 18 ft. deep, to the point of intersection by the canal from this to the brow of the escarpment, where the power is intended to be utilized near Thorold; the distance is only seven miles. There are no engineering difficulties. Allowing for the requisite inclination, there will be an available fall of 320 feet for power purposes, with a possible water-power of 250,000 to 300,000 horse-power. It is proposed to use a portion of the water in its course for irrigation purposes, the want of which is often severely felt in this district in connection with the fruit and other farms. It is intended that a portion of the power should be used near the power station for the purpose of running pulp mills, paper mills, and the manufacture of calcium carbide for acetylene gas for illuminating and the other purposes for which this wonderful discovery has been found useful, as also for the electric production of aluminum, so generally applied in the arts, and for which there is now a large and ever increasing demand; also for the generation of electric power, for power, light and heat distribution; for railway, manufacturing, and all other purposes for which the electric current is now made available. This can be done at less cost by this scheme than that of any other now before the public, and at very much less than one-half the cost of the water-power now being made available on the United States side of Niagara Falls, with double the power, if required, available, than by the United States system. The canal is proposed to be 100 feet at bottom, 160 at the surface, and 15 feet deep, with a flow of three



MAP SHEWING ROUTE OF PROPOSED POWER CANAL

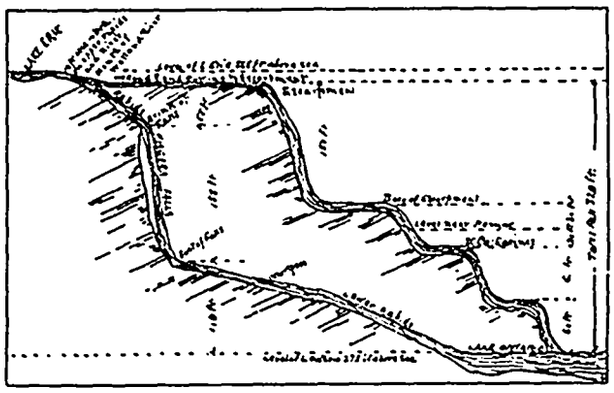
miles per hour, producing 975 horse-power per one foot of fall. It is intended that the water should be available under two heads of 150 feet each, equal to 146,250 horse-power each. Although this enormous power is possible, yet it is intended to utilize it only as it may be required. This immense amount of power can be made available by simply digging a raceway through the clay, cutting out a reservoir, and placing the wheels on their foundations on the surface of the ground, and straightening out the natural water course from the wheel houses to the lake for the tail race.

This enterprise will be situated in the garden of Canada, with a comparatively mild climate, between the lakes and Niagara River, making the location available for the placing of a large population drawn by the manufactories utilizing the cheapest power known to exist, and in the immediate neighborhood of the canals connecting our unrivalled lake system of navigation, and intersected by five railways.

The company is empowered by its charter to deepen and widen the Welland River from its mouth to its point of intersection with the proposed canal; thence by a straight open cut through the clay. The water will be conducted to the escarpment, and will run into a reservoir built at right angles to the canal along the brow of the escarpment, which reservoir can be extended as frequently as the demand for power arises. The limit of electricity is unbounded when generated by an unlimited and cheap supply of power. There can be no doubt as to the desirability of developing a part of the great power now running to waste at the Falls, for in this question of first cost lies all the future of long-distance transmission and bringing its benefits

within the broadest limits; it is therefore a question of the primary cost of converting a portion of this immense flow of water into power. This can be done as proposed here more cheaply and effectively than by any other means.

Tesla has staked his reputation on the fact that electricity of alternate high voltage may be transmitted as easily 100 or 1,000 miles as one mile. It is only waste of time and space to enlarge on the importance



of this water-power; as a commercial and financial venture it could not but be profitable. Notwithstanding the great cost of water-power utilization on the United States side of Niagara Falls, the $100 shares are now held by the company at $680 each; whether this is warranted by the prospects of the company or not has not been made public. A United States capitalist, who reviewed this question, stated that if the same proposition as unfolded by this company were possible in the States, the whole capital required would be subscribed within one week. The company will be in a position very shortly to offer stock in this undertaking to those desiring it.

THE NEW PHOTOGRAPHY.

Among the most startling things that the scientists have claimed to accomplish this century is the discovery by Prof. Rontgen, of Vienna, of a method for photographing objects that are enclosed in substances generally considered opaque, as for instance, the coins in a purse, or a man's skull taken while he was yet alive. The whole idea is so novel as at first to cause us to deny its possibility; but the older generation of us did the same with the telephone when it was first announced. Upon looking into the subject, however, we begin to see that a possible explanation of the process may be found in the difference in the nature of photography and vision. Vision is caused by the excitement of the nerves of the eye by the rays of light, and photography is produced by chemical changes which go on when certain substances are subjected to light. The human eye is not excited by light unless it is caused by waves which are between .00036 mm. and .00081 mm. in length. The substance used in photography, iodide of silver, it happens, is acted upon chemically by rays of light which are produced by waves of nearly the same length as those that excite the human eye. Now, if substances can be found that can be acted upon chemically by rays of light other than those by which the eye is affected, we will be able to produce photographs of objects that are invisible to the eye. No one will deny the possibility of finding a substance which may be thus affected, in view of what science has already done, and when it is found all that is necessary is to adapt apparatus to its use, as has been done in ordinary photography, with iodide of silver, the art is revolutionized. The advances which will be made in many branches of industry and science by the introduction of this process cannot be summed up in a paragraph like this. Already surgeons are looking forward to an advance in surgery which will equal in one step the already great progress of the earlier part of this century. It will be possible to study the living organs, and to determine pathological conditions with absolute exactitude. The location of foreign substances such as bullets will become a simple matter. The application of this omniscient agent to metallurgy will make testing a matter of easy accomplishment. It is found that while most metals are opaque, all variations in their structure are recorded on the plate. No two metals are alike when photographed in this way, and all alloys or composite metals betray at a glance the nature of their composition, the proportion of the different metals present and the evenness with which they are mixed. The exact scientific explanation of what has been achieved already will be waited for by the world with less interest only than the future developments of this wonderful science.

A TWENTIETH-CENTURY SCHEME.

Some people are said to dearly love a Lord, and this much to their discredit; but of the average dweller on this continent, it might be said a Scheme has his chief veneration. Next to "doing" somebody, it would almost seem the joys of being "done" are sought after. It is only on some such supposition as this that we can explain the presence, in Toronto, of the corpse of the Georgian Bay Aqueduct Scheme. Engineers of continental reputation have presided at its death-bed and granted the usual certificate. Decency suggested that it be put immediately out of sight; but chief mourner Macdonald insists that death has not yet taken place, and refuses to do the kindly offices he owes the departed. Is it necessary to call the promoter's attention to the ghostly evidences of the great Fact?—to the decay of the different members that once made up that splendid whole (scheme), the Georgian Bay Ship Canal and Power Aqueduct Co.? There is nothing left now but a request to the Ontario Government to be permitted to propagate frogs in the wayside puddles between Toronto and that Far Country where dwells the Owner of the Million Dollars, whose name came in rattling volleys through the promoters' hat not so very long ago. Get a new rag baby, Eddie, and perhaps the boys will play in your yard. Here's one. No charge, but please give this paper credit. A scheme to warm the water in Hudson's Bay by damming up the cold currents that flow down between Greenland and Baffin's Land, thus allowing the Gulf Stream to flow straight north and oranges to grow on Parliament Hill, Ottawa. The fish scheme is bad, Eddie; the little fishes will never consent to wear little brass tags on their little tails, marked "Licensed to swim here. E. A. M." Neither will the citizens of Toronto, Eddie, not they.

A CANNING factory at Hamilton and one at Ridgetown, Ont., are for sale or rent. When all the new ones contemplated have come into existence there may be several more "to let," unless they turn their attention to the export trade. Canadian fruit and vegetables

cannot be excelled in flavor anywhere in the world, and are superior to similar fruits grown in the U.S. It only requires that Canadian canned goods be properly introduced into foreign markets to command the trade.

THE Duryea Motor Wagon Co., whose vehicle won the first prize at the Chicago motocycle contest, informs THE CANADIAN ENGINEER that should an exhibition be held in Canada they are prepared to enter, provided the exhibition is "in the nature of a trial of speed and endurance, over any kind of course, for any distance." They add, however, that they are not prepared to enter a mere competition on a testing machine. We think they are right. A vehicle which will stand certain laboratory tests framed on pre-conceived theories is all very well, but what the public want is a vehicle that will get over the ground and do the work for which they purchase it. The vehicles that stood the laboratory tests were not the ones that got over the road when the race came to be run through the slush and mud of Chicago.

THE Applied Science Graduates' Society of McGill University was formed last June by resident graduates of the faculty. The objects of this society are, amongst others: (1) To establish a means of communication amongst over 230 graduates. (2) To awaken an interest in one another's and the coming graduates' welfare. (3) To draw the graduate and his Alma Mater closer together. The graduate wants information, the college wants support, and thus they may mutually benefit one another. Special points taken up or about to be taken up are: (*a*) The biographical index of graduates (extended). (*b*) Lectures by old graduates to resident graduates and students, which are to be published in THE CANADIAN ENGINEER. (*c*) An endowment fund to provide books for the engineering library. They have already 60 members. The officers are: Honorary-President, Prof. H. T. Bovey; President, W. J. Sproule; Vice President, M. L. Hersey; Council, W. A. Carlyle, J. M. McCarthy, T. W. Lesage, R. F. Ogilvy, W. F. Currie, H. T. Barnes, R. B. McDunnough; Sec.-Treas., Prof. C. B. Smith. The promoters of the new society are working with the energy and enthusiasm characteristic of McGill, and they will be sure to make a good record. The opening paper appears in this number of THE CANADIAN ENGINEER.

THE industrial world has become so accustomed to associating marvels with the name of Edison, that the announcement made in the New York *Herald* recently that the long-looked-for electrical process for iron ore extraction was complete is hailed with interest and pleasure only, not surprise. If the statements made in the *Herald* are exact, a most remarkable change is about to come over the iron industry; its location will be transferred to the neighborhood of water-powers, and the finished product will be enormously cheapened. The most marked characteristic of the new process is its labor-saving devices, as it is purely automatic, and from the time the car load of ore is dumped into the hopper till the bricks of pure iron emerge from the last machine in the series, no hand touches it. The ore is carried from one set of crushers to another by means of endless belts and bucket elevators, till the material is reduced to the requisite fineness, and then another series of belts and elevators carry it to the separating house, where the material falls in a fine stream across a field of large electro-magnets, which divert the iron from the direct line of fall and drop it into one receptacle, while the refuse and rock fall into another. This process is repeated a number of times, till at last the resultant product is pure magnetic oxide of iron. Carriers take the iron ore thence to the bricking plant, where the ore is mixed with binding material and pressed into small bricks for convenience in handling. These are then baked and are ready for the market.

CALCIUM CARBIDE AND ACETYLENE GAS.

Editor CANADIAN ENGINEER.

SIR,—Pray pardon me for writing you and taking up your time, but I am much interested in calcic carbide and acetylene gas, which I think is the illuminant of the future, and from the article in your January number I have got considerably mixed as to the cost. On page 239 I find as follows:

1,200 lbs. coal dust, say	$2 50
2,000 lbs. burnt lime	4 00
180 e.h.p. from water	6 00
Labor, etc.	2 50
Cost of 2,000 lbs., say	$15 00

From these figures am I to infer that there is a waste of 1,200 pounds in production of one ton of calcic carbide? Then you say, add $15 for freight. This would make $30 per ton, landed, say, here. Now, one ton will make, say, at 5 cubic feet gas per pound, 10,000 cubic feet of gas, and this 10,000 feet would cost $30, thus placing the cost of 1,000 feet at $3; yet you say it can be placed at 30 cents per 1,000.

Would you kindly reply and make this clear to me, and very much oblige,

Yours very sincerely,

J. H. SHEPPARD,
Incumbent St. Matthias, Coldwater.

January 27th, 1896.

The explanation of the apparent discrepancy noted by our correspondent is in the fact that the illuminating power of a cubic foot of acetylene gas is calculated at ten times that of common gas. We may say, however, that there is a very wide divergence in the estimates of the cost of calcium. An anonymous writer in the *Engineering and Mining Journal* is making violent attacks on the Electro Gas Co, accusing them of stock jobbing, and asserting, moreover, that calcium carbide, when produced by other than water-power, will cost from $60 to $80, perhaps $100 per ton. He quotes an article from the *Am. Gas Light Journal* which puts the cost at $160 per ton, and states that in the process of making it in the electric furnace, there is a great waste of electrical energy, owing to the small conductivity of lime and carbon, and the frequent short circuiting caused by having to place the carbon electrodes so close. The actual cost of producing the carbide and the gas will soon be determined at the large works now being erected at Niagara Falls, and in the meantime, we should advise those interested to await the results without prejudice, and not to come to any conclusion based on the statements of anonymous correspondents.

FIRES OF THE MONTH.

Jan. 15th.—Steam sawmill, Canterbury, N.B., James Smith & Sons Loss, $4,000; no insurance.——Jan. 19th.—Sawmill, Hartland, N B., Samuel E. Campbell. Loss about $13,000; insurance, $4,700.——Jan. 21st.—Alexandria Mfg. Co., Alexandria, Ont. Spontaneous combustion. Loss about $20,000; insurance about $12,000.——Jan. 23rd.—The C P.R. station, Parkdale, Toronto. Electric wire crossing caused fire. Building partially gutted, and books, etc, of company destroyed.——Jan. 27th.—Hosiery mills, P. T Lemoine, Pembroke, Ont. Stock room partially destroyed. Loss, $1,000; some insurance.——Jan. 30th.—Planing mill, Toronto, J. Carlyle. Loss about $25,000. —Feb. 3rd.—Island City White Lead and Varnish Works, Montreal. Loss $50,000. The stock, valued at $75,000, was partially insured.

THE MONTREAL WATERWORKS.

BY JOHN KENNEDY, C.E., M. INST C. E., CHIEF ENGINEER OF MONTREAL HARBOR.

At the beginning of the present century, Montreal was a town of only about 9,000 inhabitants, who lived mainly within the old fortifications, or in other words, within the area bounded by the sites of McGill street, Fortification lane, Berri street, and the St. Lawrence. St. Paul street was then considered well up-town, and Notre Dame street and vicinity were called Upper Town. The only means provided by the municipality for the supply of water consisted of public pumps at the Place d'Armes, the Market Place (now Place Royale), Notre Dame street near the Court House, St. Jean Baptiste at near St. Paul st., and possibly a few other points. For the rest, the citizens supplied themselves with water from private wells and cisterns, and by water carts from the St. Lawrence and the creeks, the principal of which was the Petite Riviere which ran where Craig street now is. The need of waterworks was, however, already recognized, and on April 5th, 1801, an Act was passed incorporating Joseph Frobisher (one of the founders of the North-West Trading Co., and builder of Beaver Hall) and his associates, under the title of "the Company of Proprietors of the Montreal Waterworks," with a capital of £8,000, and power to increase it to £12,000 or $48,000 in all, with exclusive rights for fifty years A gravitation system was determined upon and construction commenced at once. Water was obtained from the pond in the rear of the present Cote des Neiges College, at Cote des Neiges Village, and was brought to the city through wooden pipes laid round the southern slope of the Mountain *via* Monklands (now Ville Marie), and the Cote St. Antoine road, to two reservoirs which were placed, one on the corner of Guy and Dorchester streets, and the other on Notre Dame street just west of Dalhousie square. Some of the old wooden pipes were found in digging in Notre Dame street in 1869, and others in Cote St. Antoine road in 1892. The supply of water proved so scanty, from deficiency of the springs, and so precarious from frequent burstings of the pipes, that both the works and the enterprise became failures.

In 1816 the works and unexpired franchise of 35 years were offered for sale, and in 1819 they were purchased by a new company under the management of Mr. Thomas Porteous, for £5,000 ($20,000). The inadequacy of the works before this change, as also of all other provision for extinguishing fires, is shown by an instance of a large fire in January, 1819, in Eager's pork storehouse, near the present Custom house, which was put out by snowballs, because no water could be had either from the works or through the shoved ice on the river.

The new company abandoned the gravitation supply from the mountain springs and substituted a steam pumping system, with supply from the St. Lawrence. Four-inch iron pipes were substituted for the wooden ones, and wooden cisterns were placed on Notre Dame street east of Bonsecours street. The wooden cisterns failed, and were replaced in 1827 by others which were lined with lead. They were of 240,000-gallon capacity, and had an elevation of 97 feet above the river. The pumping engine was placed on the west corner of Water and Friponne streets, and the water was drawn from the riverside opposite. The amount expended by Mr Porteous was about £40,000, or $160,000. The four-inch pipes proved insufficient, and in consequence of this and the death of Mr Porteous, whose enterprise had sustained the undertaking, it again fell into disrepute.

After being advertised for sale for two years, the works were purchased in 1832 for £15,000 ($60,000) by Mr M J. Hayes, who formed a third company. This company laid some pipes of ten inches diameter, renewed the pumping engine and added others. In 1843 there were two pumping engines; one, rated at 40,000 gallons capacity per hour, was used both for pumping and grinding, a grist mill being attached to the works; another, rated at 53,000 gallons per hour, was used for pumping only This would give a combined capacity of two and a quarter million gallons per 24 hours, but ten years later, and after a third engine had been added, or possibly substituted for one of them, the whole reliable capacity was stated at only one million gallons. Adjoining the engine house was a work shop containing a lead pipe-making machine, driven by steam. By Feb. 1st, 1843, the company had laid 14 miles of pipe; had established three public water taps for the sale of water to water carters, and had 16 fire hydrants of their own, as distinguished from other hydrants owned by the city The expenditure by Mr. Hayes' company was about £10,000 ($40,000).

In January, 1843, the propriety of the city becoming owner of the waterworks was first mooted in the city council. After treating for two years the city bought out the company in April, 1845, for £50,000 ($200,000). In the ensuing summer the city corporation, in order to obtain purer water, extended the intake pipes of the pumps to the outer end of the Victoria pier, the first part of which was then being built. In 1847 the corporation offered a premium for the best plan of pumping water from the St. Lawrence to reservoirs on the Mountain, by means of water power from the newly enlarged Lachine Canal, but, instead of anything being accomplished in carrying out that scheme, the steam pumping works were strengthened by the addition of another engine. The waterworks were otherwise enlarged about the same time. In 1849 a reservoir was built in Cote a'Barron, where St. Louis Square now is, with a capacity of about 3,000,000 imperial gallons, at 130 feet elevation above the river. In June, 1850, a great fire occurred in Griffintown, destroying 207 houses. Two months later another occurred in the vicinity of St. Lawrence and Craig streets, destroying over 150 houses The great scarcity of water at these fires, and the inflammability of the wooden buildings then so common, led to improvements in the waterworks, and to the enacting of laws prescribing the kind of building which might be erected, with a view to the prevention of conflagrations. Water pipes were soon afterward laid in Griffintown and other parts of the city not hitherto supplied, and the number of fire hydrants in the city was increased to 100 The waterworks were, however, still quite inadequate to the wants of the city; and, worse still, the water supplied was unwholesome. The pumping capacity was only about one million gallons per day;* the reservoir was too low, the pipes too small, and the hydrants too few to prevent great fires. The taking of water from the works for domestic use was by no means general. Nearly all poor families, and many of the middle class, were supplied by water carters who bought at public plugs supplied from the city pipes, or who took water directly from the river, while both the waterworks and the bulk of the carters drew their supply from below the great sewer, which to this day discharges at the Custom House. It was felt that this could not be allowed to continue, and a radical change was determined upon. On May 12th, 1852, on motion of Ald Atwater and Ald. Valois, the city council voted £250 ($1,000) for a survey, plans and estimate for introducing water from Lower Lachine or elsewhere. Mr. Thos. C. Keefer, C E, was commissioned by the water committee to prepare plans and estimates for the supply of 5,000,000 gallons per day, to be taken from Lower Lachine.

Fires are great promoters of waterworks, and their help was not lacking in this case. On June 7th, two days after plans for the new scheme were ordered, a fire started on St. Peter street, at St. Sacrament, swept through the blocks between that and St. Frs Xavier, and thence along St. Paul to the Hotel Dieu at St. Jean Baptiste street. A month later, on the 9th and 10th of July, the great fire of 1852 occurred. It commenced on St. Lawrence street below Mignonne (now Joly street), swept away nearly all the buildings up to Mignonne, thence along Mignonne to St. Dominique, where it widened southward to Dorchester, and kept on across St. Constant to St. Denis and southward to Craig, from whence it continued through by Dalhousie Square, making a clean sweep of everything between Lagauchetiere street and the river, until it died out near the gaol. About 1,100 houses were burned, and property in all to the value of $800,000 was destroyed. On the 25th of October following, Mr. Keefer submitted an able report, discussing various feasible schemes for the new waterworks, and recommending the one which was afterwards constructed, namely, the water power pumping system, in which the water for the city is taken from the St. Lawrence above the Lachine Rapids and pumped to the city under the pressure of the McTavish reservoir, by power obtained through utilizing the fall of the rapids. The estimated cost was £150,000, or $600,000. This was looked upon as a large sum, for in those days the city did not lightly borrow and spend millions. Public opinion was, however, strongly in favor of an abundant supply of pure water, and that with the least possible delay, and the project was adopted. Mr. Keefer was forthwith instructed to prepare plans for the vigorous construction of the works, and legislative authority was obtained for borrowing the necessary money. On the 20th of May, 1853, ground was broken for the construction of the aqueduct; contracts for the pumping machinery and pipes were made soon after in Britain, and by the end of the year great progress had been made in the construction of all the heavier parts of the works.

In June following, the great cholera of 1854 broke out, and its ravages amongst the immigrant laborers on the aqueduct were especially severe. Many a stalwart fellow worked through the forenoon and was dead by evening. Medical aid was rarely procurable, for the doctors were literally being worked to death in the

* The imperial gallon and the day of 24 hours are always used hereafter.

city, but engineers, contractors and foremen did what they could to stay the disease and alleviate suffering. Prominent among them all was Mr. Robert Forsyth, whom we now know as the proprietor of the Forsyth Granite Works, then of the engineering staff, and known among the men as "the doctor with the red shirt," for he wore a red Garibaldi, and was well nigh everywhere at once giving medicine and ministering to the distress. The cholera made terrible ravages in the city as well. There were 1,186 deaths in a population of 60,000, one death to every 51 persons. Large as this proportion is, it was exceeded by the cholera of 1832, when there were 1,889 deaths in a population of 29,000, or one in 16. We can now see, by the light of modern science, that much of the great mortality of both cases must have been because both waterworks and water puncheons took their supplies from the river below the custom house, where a great part of the sewage of the city was discharged, that is to say, the cholera microbes circulated round with the drinking water and the sewage, and made frightful slaughter every journey. The new waterworks were finished in the summer of 1856. On the 10th of October they were publicly tested as to their capability for throwing fire streams, and gave great satisfaction. Hose were attached to the hydrants in various parts of the city, and streams thrown over the highest commercial buildings of the time. At Notre Dame Street Church, Place d'Armes, they measured 110 feet in height. The distributing pipes of the old works were forthwith rearranged and connected with the new mains, and the old pumping machinery and reservoir were superseded by the new. Three years later the old engines of the Notre Dame street tank and their sites were sold for $23,320. The new waterworks cost $1,144,945, and the combined cost of new and old up to the end of 1856, just after the new were put into use, was $1,640,000 The population of the city was then about 60,000, and the consumption of water averaged about two and a-half million gallons per day.*

AQUEDUCT AND PUMPING MACHINERY

The aqueduct as originally made commenced a mile above the Lachine Rapids and extended toward the city to Gregory's, where it ended, and still ends, in a settling pond at the lower end of which the wheelhouse and pumping machinery are placed The aqueduct is an open channel or canal 4¾ miles long, 20 feet wide at the bottom, and 40 feet wide on the water line when carrying its average depth of 8 feet. It had an inclination of 2 feet in its length, and therefore practically brought the head level of the rapids to the wheel house, and there furnished both the pure water to be pumped to the city and the water-power to pump it. The little St. Pierre River was used as a tail-race from the water-wheels.

The pumping machinery was of a capacity of six million gallons per day, and was divided into two independent sets. Each set consisted of an iron breast wheel of 20 feet diameter by 22 feet breadth, and three bucket and plunger pumps of 20 inches diameter by four feet stroke The water-wheels were made by Sir William Fairbairn, of Manchester, and the pumps by Lord Armstrong, of Newcastle, both already celebrated engineers, though not yet distinguished by titles. The excellence of their work is attested by the fact of one of the water-wheels and its pumps having worked and held their own against modern machinery for thirty-six years, and the set of pumps which belonged to the other wheel being still in use after thirty-nine years of hard service. The pumps forced the water through one 24-inch pipe to the McTavish reservoir, above McGill College, which contained 13½ million gallons at a surface height of 204 feet above the river, which gives 175 feet head at Victoria Square, 110 feet at Dominion Square, and 85 feet on Sherbrooke at St. Lawrence.

But ample in capacity as the new works seemed to be, and as they really were in summer, the action of the ice within the aqueduct was such as soon to make it difficult to meet the city's needs in mid-winter. The frasil, or anchor ice, forming in vast quantity in the open river above the aqueduct, entered with the water, and partially choked the upper end of the aqueduct. This caused the water in the remainder of the aqueduct to fall, and the sheet of ice which covered it to fall also; and worse still, the sheet became frozen fast when down, and could not rise again until the spring thaws. It thus became necessary to carefully manage the draft on the aqueduct in severely cold weather, in order both to avoid the drawing in of frasil and the reduction of capacity by lowering the surface ice. In addition to this, the St. Pierre, which temporarily acted as a tail-race, was unsuitable in form of channel, and in severe frost, especially when accompanied by snow storms, it became choked with ice, and backed up the water under the water-wheels so as to seriously reduce their power.

The St. Pierre was deepened in 1857 and 1858, in order to mitigate the evil, and in 1863 an entirely new tail race was made, which abolished back water altogether. In order to utilize the increased fall thus obtained, as also to keep the pumping machines up to the city's needs, a Jonval turbine and pair of double acting piston pumps, of four million gallons capacity per day, were added in 1865. The new machinery was designed by Mr. Emile Geyelin, of Philadelphia, and built by Mr. John McDougall, of Montreal. After thirty years use it is as good as at first.

The turbine of 1865 mitigated the winter trouble by utilizing more head, and working better in back water than could the breast wheels, but much still remained At the beginning of 1869, the rising consumption of the city, and a lowering of the river at the head of the aqueduct, made a water famine more than probable, and to avert it a steam pumping engine, nominally of three million gallons capacity per day, was very hurriedly built by the late Mr. Wm. Bartley, of Montreal, and set up in a new building alongside the wheel house. It proved unsatisfactory, and in 1872, or three years later, when the river was exceptionally low, another three-million gallon engine, built by the late Mr. E E. Gilbert, of Montreal, was added. About the same time a pair of engines were placed alongside the turbine of 1864, and so arranged that they could be coupled on and either drive the pumps independently or in conjunction with the turbine. None of these engines proved suitable for regular service, and one after another they were removed as useless, or to make way for others more reliable in working, or more economical in the use of fuel. In 1874 one of the Fairbairn breast wheels was taken out and a Jonval turbine, designed by the late Mr. Louis Lesage, the able and long time superintendent of the water works, was put in its place, and set to drive its three pumps of three million gallons aggregate capacity. The object of the change, as in the case of the other turbine, was to utilize more head and lessen the effect of back water. But much of the winter difficulty still remained, and in 1875 a Worthington compound pumping engine of eight million gallons capacity was added. The steam engines were all looked upon as temporary make-shifts. Mr Lesage, the superintendent of the works, and eminent engineers who were called in consultation, were of opinion that the Lachine Rapids could always furnish the best and cheapest pumping power, and that to overcome the difficulties caused by frasil, as also to increase the power to meet the increased needs of the city, the aqueduct should either be enlarged or duplicated on a larger scale, and that it should have an entrance of liberal size farther up the river, in order that greater head might be obtained. Plans were prepared by Mr Lesage, and the construction of what was intended as the upper section of an entire new aqueduct was commenced in 1873 It was put into use in the winter of 1877, but not finished until the year following. The cost was $514,677. The construction of the remainder of the proposed new aqueduct, then estimated to cost $1,370,000, has never been undertaken, and Mr. Lesage was strongly of the opinion that until it is built the first section is not worth its cost The section already built, known as the Inland Cut, is used as a new entrance to the old aqueduct, and as such is of value. It commences 2,800 feet above the old entrance, and joins the aqueduct 3,500 feet below, and it raises the head about ten inches. It has an average depth of water of 14 feet, with a surface width of 129½ feet, and a bottom width of 78 feet. It is several times larger in winter capacity than the old aqueduct, and has materially increased the effective power of the remaining part of the old aqueduct by thus far preventing the choking by frasil, and raising the water level.

The consumption of water kept pace with the growth of the city, and to keep up the supply a new set of water-pumping machinery designed by Mr. Walsh, then mechanical engineer of the wheel-house, was added in 1881. It consists of a Jonval turbine and two horizontal double-acting pumps of three million gallons combined capacity per day, and is placed in the east end of the first wheel-house. This raised the aggregate capacity of all the water-power machinery to thirteen millions per day, which barely gave one set of pumps as a reserve, for by that time the summer daily consumption of the city had risen to eleven millions. It was soon afterward felt that with no immediate prospect of finishing the large aqueduct, the steam pumping plant must be enlarged in order to make the winter supply secure, and a Worthington engine of ten million gallons capacity was therefore added in 1886. This was one of the earliest examples having the now well-known compen-

* In order to obtain some definite conception of the bulk of a million gallons, suppose a trough a foot in depth and width and of indefinite length. One million gallons would fill thirty and a half miles in length of such a trough. Sixteen and a half million gallons, which is now an ordinary day's consumption of water for Montreal, would fill five hundred miles of it, and a week's consumption would fill three thousand five hundred miles, about equal to the breadth of the continent between Halifax and Victoria.

sating cylinders for doing the duty of the fly wheel in other engines, and it has proved itself an excellent engine. In 1894 still another Worthington engine was added, of about nine million gallons capacity per day at proper working speed. In the current year, 1895, there has been added to the water-power machinery a pair of Leffel turbines driving a pair of double-acting plunger pumps of five million gallons easy capacity per day. They were built by the firm of John McDougall, and take the place of the last of the original breast wheels and its set of pumps.

The additions and demolitions, thus outlined, leave the present strength of the pumping plant as follows.—

Water Power Pumps.	Capacity per 24 hours imperial gallons.
Three pumps of 1856 (nearly worn out) driven by the turbine of 1874	3,000,000
Turbine and pair of pumps of 1865	4,000,000
" " " 1881	3,000,000
" " " 1895	5,000,000
Total water power pumping capacity	15,000,000
Steam Pumps.	
Worthington low duty engine of 1875	8,000,000
Worthington high duty engine of 1886	11,000,000
" " " " 1894	9,000,000
Total steam pumping capacity	28,000,000
Grand total water and steam capacity	43,000,000

The present daily consumption of the city varies between 14 and 18 million gallons, and averages about 16 million gallons per day for the year round Our water-power machinery is thus deficient, at its best in summer, by about three million gallons per day, while at the worst in winter, it is well nigh useless because of the action of the ice in the little old aqueduct. It therefore follows that one of the two high-duty steam engines must always be in use—much of the time both must be in use – leaving only the old low-duty engine in reserve. The cost of steam pumping in 1894 was about $43,500, and this year it will probably be over $45,000. The ratio of cost of pumping by steam and by water has recently been about nine to one, and the pumping expenses will this year, therefore, be some $40,000 over what they would have been if the water-power had been sufficient.

Mr. Thos. C. Keefer and Mr. E. Vanier, civil engineers, were called upon, two years ago, to deal with the question of an increase of the water power, and in a comprehensive report, dated March, 1894, they agreed with former eminent engineers in advising the completion of the new aqueduct, and with it the increase of the water-power machinery and improvement of the tail race. The capacity of the enlarged water-power thus recommended would be 45 million gallons per day in winter, and 50 to 60 millions in summer. The estimated cost of the entire work incident to the enlargement is $1,500,000, and it was calculated that the saving in pumping expenses would balance the interest on the outlay when the city's consumption reaches 25 million gallons per day.

PIPING.

The water from the pumps is conveyed to the city and distributed throughout the streets by 216 miles of main and distributing pipes. By these it is conveyed to the consumers' houses, factories and other premises, by 55,850 service pipes, these being the respective figures for the end of 1894. The main and distributing pipes are practically all of cast iron, and of four to thirty inches diameter. The services are practically all of lead, and mostly ¾ and ¾ diameter. The exceptions are few, and they chiefly occur where a distribution pipe smaller than four inches is laid in a short street or alley to supply a few consumers, and where iron services of greater size are laid for steam engines and fire protection in large buildings.

In 1856, when the new works were opened, there was only one pumping main. It was of 24 inches diameter, and extended from the pumps to the reservoir, *via* Atwater ave., St. Catherine street and McGill College avenue. It had an extension of the same size to Phillips square, where it branched into smaller pipes. Atwater avenue, into which the main was laid, when opened as a street, was appropriately named after Mr. Atwater, the chairman of the water committee during the construction of the new works, and the able and untiring leader in the council in all measures for the carrying out of the enterprise. In 1867 the 24-inch main was doubled. In 1875 a third main, of 30 inches diameter, was laid from the pumps through Atwater avenue and Sherbrooke street to Papineau road, in order to carry a large body of water at full pressure along the high ground and thus feed the pipes running to the lower levels. When Mr Porteous' company discarded wooden pipes about 75 years ago, they substituted iron distribution pipes of 4 inches diameter, and for over 60 years that continued to be the size generally laid down. In 1880 half of the entire pipage of the works was four inch. In 1877 and 1885 the superintendent, Mr Lesage, drew attention to the inability of such small pipes to supply either sufficient water or sufficient pressure for fires in high modern buildings. The insurance companies also took the matter up and agitated that and other questions relating to fire protection, with such effect that a general system of arterial mains was devised and speedily laid down for feeding the hydrants direct where most needed, and for feeding the small pipes at short intervals. Eight inches diameter was adopted as the least size for distribution pipes to be subsequently laid. A systematic changing of the hydrants in the more important districts was undertaken, the smaller old hydrants being replaced by large ones with four nozzles for ordinary hose and a large nozzle for feeding steam fire engines. Many miles of small pipes, some of them half a century old and nearly choked up by rust, have been taken up or abandoned entirely, and larger sizes laid instead The outlay for all this was very heavy, but it has restored the fire pressure, reduced insurance rates, and given what is in general a good efficient distribution system.

All the pipes and hydrants in public streets are the property of the city, and are laid free of charge to consumers. House services within the street lines are also the property of the city, and are laid free of charge to consumers, All extensions of the service pipes upon private property must be made by the owners.

RESERVOIR.

The reservoir of 1856, now called the McTavish or low level reservoir, was originally of oblong shape with semi circular ends, and it was so placed in the mountain slope that the surface of the rock was about level with the water surface on one side and with its bottom on the other The natural rock was used as a wall on the upper side, but on the lower side the water was and is still retained by a masonry wall backed by an embankment, both wall and bank being formed of rock from the excavation. The reservoir was divided transversely into two equal parts by a masonry wall, and together they contained 13½ million gallons. The surface elevation when full is 205 feet above the harbor. The cost was about $200,000. Upon the recommendation of Mr. Lesage, an extensive enlargement was made between 1874 and 1877, at a cost of $398,243, by widening into the rock on the upper side, the division wall being extended through the enlargement. The reservoir remains as thus enlarged; its capacity is 35,000,000 gallons, and its entire cost must be about $600,000. Under the gate-house, which stands on the reservoir bank, there is a well or distributing chamber. Into the bottom of this well the main pipes from the pumps and city are led, and opposite to them is a separate passage to each division of the reservoir. The pipes and passages are all controlled by gates, and by their means the water is turned off or on either division, or either main pipe, at will. The well itself may also be used as a stand-pipe for the pumping machinery in case both divisions have to be emptied at once. The water from the pumps does not go first to the reservoir and thence to the city, as popularly supposed. The reservoir is merely connected with the pumping and city mains by branch mains, and it acts by taking the surplus water when the pumps are delivering faster than the city consumes, and by supplying the deficiency when the pumps are furnishing less than it consumes. The 35,000,000 gallons contained by the reservoir, when full, could supply the city for barely two days. At first thought this appears almost a dangerously small reserve store of water. Whether it is really so or not depends altogether upon the unit division, and the aggregate capacity of the pumping plant and its pumping mains, as related to the city's consumption. If the pumps and pipes be kept so far above all requirements that no reasonably possible break-downs or bursts can leave the pumping capacity short of the consumption, the city is safe with very small storage capacity.

HIGH LEVEL WORKS.

Above the level of Sherbooke at Mountain and of St. Denis st. at Rachel, there is a large area of the city which is too high to be efficiently served by the McTavish reservoir, even for domestic purposes. To supply this there is the High Level System, a complete little waterworks, drawing its water from the main works, but having its own pumping station, reservoir and pipage. Its pumping station is at the McTavish reservoir, and it is equipped with a high-duty steam pump of three million gallons capacity per day, and also with an old low-duty pump of half a million gallons capacity, which is kept only for emergent use. The pumps draw their water from the McTavish reservoir, and discharge into a 12-inch main which connects with the high level distribution

pipes and reservoir The reservoir is 213 feet higher than the McTavish reservoir, or 418 feet above the harbor, and it is situated on the mountain side just above the McTavish monument in the line of Peel street. Its capacity is one and three-quarter million gallons. The high and low level distribution pipes overlap each other throughout a considerable area, which is determined by the different pressures required for domestic and fire service. Roughly speaking, the low level pipes reach up to a line running along just below the west end of Sherbrooke street to Mountain street, thence above Sherbrooke through the McGill College grounds to the upper side of Pine avenue at Durocher street, and thence diagonally to St. Denis at St. Rachel. Up to this contour, which averages about 70 feet below the McTavish reservoir, the houses are supplied by the low level pipes, but the water pressure near the line, although fairly efficient for domestic purposes, is quite insufficient for fire protection, and the pipes of the high level system are therefore extended considerably farther down, and have the hydrants connected with them. The hydrants, for instance, on Dominion Square, and even some of those at the Bonaventure station of the G.T.R., are supplied by high level pipes. The water pumped by the high level engine averages 1¼ million gallons per day, and as it is first pumped by the low level pumps, it is of course included in the low level records also. The pipage and house services, together with the expenditures and other statistics of the high level system, are also all included in the general waterworks statistics.

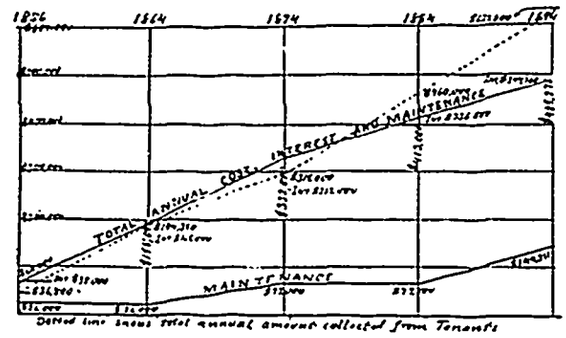
MANAGEMENT.

The general management of the waterworks is under the control of the water committee, which is appointed by the city council yearly, and consists of seven of its members. The moneys for working and maintenance expenses are granted by the city council, usually in one sum for a year. Such moneys come out of the revenue of the works, or, in other words, the water rates, and are paid out by the city treasurer on warrants drawn by the water committee, and charged up in the waterworks accounts under the head of Administration. Moneys for new works, such as additions to the pipage, pumping plant, reservoirs and aqueduct, are also voted by the council at intervals, and more or less specifically as to items, but for such purposes the moneys are taken from the proceeds of city loans for waterworks purposes, and are charged up in the waterworks accounts under the head of loans. They, therefore, represent capital expenditure, and their accumulated amount at any date is the total cost of buying and building the works up to that date, as distinguished from the cost of running them. It is the custom in the waterworks accounts, as also in those of the city treasurer, to make no deduction from capital cost for pipes and pumping machinery, or other important items, of the plant which have become worn out or obsolete. One large water-wheel, a whole set of water-power pumping machinery, two complete steam pumping engines, an auxiliary engine, and many miles of distribution pipes have been thus demolished or abandoned within a few years without being written off the capital, while the cost of the new machinery and pipes, which were substituted, have been added. Such new items, large though they be, are incident to the maintenance of the works in efficient state, are in fact large repairs, and might, therefore, so far as they merely replace the old, be charged to maintenance expenses in order to correctly show what maintenance costs. The income of the waterworks is almost wholly derived from the water-rates paid by consumers. These are collected by the Finance Department by means of a special staff of clerks and collectors, whose salaries are charged up to the Finance Department, and not to the waterworks. The immediate management of the works, and of the officers and men for working them, is in the hands of a superintendent, who is an engineer holding his appointment from the city council, but acting in all ordinary matters under the direction of the water committee. At present, strictly speaking, there is no superintendent: the duties of the office are performed by Mr. Laforest, who was assistant superintendent for several years, and has recently been appointed acting superintendent by the council. The incumbents of the office have been as follows:—Mr. Leblanc, superintendent of the old works previous to 1856; Mr. Louis Lesage, from the starting of the new works in 1856 until his death in 1889; Mr. B. D. McConnell, from promotion from assistant superintendent in 1889 until his voluntary resignation in 1892; Mr A Davis appointed in 1892 and dismissed in 1895; Mr. J. O. Alfred Laforest, formerly assistant superintendent, appointed acting superintendent, 1895.

The entire official and working staff averages about 350, and is made up as follows. The superintendent, assistant superintendent, 3 draftsmen and 5 clerks in superintendent's office. One guardian and two assistants on the aqueduct. One chief engineer, 4 assistant engineers, 5 oilers, 9 stokers and others at the low-level pumping station. One foreman and 16 others in the brass foundry and shop at the low-level pumping station. One engineer, 1 assistant and 1 stoker at the high-level engine-house and McTavish reservoir. One general foreman over city pipage works. One foreman in repair shop, Lagauchetiere street, 10 turncocks, 4 hydrant inspectors in summer and about 25 in winter, six house service inspectors; 250 sub-foremen, mechanics and laborers. Besides this strictly waterworks staff, there are about 18 clerks and 20 collectors in the waterworks' branch of the city treasurer's staff.

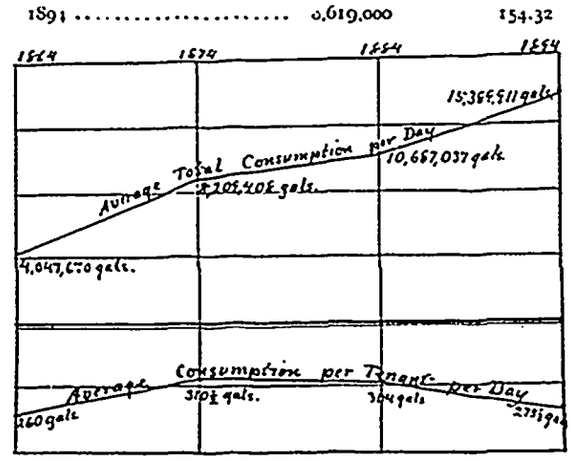
Water is furnished to citizens under a tariff of charges established by the city council. By far the greater part is furnished for domestic use, and for this the annual rate is 7½ per cent. of the rental, with certain additional charges for baths, etc. For stores and offices the rates are $4 upon a rental of $50, $5 on $75, $6 on $100, and $1 upon every $25 additional rental. In all these cases the charge is against the tenant. Payment is compulsory, whether water be taken or not. No person is allowed to draw water for himself or others from the river, nor to buy it from the works by meter for ordinary domestic use. For engines, elevators, factories and other industrial uses, it is supplied through meters, and charged under a sliding scale of rates from 30 cents per 1,000 imperial gallons for less than 1,000 gallons per day, to 15 cents per 1,000 for 9,000 gallons, or over, per day. For building purposes, garden-hose, and sundry other temporary or annual wants, water is supplied at specially prescribed rates. The tariff charges include all the obligations of individual citizens arising from the waterworks. There is no charge for hydrants, and nothing is charged under the guise of general tax for interest, sinking fund or the like. St. Denis Ward alone is excepted from the general tariff, it being supplied with water through a company under a contract made before its annexation to Montreal.

The accompanying diagrams show the growth and cost during the last forty years:—



Dotted line shows total annual amount collected from Tenants

	Total cost of works.	Av. capital cost per tenant.
1856	$ 637,719	....
1864	2,482,000	$159 45
1874	4,247,000	160.50
1884	6,101,460	173.60
1891	6,619,000	154.32



SUBURBAN SUPPLY.

The belt of separate municipalities which completely encircle the city, except on the river side, and which are peopled by the city's overflow, are supplied by a separate waterworks system which merits a few words: With all the municipalities which touch the city's boundary, and with several beyond, a company, formed some four years ago, called the Montreal Water and Power Co., has contracts for supplying water for 50 years, commencing about 1891. In the case of Westmount and some others, the con-

tract rate for supplying houses is half the Montreal rate, but $50 per hydrant per annum is paid by the municipality in addition. In other cases, and notably with what is now called St. Denis ward, of Montreal, the present house rates are 75 per cent. of those of Montreal, and no charge for hydrants The water company has a steam power pumping plant of 5,000,000 gallons daily capacity, on the river side in St. Gabriel ward, Montreal, which draws water through a submerged pipe from the middle of the channel between the main shore and Nun's Island, and supplies St Cunegonde, St. Henri, Cote St. Paul, Turcot and Westmount, having an aggregate population of over 30,000 On Clarke avenue, at 200 feet elevation above the harbor, there is a sunken tank, or small reservoir holding 180,000 gallons. At this there are two pumping engines of three-million gallons combined daily capacity, which supply the higher levels and discharge into a large reservoir on the Cote des Neiges road, of seven millions capacity and 478 feet elevation above the harbor. The water company has pipes and hydrants in the municipalities of Maisonneuve, St. Louis de Mile End, and St. Denis Ward of Montreal (formerly Cote St. Louis), but having as yet no pumping system for these parts of its territory, it supplies them with water from the Montreal waterworks pipes. The water thus taken is measured by large meters placed on the junctions of the two-pipe systems, and the stipulated price is 40 cents per 1,000 gallons The company is thus a wholesale buyer of water from the city, and a retailer to its own consumers, but although it quite properly collects for its sales, it strangely refuses to pay for its purchases. The city in its poverty cannot afford to be thus treated, and it would appear at first sight that its simple duty to its own citizens is to promptly shut off the water connections and make the company pay up. The matter, however, cannot be so easily and summarily dealt with, for the people who are dependent on the water have to be considered. In the case of St. Denis ward, shutting down the city valves would be depriving a portion of Montreal's own citizens of water, and in the case of outside municipalities it would be, to say the least, an act too harsh to be lightly done.

The company is constructing a large water-power pumping plant on the Back River, above Sault aux Recollets, from which it proposes to supply all the municipalities with which it already has contracts, as well as any others with which it may yet arrange. The scheme has an important bearing on the future of the waterworks of Montreal, because, if successfully carried out and worked, it obviously limits the Montreal works to the area which they now occupy, and their future increase of capacity to that which may be required by increasing density of the population.

For much of the foregoing information we are indebted to the kindness of Mr. Laforest, superintendent of the Montreal waterworks; Mr. McConnell, ex-superintendent; Mr. Robb, city treasurer; Mr. Keefer, who designed and has so often been consulted in improving the works; Mr. Vanier, recently associated with him, and Mr. Keith, engineer of the Water and Power Company.

PUBLIC WORKS OF THE COMING YEAR

The following are some of the leading items of outlay for railways, canals, and other public works of the Dominion, as foreshadowed in the estimates brought down in the House at Ottawa.

INTERCOLONIAL RAILWAY.

Rolling stock, $15,000, increased accommodation at Moncton, $30,500, extension to deep water at Sydney, $20,000: works at Halifax, $105,000, Dartmouth branch, $20,000, and improvements at various stations, amounting to about $18,000.

CANALS.

Construction Soulanges Canal, $800,000; Cornwall enlargement, $183,000; Rapide Plat, $170,000; Gaolps, $250,000: St Lawrence channel and surveys, $20,000, Murray equipment, $5,000, Trent construction, $500,000; Sault Ste. Marie construction and equipment, $44,000; Lachine, $238,000; Lake St Louis channel, $95,000; Grenville enlargement, $90,000; Welland improvements, $5,000 *Lachine*—Stop logs, $2,100, extending electric lights along canal, $4,550, providing and planting boundary stone, $700. *Beauharnois*—Dredging shovel at upper entrance, $5,000: replacing cope stones on nine locks, $1,600; changing circuit of telephone from ground to metallic, $800. *Chambly*—Build rubble walls along highway, $2,500; rebuild abutment walls, etc., lock 8, $4,000; gravel bank of canal, $1,500, purchase half acre of land and build shed and fence, $1,000, to build culvert under canal at St. Johns, $6,000 *Carillon and Grenville*—Build a set of spare lock gates, $2,900. *Trent*—Build new dam at Chisholm, $5,500; remove rock in channel at Hastings, $3,500, build guard booms and piers at Peterboro swing bridge, $2,500, dredge channel at Katchananwan Lake, $2,500, build landing pier at Burleigh, $2,000; remove rock in channel at Bobcaygeon, $3,500: provide hoisting engine and boiler, $1,000 *Rideau*—Construct bridge across by wash at Smith's Falls, $5,000: complete sheet piling at Deep Cut, Ottawa, $8,500. *Welland*—Remove sand bars in Dalhousie and Port Colborne harbors, $4,000; toward building superstructure of piers at Port Dalhousie, $30,000; rebuild in cement walls of lock No. 24, $25,300; renew towpath bridge $5,000; renew one pair of lock gates and raceway bridge, lock 7, old canal, $5,000; clean and deepen feeder back ditches, $2,000. St Lawrence ship channel, $75,000; River Kaministiquia, $10,000.

PUBLIC BUILDINGS.

Halifax Drill Hall, $100,000, Marysville, N.B., Public Building, $8,000; Tracadie Lazaretto, N.B., $1,000, Grosse Isle quarantine station, $6,000; Montreal Dominion Public Buildings—Improvements, alterations, renewals, repairs, etc, $12,000; Quebec Post Office—New wing, and repairs and alterations to old building, furniture, etc., $2,500; Richmond Q., Post Office and Customs and Inland Revenue offices—Re-vote of $14,000 lapsed—To complete, $14,000; Rimouski Post Office, Custom house, etc.—To complete, $10,000; St. Vincent de Paul Penitentiary, $7,000; Dominion Reformatory, Alexandria, Ont., $30,000; Picton, Ont., Post Office, Custom-house, etc., $13,000; Portage la Prairie Post Office, etc., $20,000; Regina, lock-up and police accommodation, $2,000; Moosomin Court-house—Additions, etc., $3,000; Prince Albert Court-house and Jail accommodation—New works and repairs, $13,000; New Westminster Drill Hall, $6,000; Victoria Drill Hall (re-vote), $4 000; Victoria new Post Office, $100,000.

HARBORS AND RIVERS.

Digby, N.S., pier, $2,800; Georgeville, N.S., extension of wharf, $3,000; Grand Etang, N.S., $5,000; Kier's Shore, P.E.I., extension of pier, repairs and dredging, $2,500; Souris—Reconstruction of the breakwater at Knight's Point, $37,500; Burnt Church, N.B.—Wharf, $2,000; Gardiner's Creek—New wharf, $3,150; Negro Point Breakwater, St. John Harbor, $20,000; River St. John, including tributaries, $16,000; Anse a l'Eau—Tadousac pier, $1,500; Baie St. Paul—To complete wharf at Pointe aux Corbeaux, repairs, etc., $2,500; Etang du Nord—Repairs, etc., $1,000; Grande Riviere—To complete harbor of refuge by strengthening and extending the wharf, etc., $2,000; Laprairie—Works in connection with ice piers, dredging steamboat channel, etc., $10,000; Phillipsburg pier, the municipality having contributed $4,000, $1,000; Piers—Lake St. John, including improvement of approaches, $2,500; River Richelieu—Belœil channel guide piers, $3,000; River St. Maurice—Improvement of channel between Grandes Piles and La Tuque, dredging plant, $5,000; St Jean, Ile d'Orleans, $400; Collingwood—Repairs to breakwater, $2,850; Kingston, Ont., harbor, $5,000; Lake Simcoe and Couchiching—Regulation of waters of, $5,500; Owen Sound harbor—Dredging, etc., $20,000; Toronto harbor—Works at eastern entrance, etc., the city of Toronto having contributed $100,000, $50,000; Wharves on Lake Winnipeg, $8,500; Columbia River—Improvements above Golden, $4,600; Victoria Harbor—Dredging in inner harbor, $10,000; Fraser River—Improvements of ship channel, $10,000; Skeena River, $3,500: New dredging plant, $40,000, Dredge vessels, repairs $30,000: Dredging—Nova Scotia, Prince Edward Island and New Brunswick, $50,000: Quebec and Ontario, $40,000: Manitoba, $8,000: British Columbia, $15,000, General service, $5,000

ROADS, BRIDGES, AND MISCELLANEOUS.

Bridges, Ottawa city, $7,000, bridge at Edmonton, over Saskatchewan, $50,000; bridge over Burlington canal, $15,600; telegraph line, north shore St. Lawrence, $1,000, artesian well boring in N W.T., $7,000.

The above items do not include the usual appropriations for repairs, maintenance, etc., in the various departments.

THE ENGINEER.

Editor CANADIAN ENGINEER

SIR,—The experience of no one man, no matter how extensive his practice or how varied his opportunities, will cover much of the aggregate field of engineering. Think for a moment how little of your knowledge of engineering is based upon your own unaided efforts and experience. How many of the rules which you use did you work out for yourself from data derived only from your own practice? When you have a piece of work to do that is entirely different from anything you have attempted before, what do you do? You hunt for an instance where somebody has successfully done such work before: or, if no such case exists, you lay out the work as best you can in the light of what has been done, taking the result of other men's tests as to strength of materials, propor-

tions of parts, etc., and the failure or success of your work becomes a precedent to be avoided or followed by the next man who has a similar task to perform. It is the aggregate experience of the profession that constitutes engineering knowledge, and the more a man reads, the more of other men's thoughts and experience he absorbs, the more valuable he will become. Think of this the next time you hear a slur thrown at the "book engineer." It is not the function of books or papers to make engineers, but to record and disseminate the progress and experiences of the profession, thus adding to the aggregate knowledge of all. You can make up your mind, when you hear a man boast that he can get along and run his plant without reading, that he has not got along far enough to know how little he knows, or to be entrusted with the execution of work that requires any knowledge to speak of.

YOUNGSTER.

Deseronto, Jan. 28th, 1896.

DEVELOPMENTS IN FORCED DRAUGHT.

Whenever there is dry refuse to be removed in a finely divided state, no better method can be followed than to employ a blower. In many industries blowers are used to transfer material great distances from one part of the premises to another, as the chips in a pulp mill, for instance. A field of almost greater extent is found in ventilation and the creation of forced draughts Th.s extensive employment of blowers may be dated from the inventions and improvements of B. F. Sturtevant. The revolution in

B. F. STURTEVANT.

fortune's wheel which took Sturtevant from the shoemaker's bench and placed him at the head of a large iron manufacturing establishment, is interesting to trace. The young shoemaker first showed his inventive genius by producing a machine for pegging shoes, which was so original and so valuable that it still leads in that department. A buffing-wheel for smoothing the soles of shoes came next. The adaptation of an exhaust to remove the dust caused by the use of this wheel was the final step in the change. The series of inventions was complete, and the boy who began on the shoemaker's bench had reached a point where he could become himself an employer of labor and undertake the manufacture of the machines which his ready wit had called into existence. Works were established at 72 Sudbury street, Boston, in 1862. The blowers were applied to the removal of dust from wood-working machinery, and also to blowing forge, boiler and cupola fires. In this connection, both a high pressure blower and a low pressure blower were developed. About this time, experiments were made in combining the blowers with steam heating apparatus, and a number of successful appliances were put on the market as a result. In 1866 the House of Representatives, at Washington, was supplied with two large fans which formed part of the ventilating system. In 1873 the firm got out a catalogue, which was one of the most extensive of the day, and had a very marked effect on the business. It had outgrown the Boston premises by 1878, and so, in that year, the industry was transferred to Jamaica Plain, a suburb of Boston. Here a number of new departures were made, each new machine turned out leading up to another, and all assisting in the growth of the business and the enlargement of the premises which went steadily on. Steam fans, blowers connected direct to the engine, were one of these, and the "naval fan" grew out of those. Portable forges came next on the list of successful ventures. A very great enlargement of the steam-heating blowers was made, and

E. N. FOSS.

they were adapted to various uses in which a hot-blast is necessary. In addition to the other features mentioned, the B. F. Sturtevant Co. now turn out electrically driven fans and motors. When the founder of the business died in 1890, it was incorporated under the name of the B. F. Sturtevant Co., with E. N. Foss as treasurer and general manager. The buildings as they appear in the cut on next page were completed in 1895.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

A COMEDY IN ONE ACT.

An amusing incident occurred at the recent C.A.S.E. Convention at Ottawa. At the annual banquet Mr. Wall sang a song, in which each verse ended in the refrain "turn over." The next morning everyone was repeating the words, and a number going into the bar together, shouted in chorus "turn over." At this, a tall gentleman standing at the bar turned pale and said in French, at the same time crossing himself, "I am not turned over." Seeing there was some meaning taken from the words, they pursued the subject and again shouted "turn over." On this the gentleman raised his cane dramatically and protested with great vehemence, "I am not turned over." Brother D., of Kingston, who has a sense of the ludicrous, stepped up to him, put his mouth to the gentleman's ear, and said in a stage whisper, "turn over." At this he dropped on his knees, crossed himself again, and looked wildly from one to the other. The bewilderment and consternation on his face were indescribable, but the boys laughed so long and heartily, that it began to dawn on him that nothing personal was meant. Then he got up and assured the boys that he had not turned over. He then explained that he was the editor of a paper in the village of ——— Quebec, and had been accused of changing his politics, which he had not done. He then pulled out of his pocket a letter from the Hon. Mr. Ouimet! This letter stated that Mr. Ouimet had examined into the matter, and could assure all whom it might concern that the bearer's politics were all right. It was evident that the poor fellow had got it into his head that the boys were a band of inquisitors connected with the Government, who had got wind of his reported "bolt," and had come to decapitate him. At all events, a great load was lifted from his mind when the boys asked him to drink, and showed him there was no design on his life.

THE HAMILTON BRANCH.

Wm. Norris, secretary Hamilton No. 2, reports the continued progress of this branch. The meetings continue to be of a very pleasing character. The members are becoming more deeply interested in the education side of the association, and have supplied the rooms with books, models, and a good indicator for the use of the members, so long as they follow the rules laid down by the committee. The instruction meetings have been begun. At the first

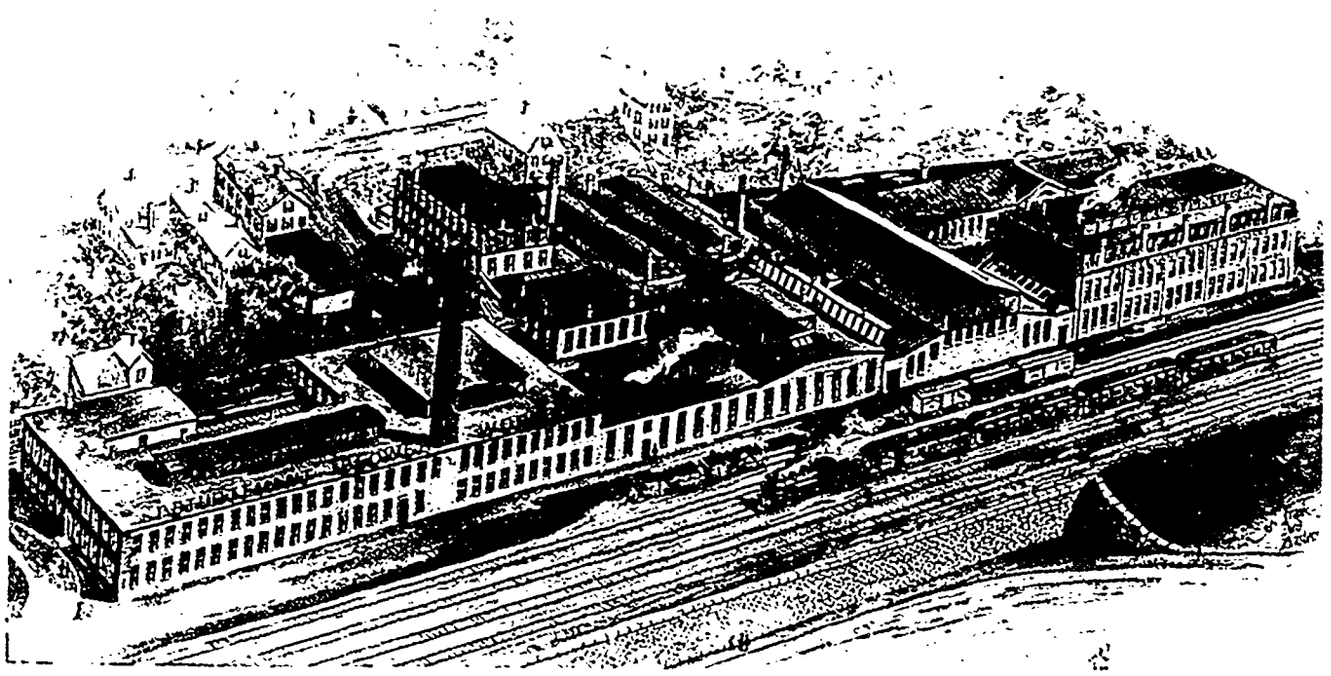
one Wm Norris read a paper on "Electricity," which was well received A number of very interesting discussions took place on pumps, engines, steam and exhaust ports, etc

MONTREAL'S ANNUAL DINNER

The sixth annual dinner of the Montreal branch of the Canadian Association of Stationary Engineers was held on Thursday, January 30th, at the Queen's Hotel, at which about 160 persons sat down. Letters of regret were read from G. C Cunningham, A. Ramsay, S. Jackson, Jno. Peck, W. N Brown, H. Holgate, W B. Blackgrove and S. E. Stephenson The chairman, Jno. J York, in addressing the visitors and members, remarked that probably not one-quarter of the steam users of Canada knew anything about the objects of the association, although it has caused and encouraged the present economy in the use of steam plants by its method of educating the engineers In November, 1885, H Nuttall read the first paper before the association, on "Priming in Steam Boilers" Since then, at every meeting, some subject connected with the use of a plant is taken up and discussed. At the Association Hall, Dorchester street, where weekly meetings are held, every other meeting is devoted to those members who wish to catechise the ecturer for the time being, and the questions often display a surprising amount of enlightened study on the part of engineers actively engaged in the shops. Mr. York says that if the steam users would only exchange confidences and take the advice of the engineers throw light on the action of valves, super-heating, lubrication, indication of horse-power as to cost, the bursting of fly-wheels, etc. After the toast to "Our Queen and Country," Walter Laurie spoke to that of "The Council of Arts and Manufactures." Col. Stephenson, supported by B. A. York and O E. Granberg, replied ably to the toast of "Boiler Inspection" Then followed the "Brotherhood of Locomotive Engineers," "Our Tormentors—the Oil and Supply Men," "Our Guests," and "The Press." The guests, all of whom highly complimented the association on the great advances it had effected and its future usefulness, were Mr. Morton, Col. Massey, Mr. Morrice, of the Ames Holden Co., H. R. Ives, Mr Hersey, John Dyer, W. T. Bonner, Wm. Vallance, of the White Boiler Company, and W. D. McLaren. The evening was very informative to both steam users and engineers, while the interspersed music and occasional impromptus from general favorites made it one of the most jovial entertainments in the history of the Association.

The dinner committee consisted of John J. York (chairman), O. E. Granberg, Joseph Elliott, J. G. Robertson, Harry Nuttall and B A. York, secretary.

We are pleased to record that John J. York, president of Montreal, No. 1, C.A.S.E., was recently the recipient of a "smoker's set," containing a valuable meerschaum and a briar pipe, as a mark of esteem from members of the Montreal Board of Trade engineering staff.



WORKS OF THE B F. STURTEVANT COMPANY, BOSTON, MASS. (See page 273)

association, paying it 25 per cent. of the saving effected, the association would soon own a hall of its own larger than the hotel in which they had been dining The engineer has it in his power largely to increase or decrease profits A certain manufacturer, known to the speaker, increased his plant, and was surprised to find that the consumption of coal increased at a greater rate The engine builder was called in and it was finally agreed that the builder should receive the savings effected by his advice for a few days As a result, and much to the surprise of the manufacturer he received $175 Every employer sought out an expert bookkeeper Then why not an expert engineer? But while the steam users were content to be expert bookkeepers themselves, leaving a thorough knowledge of ... r steam plants out of calculation, they do not excite a proper emulation amongst the engineers and must expect to suffer The chairman added that the Montreal association now possessed models to the value of about $700, and was about to sign an order for $150 worth of books for the library Prof Nicholson, in speaking to the toast to the "Faculty of Applied Science," explained lucidly the difference between the results obtained in an experimental school and those possible to an engineer actively engaged in a shop F W Taylor, of Philadelphia, made his experiments on belt data during nine years of work in a machine shop Theoretic men are deficient in experiments on the steam pump vs condensers, a subject easy to thrash out for a man actively employed Let some of the engi-

TORONTO, NO. 1, IN A NEW HALL.

On the evening of January 23rd, Toronto Branch, C.A.S.E., had a most enjoyable "house-warming" to celebrate their advent into the new hall, in Victoria street. Their new home could not have been better if it had been specially built for the association. The suite of rooms include, besides the main assembly room 45x35, a long room which will make an admirable library and reading-room, an ante-room and a cloak-room and lavatory. The library room is so situated that it can be entered without passing through the main room or disturbing a meeting. Though the opening night was stormy, the large hall was filled, the ladies turning out in strong force. The walls were decorated with banners, streamers and mottoes, and looked very attractive. The programme consisted of an entertainment, followed by refreshments and a dance. The chair was occupied by Wm. Lewis, president, and during the evening a short address of a retrospective nature was given by A. M. Wickens, who is regarded as the father of the association. Mr. Wickens said it was only nine years since this association was formed, with a total membership of twelve or thirteen. At the end of the first year the membership had grown to forty, and at the end of the third year the executive council was formed, and branches had been organized in other cities, Now there were branches extending from Winnipeg to Montreal, and the association was growing right along, both in membership and influence. The Toronto branch were in a great measure the creators of that admirable institution, the

Toronto Technical School. The chief glory of this association, indeed, was its educational influence. In the year in which it was organized the number of boiler explosions and accidents resulting in loss of life from the carelessness or ignorance of engineers was enormously greater than now, in proportion to the population and steam power used. The association in its infancy had great difficulties to contend with. The trades and labor organizations were in arms against them when it was found that the C.A.S.E refused to interfere in any way with labor disputes, while the employers on the other hand looked on them with suspicion or disdain, and there was the apathy of a great many of the engineers themselves. By keeping the one great object—their advance in knowledge—steadily before them, they have been able to overcome all these obstacles, and they were not ashamed of the work they had accomplished. He congratulated the members of Toronto, No. 1, on their fine hall, and hoped they would live to have many social gatherings such as the present. The entertainment was supplied by Miss Warnock, Mrs. Coutts-Bain, Messrs. Mills, Eversfield, Blackgrove, Grant, Towers, Phelps, Allcott, Parks, Vaughan, and last and best, our only James Fax, who is hailed by no class of Toronto citizens with greater delight than the stationary engineers. One of the best hits of the evening was the topical song, "Goodness Gracious," in which he introduced some new verses for the occasion. The following were two of the verses:

Do you know what I said when I entered this hall?
O goodness gracious!
Those were the words, but that wasn't all,
Good-goodness gracious.
I said "It's a beauty," as it now appears
I think it speaks volumes for our engineers,
And I wish them in it many happy New Years,
Gracious, good-goodness, goodness gracious!

When Wickens first started the C.A S.E.,
O goodness gracious!
Folks thought he was off of his b-a-s-e,
Good-goodness gracious
But now we have Edkins and Phillipses too,
George Mooring, Tom Eversfield—doodle dum-do,
And then as a climax this hulla-ba-loo,
Gracious, good-goodness, goodness gracious!

Mr. Grant gave excellent assistance and the hits in this song were uproariously received. Mr. Parks operated a phonograph to the delight of the audience, and the calisthenic feats of Mr. Eversfield were much admired, especially by the ladies. During the evening several gentlemen announced their readiness to donate books when the library was in shape, and the president expressed the hope that many more would come forward with contributions of works relating to engineering and kindred subjects.

IS THERE ELECTRICAL EXHAUSTION?

Editor CANADIAN ENGINEER

The following statement appears in the January number of THE CANADIAN ENGINEER, by Wm. Golding, C.E., of New Orleans, in an article ca led "Over-crowding in the Installation of Electric Generators":—

"It is the practice to install as many electric generators in a given area as the floor space will admit of, never thinking that the electric fluid which is being got from the atmosphere may become exhausted."

We have from this statement to assume that Mr. Golding has some evidence that the atmosphere contains a limited quantity of electric and magnetic force. It has never been proved that such is the case, and further that the electric potential is derived from the atmosphere, and not a result of the power applied to the generator. If Mr. Golding will look over the illustrations in the January number of THE ENGINEER, in which his letter appears, he will find a description of a Storey dynamo in which every part of the apparatus but the conducting wires is hermetically sealed from the atmosphere, no part of it being visible but the outside of the steel case enclosing the machinery, and the end of the armature shaft and pulley driving it, together with the conducting wires to distribute the current. There is not a sign of outside magnetism to be found on it, yet this natural magnetic field is of great density, and is stated to give a greater potential for power applied than any electric machine now on the market, and is so closely sealed that water may be dashed all over the case without in the least affecting its working. Now, if dynamos in an electric station are overcrowded, how much more must this be so? Yet there is no evidence of any deficiency in the working of the many hundreds in use. It is now being realized what has been surmised for a long time past by scientists, including our greatest electrician, Tesla, that ether, an imponderable entity—now known to exist, but having no visible parts, but believed to fill all space in the universe, and, as proved by Tesla, passes through glass with the same freedom as light, in fact is believed to accompany it and travel at the same rate—is the main factor by which force is accumulated and distributed by the power applied to dynamos, and according to Faraday, having a magnetic affinity with the velocity of light In reference to this, Prof. C. A Chant, B A, of Toronto University, in his lecture on "Electrical Radiation," says, "there is a certain all-pervading, practically imponderable medium through all space that is now well known as ether, and its vibrations are believed to be motions made in transmitting radiant heat and light with a velocity of 185,000 miles per second." Maxwel"s mathematics led him to believe that electro-magnetic effects are transmitted with the very same speed, they also must be propagated by some medium Heinrich Heitz, one of the greatest of German scientists, demonstrated that electric energy is transmitted exactly as Maxwell predicted thirty years before this was formulated. The greatest scientist of his age, Faraday, conjectured that the same medium that is concerned in the propagation of light might also be the agent in electro magnetic phenomena external to the magnet; such an action may be a function of ether; it should have other uses than simply the conveyance of radiation. This conjecture has been strengthened by all subsequent investigation The electro-kinetic energy, on the other hand, is simply the energy of the motion set up on the medium by electric currents and the magnets, the motion not being confined to the wires that carry the currents and to the magnets, but existing in all places where the magnetic currents are found, and would under all circumstances maintain its equilibrium till power applied is to it by the action of the dynamos. When this power is applied the velocity of the current is increased by the increased voltage, while the amperes may remain the same, returning to the dynamos to be again reinforced to do its work over again. Under all the circumstances, it cannot be conjectured that the ether or electric energy in any given space can be limited by absorption, as it fills all space, and must, as everything else in nature, maintain its equilibrium. A great deal more might be stated to strengthen the position assumed here. It may be expected that others, better versed in electric science, and observers and experimenters on the laws governing electric phenomena, may throw light on it, in any case, whether right or wrong, this communication may influence others to take up the question and throw more light on it.

J. H. KILLEY.

CALCIUM CARBIDE.

Editor CANADIAN ENGINEER.

SIR,—I have read with great interest your article on calcium carbide and acetylene gas, which, I notice, has been copied extensively by other papers. Calcium carbide and its development into light, heat, power and its various useful chemical combinations, will affect many industries in a profound way. This will have in the near future to be manufactured on a large scale in Canada, requiring many thousands of horse-power in its production and in forcing its gas into a liquefied form, taking up a small space for transport, in this form it is capable of generating a very large amount of heat, light and power in proportion to its bulk. There is no question about its cheapness and usefulness, this has already been proven, but not so the cost to the public. The important purposes to which it can be applied have attracted the attention of United States capitalists and gas companies, so that it may become a monopoly as long as the patent holds good, unless some improved method of manufacture may be devised. This has been the case in the past with many important franchises, and may be so in this, yet even if it becomes a monopoly it will be a public benefit.

Fortunately in Canada we have the possibility of the cheapest and the most powerful water-powers on earth, to enable us to supply all we require ourselves and to supply England and other nations also. Its small weight in its liquefied form allows it to be carried at a comparatively small cost in proportion to its value in the arts.

Yours truly,

CANADIAN.

ONTARIO LAND SURVEYORS.

The fourth annual meeting of the Association of Ontario Land Surveyors will be held at Toronto on 25th, 26th and 27th inst. Papers will be contributed as follows. Artesian Wells, by V. M. Roberts, St. Catharines, An Exploration Survey through the Barren Lands, by J. W. Tyrrell, Hamilton, Boundaries of Ontario, by A. Niven, Haliburton, Sectional Surveys, by P. S. Gibson, Willowdale, National Boundaries, by A. P. Walker, Toronto, Field Testing of Minerals, by W. Hamilton Merritt, F.G.S., Toronto, The Use of Concrete in Bridge Foundation, by Jos

DeGurse, Windsor; Road Metal, by H. J. Bowman, Berlin; Country Roads in New Jersey, by T. B. Speight, Toronto; Crown Surveys, by Jas. Dickson, Fenelon Falls; The Ditches and Watercourses' Act of 1894, by B. J. Saunders, Brockville; Some Notes on Concrete and its Application to Various Works, by M. J. Butler, Napanee; Measurement of Base Lines with Steel Tape, by L. B. Stewart, D.L.S., Toronto, Evidence, by V Sankey, Toronto; The Maintenance of a Separate Sewerage System, by T. Harry Jones, Brantford; The Engineering Field of America, by A. R. Davis, Napanee. Also others not yet specified.

Reports from the following committees will also be presented, viz: Land Surveying, Drainage, Engineering, Entertainment, Publication, Topographical Surveying, Polar Research, Standard Measures of Length, Biography.

JOSEPH HOBSON, M.I.C.E., ENGINEER IN CHIEF OF THE GRAND TRUNK RAILWAY.

Joseph Hobson, C.E., who has just been promoted from the position of divisional engineer to be engineer-in-chief of the whole Grand Trunk system, is a Canadian, having been born near Guelph, Ontario. He served his apprenticeship as a Provincial land surveyor in Toronto, and after having passed his examinations as such, he was engaged for a number of years in private practice as a surveyor and an engineer, and in the location and construction of different lines of railway in Canada and the United States. At the beginning of 1870 he was appointed resident engineer of the international bridge at Black Rock, Buffalo, and was continuously on the ground during the construction of the bridge. On the completion of the work at the end of 1873, he was appointed chief assistant engineer of the late Great Western Railway of Canada, his associate being Mr. Kennedy, now engineer of the Montreal Harbor Board, and about two years later he was appointed chief engineer of the line. He still holds that position under the management of the Grand Trunk Railway Company. His professional experience extends over a period of about thirty-two years The Grand Trunk Railway tunnel under the St. Clair River was designed and constructed to a finish by Mr. Hobson, Sir Henry Tyler being president of the road at the time. This gentleman had every confidence in Mr. Hobson s ability to build this marvellous piece of engineering work, yet Mr. Hobson, by the way, is one who, to quote Sir Henry Tyler, had never been outside of Canada to profit by the advantages and education which Sir Henry appeared to think could not be had in this country—a country, however, from which the Shanlys went forth to complete the great Hoosac Tunnel in the United States, after the engineers there had hesitated before the task. The St. Clair tunnel, built to carry the traffic of a great railway under a wide and deep river, is the first of its kind on this continent or elsewhere in operation. It is, however, likely to be followed in other localities. After Mr. Tyler and the G. T. R. board in London, England, had got every information on it, they decided on the employment of Mr. Hobson as the engineer of the great undertaking. At a banquet held at the opening of the tunnel, when there were United States and Canadian railway notabilities present, Sir Henry Tyler spoke of the numerous difficulties encountered and overcome in its construction; he ended by proposing the health of Mr. Hobson. The applause by which this was received made the rafters ring. When called on to respond Mr. Hobson spoke as few words as possible, and what little was said regarding the technical work was extracted from his assistant, Mr. Murphy. There are few great engineering works of modern times that have exhibited greater skill or have been so economically and carefully brought to completion as the Sarnia Tunnel, but Mr. Hobson seldom alludes to the subject, and when he does so speaks of his own part in the work in a self-depreciating way, and is careful to inform the enquirer that the idea of excavation by a cylindrical core was not original with him. Among men whose life work is historical it would be hard to find one who is so completely free from vanity or egotism. He never pushed himself forward, and all his promotions have been made because those at the head of affairs perceived his solid abilities. Perhaps the best evidence of the rare gift which the new general manager of the Grand Trunk seems to possess of selecting capable men and reading men almost at a glance, is shown in "sizing up" Mr. Hobson after a short interview on his way to Montreal.

It may be of interest here to give a few facts respecting the Sarnia Tunnel, which an American engineering paper describes as the "greatest sub-marine tunnel on the North American continent." It extends from Port Huron, in the State of Michigan, to Sarnia, in the Canadian Province of Ontario, and connects the Grand Trunk railway system of Canada with the lines operated under Grand Trunk management west of the St. Clair river, and with the Flint and Pere Marquette and other Michigan railways. The tunnel was built and is owned by the St. Clair Tunnel Company, organized under special Act of the Canadian Parliament. The length from portal to portal is 6,025 feet; length from portal on the American side to river bank, 1,729 feet; length from portal on Canadian side to river bank, 2,006 feet; length under river bed, 2,290 feet. The tunnel is a perfect cylinder with an interior diameter of 19 feet 10 inches; the segment filled in at the bottom for the railway road bed has a flat surface from side to side of 11 feet 6 inches; the length of the cutting on the American side to the portal is 2,487 feet. The depth at the portal to the road bed, below the natural surface, is 50 feet; the length of the cutting on the Canadian side to the portal is 3,116 feet, and the depth of the portal is 57 feet; the grade on the American side is 1 in 50, or 105.60 feet per mile; the grade on the Canadian side is 1 in 50, or 105.60 per mile. The cost was $2,500,000.

Mr. Hobson is a member of the Institute of Civil Engineers of Great Britain, of the American Society of Civil Engineers, and of the Canadian Society of Civil Engineers.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the society was held on Thursday, 9th January ult., at the society rooms, Montreal, the subject for discussion being "The most suitable shape of timber for testing." Messrs. Irwin, Smith, Vantelet, Kennedy and Wallis took part in the debate.

Prof. C. B. Smith, M. Can. Soc. C.E., read Part 2 of his paper on "Cement Testing."

W. C. McDonald was elected an honorary member of the Can. Soc. C.E., in consideration of the benefits he has conferred upon the engineering profession of Canada, in the erection, equipment and endowment of the Engineering and Physical buildings for the Faculty of Applied Science of McGill University.

Alexander King Kirkpatrick, of Smith's Falls, Ont., and Arthur Tristram Phillips, Ottawa, Ont., were transferred from the class of associate member to that of member of the society.

Charles Burrard Kingston, of Montreal, and John King McDonald, of Dunkirk, N.Y., were transferred from class of students to the class of associate members.

Walter Moffat Scott, of Charlottetown, P.E.I., was elected to class of student.

At the regular meeting on Jan. 30th the discussions on W. B. Dawson's paper and Prof. Cecil B. Smith s paper regarding frost tests of cement, were continued.

At the meeting on Feb. 13th the following question will be debated. "Resolved that engineering works should be constructed by day's work, under the immediate direction of a civil engineer, instead of being done through a contractor."

THE ANNUAL MEETING.

The annual general meeting of the Canadian Society of Civil

Engineers was held in the rooms of the society, 112 Mansfield st., Montreal, on January the 14th and 15th last Among the non-resident members present were: Messrs. Alan Macdougall, H. D. Lumsden, C. H Rust, E B. Temple, Major H. A. Gray and W. G. Warner, of Toronto; G. A. Mountain, of Ottawa; E. A. Hoare, of Quebec; J. D. Barnett, Stratford, Ont.; H. E. C. Carry, of Vancouver, B C; G. E. Robertson, of Cardinal, Ontario; M J Butler and F. B. G. Allan, of Napanee Mills, Ont.; J. K. Macdonald, of Dunkirk, N.Y.; Thomas Monro (president), Coteau Landing; J. L. Allison, Coteau Landing.

HERBERT WALLIS, PRESIDENT.

The report of the retiring Council, of which the following is a synopsis, was presented:—

The elections of the year comprised one honorary member, three members, six associate members, two associates and fifteen students. Five associate members have been transferred to the class of members, and ten students to the class of associate members One associate member has been replaced on the roll on application. Resignations have been received from three members, one associate member, one associate, and six students, while eighteen members, twelve associate members, seven associates and eighteen students have been removed from the roll for non-payment of dues.

PROF. H. T. BOVEY, VICE-PRESIDENT.

The deaths have been.—*Members:*—Charles Sproatt, Patrick Kennedy Hyndman, John Fraser Torrance and Arthur N. Wellington.

At the present date the membership stands as follows:—

	1894.	1895.
Honorary members	7	8
Members	286	269
Associate members	141	140
Associates	50	44
Students	164	145
Total	648	606

There is therefore a falling off in the total membership of forty two, the decrease having taken place chiefly in the classes of members and students. The decrease is, however, more than accounted for by the large number removed from the roll early in the present year for non-payment of dues. Taking this fact into consideration, the effective membership of the society remains practically unchanged. The membership of the society has now, in the opinion of the Council, reached as large a number as should be expected from the population of the country, and no material increase in its numbers should be looked for in the near future. Three new applications for admission are in hand. There were fifteen ordinary meetings of the society during the past year.

A renewal of the lease of the present rooms was secured for two years at $550 per year, but the question of permanent future quarters would be considered by a committee.

The Committee on Professional Status has reported to Council, presenting drafts of bills for incorporation in the Dominion and Local Legislatures. These have been issued, confidentially, to the corporate members of the society, and will be further considered.

The income for the year was $3,591.11, and the expenditure $3,190.78, leaving a balance of $400.33, and a total balance to carry forward in the general fund of $7,217.77, which is on deposit in the Merchants Bank of Canada, bearing interest at 3½ per cent. per annum.

WM. M'NAB, LIBRARIAN.

Appended to the report is the recommendation of a Committee (composed of Herbert Wallis, G. H. Duggan and J. D. Barnett) on an International Gauge, in which the resolution of the Joint Committee of the American Society of Mechanical Engineers and the Railway Master Mechanics' Association in "earnestly deprecating the use of any of the numerous wire and sheet metal or other trade gauges now in vogue, and in strongly urging the use of thousands of an inch for all kinds and classes of small measurements," is unanimously approved. The committee recommends that all gauges be in terms of thousands of an inch. It was unanimously resolved that the Canadian Society of Civil Engineers recommend to its members, and to all persons interested in uniform practice, the abandonment of the use of arbitrary gauges in favor of gauges expressed in thousands of an inch.

The society resolved on the invitation of some of the Toronto members to hold a summer session for the reading of papers and visitation of works in Toronto. From the interest manifested in this question it is expected that the Toronto meeting will be a very largely attended and interesting one.

Mr. Alan Macdougall, chairman Committee on Close Corporation, presented his report, which was adopted, and the Committee dissolved. It was resolved to apply to the Dominion Government for amendment to the charter, and to form committees in each province to ascertain the prospects of provincial legislation, at an early date.

KENNET W. BLACKWELL, TREASURER.

The report of the Gzowski Medal Committee, of which Prof. Galbraith of Toronto acted as chairman, was read. The committee unanimously recommended that the medal be awarded to Prof. Henry T. Bovey, Mem. Can. Soc. C. E., for his paper on "The Strength of Canadian Douglas Fir, Red Pine, White Pine, and Spruce."

As a result of the ballot, the following were elected officers of the society for the ensuing year:

President.—Herbert Wallis, Montreal.

Vice-Presidents.—Henry T. Bovey, Montreal, Chas. Macdonald, New York; William G. Thompson, St. Catharines.

Treasurer.—Kennet W. Blackwell, Montreal.

Secretary.—Clement H. McLeod, Montreal.

Librarian.—William McNab, Montreal.

Council.—W. D. Barclay, Lethbridge, N.W.T.; J. D. Barnett,

Stratford, Ont.; St George Boswell, Quebec; M J. Butler, Napanee, Ont; W. R. Butler, Windsor, N.S; H. J. Cambie, Vancouver, B.C.; G C Cunningham, Montreal; W B Dawson, Ottawa; G. H. Duggan, Montreal; H. Irwin, Montreal; E H Keating, Toronto; Alan Macdougall, Toronto; W G Matheson, New Glasgow, N S; D. A. Stewart, Winnipeg, Man.; W J. Sproule, Montreal.

The committee elected by ballot for the nomination of officers for the year 1897 is as follows:—W J Sproule, H Irwin J. Galbraith, A. Macdougall, W. T. Jennings, M. Murphy, H. N Ruttan and Henry T. Bovey. John Kennedy, E. P. Hannaford, P Alex. Peterson and Thomas Monro, Past-Presidents of the Society, are, in accordance with the by-law of the Society, also members of the committee.

Arising out of a communication presented by M. J. Butler, of Napanee, Ont., an important discussion took place on the Dominion and Provincial laws relating to standards of length, and on the existing facilities for standardizing, tapes, chains, etc A committee of the society was appointed to make further enquiry into the matter, and to report to the society at an early date.

After the thanks of the society had been presented to its retiring officers and to the railroads, Thomas Monro, of Coteau Landing, the retiring President of the society, read an address on "The St. Lawrence as the great Water Route of our Country." The address was an important resumé of the history of canal construction in Canada.

PROF. C. H. M'LEOD, SECRETARY.

A largely attended members' dinner was held in the Queen's Hotel on Tuesday evening, and on Wednesday evening the members attended a lecture given by Prof. C. A. Carus-Wilson in the physics building of McGill University, on "Electric Power Waves." The lecture was illustrated by lantern projection, and was an exceedingly instructive address

GEO. B. REEVE.

Among the many changes that the new general manager of the Grand Trunk Railway has made in the short time during which he has been in charge, one of the most important is the appointment of a general traffic manager for the whole system, with headquarters in Montreal. This is in accord with what is believed to be the policy of the new head, *i.e.*, to centralize everything in Montreal, where he can have every detail brought under his own eye at a moment's notice. Geo. B. Reeve, who has just been appointed general traffic manager, has held the position of traffic manager, at Chicago, since 1881. As Mr. Reeve began railway work on the G.T.R., he will feel quite at home in his new position.

CANADIAN MARINE ENGINEERS' ASSOCIATION.

At the annual meeting of the Canadian Marine Engineers' Association, held in Toronto last month, the following officers were elected for the ensuing year. President, O. P. St. John, first vice-president, J. S. Adam, second vice-president, J. Parsall. Council—J. Findlay, R Hughes, S. Gillespie, D. F. Campbell, R. McLaren, treasurer, D. L. Foley, secretary, S. A. Mills. Auditors—R. Childs, J. H. Ellis. Inside guard—E. Abbey.

This association meets weekly in the Forum Hall, Yonge st., the season's meetings beginning on the 1st Dec. and continuing till about the middle of April. During the past year nine new members were elected and five new members were proposed at this annual meeting. The total membership of the association is now 86. An "At Home" was held in the association's hall on the 5th inst., the proceeds from which will be given to the widows of the engineers who were lost on the steamer "Africa" last year.

E. P. HANNAFORD.

The retiring chief engineer of the Grand Trunk Railway has just entered upon the thirty-ninth year of his service with the company. Mr. Hannaford has been chief of his department since he built the International Bridge over the Niagara in 1866. Mr. Hannaford has issued the following parting address to the officials of his department.

MONTREAL, Jan. 24th, 1896.

To the Staff of the Engineers' Department, Grand Trunk Railway:

It is with regret that I inform you that I give up charge of the department at the end of this month My thirty-eight years' service with the company, thirty of which I have been chief engineer, has formed official and social connections that a separation will make painful to sever. I know I have had the loyal support of the staff; that you have never failed in your duty to the company, and I ask you to accept my thanks for your forbearance and support, and most cordially wish you success in the service.

E. P. HANNAFORD.

WATER-TUBE BOILERS.*

BY WM. T. BONNER, MONTREAL.

Not at all unfrequently are the promoters of water-tube boilers called upon to furnish evidence of the extent to which such boilers are and have been used. The prevailing idea in the minds of many steam users appears to be that of mistrust in the principle and effect of water-tube boilers. It is not what their fathers used, neither does their local boiler maker approve of them, a negative premise naturally calling for a negative conclusion.

Why are not water-tube boilers in more general use? Because, as was explained in a discussion† of the subject by the American Society of Mechanical Engineers, they require a high class of engineering to make them successful. The plain cylinder is an easy thing to make. It requires little skill to rivet sheets into a cylinder, build a fire under it, and call it a boiler; and because it *is* easy and *anyone* can make such a boiler, because it requires no special engineering, they have been made, and are still made, to a very large extent. The water-tube boiler, on the other hand, requires much more skill in order to make it successful, a fact proven by the great number of failures in that line.

Water-tube boilers are not new. From the earliest days there have been those who recognized their advantages, and in modern practice to refuse them equal consideration with the best known mechanical appliances of other types, is only pardonable on the ground of ignorance or injustice.

I was greatly amused recently to find in a so-called engineering journal the following item of news: "At Davenport, Ia., the old battery of four boilers at the Arsenal is being replaced by two new boilers of novel construction in that region. The new boilers are of 200 h.p. each, and instead of the heat passing through tubes surrounded by water, as in the ordinary boiler, the process is reversed and the water in pipes passes through a current of hot air, thus giving a greater heating surface and insuring the greatest safety." Plainly those are nothing more or less than our ordinary water-tube boilers, and it is quite evident that the author of that item gauges the progress of this world by the developments on the little rock island in the Mississippi occupied by the U.S. Arsenal.

Contrast with this another item of news in the *Youths' Companion*, to which my nine-year-old boy called my attention only a few days ago. It read as follows: "An interesting discovery has recently been made in the museum at Naples, where the works of art and utensils found in the buried city of Pompeii are preserved. Careful inspection of one of the ancient copper vase shaped vessels there, has shown that it is in reality a tubular boiler. That this form of boiler should have been known to the Romans two thousand years ago is somewhat remarkable. For just what purpose it was used is not known, but the boiler is well constructed and contains five tubes running across a central fire-box, and so arranged as to permit the water surrounding the fire-box to circulate through them in a continuous current. The soldering of the tubes was so skillfully done that it remains intact to-day, and the cover of the boiler closes hermetically. The entire height of the machine, which, as

* A paper read before the Mining Association of Quebec.
† Transactions Am. Soc. Mech. Eng., Vol. VI., page 256.

remarked above, is shaped like a vase with two side handles and three feet, is only about seventeen inches. It has been suggested that it may have been employed for distilling purposes. However that may be, its preservation under the ashes of Vesuvius proves that tubular boilers are not altogether a product of modern invention."

No doubt you have all read Lord Lytton's account of the "Last Days of Pompeii," and recall his description of the wonderful therme or baths, which formed so prominent a feature of every Roman city during the first century Possibly this ancient boiler was designed by one of those bright Roman or Grecian mechanics for heating the water for the Sudatoreum or warm baths. We find it duplicated almost exactly in the Galloway water tubes of the present day, and I have no doubt, if we could follow up this investigation of ancient boilers, we would find the knowledge possessed by the ancient Greeks and Romans was not confined alone to poetry, sculpture and art, but that even water-tube boilers or heaters were known to them. The principle of the Galloway tube originated at the time when probably the first steam boiler ever made

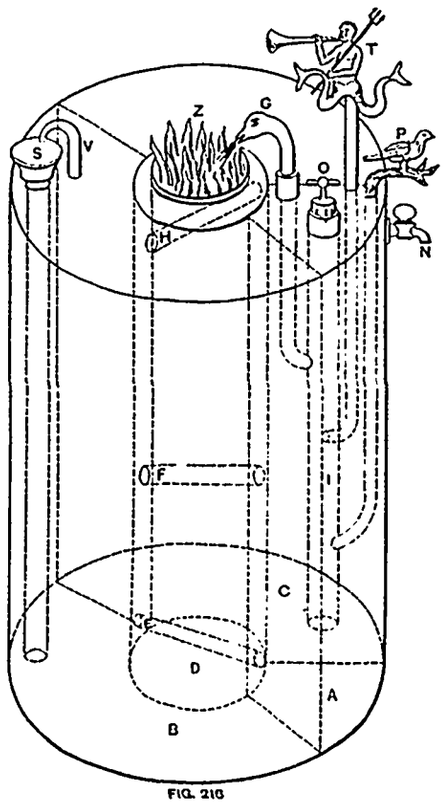


FIG. 216

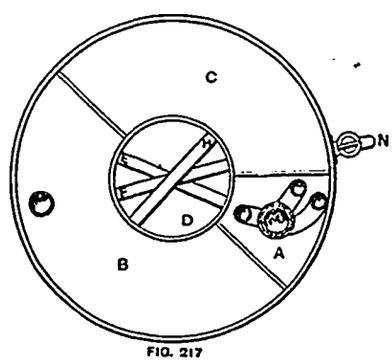


FIG. 217

in this world was constructed It is not known when the first steam boiler was constructed, but the first steam boiler recorded was made at least 200 years before the year one of our era. In a discussion* of various forms of shell and water-tube boilers at the New York meeting of the American Society of Mechanical Engineers in 1885, Mr. W. R. Durfee gives an illustration† of this very unique boiler, copied from the first Latin translation of the "Pneumatics of Hero of Alexandria," who lived and wrote about 200 B C.

Its construction is shown in Figs. 216 and 217. The first figure is copied from the Latin translation referred to and represents a perspective elevation of the boiler and its appendages, showing its internal construction by dotted lines. The second figure (217) was drawn by Mr. Durfee to facilitate explanation; it shows a horizontal section of Fig. 216 taken just below its top.

The apparatus consists of a vertical cylindrical shell, whose ends are closed by heads, through the centre of which passes a vertical cylindrical flue, *D*, whose upper end is provided with grates for the support of the fire, *Z*, the hot gases from which passed downward through the flue. The space between the flue and shell is divided by diaphragms into three unequal compartments, *A*, *B*, *C*, in the first of which steam is generated, the others being simply reservoirs of hot water. The central flue, *D*, is crossed by three cylindrical tubes, *H*, *F*, *E*; the tubes *H*, *F*, connecting the hot water spaces *B*, *C*, act in the same way as the Galloway tubes, now in common use, but the bottom tube is closed at the end, *E*, its opposite end opening into the smallest or steam compartment, *A*. The compartment, *B*, is provided with a funnel, *S*, whose tube extends nearly to the bottom of the boiler; and also with a safety tube, *V*, whose curved upper end is immediately above the funnel, *S*. The compartment, *C*, has a cock, *N*, from which the hot water is drawn. The compartment, *A*, has within it a three-way cock, *I*, the three-discharge pipes of which are connected with the goose-neck blow-pipe, *G*, the triton, *T*, and the singing-bird, *P*, respectively. The three-way cock, *I*, is operated by a cross handle, *O*, and the upper end of its plug has graduations which, when brought opposite an index mark on the shell of the cock, determine which of the three discharge pipes shall receive the steam generated in compartment *A*.

The principal function of this apparatus was to furnish hot water, and it is so contrived that it is impossible to draw any considerable amount of hot water from the cock, *N*, without putting in an equal quantity of cold at the funnel, S. In order to put this apparatus at work, the compartments, *B* and *C*, were filled with water to a level above the upper water tube, *H*, by means of the funnel *S*; the goose-neck, *G*, was then removed and enough water poured into the compartment, *A*, to fill it nearly to the lower end of the three-way cock, *I*; the fire was then lighted, and as soon as steam manifested itself, the goose-neck, *G*, was returned to its socket and placed in such a position that the fire, *Z*, was blown by the issuing steam. The three-way cock, *I*, could be turned by its handle, *O*, so that the steam would cause the Triton, *T*, to sound his trumpet, or the bird, *P*, to warble, and thus announce to interested parties that the water was "boiling hot." In case any steam generated in the compartments, *B* and *C*, it found an exit through the safety pipe, *V*, and any entrained water re-entered the boiler through the funnel, *S*. In case it was desired to draw hot water in any great quantity from the cock, *N*, it was necessary to supply an equal quantity of cold water through the funnel, *S*, this requirement insuring a constant volume of water in the boiler.

But I need not weary you with ancient history—it may satisfy our curiosity and lend some additional color to Solomon's proverb that there is nothing new under the sun—yet we cannot expect ancient Greece or Rome to furnish models for our boiler-makers of to-day. Only by comparison do we really begin to appreciate the vast changes by which the engineering talent of to-day is taxed to its utmost to produce machinery and appliances which will accomplish the greatest amount of work for the longest period, with the least expenditure of effort. Steam boilers, perhaps, have not attained that degree of perfection usually accorded to the steam engine, yet, when we note the progress which has really been made, and realize how close we have approached to the theoretically perfect boiler, we have great cause to feel encouraged.

Of the two hundred and sixty odd boilers recorded in Mr. Bell's most valuable Directory of Canadian Mining Industries, 30 per cent., or 5,400 h.p., are of the water tube type, and 50 per cent., or 9,000 h.p., are shell boilers, leaving 20 per cent., or 3,600 h.p., unclassified. Since practically all of the above water-tube boilers have been installed within the past ten years, we can safely infer that in the mining trade, at least, more horse-power of water-tube boilers are now sold each year than all the other types combined.

There is no better evidence of the survival of the fittest in modern boiler practice, than a comparison of the various types exhibited at the Centennial Exhibition of 1876 with those shown at the World's Fair, seventeen years later. At the Centennial there were exhibited fifteen different types of boilers, of which two were cast iron sectional, four were shell or tubular tubes, two were shell boilers with water tubes crossing internal fire tubes, while seven

*Transactions Am. Soc. Mech. Eng., Vol. VI., page 566.
†Heronis Alexandrini Spiritalium Liber. A Federico Commondino Urbinate, ex Graeco, nuper in Latinum Conversus: cum privilego Gregorii XIII. Pont. Max. Urbini, 1575.

were exclusively water-tube boilers. Of the whole number exhibited at the Centennial, but one, the Babcock & Wilcox, reappeared in its original form at the World's Fair in 1893 Of the fifty-two boilers exhibited in the main boiler room at the World's Fair, all were of the water-tube type, while thirty-one of them were distinct copies of the original boiler patented by Stephen Wilcox in 1856, just forty years ago.

THE PERFECT BOILER.

What really constitutes a perfect boiler? Mr. George H. Babcock, in his lifetime, undertook to formulate the twelve fundamental principles upon which it should be built. It was about twenty years ago that his formulas were first published, yet those same principles still live, and are looked upon to-day as the acme of scientific boiler construction.

Few boilers there are entirely devoid of all good talking points, but do not be satisfied with a boiler simply because it is made of good materials and workmanship, or because it has a mud drum, or because it has large water and steam capacity, or because it has a large disengaging surface, or because it has a good circulation, or because it is built in sections, and is therefore safe in the event of explosion, or because it is able to withstand high pressure and unequal expansion and has its joints protected from the fire, or because the furnace is provided with chambers for the proper combustion of the gases, or because the heating surface is composed of thin metal so arranged that the heating gases will cross it at right angles and only leave it when the greatest possible heat is extracted from them, or because it will work up to or over its full-rated capacity with the highest economy, or because it is fitted with the best quality gauges and fittings. Each of these qualities add greatly to the value of a steam boiler, but that one is *best* which combines the greatest number of such qualities, and, therefore, proves the best investment independent of first cost.

Messrs Galloway (Ltd.), of Manchester, Eng., illustrate on page 94 of their late catalogue, what they are pleased to designate as their "Manchester Boiler," but which is in reality a reproduction of the ordinary inclined water-tube boiler, built by so many different manufacturers of to-day In explanation of this marked deviation from the Galloway, Lancashire and Cornish boilers, which they have been building for so many years, Messrs Galloway (Ltd.) say: "For ordinary pressures the Galloway boiler possesses great advantages, but beyond that, cylindrical boilers are frequently of large diameter, necessitating extremely heavy plates, and although for marine practice this is carried out, yet for situations where the conditions are less rigid, it is advisable to have a boiler more suited to the requirements of the case In addition to this, where transport of large pieces is difficult, the Manchester boiler offers considerable advantages, as the largest piece is the upper vessel, which rarely exceeds five feet in diameter, twenty feet in length and four tons in weight, the tube rods and boxes being separate. It will be seen that all the tubes are inserted into one water-box or chamber at each end, the front one connected to the upper vessel by a wide neck, and the back chamber by a large circular connection, by which means an even circulation is kept up. The boiler is further provided with an internal arrangement in the upper vessel for separating the steam from the water, thus preventing priming and its attendant evils. This arrangement of boiler has been largely adopted on the Continent, and we anticipate that when its merits become known it will be received with great favor by steam users requiring boilers for high pressure.

That is good; coming from such an eminent authority, we can only interpret their adoption of the water-tube principle as a strong endorsement of the work accomplished by their predecessors in that field of engineering. I fully expect, however, in the next issue of their catalogue, Messrs. Galloway will have overcome their prejudices sufficiently to limit the diameter of their drums to 36 or 42 inches, and that they will further arrange to enclose the drum so as to utilize its surface for heating rather than condensing. Then they may add to the merits of their boiler, safety and economy I might add that although Messrs. Galloway are pleased to limit the use of their water-tube boilers to stationary work, the boilers of that type are just now making tremendous strides in the race for supremacy in marine practice. In proof of this statement I might refer to the steamers "Turret Cape" and "Turret Crown," which have just closed a very successful season in the coal carrying trade between Sydney and Montreal. From their lessees, the Dominion Coal Company, I learn that the two steamers have a combined record of 27 trips, extending over a period of 44 weeks, during which time they brought 66,981 tons of coal into this port. To this total should be added 11,700 tons for short cargoes, made necessary by the very low water in the river and canal which prevailed through all last season. The actual carrying capacity of each of the turret boats is 3,000 tons. They are fitted with water-tube marine boilers, 2,200 square feet of heating surface being the total for each boat. They have been kept in continual service right through the season, and the captain's log shows a clean record for the boilers. Many other and larger steamers fitted with water-tube boilers have gone into commission during the past few months, and in every case the boilers have given the greatest satisfaction.

CAPACITY.

The term "horse power" is one which admits of a wide interpretation, being little understood by some and often misapplied by others. Originally used as a unit of capacity by James Watt, and supposed to be the average amount of work performed by a good strong English cart horse, its value is 33,000 lbs. raised one foot high per minute. It may be expressed in any equivalent of this unit as one pound raised 33,000 feet high per minute. At best this is but an arbitrary unit, since the actual value of a horse power depends, as a Yankee boiler maker has very aptly expressed it, upon the size of the horse. The evolution of the term "horse power," as applied to steam boilers, has been gradual, but not the less marked. Prior to the advent of compound and triple expansion engines it was always customary to calculate the steam consumption of the ordinary slide valve engines, then in most common use, at the rate of one cubic foot of water per hour, or say 62½ lbs. For instance a 10 h.p engine would require a boiler capable of evaporating 625 lbs. of water per hour. In general practice it was found that boilers of different types of construction varied in evaporative capacity according to the efficiency of their total heating surface, the amount required per h.p averaging about as follows. For plain cylinder boilers, 10 square feet; for flue boilers, 12 square feet; for horizontal multi-tubular boilers, 15 square feet.

Of late years tremendous strides have been made in the development of the steam engine, so that instead of one cubic foot of water, or 62½ lbs steam consumption per h.p. per hour, the modern engine builder knows that he must develop a h.p. with less than 30 lbs. of steam for simple non-condensing engines, and from that down to 13 lbs. or less for triple expansion condensing engines, depending on the size of plant and number of cylinder expansions. Here then arises a serious complication in the determination of h.p. Shall it be a large or small horse? The prospective purchaser should consider this matter carefully and demand that all tenders must state specifically the actual evaporative capacity of boilers to be purchased, to be determined if necessary by a practical test. The American Society of Mechanical Engineers has very properly solved this problem by the favorable consideration of its special committee's report* at the New York meeting in 1885, whereby the equivalent evaporation of 30 lbs. of water from a temperature of 100° F into steam at 70 lbs. pressure, is fixed as a boiler h.p. American manufacturers generally have adopted this standard, and while they may differ in the number of square feet of heating surface they allow for developing a h.p., there is no longer any doubt as to the size of the horse.

I cannot leave the subject of h.p capacity without first making a strong appeal for a more uniform rating of boilers, a rating which has some tangible basis. Not until you are able to compare boilers by the actual number of square feet of *effective* heating surface they contain, or the actual number of pounds of water they will evaporate under ordinary working conditions, can you judge whether one boiler is cheaper than another I confess I was greatly shocked only a few days ago, to hear the admission of a fire tube boiler man, that he figured only the upper half of his tubes as effective heating surface. I shall always remember him as an honest man of good sense. There is no question but that fire tubes and shell plates exposed to the direct action of hot gases, form very efficient heating surface when they are clean, but who is there who will claim the possibility of keeping such surface constantly clean while the boiler is in active service? Effective heating surface is that which receives the direct contact of the hot flames or gases, and continues to do so without interruption from soot, or interference by close furnace walls, or baffle plates. This is the proper basis upon which to purchase your boiler, other conditions of course being equal.

SAFETY.

I have been asked why a water-tube boiler is necessarily a safety boiler? It is not necessarily a safety boiler! In fact, I could name a number of water-tube boilers which are safe in name only. Certainly a boiler with very wide flat stayed surfaces, enclosing chambers receiving the combined circulation of all the tubes, should not be considered as a safety boiler. Stay bolts and braces at best are a constant menace to safety, since they are usually located in inaccessible places, difficult to inspect and

*Transactions Am. Soc. Mech. Eng., Vol. VI., page 256.

repair. But the principal objection appears to be the impossibility of providing braces which brace at the proper moment. How is it possible to assemble a number of pieces of metal, all of different sizes and shapes, and subject to greatly varying temperatures, and expect them to expand, contract and remain uniformly tight at all times? But it is to be regretted that in defending the principle of water-tube boilers there are other weaknesses to apologize for than braces or stays. There are those with tubes closed at one or both ends, the aggregation of pipe and fittings, and the bent tube monstrosities, so aptly described in a recent publication called "Facts," all more or less dangerous because they cannot be cleaned.

METAL TRADE WITH BRITAIN.

The following table from the British Board of Trade returns shows the value in sterling money of the export of metals, etc., from Great Britain to Canada for the month of December and for the past year, compared with 1894:

	December,		The Year	
	1894	1895.	1894.	1895.
Hardware and cutlery	£3.366	£2,713	£66,038	£54,413
Pig iron.....	1,052	463	23,125	33,467
Bar, etc	1,268	341	18,673	15,116
Railroad	96	5,479	219,657	144,248
Hoops, sheets, etc.....	1,778	2,332	84,064	61,291
Galvanized sheets	666	2,144	55,674	68,172
Tin plates.....	14,632	11,893	197,064	179,927
Cast, wrought, etc., iron ..	4,810	3,485	68,028	60,536
Old (for re-manufacture)..	....	309	19,594	23,597
Steel	3,128	4,435	88,132	75,604
Lead	380	268	12,151	23,061
Tin, unwrought	1,145	313	25,099	25,065
Alkali.....	1,630	1,327	61,242	54,454
Cement	458	245	36,057	25,647

Industrial Notes.

THE Perth, Ont., canning factory is now in operation.

W. CHAPLIN'S saw factory, at St. Catharines, has been granted an exemption from taxation.

DR. MURPHY, provincial engineer, inspected the new Simon's Bridge at Digby, N.S., recently.

THE Citizens' Gas Control Company of London, Ont., capital $9,000, has been incorporated.

THE Fort William Milling Co. has bought the machinery from the Stewart mill at Port Arthur.

R. DEWAR & Co., New Glasgow, N.S., shipped a car load of bicycle rims to a Boston firm recently.

THE West Coast Packing Co., Vancouver, B.C., has been incorporated, with a capital of $30,000

THE Bedford Manufacturing Co will be aided by the town's taking shares to the amount of $15,000, says the Sherbrooke *News-Letter*.

THE city engineer, Toronto, recommends that the city purchase a stone crusher at a cost of $400, and a sand pump at $18,000.

THE machinery is being now placed in W. C. Purves' new sawmill at Carleton, N.B. The mill will be ready for work when the river opens.

J. R. BOOTH, the millionaire lumberman of Ottawa, has offered to give $10,000 towards founding a sanitarium in the Algonquin National Park.

HAMILTON, ONT., is applying to the Ontario Legislature for amendments to the charter of the gas company, which will tend to narrow its franchise.

SUMNER & Co., Moncton, N.B., have purchased a 250 horse-power engine for their new mill, at Bathurst, from E. Leonard & Sons, London, Ont.

THE moulders in the Malleable Iron Works, Smith's Falls, Ont., struck one day not long ago, but after talking affairs over with the management, they went back to work.

MOWRY & SONS, Gravenhurst, Ont., have completed the repairs on the machinery for J. B. Smith & Sons' sawmill at Callendar, Ont., which was burnt down last summer

LETTERS patent have been issued in Ontario to the following: the Toronto Junction Foundry Co.; the Modern Office Systems Co., Toronto; the Stony Lake Summer Resort Co., Ltd.

A CHEESE factory is to be built near McDonald's Corners, Lanark, Co., Ont. It will be a co-operative company. The postmaster will give information.

ST. JOHN, N.B., is likely to receive aid from the Provincial Government in establishing cold storage, as Attorney-General Blair is moving in the matter.

THE south pier at the beach, Hamilton, Ont., upon which the bridge will swing, is complete, and it is said that the Dominion Bridge Co. will put on the superstructure.

THE Fraser River Fish Curing Co., Vancouver, B.C., has been incorporated with a capital of £100,000. M. Costello, C. Tetley and A. Williams are the provisional directors.

THE new buildings for J. G. Miller's foundry, at Chatham, N.B., which were rendered necessary by the fire of October last, were ready in January, and the foundry is now in operation once more.

ALEX. GIBSON has had some new gang-saws in his lumber mills at Marysville, N.B., and also improved water-wheels. The absence of snow in the Lower Provinces has caused a demand for portable saw-mills.

THE town of Shallow Lake, Grey County, Ont., has a new industry, the R. J. Doyle Co., manufacturers of white building brick, sewer tile and bath bricks. These are said to be the only bath bricks manufactured in Canada.

THE mayor of Barrie, Ont., in his inaugural speech, recommended a resident engineer for the summer months of each year, and that a stone crusher and a steam roller should be also added to the town's equipment.

THE stock of the proposed furniture factory at Goderich, Ont., has been fully subscribed, through the efforts of the citizens' committee (A. McD. Allan, secretary), and the building will be gone on with at once. It is said that it will be in operation by June next.

THE Londonderry Rolling Mills at Acadia Mines, N.S., are now at work. The first shipment since the mills were put in repair was made the other day. It consisted of two car-loads. Nine puddling furnaces are in use, and about one hundred men employed.

THE Garlock Packing Co., Hamilton, Ont., inform us that their waterproof hydraulic packing is steadily gaining ground among Canadian engineers and orders are coming in from all quarters. Mr. Byrne, the manager, has been on a visit to Montreal, *where the company have an increasing business.*

C. WHITEHEAD, who has the contract for the St. Andrew's drain near Winnipeg, says he will begin work with two dredges as soon as the ice breaks up. The lateral drains, under 10 feet base, will be made by men and teams. If Mr. Whitehead has a good season, he expects to finish the work by November 15th. From 150 to 200 men will be employed.

THE town of Blenheim, Ont., is still exercised about its town hall. Plans were adopted which called for $7,000, but upon going into the matter a little further, $2,000 additional appeared requisite. As the plans adopted had been preferred to others, chiefly because of their coming within the limit named, the architect is naturally coming in for some criticism.

THE People's Light and Heat Company, Halifax, N.S., has bought the old penitentiary property on the North-West Arm, Halifax. Already $60,000 have been spent on the land and in wages. A large wharf will be built for handling coal, and a tramway run to the I.C.R. for handling coke. It is expected that for the next nine or ten months, about a thousand men will be employed.

THE liquidators of the Waterloo Wood Manufacturing Company of Waterloo, Que., are paying the creditors their dividends. The privileged creditors are receiving $12,389.98 and the unsecured creditors $10,520.21, or at the rate of 42 cents in the dollar. The dividend sheet was not contested. The ordinary creditors may receive a small supplementary dividend in the course of a few weeks.

A. GIBSON, JR., of Marysville, N.B.; J. McAfee, of St. John; P. A. Logan, of Gibson; John Gibson, of Marysville; A. M. Shaw H. N. Fradsham, E. Johnson, of Gibson; John Carten, of Fredericton; J. F. Miles, T. D. Babbitt, and J. E. Simmons, of Gibson; J. S. Neill, of Fredericton, James Pickard, of Gibson, H. G. Kitchen, J. D. Shea, F. Bliss and John Black, of Fredericton, are seeking incorporation as the Gibson Foundry and Machine Company, to manufacture iron, brass and other metals at Gibson. The capital stock is $20,000, divided into 1,000 shares of $20 each; $10,400 is already subscribed.

THE Lachine Rapids Hydraulic and Land Co. (Ltd.), Montreal, Que., has received its charter.

THE estate of Jas. McLaren Ottawa, Ont., will build an extensive dock at that city immediately.

FENSOM'S Elevator Works, Duke street, Toronto, were the scene of a fire recently Fortunately the damage was not great.

AT the sale of the D. Aitchison & Co estate, Hamilton, Ont., James Houlden bought the mill and machinery for $7,150, and the lumber for $1 020.

BLYTH, ONT., wants E. Livingston, of Belgrave, Ont., to remove his saw-mill to the former town They think it worth a bonus of one thousand dollars

THE people of Kingston are determined to have a new drill shed if the Limestone City can get enough influence to bear on the Government to secure it.

THE Montreal Harbor Board refuses to pass upon the Montreal Bridge Co 's scheme for bridging the river at Ile Ronde till the plans have been submitted to the Government

A. W. OGILVIE, C. A. Dugas and L. A. Wilson have retired from the Board of Directors of the proposed British Empire Exhibi" n, leaving those who may subscribe stock to name their own directors

J. R. BOOTH is experimenting in railway transportation, instead of floating, to bring saw-logs to his mills in Ottawa, Ont Logs will be carried from the limits to the mill *via* O. A & P. S Railway, says the *Ottawa Journal*.

THE business of the Canadian Watch Case Co., Montreal, conducted by Wm N Cock and Wm J. Palmer, has developed to such an extent that it is about to be re-organized into a joint stock company under the same management.

THE Iron Founders of the Board of Trade, Montreal, held a meeting for organization lately. Walter Laurie, Wm. Rodden W. Greig, H R. Ives and Joseph Amesse were appointed a committee to draft rules for the proposed association.

MAYOR ELLIOT, Kingston, Ont., will petition Parliament to set aside the clause in the charter of the Cataraqui Bridge Co. which prevents another bridge being built within a mile of the present bridge. Another will be built at Bell's Island.

THE Wire Fence Mfg Company, St. John, N.B. (E. B. Ketchem, secretary, and A. J. Machum, manager), is a new industry that promises to prosper, owing to the facilities for shipment it possesses being so good and fuel inexpensive.

THE Ottawa Car Company has increased its capital by fifty per cent., and proposes to make also wagons, carriages, and other vehicles Their estimated output of farmers' wagons during the coming summer is two hundred, which are to be made under the Snowball patent.

SINCE the defeat of the money by-law to carry out the plans proposed last year for remodeling the Hamilton waterworks, Engineer Haskins of that city is bringing forward another scheme by which it is hoped the defects of the past will be remedied. He will ask for an enlarged appropriation, and carry the work out gradually.

WE have received from the Mechanics' Supply Company, of Quebec city, one of their handy pocket price-lists, which is very complete. It gives all the latest lists on iron pipe and fittings of all kinds. It is invaluable to any one using or buying these goods, as a ready reference. A copy will be sent to any of our readers for the asking.

THE Standard Gas Co. is being formed in Montreal to place upon the market the Lawrence Gas Mixing and Atomizing Process, by which the illuminating and heating qualities of coal gas are increased Senator Ogilvie, Robt. Bickerdike, G. N. Ducharme, F. J Freese, J C Ross and W. P. O'Brien are among those interested.

AN injunction has been granted by Judge Rose, restraining W. H Bamfield & Co., Toronto, from making any use of patterns supplied to them by J M Downer, a pattern drawer, as the said patterns were supplied in breach of agreement with the Safety Barb Wire Co , from whose machines and to whose order the original drawings were made

IN a recent editorial the *Toronto World* urges the city government to secure a dredge for use in Toronto harbor somewhat similar to those used on the Mississippi river, which will cut through sandbars at the rate of ten feet per minute, cutting a path for itself sixty feet wide and six feet deep Such a machine as this would make a great addition to the Island and reclaim Ashbridge's Bay at a not very great expense.

THE Kingston foundry is increasing its staff. Ten men have been put on since the beginning of the year.

WALKERTON, ONT., applies for legislation enabling it to give a bonus of $6,000 to the Walkerton Chair Factory Co.

A SAW-MILL is being built at St. Victor, on the new line of railway connecting Tring on the Q.C.R. and Megantic, Que.

W. H. LAURENCE and H. W. Laurence, of Keswick Station, N.B., will build a large tannery at the mouth of the Cardigan, York county, N.B.

AT the coming session of the New Brunswick Legislature application will be made to revive and amend the Courtenay Bay Bridge Company's charter.

WE understand that the sale of the St. Johns, Que, Stone Chinaware Company to the syndicate in Paris, France, has finally been concluded by Count de Bouthillier for $125,000. It is understood that the purchasers will take possessi on at once, and be ready this spring to manufacture not only ordinary crockery, but fine porcelain ware as well.

THE Henderson Bicycle Co. is now located in its new works at Goderich, Ont. A new building was added to the Runciman foundry property and the machinery brought in from Brantford, where the business had formerly been carried on. The officers of the company for the ensuing year are: Geo. Acheson, president; E. Downing, vice-president; D. S. Henderson, manager and superintendent; J. A. McIntosh, treasurer, and R. McK. Inglis, secretary; whilst the directors are Messrs. Geo. Acheson, E. Downing, Jas. Clark, Jas. Wilson, E. Sayles, J. T. Garrow and D. S. Henderson.

MICHIGAN CENTRAL BRIDGE CO., of Detroit, organized with a capital stock of $2,000,000, for the purpose of constructing a bridge across the Detroit river at Detroit, has filed articles of association with the Secretary of State. The estimated cost of the bridge, which is to be three miles in length, is $4,000,000. The incorporators are Cornelius Vanderbilt, Chauncey M. Depew and C. F. Fox, of New York, Ashley Pond, Henry M. Campbell, H. B. Ledyard and Henry Russell, of Detroit, each of whom is the owner of ten shares of stock of $1,000 each. The balance of the shares are owned by the Michigan Central Railroad.

THE by-law to raise $172,000 to provide a system of waterworks for Petrolia, Ont., was carried by 226 majority. The scheme proposed is to take water from Lake Huron, near Perche Station, by an intake pipe laid 900 feet out into the lake. The estimate of Willis Chipman, the engineer of the works, provides $4,000 for the 900 feet of intake pipe; $500 for the land, grading and crib work at the intake; $3,500 for a building for the pumping station on the lake shore; $6,000 for the boiler and pumping machinery; $1,000 for a house for the engineer, and $500 for a gas well for fuel. The main pipe to carry the water from the lake shore to Petrolia is to be 12-inch, 66,000 feet long, and is estimated to cost $101,000: right of way, $2,000, and $8,500 for a stand pipe at Petrolia, 25 feet in diameter by 70 feet. The distribution service at Petrolia is estimated to cost $31,000 · 300 meters, $3,000; valve chambers, $4,000; and $7,000 allowed for engineering and contingencies, make up the balance of the $172,000. The debentures are to be for $100 each at four per cent., and are to run for thirty years.

THE Canadian correspondent of the *Horseless Age*, N.Y., writes: "A number of English firms are in communication with the leading motor enthusiasts here and everyone is looking forward to the coming Canadian exhibition of motor vehicles with great interest The exhibition was first proposed by THE CANADIAN ENGINEER, a technical journal in Toronto, which has given a great deal of space to the subject of motors lately, and the proposal was warmly seconded by a number of leading journals. The location of the exhibition is still unsettled. Toronto, Hamilton and Montreal are all eager to secure the prize. At present things are looking Montreal's way, as the British Empire Exposition is to be held in that city from May to September, 1896, and promoters are naturally anxious to add so novel an attraction to their programme. Wherever it is to be held, it is sure to be a success. Many of the motors which are now at an experimental stage will, by that time, be in shape for a practical exhibition of their powers, so that the number of machines exhibited is sure to be very great.

EXPERIENCE seems to show that the use of storage batteries in central stations, affords a certain flexibility which makes them a desirable adjunct to the generating machinery, and as this has become generally recognized, it has resulted in their adoption, not only in central stations, but also by several of the larger manufacturing concerns in connection with their own power plants.—*Chas. T. Rittenhouse, in Electric Power.*

Mining Matters.

PARTIES are prospecting for mica near Charleston Lake, Leeds county, Ont.

THE iron mine at Mount Pleasant, near Digby, N.S., is soon to be opened again.

NOVA SCOTIA gold mines are credited with a production of 22,000 ounces in the past year.

THE *Arnprior Chronicle* says that James McMaster, of Scotch Bush, discovered a vein of nickel ore when digging a well.

OIL was struck in Yarmouth township, Elgin county, near St. Thomas, Ont., recently, by a farmer who was digging a well.

IT is said that 1,500 tons of red hematite ore from the Wallbridge mines, Madoc township, have been sold to the Hamilton Smelting Works.

HUGH LEONARD, of Garthby, Que., has sold 400 tons of chrome iron to an American firm. About 60 men are employed in the mine.—*Sherbrooke News-Letter.*

THE War Eagle Mine, Kootenay, B.C., is producing 50 tons of ore a month. The machinery for a new 20-drill air compressor plant is now partly on the ground.

THE North Star Mine, Kootenay, B.C., is sending out 30 tons of ore a day, and a contract for the delivery of 5,000 tons during the coming summer has just been made.

THE Josie Gold Mining Co., capital $700,000, is incorporated to mine in British Columbia and the United States. The incorporators are citizens of the United States.

SHEDIAC and Sackville, N.B., capitalists are applying for incorporation as the Northumberland Stone Company, Ltd. Capital, $10,000. Alex. Gibson, of Marysville, is interested.

PROSPECTORS who have been working through Cape Breton during the past year, claim to have discovered both gold and silver bearing ores of sufficient richness to warrant development.

GEO. HUFF, M.P.P., says that in the Alberni district mining is progressing very favorably. The Cataract claim is doing well, and preparations are being made for working the Duke of York, an adjoining claim.

THE Standard Oil and Gas Co., which has been drilling for a month at well No. 5, two miles east of Kingsville, Ont., struck a gusher there a short time ago, which was estimated to yield 7,000,000 feet per day.

THE manager of the gold mine at North Brookfield, N.S., W. L. Libby, deposited a brick of gold in the Merchants' Bank at Bridgewater recently, which represented the result of one month's work at the mine. The brick weighed 561 ozs., and was worth $10,400.

THE Joggins mines, belonging to the Canada Coal and Railway Company, Nova Scotia, are the scene of a labor dispute. The men refused to work at a reduced wage, and so the mines closed down. As the management appears firm, a number of the men are leaving the place.

THERE has been a discovery of gold in the Birch Hills, about thirty-five miles from Prince Albert, N.W.T., says the *Prince Albert Advocate.* It promises to be as rich as the famous Black Hills. The Rev. N. Williams, Kinistino, brought samples of the gold to the office of the *Advocate.*

THE manager of the Empire Gold Mining Co., Fort William, Ont., has ordered a ten-stamp mill in Chicago for their mine, which is located at Jackfish Bay, Algoma, Ont. This mine has, it is said, a vein 20 to 40 feet wide, and the assays run into figures which are remarkable.

THE old Bothwell oilfields have been taken in hand by Petrolia investors. The demand for crude oil is so strong that wells of a very small yield are being pumped Some of the Bothwell wells yield a barrel an hour, which accounts for their coming into use, as some of the wells in Petrolia now yield only four or five gallons per day.

W. HAMILTON MERRITT, in an interview in the Kingston *News*, is very enthusiastic about the prospects of smelting in Ontario and the development of the iron mines in the Kingston district. He is of opinion that the Government should test the depth and quality of the different iron fields indicated on the map of the geological survey, by sending out diamond drills to ascertain the exact facts. Capitalists would then feel more confident in investing.

THERE is talk of establishing a smelter in Vancouver. The promoters intend to look to the city for assistance in the matter.

THE British Columbia Smelting and Refining Company, Trail Creek, B.C., is now receiving 100 tons of ore daily from the Le Roi mine.

THE exports of copper ore from Canada to Great Britain for year ending December, 1895, were valued at £48,656, as against £26,956 for 1894.

THE School of Practical Science, Toronto, is having a three-stamp mill placed in the mining laboratories this month. Ores in quantities up to one ton can be treated at the school.

THERE seems to be some prospect of labor troubles arising in British Columbia from the displacing of white labor in the coal mines by Chinese. Some 150 white laborers in Nanaimo have been "laid off" temporarily, and there seems every prospect of some Chinese laborers being taken on for reasons of economy. Hence trouble is feared.

SOME time ago the board of directors of the Ontario Natural Gas Co. passed a resolution removing Dr. King from the position of manager and appointing a new man in his place. Judge Horne granted an injunction restraining the new manager from acting, and when appeal was taken from this to the Divisional Court, the three judges unanimously dissolved the injunction.

THERE seems to be some prospect of the rich iron deposits in the county of Lanark, Ont., being worked at last. A. B. Rudd, of Perth, has opened a very valuable find on lot 15, 5th concession of Oso, within two hundred yards of the C.P.R. The vein is a hundred yards wide, and ... lands for some miles east and west. The ore is estimated to yield 70 per cent. pure iron.

THE smelter at Nelson, B.C., was blown in on January 14th, the furnace hands having been brought from Salt Lake City to take charge of the operations. The furnace will treat 4 tons of ore per hour, making 96 tons per day. About 2,000 tons are in the bins and 6,000 or 7,000 tons on the dumps at the mines. Twenty-five tons of coke are used to 100 tons of ore and ten per cent. of iron and lime.

A NUMBER of new mining companies have been recently incorporated in British Columbia, as is seen from the notices in the *Official Gazette.* Some of them are: The Silver Key Co., C. M. Gething, president, capital $100,000; the Peter's Creek Co., C. S. Stanford, managing director, capital $25,000; the Homestake Co., Thos. Dunn, $500,000; the Sunshine Co., N. D. Moore, $500,000; the O. K. Co., British Columbia and Spokane, U.S.; the North Saanich Coal Co., T. W. Paterson, $25,000; the Cumberland Co., N. D. Moore, $500,000; the Great Western, British Columbia and Spokane, U.S.; the Old Ironsides Co., British Columbia and Spokane, U.S.; the Elk Co., O. Marstrand, $10,000; the Invicta Gold Co., England, £100,000.

Railway and Marine News.

ON January 15th seventy men were discharged from the C.P.R. car shops at Perth, Ont.

A NEW steamboat to run on the Fraser River and Harrison Lake is to be bought by Mr. Menton, of Chilliwack, B.C.

A COMPANY is organizing in Winnipeg to improve the navigation of the Red River by building a lock at St. Andrew's.

AT the annual meeting of the Hamilton Steamboat Company Murray A. Kerr was appointed president for the ensuing year, and M. Leggat, vice-president.

WM. EDWARDS, boatbuilder, Gananoque, Ont., has been offered the building of a half rater for a Montreal man, to challenge next year for the American yacht races.

THE Sault Ste. Marie and Hudson Bay Railway Company is applying for extension of time for commencing and completing the road, and for leave to use electricity.

THE engines are being taken out of the steamer "Calvin," which was wrecked on Napp's Point last summer. New boilers will be required before the engines are again used.

WORK is being prosecuted on the temporary work at the railroad bridge at Upper Woodstock, N.B., preparatory to permanent work. Quite a large crew is engaged, F. M. Curry in charge.

PARTIES in Buffalo and Fort Erie have purchased the old Detroit River ferry steamer "Hope," for $5,000 cash. The vessel will be rebuilt to run on the Canadian side of Niagara River, between Buffalo, Black Rock and Victoria.

THE G.T.R. car-wheel works at Hamilton, Ont., are running with a full staff of men.

THE earnings of the Galt, Preston & Hespeler Railway are fifty per cent. over those of last year During that time 13,000 passengers were carried.

KENNEDY & SONS, Owen Sound, Ont , are repairing the C P R. steamship "Alberta," which was damaged at Fort William by the steamer "United Empire"

IT is reported that the Nova Scotia Central has passed out of the hands of the receiver. A company called the Central Railway Co. has been organized and takes over the road.

ANDREW CARNEGIE, Pittsburg, U.S., and others are to be incorporated as the Lake Erie and Ohio River Ship Canal Company, to construct a ship canal between the points named.

THE contractor for the Kirkfield section of the Trent Valley Canal is calling for tenders for a large quantity of hemlock timber, required for flooring the canal at several points where quicksand has been encountered.

IT is reported that the projectors of the Manitoba South-eastern Railway—the proposed lumber road from Winnipeg to the Lake of the Woods—will apply again for aid to the Provincial Government.—*Winnipeg Commercial.*

THE steamer "Lake Ontario" recently arrived in St. John, N.B., ahead of the manifests of her freight. As the manifests came *via* the crack mail boats to New York, the St. John people think well of their position as a winter port.

THE Grand Trunk special train which brought Dr Roddick from Montreal to Kingston to see the late Dr. Fenwick, made extraordinary speed Between Brockville and Kingston, a distance of 48 miles, was covered in 45 minutes.

THE plan of the proposed railway and traffic bridge of the Edmonton District Railway Company, at Edmonton, Alberta, has been received there The plan is the same as that of the Government traffic bridge, with a roadway on each side supported on brackets.

A STANDARD gauge railroad from Kamloops, B.C., to Barkerville, in the heart of the Cariboo country, a distance of about 350 miles, almost directly north from the Canadian Pacific, is said to be practically assured, and the plans to build it are now being prepared.

BRECKENRIDGE'S MILLS, ONT., is the present terminus of the I. B. & O. Railway and is fourteen miles from Bancroft. It has a suitable station-house, and the railway company has put up a fine store Tracklaying is completed about five miles further in this direction —*Bancroft Times*

IT is reported that the Michigan Central Railway have in contemplation the erecting of an addition to the shops at St. Thomas, Ont., and the building of more new cars, as they can be built more cheaply there than at the Jackson, Mich., shops. If the change is decided upon it will give employment to a large number of mechanics.

THE Ontario, Belmont and Northern Railway is applying to the Ontario Legislature for leave to run their line from the Central Ontario Railway, near its junction with the C.P.R., north through Marmora to the Irondale, Bancroft and Ottawa Railway, and thence to Baysville in Muskoka.

THE International Deep Waterways Commission has just completed its session at Detroit. The utmost harmony prevailed during the meeting. Messrs. Keefer and Monro, of the Canadian commission, and Cooley, of the United States commission, were appointed to prepare the report of the commission.

E F FAUQUIER, of Toronto, has been given the contract for the remaining 47 miles of the O A. & P.S. Railway between the Georgian Bay and Ottawa ends of the road. Half a million dollars is the price, and the work must be completed this year. Three thousand men will be required.

J M BARNES, M P P , of Kent county, who has the contract of the Central Railway extension from Chipman, N.B., to the coal fields of Newcastle, is building houses for the workmen who will build the railway bridge across the river this winter. The bridge is to be completed in May next, when the work of forming the road bed will be commenced.

THE case of O'Neill & Campbell *vs* the Queen is before the Exchequer Court About $100,000 is involved. The matter in dispute is the line recently constructed from Digby and Annapolis, which was to have been paid on schedule rates Already $509,682 has been paid, and the additional sum is claimed on five bridges.

DURING a recent cold snap one of the Port Dover coal ferries got frozen in some miles out in the lake. A rather novel sight was the transfer of several loaded coal cars from one boat to the other in the open water, in order to lighten her enough to make the harbor.

APPLICATION will be made at the next session of the New Brunswick Legislature by Frank P. Killeen, C.E., for authority to incorporate a company to construct a railway from Fredericton or Gibson to Moncton The new company will be called the Central New Brunswick Railway Company.

THE Coast Railway, N S., is making progress. Currie Bros. & Bent have completed the stations at Arcadia, Tusket and Bellville, and the engine-house and coal-shed are nearly completed, The road will be operated by telephone. Townsend & Co. are track-laying between Tusket and Bellville.

THE British American Land Co. has offered a large plot of land for the location of the new Quebec Central shops at Sherbrooke, Que. The railway company have signified their intention of removing their works to another point on their line, and the city is offering inducements to keep them there.

THE changes made by General Manager Hays, since taking charge of the G.T.R., are in the direction of centralizing the different departments of the road and the authority at Montreal. For instance, division superintendents are being done away with altogether, and one general superintendent appointed, with authority over the entire system, the claim being that division superintendents worked for their own particular division rather than the general interests of the road.—*Toronto Globe.*

LIKE Montreal's, Quebec's shipping trade during the past season shows a considerable falling off; but in the case of the latter port it is to be remarked that this diminution has been going on steadily since 1880. During the season of navigation just closed, the total number of vessels entered inwards at Quebec was only 300 and of clearances 230. Of the former, 98 were steamers and 202 sailing vessels, and of the latter 115 were steam and 115 sailing vessels. In 1880, on the other hand, the total number of vessels entered inwards was 849 and outwards 842. Since then, the decline of Quebec's maritime trade has been, with the exception of one or two years, steady and unbroken.

S. A. KING, vice-president of the L. E. & D. R Railway, reports that he has been successful in his interview with the Premier and Minister of Public Works, as to the reconstruction of the harbor works at Port Stanley. The docks will be reconstructed, the pier extended, and the harbor dredged, all to be ready for operation the latter part of spring. This work will be done so as to allow the landing of the proposed car ferry boats from Cleveland, and which will connect with the London & Port Stanley, a branch of the L. E. & D. R. Railway. The harbor is in a very bad condition, and has not been improved since the London & Port Stanley was operated by the Grand Trunk Railway. It is estimated that the work will cost about $40,000.

THE St. Catharines and Niagara Central Railway is not enjoying the most complete prosperity. Traffic returns show a falling off and the directors are not in the most perfect harmony. A number of the directors are determined to sell the road, and it is said the G.T.R. will be the purchaser if it comes into the market. This, the St. Catharines people do not look forward to with any pleasure, as it would mean that they would have only one railway. The Rolls estate is taking action to force the sale, claiming that the majority of the shareholders favor that course. As the city is a heavy shareholder, it is probable that the townspeople will see that their interests are safe-guarded.

SINCE the car ferry steamer "Shenango, No. 1," began running last August, it has carried to Port Dover from Conneaut, not to speak of any return freight, 1,354 cars of coal, 78 cars of iron ore and manufactured iron of all kinds, two cars of stone, three cars of pumpkins, two cars of walnut logs, and one car each of lumber and coke. The coal weighed 78,408,000 pounds, of which over 51,000,000 was for the G.T.R. The iron ore, etc., amounted to 2,960,000 pounds, the stone to 80,000, coke 20,000, walnut 80,000, lumber 40,000. Assuming that "Shenango, No. 1," brought freight at the same rate for the next nine months that she has during the past three, and there is no reason to suppose that she won't do even better when everything is in good running order, she would carry in the same direction at least 290,000,000 pounds of freight a year, and her consort should do equally well, making a total of freight landed there of about 600,000,000 pounds a year, not to speak of the return freights, or the revenue to be derived from passengers, a revenue, which, as time goes on, will undoubtedly grow.

THE new steamer being built by the Calvin Company at Garden Island is 125 feet long. It will cost about $5,000. The machinery from the steamer "Traveler" will be placed in the new boat.

AT the annual meeting of the shareholders of the Hamilton & Barton Incline Railway a dividend of 5 per cent. was declared, and a small surplus was carried over. The following were elected directors: W. G. Walton (president), John Dickenson (vice-president), Wm. Magee, jun. (sec.-treas.), J. D. Evans and James Chisholm.

AT the annual meeting, the Canadian Marine Association commended the action of the Government looking towards improved water communication. The rates of wages and freight tariffs for the coming season were also decided upon. The election of officers resulted as follows: President, R. C. McKay, Hamilton; vice-president, W. A. Geddes; secretary-treasurer, J. G. Trowell; executive committee, Capts. Crangle, Gaskin, Fairgrieve, Sylvester, S Neelon, and Messrs. J. B. Miller, C. A. Jacques, and D. G. Thompson.

THE Department of Public Works, Quebec, attempted to appoint a sequestrator to the Baie des Chaleurs Railway, now a portion of the Atlantic and Lake Superior system, because it was alleged that the road in question was insolvent and not being worked, consequently Hon. Mr. Nantel held that by the Quebec Railway Act his department should work the line and protect the creditors. On the other hand, Hon. Senator Thibadeau, with his co-directors, as well as the creditors, swore that the company was perfectly solvent, and that, anyway, the local Government had no right to touch a road having a Dominion charter. Judge Pagnuelo, of the Superior Court, decided that the Department of Public works was in the right, and named A. B. McDonald, of the I.C.R., as sequestrator. However, the Court of Appeals, presided over by Sir Alex. Lacoste, decided that the hand of the sequestrator must be stayed until the case has been heard in appeal.

A MEETING of the directors of the Lindsay, Haliburton and Mattawa Railway Company, an extension of the Haliburton branch of the Grand Trunk to Mattawa, was held in Lindsay on January 25th. The following officers were elected for 1896: Major Sam Hughes, M P., Lindsay, president; Hon. John Dobson, Lindsay, vice-president; Wm. McArthur, Fenelon Falls, secretary; John H. Brandon, Fenelon Falls, treasurer; directors, Frank Sandford and William Jordan, Fenelon Falls; J. O. Revel, Coboconk; Michael Brown, J. W. Watson, James Mortimer, and William T. Gainer, Minden; Robert Bryans, Lindsay, and George Laidlaw, Victoria Road. It was decided to arrange with the Boards of Trade of Toronto, Lindsay and Mattawa, as well as with the county councils of Victoria and Haliburton, to wait upon the Ontario and the Dominion Governments with a view to secure bonuses for the road. The extension would open up to Toronto a large territory, rich in timber, minerals, farming and grazing lands.

Electric Flashes.

SLEEPER & AKHURST, Coaticook, Que., have put in a new water-wheel in their electric light plant.

ROCKWOOD ASYLUM, Kingston, Ont., has had an electric pump put in in connection with the water supply.

THERE is a movement on foot to connect Kingston, Gananoque, Rockport and Brockville, Ont., by an electric railway.

ALL the work on the Hespeler, Ont., extension of the Galt, Preston & Hespeler line is now complete. Government Inspector Ridout went over the line on January 24th.

THE Deschenes Electric Co., Aylmer, Que., has been incorporated to build and operate works for the distribution of electricity. R. H. and John C. Conroy are among the promoters.

T. B. RIDER, M.P., is about erecting a large building at Magog for the purpose of putting in an electric light plant and for the accommodation of the Stanstead county *Herald*, which will be published there.

THE township of South Grimsby, Ont., has handed over to the T., H. & B. debentures to the amount of $4,000, that being the bonus voted by the ratepayers. The company was also granted exemption from taxation.

THE people of Uxbridge are listening to reports as to the possible failure of their electric railway scheme to go through, and they are wondering if they are liable for the second instalment on the subscribed stock in case it does not.

THE Bell Telephone Company is about to erect a handsome building in Winnipeg.

MONCTON, N.B., has a new dynamo from the Royal Electric Co. It is of 1,500 light capacity.

A. F. FOLGER has been appointed managing director of the Kingston Heat, Light and Power Company.

IT is reported from Windsor Mills that the proposed electric railway between the dam and the paper mills will be built soon.

THERE is a good deal of talk in Lennoxville about the advantages of having an electric railway between that town and Sherbrooke, Que.

THE Yarmouth, N.S., Telephone Co. is stringing wires for the use of the Coast Railway Co., which will be operated by telephone instead of telegraph.

THE townspeople of Seaforth, Ont., are going to instal an electric fire alarm, purchase additional hose, and generally improve their fire department.

THE city council of Moncton, N.B., has unanimously decided to petition the New Brunswick Legislature for the cancellation of the charter of the Moncton Electric Tramway Co. for failure to fulfil the conditions of the charter.

REV. DR BURNS and Engineer Power, who are promoting the electric road to run from Hamilton to Waterloo, held a meeting at Rockton, Ont., recently. The citizens are heartily in favor of the scheme and no doubt "something will be done."

THE shareholders of the Toronto Electric Light Co., at a meeting, Jan. 27th, empowered the directors "to purchase stock in another corporation." It is an open secret that the stock of the Incandescent Light Co. is the stock to be bought.

THE Toronto Street Railway has paid two dividends of 1¾ per cent., amounting to $210,000. Net profits for the year were $301,310, as compared with $250,695 in 1894. Net earnings are double what they were four years ago. The company built 30 open cars, 20 closed cars, and six sweepers in their own shops.

THE Canada Electric Co., of Montreal, have now completed their contracts with the Long Point Insane Asylum, having installed electric light plant of 600 lights with dynamos complete, the Warner system of electric time throughout the buildings, watchman's electric time detector, telephones, electric bells and other electric work.

GEO. A. POWELL, assistant manager of the Packard Electric Co., who has been in Toronto for a few days, reports business with his company as steadily increasing. This company have been appointed agents in Canada for the Bryant Electric Co., of Bridgeport, Conn., manufacturers of switches, sockets and other electric supplies.

THE Montreal Street Railway professes to have no desire to build a line up the mountain; they would only do so in order to prevent some one else doing it, and at the earnest request of the council. G. C. Cunningham, manager, says the line would cost $100,000, and as it would be open only four months in the year the returns could not be such as to make it a profitable investment.

JAS. BONFIELD, of Eganville, was in Arnprior on Saturday last, feeling the pulse of the citizens regarding putting in another electric plant. He petitioned the council on Monday night for the use of the streets, but they referred it to the fire and light committee for more information. We have since learned that Mr. Bonfield has secured 1,000 lights, and consequently will at once commence operations.—*Eganville Star.*

THE Berlin and Waterloo Street Railway is undergoing changes. The controlling interest held by Mrs. Burt, of New York, has passed into the hands of W. H. & E. Carl Breithaupt. This will have a good effect on the road, as the new owners are citizens of the town and greatly interested in its progress, T. M. Burt and T. E. McLellan retaining their places in the management, but E. C. Breithaupt is president.

CORNWALL is to have an electric street railway. The contractors are W. Harper, of New York, and D. H. Starr, of Montreal. The contract was signed January 23rd, and tenders have been called for for two thousand cords of stone for the roadbed, to be delivered immediately. The contractors expect to have the cars running by the first of June. W. R. Hitchcock was the promoter of the scheme. A line is to be run from the Grand Trunk station to the Canada Cotton, Stormont Cotton, Cornwall Manufacturing Company, and Toronto Paper Company's Mills. The company will likely secure the Grand Trunk freight. The town council voted five hundred dollars yearly to the company to keep the road between the rails and eighteen inches on each side of the rails in condition.

A ST. THOMAS gentleman is said to be negotiating for the purchase of the St. Thomas street railway from Hunt & Cameron, of London, Ont. A price has been set on the franchise, and it is not unlikely that the road will pass into new hands on the first of March.

AN unknown man walked into the office of the Winnipeg Electric Railway and without a moment's warning fired a revolver shot at the head of Supt. Glenwright, who, when he saw the revolver raised, jumped to one side and escaped unhurt. The would-be murderer then ran out of the back door

THE secretary-treasurer of the Brantford Electric and Power Co. has been appointed liquidator instead of Robert Henry, who had been appointed by the local master. Hardy, Wilkes & Hardy represented creditors to the amount of $66,000 out of $68,000, and order was made on their appeal.

THE Manitoulin and Pacific Railway Company is making application for an Ontario charter to build an electric railway from a point in Manitoulin Island to a junction with the C.P.R., between Sudbury and Algoma Mills, with power to operate a ferry or build a bridge at Little Current.

THE Supreme Court at Ottawa has dismissed the appeal of the City of Vancouver. This upsets the by-law passed by the ratepayers in 1894, authorizing a civic electric lighting plant. The council has now passed a by-law providing for the lighting of the city by the Western Electric Company.

THE Lachute Electric Company's case was recently heard by Judge Belanger in Montreal. J. Palliser claims $20,000 damages for injuries resulting from his alleged illegal and forcible expulsion from the premises of the Lachute Electric Company, which he alleges had been sold by T S. Vipond to W. J. Simpson and J. Boyd without his consent.

THE Lincoln Radial Electric Railway Co. is applying for a charter to build lines from St. Catharines to the villages of Jordan, Beamsville and Grimsby, with a branch to Smithville, and to Port Dalhousie, and also to Queenston, with power to buy the Lincoln Street Railway Traction and Light Co., Ltd.

THE recent sleet storm in Ontario caused great damage to the property of the different companies owning overhead electric wires. The great advantage of the underground system is demonstrated by the fact that the Toronto Incandescent Light Co. came out without any loss, while the other companies lost heavily. The railways were also losers, but the G T R. less than the others, owing, it is believed, to the fact that that company's poles are shorter and stouter than is usual The C P R. was helpless for a short time with wires down in all directions. The Bell Telephone Co.'s loss in Toronto is estimated at $20,000, twice the amount of the loss in the storm in 1893. That amount would put a good many wires underground, where they lawfully belong, and it is probable the company will give the matter their attention at an early date. The G.N.W Telegraph Co had its lines in working order in a day, but the other companies were much less fortunate. The electric plants in the towns in the storm-swept district, all suffered heavily.

IT would appear from the following correspondence in the *Lindsay Post*, that though the good people of Port Perry have "money to burn," they insist on, at least, having the satisfaction of a sight of the smoke produced by the process "Mr. Pew, the promoter of this scheme, was in town last week trying to collect the balance, $500, of the $1,000 subscribed to the road by Port Perry. As this amount was not to be paid until the charter was secured, there is considerable uneasiness among those who subscribed, and it is not unlikely he will fail in his mission. Your correspondent would like to see the road go through, as it would undoubtedly be a great benefit to the town, but the methods of the promoter are, to say the least, peculiar and unbusinesslike, and our monied men will do well to think twice before handing over their cash in support of a line that has yet no existence except in the imagination of Mr. Pew. Let the charter be produced, and there will be no difficulty in getting Port Perry's share of the money required to build the road."

Personal

J. H. KILLEY, mechanical engineer, Hamilton, Ont., gave evidence as an expert in five different cases at the last assizes at Hamilton.

J H. MEIKLE, bookkeeper for Frost & Wood, implement manufacturers, Smith's Falls, will travel for Lewis Bros., wholesale hardware, Montreal.

ALEX. KAY, who has carried on an electrical business in Hamilton for some years, died there on January 14th Mr. Kay was a resident of Hamilton for twenty years.

ROBERT WILSON, the late foreman of the Grand Trunk Railway boiler shop, Point St. Charles, Montreal, is to be succeeded by Mr. McIntyre, foreman of one of the Stratford, Ont., locomotive shops.

G. A. BROWNE, of the Deseronto Navigation Co., who has resigned and accepted the position of assistant manager of the Richelieu and Ontario Navigation Co., will soon take up his residence in Montreal.

JOSEPH HOBSON, the new chief engineer of the G T.R, of whom there is a sketch in another column, will be accompanied to Montreal by his son, Robert Hobson, chief clerk, and Arthur Tisdale, stenographer, from Hamilton.

R M. HANNAFORD, son of E. P Hannaford, chief engineer of the G T R, formerly of the Phœnix Bridge Co., Phœnixville, Pa., has been appointed bridge engineer of the G.T.R., with his headquarters at Montreal.

W S. KINNEAR, formerly assistant engineer of the Canada Southern Division of the M C R., and latterly engineer of construction of the T, H. & B., has been appointed assistant chief engineer of the whole M C R system, with headquarters at Detroit.

THE death is announced of Wm. C. Hobbs, an old and respected resident of London, Ont., for nearly 35 years. The deceased for a long time owned a brass foundry and machine shop on Clarence street, but, owing to old age, was compelled to retire a few years ago He was a native of Prince Edward Island, and was 89 years old.

CAPT J I. LANG, R.E., made a companion of the order of St. Michael and St George for services in connection with the railway survey and delimitation of the western boundary of the Gold Coast Colony, is one of the several graduates of the Royal Military College of Canada who have come well to the front in the Imperial service. He is now on the staff of the School of Military Engineering, Chatham, as assistant instructor in estimating and construction. He is a native of St. Mary's, Ont., and graduated from the Royal Military College, June, 1883. Capt. Lang was secretary of the Canadian Commission of Defence, 1888, and conducted a detailed survey at Victoria, B.C., in the same year.