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
- ☑ 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.
- ☐ Additional comments:/ Commentaires supplémentaires:

- ☐ 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
- ☑ 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

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. VI.—No. 3. TORONTO AND MONTREAL, JULY, 1898. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

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

SUBSCRIPTION—Canada and the United States, $1.00 per year; Great Britain and foreign, 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, 1892. 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, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

STREET PAVING MATERIALS.

BY J. J. BELL.

It is clear that the experimental stage has not yet been passed in determining what is the best material for street paving. So many points have to be considered—durability, facility of repair, noise, sanitation, cost, etc., that it is difficult to determine what material combines these qualities in the greatest degree. What is suitable for one kind of traffic may be unsuitable for another, what is a success in one climate may be totally unfitted for another, a cost which is possible on a great business thoroughfare, or a fashionable residential street, may be out of the question on the poorer streets, where property owners cannot afford an expensive pavement. A good deal has yet to be done in the way of experiment, and the material employed must vary according to local conditions.

Wood and stone are the two natural materials which suggest themselves for street paving. The noise produced by traffic over a stone pavement precludes its use on residential streets, except in the form of macadam, while wood, so far as used hitherto in this country, is not sufficiently durable for heavy traffic. There is, however, a growing tendency to go back to wood in European cities, especially Berlin, and it is said that before long three-fourths of London will be surfaced with this material. The wood employed there is the Australian jarrah, which has displaced all kinds of wood except Baltic fir, which it is rapidly driving out. Jarrah is an exceedingly hard wood and is said to be equal in wear to granite. It is impervious to moisture, and being a species of eucalyptus is antiseptic and therefore no objection can be urged to its use on sanitary grounds. Another Australian wood, karri, is second only to jarrah, and the Tasmanian blue gum has stood very satisfactory tests in Glasgow. Of course none of these woods are likely to come into use in America, as it would cost too much to import them, where other suitable material is so abundant.

The experience of cities on this continent seems to point to asphalt as the best all-round paving material, cost being the principal objection. Laid on concrete it is durable, clean and easily repaired, and heavy traffic seems to harden and consolidate it. It is liable to rot from water lying on it, but this may be overcome by giving the roadway sufficient crown to allow the water to run off freely and by substituting stone or other material for gutters next to the curb. Asphalt will not answer for track allowances or the strip close to the rails, where the jarring of the cars rapidly disintegrates it, but with granite blocks, or better still, so far as bicycle traffic is concerned, scoria or brick on the tracks, asphalt makes an almost ideal street. An objection is the tendency of horses or bicycles to slip. With a thin coating of ice or snow, or in muddy weather, they are liable to do so, but there are comparatively few days in the year when such conditions exist to an extent to cause inconvenience. An interesting test of the merits of different pavements for slip was made in London, England, some time ago, when a record of the accidents for 50 days showed asphalt 1,066, granite 719, wood 542. On streets of steep grade asphalt cannot be employed. In Halifax concrete is used on grades and asphalt on the level. In New York asphalt is being substituted for granite on some of the streets, the asphalt surface being laid over the granite just as it is, instead of removing it and putting down concrete foundations.

So far as sanitation is concerned, an interesting fact is stated with regard to Buffalo, N.Y., which has more asphalt pavement than any city in the world. It is asserted that since the introduction of asphalt the death rate has decreased, especially among children. This, if verified by the experience of other cities, should go far to encourage the use of asphalt.

Next to asphalt in favor as a permanent paving material, and rapidly winning its way, is brick. In Toronto it is somewhat cheaper than asphalt, and could a good vitrified brick be supplied at a reasonable figure it would come into general use in replacing the cedar blocks which were so extensively laid down some years ago and which have proved such a failure. Brick is somewhat noisy, but it is not so slippery as asphalt, and is easily repaired and durable. A section of brick pavement at the intersection of six streets in Richmond, Indiana, which has been down for six years, and subject to heavy traffic, has not cost a single cent for repairs, and looks as if it was good for six years more. Asphalt and brick are likely to be the two favorite paving materials for city streets in the future.

Macadam will always be employed more or less for

roadways. Heavy traffic cuts it up, but by the use of broad tires this difficulty may be obviated to a great extent. No matter how well constructed, the stones are liable to work out, and it is dusty or muddy according to the season. By the use of trap rock, instead of granite or limestone, the highest perfection of macadam may be attained. There is a large deposit of trap near St. Joseph's Island, on the north shore of Lake Huron, which costs little more than the expense of quarrying. An experiment in its use was made at Cleveland several years ago. Two miles of road was made in one of the parks, which has worn well. The foundation is crushed limestone ten inches deep, then eight inches of trap in three layers—coarse screenings, fine screenings and dust—all well rolled. The road cost $3.10, $3.19 and $3.65 per square yard according to grade. Trap is extensively used in Germany, where it has proved very satisfactory. There are extensive layers of trap rock on the St. Lawrence near Kingston, convenient for loading on vessels, and therefore easily available for use in cities situated on the great lakes.

A very unlikely material for paving has been employed in the vicinity of the stock yards in Philadelphia. It is supplied from a plant set up at Norfolk, Virginia, to manufacture the grass that grows in the salt water marshes into paving blocks. The grass is subjected to enormous pressure, and then cut by circular saws into blocks 5½ inches thick. These are treated in three tanks containing different kinds of oil, which renders the fiber supple. A wire helps to hold each block together. The pavement is said to be smooth, noiseless and free from slip. The most remarkable paving material which the readers of this journal probably ever heard of is molasses! In the process of sugar refining in the Southern States large quantities of molasses are produced, which is a waste material, sometimes difficult to get rid of. The head chemist of a refinery in Chimo, Cal., bethought him of a means to turn it to account, and he had a walk, 1,000 feet long, constructed of slabs of molasses mixed with sand. It dried quickly, became hard and was not affected by the sun. A slab two feet long and one foot wide was tested by being placed on supports for a couple of inches at each end. When struck with a heavy hammer it showed no sign of either cracking or bending.

As cost is a very important factor in paving, a statement is appended showing the approximate cost per square yard of the pavements in general use in Toronto. The relative cost will be much the same in other Canadian cities. The figures are for a roadway 24 feet wide:

Heavy asphalt, 6 inches concrete, 2½ inches asphalt	$2 70
Light asphalt, 4 inches concrete, 2 inches asphalt	2 30
Brick on 4 inches concrete	1 60
" on broken stone	1 45
" on gravel	1 30
Cedar block on 6 inches concrete	1 40
" on 6 inches gravel (wooden curb)	70
Macadam	1 20

THE WHITE SLAVES OF THE PASS.

That there is no slavery under the British flag has been our boast for two generations and we have looked not uncomplacently upon the people of the United States, who by law made all men free and equal, yet for many years bought and sold their fellowmen in the open market. It is no longer lawful for a man to sell himself into bondage, or his wife or children, to pay his debts, but in Canada we have discovered recently that men may be decoyed into the waste places of the earth and there forced to toil their lives out in misery at the pistol's mouth. We quote one paragraph from the voluminous report of the commission appointed by the Dominion Government to enquire into the subject: "We note some special facts, such as, for instance, the fainting of men on the works; the refusal on the part of teamsters, whose wagons were hardly loaded, to give a ride to wounded men, such as young Joseph Bourgignon and Theodore Lambert; some threats of Noble, one of the foremen, to kick them; the alleged bad treatment by the same foreman of men who had had difficulties with the company, and who were discharged one day after they had returned to work; the refusal of food generally to all men discharged or quitting work, and the hardship experienced on account of this, which caused one Weir, for instance, to faint, and others to feel very weak, three men having to subsist for a whole day on one onion; a pinch of salt refused to men leaving camp, which they asked for in order to salt fish they might catch with a fish-hook given them by one of the men. All this when they were at distances ranging from 70 to 150 miles from, and having to walk to McLeod, often having no money, and, even with money, being unable to obtain food, and having sometimes to rely on remnants thrown away on the road." We do not repeat the tale of horror which recites the death from most painful disease of men who passed their last hours under such conditions of exposure to hunger and cold that their companions who were in health could not have avoided freezing except by the most continuous exertions.

The president of the Canadian Pacific Railway when interviewed on the subject is reported to have said that the contractors could not provide feather beds for the laborers. When a public complaint was brought to the attention of Sir Wm. Van Horn's fellow-countrymen, that other great United States railway dictator, Jay Gould, he said, "The public be d——d." The question which should be considered by every thoughtful Canadian is whether we are governed according to the B.N.A. Act or the C.P.R.

SANITARY EXPERIMENTS AT COLOGNE, GERMANY.

BY W. M. WATSON.

The city of Cologne, Germany, reframed its plumbing and private drainage by-laws, some years since, to comply with the fashion of the times, ordering back-air vents on all fixtures, and also traps and breathers on the main line house drains, but, after giving them a few years' trial, it was proved that the advantages of the system were not equal to expectation, or even so good as the method previously employed, which was erecting the appliances with as much simplicity, coupled with good workmanship, as possible, and a short time since the city fathers appointed a committee, together with Herr Maniewski, the leading architect, and Herr Unna, the noted sanitary engineer, to make a thorough investigation of the whole system.

The committee erected sets of soil pipe and drains made from glass; they also had a variety of water-closets, traps and small waste pipes made from the same material, and fixed them to a temporary erection, consisting of three flats, in the most public place in the city. They also got permission to cut out and examine a number of the oldest back-air vents in the city. They had been in use several years. Having lately finished the investigation, their report has been published in detail in No. 4 and 5 of the Gesundheits Ingenieur for 1898, a German engineering journal, and as the experiments are of great importance, the report has been republished in the English-speaking papers. This report relates that all the old back-air pipes the investigation committee cut out were choked up with either grease or coffee grounds, or cobwebs, which would of course prove that the vents had been useless, on several

grounds: 1st, Because none of the traps to which they were attached could ever have been in danger of being siphoned, or the back-air pipes would have passed down air to break the vacuum in the waste pipe, and to relieve the draw or suction on the water seal of the traps, and if any air had ever passed down the vent pipes there would have been no cobwebs choking them. 2nd, That they create complications, expensive intricacies and obstructions, interfering with the smoothness of the waste water flow, and are liable to become blocked up with the most poisonous and dangerous part of the sewage, viz., the frothy scum odors.

In the experiments the committee noted the influences of the sewage and air on various sized soil pipes at various grades and inclinations, also in vertical and horizontal position, and studied various sized traps, back-air pipes and connections, and depths of water seals. The influences on the flow of sewage, when the soil pipe was extended through the roof and the end left full open; when only partly open; also when the head of the soil pipe was totally closed up, and when the heads of the soil pipes and the back-air pipes were enlarged in the usual way immediately before passing through the roof. Also the action and influences on the private drains when main line traps and breather pipes were used. They found that a solid piston or column of water was only formed when the waste water from the fixtures was passing through inclined and horizontal pipes. And we know that when a piston is formed that there will be a suction of air or a vacuum behind the column that would siphon the trap or a number of traps, under certain conditions; but as such conditions never occur when the plumbing is installed by a competent person and used properly and in an ordinary way, it is a waste of money and is contrary to sanitary science to use back-air vent pipes.

They appear also to have proved that there is a limit to the pressure of the suction and the vacuums caused by water pistons, which can be overcome by arranging the plumbing so that no inclined branch can be longer than 39 inches, or by increasing the depth of seal in the traps, and by increasing the size of the waste pipes to about three times the capacity of the strainer or the mouth of the inlet. But our experience has proved that all risks can be avoided by making the branch from each fixture as short as possible, and branching them direct and almost level into a line of waste pipe that is extended through the roof, and the end left opened, so that the air can be drawn down when necessary. See illustration and full explanation in the issue of this journal for April, 1897.

The committee found that there was no advantage in increasing the size of the head of the soil or ventilation pipes as is customary at present, except it was possible to decrease the interior by hoar frost in winter, and this they were unable to demonstrate. When water was poured down one of the smaller fixtures it dashed against the opposite side of the vertical soil pipe, and at once resolved itself into fine, single threads, as if delivered from a sprinkler, and the number of threads increased in proportion to the amount of water poured down, until the bore of the soil pipe was entirely filled with thread, which acted as an air injector into the sewers and aerated the waste water passing down at the commencement of its flow towards the sewer mouth. In order to gain a knowledge of the amount of air sucked into the soil pipe an anemometer was carefully fixed on the mouth of the soil pipe above the roof, and one bucket of water was poured down a fixture when the anemometer showed that three cubic feet of air had passed down, and when four pailfulls were rapidly discharged down a fixture there were 17¼ cubic feet of air carried down with the water. Supposing the four pails held two cubic feet then it would prove that the water carried over eight times its own bulk of air with it down the soil pipe into the drains. When water was poured in at the top of the vertical soil pipe the moisture of air sucked in was only half the amount that was drawn in when discharged into the soil pipe through a branch. When the head of the soil pipe was partly closed the number of threads was reduced proportionately, and the seals of the traps showed signs of agitation, and when the top of the soil pipe was closed altogether and the four buckets of water were poured down quickly the water did not break up in threads, but formed a piston which siphoned the traps of all the fixtures except those that branched into a secondary line of waste pipe that had an open end above the roof. When the sewage was flowing through the horizontal sewer it formed a concave surface which largely increased friction and reduced the speed.

When any of the small waste pipes were extended at the upper end and the end left open so that air could pass down when required, the same result was obtained as when experimenting on the soil pipe.

It was shown that when a main interception trap was used, that it not only modified the speed and partly obstructed the flow of sewage, but it prevented any of the air carried down by the soil and other waste water pipes from discharging into the street sewer where its aerating functions are so necessary to commence the purification of the sewage in the drains and assisting in preventing sewer gases generating in the sewers. It was also shown that when the main interception trap is omitted there is a superior and self-cleansing flow of sewage, and that large volumes of air pass forward to the street sewer, creating a healthy atmosphere and circulation of air down the soil pipe through which the fluid is passing, and up other soil pipes that are at the time standing idle.

These experiments, especially those that show that air is carried down with waste waters and that the main trap is a dangerous obstruction, fully explain the reasons why those towns that do not use back air pipes and that extend their soil pipes from the crown of the drains to the highest point of the roof and which make every rain water leader and waste water pipe to pass to the street sewer without any obstructing trap or sharp angles or interruptions of any kind, are almost free from odors in the houses and streets, and free from diseases that can be traced to sewer gas poisoning. While, on the other hand, those cities which have adopted the principle of interception, traps, back air ventilation pipes, with all their intricate complications, are often quite the reverse, and of disease a great deal is found among the inhabitants who happen to live in the modern built houses where the obstruction system has been installed. And this is in spite of the fact that the same towns often spend large sums of money in flushing drains and artificially ventilating the street sewers, a thing which is never necessary if the sewers are laid down properly and the straight unobstructed system is adopted. The city of Cologne has now had enough of the complicated system of plumbing and draining and in future will avoid such expensive luxuries and again allow their sewage water to leave inhabited premises with as much expedition as possible, and secure all the aeration it can throughout the journey to the outfall, without making itself a nuisance to the public.

The Cologne investigation has a bearing on sewage purification. It will be remembered that more than twenty years ago Dr. Pasteur, of Paris, and Dr. Warrington

declared that sewage contained the necessary organisms for its own purification. Dibdin, of London, England, has shown us the way to compel sewage to clean and purify itself. Adney, of Dublin, has proved that domestic sewage requires three times its own bulk of air regularly and evenly supplied and distributed to every particle or atom of the sewage to enable the friendly bacteria to destroy the poisons, etc., the sewage contains. Lowcock, Birmingham, has shown us a method of applying the atmospheric air to the sewage, and Reid, of Staffordshire, recommends that all sewage should be purified while fresh before putrefaction sets in or sewer gas begins to generate The fathers of the city of Cologne have shown us by their experiments that the sewage will split up into fine threads of spray and take up atmospheric air in larger quantities even than Adney tells us is needed during the time it is falling vertically down the waste pipes. Therefore the bacteria can secure all the oxygen needed for a short period and when the sewage is in a fresh state. If every house rain water leader and waste water pipe were made to form a street sewer ventilator, and the water coming down each of the pipes will bring down four times its own bulk of air, which will go a long way towards providing all the air that is needed to do the necessary work of cleaning the sewage, and in that case the public sewers will be changed from a gas generating chamber to a receptacle for the aeration and purification of sewage and dirty filters, in that case they would be harmless. While under obstructive plumbing by-laws and private drain arrangement of interception traps, no aeration of the sewers can take place, therefore putrefaction immediately sets up and sewer gas is generated abundantly, which poisons the dwellings and the atmosphere of dense populated towns.

The Cologne investigation has demonstrated that most sanitary appliances can and ought to be made of glass, that all soil pipes and lines of waste water pipes should finish with an opening outside, that no rain water leader should join to soil or waste pipe until it reaches a point below the inlet of the last branch pipe coming from the lowest sanitary fixture.

The German scientists are reliable, and their experiments and judgments can be acted upon with safety, and the expensive experiments they have made may be freely taken advantage of by other towns.

THE QUEEN CITY OIL COMPANY.

The location of business houses in Toronto has been undergoing considerable change of late years, and the tendency of trade has been towards concentrating on Yonge street, as near King as possible. Among other well known firms which have moved with the times is the Queen City Oil Co., which has just transferred its extensive business from 30 Front street east to the handsome new Lawlor Building, corner King and Yonge streets, Toronto. The offices occupy the whole of the flat, a dimension of 60 x 90 feet, with 14-foot walls, and are the finest in Toronto for ventilation, light and convenience. They will be occupied by a staff of twenty-five, the hands employed in Toronto, the headquarters, numbering about 200.

The phenomenal progress made by this organization during its history of nearly a quarter of a century is largely due to the tireless energy, conspicuous business ability and unswerving integrity of Samuel Rogers, the founder and present manager of the company. When Mr. Rogers started in the oil business in 1876, he found difficulties confronting him in every quarter. But armed with an iron will, and a resolve to be second to none, he overcame the obstacles one by one. From the very first he determined to encourage Canadian industry, and he has resolutely persevered in that course, to the advantage of the people at large, as well as of the large force of men in his employ.

With the firm, Fairbank, Rogers & Co., he opened a refinery at Petrolia, which has since been merged into the refinery at Sarnia, now the largest in Canada. Although he is now over sixty years of age Mr. Rogers has not relaxed his efforts in one particular, and he is still the central moving spirit in the large and successful company of which he is the founder. He has now associated with him in the company his two sons, Albert S. Rogers, secretary and treasurer of the company, and Joseph P. Rogers, manager of the lubricating department.

The Queen City Oil Company, besides the works on Princess street, Toronto, has branches established in all of the principal towns in Ontario, and sells in Canada the products of the Standard Oil Company. By care in treating the oils they have been able to furnish a product at least equal to the best American oils, and the company has gained the confidence of the public wherever its goods have been offered. The various oils are too well known to need extended mention, Among the best known are the Sarnia White Burning Oil, and the Peerless Oil for farmers' use, one of the best lubricating oils on the market.

Altogether Mr. Rogers is to be congratulated upon the success which has crowned his labors during the past quarter of a century.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during May and the four months ending May, 1897, 1898:—

	Month of May.		Five months ending May.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£7,730	£2,131	£25,647	£10,243
Pig iron	563	569	1,018	5 793
Bar, etc.	316	1,143	4,205	5,110
Railroad	6,935	..	20,286	6,972
Hoops, sheets, etc.	5,436	6,122	16 445	11,592
Galvanized sheets	3,975	6,909	15,998	20,980
Tin plates	8 652	21,423	80 972	61,968
Cast, wrought, etc., iron	3,880	3,408	14,965	13,658
Old (for re-manufacture)	.. ..	606	572	1,504
Steel	3 493	4,877	18,480	24,298
Lead	1,672	3,745	4,454	8,050
Tin, unwrought	1,609	3,157	8,923	9,087
Alkali	3,533	5,179	11,722	16,737
Cement	1 825	2,771	4,778	8,262

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER:

My attention has been drawn to a letter published in the June issue of the CANADIAN ENGINEER signed by "Expert," which is false, malicious and libelous in its statements. I hereby ask "Expert" to be manly enough to come out in his own name and repeat his statements so that I may have an opportunity to meet him in the open; I will not brand him as a coward yet until we see whether or not he will have the manliness to sign his own name as requested.

Yours respectfully,

JOHN MACDOUGALL.

635 Cass Ave., Detroit, Mich., June 22nd, 1898.

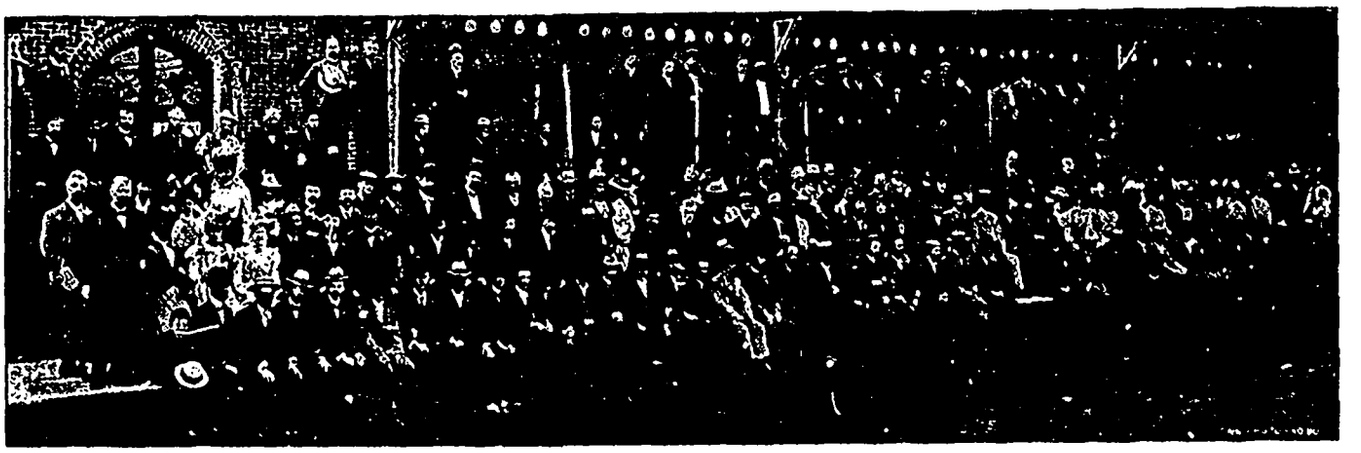
Editor CANADIAN ENGINEER:

There is an article in the June issue of your valuable periodical signed by "Expert," which contains misrepresentations of the sewage and garbage disposal processes mentioned therein which I consider to be injurious to the Company represented by John Macdougall, therefore, in justice to that company, provided his statements are true, the writer of the article should have had the manliness to sign his own name instead of a nom de plume. My knowledge of the International processes of sewage disposal and of Warner's garbage destructor, which has been obtained from a long period of study of such subjects, as well as from a personal examination of many works of that character in Great Britain last year, has compelled me to arrive at but one conclusion, namely, that the above-mentioned processes for the disposal of sewage and for the destruction of garbage have no equal either in Europe or America for efficiency and economy in their operations, and I am backed up in that opinion by many of the leading sanitary scientists in those countries, especially in Great Britain. Let "Expert" come out like an honest man under his own name, which he should do if his statements are true.

Yours very respectfully,

J. A. SMITH.

Windsor, Ont., June 27th, 1898.



THE CANADIAN ELECTRICAL ASSOCIATION, PHOTOGRAPH TAKEN ON THE DAM OF THE CHAMBLY MANUFACTURING COMPANY.

CANADIAN ELECTRICAL ASSOCIATION.

EIGHTH ANNUAL CONVENTION.

The eighth convention of the Canadian Electrical Association was held in the Windsor Hotel, Montreal, on the 28th, 29th and 30th June. On the first day, the meeting, which was the best attended in the history of the association, was called to order by the president, John Yale, manager of the Guelph Light & Power Co., shortly after 10 o'clock. After the reading of the minutes of the last meeting by the secretary, C. H. Mortimer, Mayor Prefontaine, of Montreal, was introduced, and welcomed the convention to Montreal. The president said that all were pleased to receive the greeting of the Mayor of Montreal, and called upon A. A. Wright, of Renfrew, to support him in his statement, which he did in a neat three minutes' speech.

The president then read his address as follows: "I beg to give you all a hearty welcome to this the 8th convention of the Canadian Electrical Association. The aim of the association is to gather together the members of the Electrical Fraternity, and allied interests for the purpose of mutual discussion, and to learn from each other's experience. In this way we try to benefit the whole business interests with which we are all connected. An organization of this kind confers upon its members benefits from the reading of papers, and the discussions which take place disseminate information with reference to the methods that are constantly being tried by different members in the practical conduct of their everyday operations and business methods. This association affords the means for members to become acquainted with one another. The friendships here formed should be used for the purpose of mutual protection and advice when difficulties arise. A free and friendly correspondence tends very much to strengthen, stimulate and encourage many of us in our daily struggle with difficulties. It is a matter of satisfaction to me that during the last two years you have honored me with the office of president, good progress has been made in the direction indicated; but there is still room for great improvement.

It is now almost four years since the last meeting of the Canadian Electrical Association was held in the City of Montreal. During the interval conventions have been held once in Ottawa, twice in Toronto, and last year at Niagara Falls. On each occasion matters of current interest and importance have been presented for the consideration of our members. There are many reasons why our meeting, again this year in the east, and particularly in Montreal, should be at once a source of both pleasure and profit to the members of this association. The intervening four years have done much for the Dominion of Canada, for its national life and the development of its material resources. In no department of industry has this progress been more marked than in the electrical field, in electric lighting, in electric railway work, and in the electric transmission of power; and the work must not be forgotten which has been done in extending the use and improving the service in the older branches, the telegraph and the telephone. From this development of the great modern industry in which we are all proud to have a share, no part of the country is likely to reap greater benefits than the City of Montreal and its vicinity.

The Dominion of Canada, at least, so far as Ontario and Quebec are concerned, while otherwise abundantly dowered with mineral riches, has been deprived of coal deposits, until recently an essential factor in manufacturing and industrial development. To-day, however, the possibilities of electrical transmission have rendered available as a substitute to turn the wheels of our factories, the heritage which both provinces possess in their abundant water powers. It will be our privilege to inspect what has been done in this direction by some of her far-sighted and enterprising citizens for the City of Montreal. We shall first see that great enterprise, carried out in the face of difficulties and discouragements, the successful utilization of the power of the St. Lawrence river by the plant of the Lachine Rapids Hydraulic and Land Company. Of equal interest and importance will be the opportunity given of inspecting the plant and equipment of the Chambly Manufacturing Company on the Richelieu river at Chambly, which will vie with its great rival in the beneficent work of supplying cheap light and cheap power for the citizens of Montreal. It is to be hoped that a fair dividend will be the reward of the shareholders of the two companies for their enterprise. It is proper, before entering on the work of this convention, we should glance briefly over the progress of the past year. A marked feature of electric progress in the Dominion throughout the years 1897 and 1898 has been the inception, and, in some cases, the completion of a number of important plants for the long distance transmission of power. In the Province of Quebec there are besides the two plants already mentioned, the Montmorency plant, which has been in operation for several years, and is no doubt familiar to most of you, and the North Shore Power Company, Three Rivers, a 16 mile transmission, 12,000 volts, delivering 500 k.w. In Ontario there is the Cataract Power Company of Hamilton, the distance to be transmitted 33 miles, pressure 25,000 volts with a capacity of 6,000 h.p. This plant, it is anticipated, will be in operation by August 1st next. In British Columbia a transmission installation of 1,500 h.p. capacity is being erected to supply energy for the Electric Railway, lighting and power industries of the City of Victoria, distance 16 miles. The West Kootenay Power Company recently started with an initial capacity of 2,000 h.p., pressure 20,000 volts, distance 30 miles. This power will be used for the operation of machinery in the mining districts. We have already referred to the enormous development under way in the vicinity of Montreal.

The only point at which satisfactory progress cannot be reported is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion in the hands of an alien corporation has prevented its development for the benefit of the people of Ontario. This state of affairs, we trust, will be removed before another year. Besides the important plants mentioned which are either in operation, or in course of construction, a large number of similar enterprises are at present in their initial stages and may be expected to reach their completion within the next year or two. Altogether, it is difficult to foresee at the present moment the benefits which our Canadian manufactories and industries generally may derive from the utilizing of the water powers of the country, scattered without number from the Atlantic to the Pacific. In electric railway work the development of the year has been mainly confined to the extension and the better equipment of existing city and suburban roads.

In the field of electric lighting, in which a majority of the members of the association are more particularly interested, a reasonably satisfactory condition of affairs exists. That industry is on a fairly solid basis, at least, in so far as a distribution of current for incandescent and power purposes is concerned, as rendered evident by the failure of the much-talked-of illuminant of the future, acetylene gas, to make any inroad into the field of the lighting companies. A large majority of the plants now in operation are equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, if taken on the average, the lowest in the world.

We will have before us the report of the Committee on Legislation. From this you will see how far the efforts made since our last meeting have been successful in the direction of securing equitable protection of private investments. It is to be hoped that the work of the association during the convention will be helpful to the members and that they will recognize the value they receive from their attendance here with respect to the papers which have been prepared for the convention. You will see their practical and helpful nature, and I trust you are ready to criticize and discuss the views set forth in the light of your own experience. One thing more I feel should be mentioned, and that is, the appreciation of the efforts of the different companies and individuals in Montreal who have so heartily co-operated for the success of this meeting. The proverbial hospitality of our metropolitan city is known to you all. A pleasing feature at our last convention, was the regular and prompt attendance of members at all sessions and the keen interest taken in the proceedings. This commendable practice will, I trust, be kept up at this our eighth convention, now open for business.

The president then nominated B. H. Reesor, Lindsay; A. B. Smith, Toronto, and C. B. Hunt, London, as a committee to suggest the names of the Standing Committees.

A. A. Wright, of Renfrew, then read his paper on "How to Overcome Some of the Difficulties Encountered by Central Station Men."

HOW TO OVERCOME SOME OF THE DIFFICULTIES ENCOUNTERED BY CENTRAL STATION MEN.

BY A. A. WRIGHT, RENFREW, ONT.

In treating this subject I shall do so from the standpoint of one who has to deal with customers living in a town of moderate size, and not from that of the owner of a plant in a large and populous city, because the circumstances would be, in many respects, quite different, and the requirements, as well as the mode of arranging the service, would be altogether different. I shall take it for granted that the central station is equipped with an arc and incandescent plant, that the proprietor not only does commercial lighting, but supplies light to the corporation as well.

1st. Let us take up arc lighting on the street. This brings us at once into contact with the corporate fathers, many of whom know nothing of arc lighting, except that it is not only necessary, but their special duty, to appear wise in order that they may look well after the interests of the town.

And now let me make my first suggestion, and that is, that you leave municipal politics entirely alone. If you have an inordinate craving after politics, which you have not the power to restrain, let your light shine before the throne of the Legislative Assembly or in the chamber of the House of Commons, but restrain yourself from meddling with municipal politics, lest you make to yourself enemies who will be sure to avenge themselves, sooner or later, in crippling your lighting contracts with the corporation. I do not wish you to infer from this that you should not exercise your franchise when the day for voting comes around, but on the contrary, let it be known that you and your employees always vote for the progressive and enterprising men of the town, and as every aspiring alderman will want your assistance, you if you do not make too much noise, will generally manage when he is elected to get his. Be careful not to make political enemies but to have as many of the town authorities with you as you possibly can. In most towns the contracts for street lighting are made annually, and not as in cities, for a term of years. See to it then, that your contract is so arranged that it shall terminate on the 1st of March. You can do this by informing the proper authorities that your books are so arranged that your Electric Light year begins on that date. Then see that the following harmless looking saving clause is inserted near the closing part of the contract. "And it is further agreed that either party may terminate this lease at the end of its term by giving the other thirty days' notice in writing prior thereto, and in default of such notice this agreement shall continue in force after the termination thereof, for one year, and upon the same terms and conditions as are herein expressed, and in like manner thereafter, unless such notice is given at least thirty days before the corresponding date in each succeeding year, a like renewal and extension of this lease from year to year shall be considered as made and executed by and between, the parties hereto." Furthermore have your payments fall due quarterly and on the 1st of March, June, September, and December. You know that in Ontario at least, our municipal elections are held at the beginning of the year, and as most of the aldermen will be aspiring to re-election, and would like to have your assistance to re-elect them, they will quite naturally forget, as the term of their holding office is drawing to a close, to give notice of the desirability of terminating that contract, and you almost invariably escape that threatened danger from the outgoing council. Then the new council does not assemble till the last of January and as very little business is done at the first meeting and many of the members are new ones. Electric Lighting is not thought of till your quarterly account is presented in March, when it will be too late to give the required notice, and so your contract runs on in this manner from year to year, renewing itself without any trouble whatever. Another difficulty, which you are almost sure to encounter, is the height of the poles on which your lights are placed on the streets. Some will want 50 ft. poles some 75 ft. and some even higher than either of these. When your contract is made be sure and have the clause worded in this way. "That the hangers from which the lamps are suspended shall be——feet from the natural level of the surface of the ground at the foot of the pole," and not, that the lamp shall be so many feet high, as you will notice that this makes an important difference in your favor. It is well to have it so arranged that you need not run your arc plant on moonlight nights, not merely on account of the direct saving that there is in this, but it sometimes is very convenient, if there are accidents, in giving you an opportunity to make needed repairs.

And now as to your commercial lights. Have your contracts made with your customers on a yearly basis, with same renewing clause that there is in your contract with the town, but with this difference, that the payments in this case be made to you weekly, and then see to it that you make your collections in this way, for a man will frequently pay you a small sum weekly, when he would not pay the same amount if paid quarterly. It may not be amiss to mention that in all these contracts, when stating the candle power of the lamps you are to furnish, that you should be sure and employ the words "nominal candle" power, as it may save you, under certain circumstances no small amount of trouble also.

And next, as to your incandescent service. This will, of course, be largely, if not entirely, a commercial service. You will have all manner of people to deal with and you may expect, in many cases, to have your patience sorely tried

Then to begin at the beginning. Never under any circumstances do free wiring. By that I mean that you should never undertake to wire a house for nothing, in order that you might thus get a customer for your current. Of course you should do all primary work as low as possible, but not at a loss If your power is at all limited, or if you run by steam, you will find, in my opinion, that you will make more by running your lights on the meter system than you will by giving a flat rate unless you get an exceptionally good price for them.

I understand that in many places it is customary to take the readings of your meters quarterly, as it thus saves a good deal of time in taking the readings, making out the accounts collecting them, etc. In this, as in other things, the old adage holds good that "Short accounts make long friends," and by no means should you allow your accounts to pass more than one month without being rendered, and if possible, collected It might not be so bad, in the short nights of midsummer, if quarterly collections were adopted, but in the end it will amply repay you to take your readings on the first day of each month, and make your collections on the 2nd.

And now as to the location of your meters. We were instructed when installing our plant to locate them in some out-of-the-way place, where they would not be seen, and high up, so that they would not be meddled with. Now this may all be very good advice in its way, but my advice to you is, not of course to put it in the parlor, or in such a place as to cause it to be an objectionable feature in the household, but, be sure and place it low enough that your man can get at it with as little trouble as possible, and also in a place where there is an abundance of light, so that the readings may not only be taken quickly, but accurately. When you have a large number of readings taken monthly, it becomes a matter of some moment that meters be so arranged that the work can be done quickly and accurately as well. You will be frequently told by your customers that the meter is wrong—that they know they never burned that amount of current. In such pronounced cases as these, when the assertions are very strong, I find it is better at once to say, "Well, it is possible as you say that there is something wrong; you know we are none of us infallible; we will see and have a second reading made at once," and look into the matter and at once, do as you have promised, no matter though you feel almost sure that it is all right. You may find that there is an error, and if so you should of course immediately see that it is corrected, but if you find that the reading is correct, and that Mrs. Julius Caesar still insists that that meter is no good, and declares that the thing runs whether there are any lamps on or not, and tells you in a most emphatic manner that she can hear the thing sing like a rattlesnake, lights or no lights, and she knows that it runs on wheels, what then? Above all things do not allow yourself to answer back harshly, for doubtless she really is sincere in her protestations, and it is not wise to contradict her too rashly. I have found a good remedy in replying that of course it is just possible that the meter is not absolutely correct, but that you feel quite confident that it is, and that to cover just such cases as these the government has appointed an electrical expert, to whom both parties can appeal, and if she, after considering the matter over, still thinks there is something wrong, that you will write and have the inspector come up and examine the meter, and if he finds it wrong, that you will bear all the expenses connected with the inspection, but if it is correct that she is to bear all expenses. Tell her just to think the matter over and let you know, and so far as my experience goes that ends the matter.

Another difficulty that you will doubtless meet when running on the meter system is in having your customers send out of town for 5 c.p. lamps and when only one of these is used your meter will not respond. This you will easily discern when at the end of the month you perceive that no current has been consumed, and I may just here mention that this is another reason for taking your readings monthly instead of quarterly. Such cases are not numerous, yet they do turn up where the family is small and its members are contented to do with a minimum of light. This difficulty can also largely be overcome by making a minimum rate of say 50 or 75 cents per month, which amount can be arranged according as the circumstances of the case may require.

There are of course many other difficulties that central station men have to deal with, but it is impossible to consider many in an article of ordinary length, and the remaining ones will be left for others to treat with, as they, in their wisdom, may see fit.

J. F. H. Wyse, Brantford, said he had been much interested in the paper. He had recently been through the mill in dealings with the Brantford, Ont., municipal authorities. He found the sending of notices, the third being an intimation that the supply would be cut off by a specified time unless dues were paid, was a very effective method of dealing with slow payers. C. B. Hunt, A. A. Wright, B. H. Reesor and A. B. Smith followed in much the same strain. C. B. Hunt then moved and A. B. Smith seconded, a vote of thanks to the reader of the paper and the meeting adjourned.

The members reassembled in the afternoon at 2 o'clock when W. H. Browne, manager of the Royal Electric Co., Montreal, read Louis DeWitt Magie's paper on the "Electric Utilization of Water Powers."

ELECTRIC UTILIZATION OF WATER POWERS.

By L. D. W. Magie.

The utilization of power going to waste in fast running streams has commanded for many centuries the attention of mankind. Regarded, on the whole, as "wasted energy" and as power that could be obtained "for nothing," the question of how to make it useful perplexed our forefathers, and is still giving us some study to-day. Although it would appear that, during the reign of Augustus, about 40 A. D., the first water wheels were made and used by the Romans, the scientific development of the water wheel appears to have been left until the present era, for until within the last few years, comparatively, the only devices used to convert the kinetic energy of streams into effective mechanical energy were the various forms of undershot and overshot wheels. Crude as were these instruments, they have played a most important part in the world's history, for they have done much to develop countries with natural resources. Manufacturers who sought cheap power adopted the "wheels" available and located their plants along favorable streams, where these crude transformers of energy were made to grind corn, saw wood, make cloth, etc. The inventors of the present century awakened to the necessity of improvement and have provided the present types of wheels. To their higher perfection and adaptability is due the fact that almost every power producing stream in settled districts of the civilized world is utilized.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season. The possible storage capacity must be looked after, for oftentimes by a little forethought and a comparatively slight additional expenditure, a stream that naturally gets very dry at certain seasons can be made, by properly arranged storage, to give a practically constant output the year round. Again, by carefully arranging the surrounding conditions, a stream may be made to give for a comparatively short period, when power may especially demand, double or triple its normal output capacity. Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully, the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable. Many other details must also be studied before determining the best location of the water motor power house, so as to obtain the greatest available head with the least expenditure. In the study of the question the natural conditions of the soil, water and climate, all have an important bearing, on not only the engineering success, but also on the financial success of the enterprise.

As waterfalls cannot themselves be moved from one place to another, manufacturers have had to locate the sites of their plants at the falls. In many cases it is necessary, and in nearly every instance very desirable, that the power be transmitted to a certain distance. When the distance has been comparatively short it has been accomplished by belting, gears and line shafts, but when the distance extends beyond a few hundred feet, this system becomes so inefficient, expensive or impracticable, that some other way has to be found. Rope transmission has been used quite successfully, even to a distance of a mile, and in a few instances over that distance, but as the best practical efficiency is not over 60 per cent., and the first cost, as well as maintenance, is usually very high, this system has not yet been so successful as to command its adoption very extensively. Compressed air has also been used for the transmission of energy with some success, more particularly in Paris, where there is a large plant still in existence; but here again the engineering cost has been great, efficiencies low, and maintenance high, and consequently, like the rope transmission system, has not met with general use and practice. The electric dynamo and motor have given an entirely different aspect to the transmission of energy. Although invented in the early part of this

century, it is, however, only within the last few years that the electric dynamo and motor have been developed practically and commercially. The success and high efficiency attained by electric transmission of energy is such that the "waterfall" is gaining prominence as a source of energy.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmittted by the direct current system has been up to twelve miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over two miles, and even the advisability of this is looked upon to-day doubtfully. The reason for this is not because of the inability to transmit the power effectively, but because of the inadaptability of direct current apparatus for use at high voltages. The construction of direct current machines is such, having, as they do, so many auxiliary parts, that at high voltages they are very liable to break down, especially at the commutator and armature cores, except with very costly construction, and even then they are not at all sure; at high voltages the brushes are liable to spark and cause trouble at the commutator; and as the high tension parts require continual attention and adjustment while the machines are in motion, they are dangerous to the attendants. Probably, however, one of the most important reasons for the inadaptability of direct current machines for long distance transmission at high voltages, is the inability to reduce the voltage to that at which it would be safe to operate at the place of consumption without the use of expensive and cumbersome as well as inefficient banks of motors. Such motors of high voltages, having parts under high tension which require attention and adjustment while in motion, could not or rather should not be used except under the care of expensive special experts in every separate mill or factory where such motors were installed. To place them in the care of uneducated men would be unwise, and, in fact, foolhardy. The highest voltage that D. C. apparatus can be wound for, commercially and safely, seems to be, as universally adopted, from 500 to 600 volts. The reason that power at this voltage cannot be transmitted great distances is purely a commercial one. There is no electrical reason why power by the means of direct current might not be transmitted to an indefinite distance, entirely effectively and successfully. The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 h.p. for both one and ten miles, the loss in transmission to be 8 per cent. and the voltage to be 500 volts. For each leg of a one mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each one mile long, weighing 15,312 pounds, which at 15 cents per pound would cost $2,300. For each leg of the ten mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each ten miles long, weighing 1,531,200 pounds, which at 15 cents per pound would cost $230,000; or the power would cost, at 10 per cent. interest and depreciation on copper alone, $2.30 per h.p. annum in the first instance, and $230 per h.p. annum in the second case. If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100 h.p. for ten miles, the condition would be entirely different, for instead of forty No. 0000 wires, each ten miles long, there would be required for each leg but one No. 4 or two No. 4 wires each ten miles long, weighing 15,300 pounds, which at 15 cents per pound would cost $2,300, or the same as transmitting the same amount of energy only one mile at 500 volts.

From the above it will be seen that the transmission of power at 500 volts is not entirely prohibitive for short distances, but as the distance increases it becomes one of vital importance, for the cost of copper is not the only item of expense then to be considered; the pole line itself becomes a very grave matter, especially when we have to consider the weight of forty No. 0000 wires, as in the example for only 100 h.p., and the cost becomes one that investors cannot afford, for the reason that power can be obtained cheaper from other sources, so that commercial transmission of power long distances by direct current at practical voltages is not practicable. Although, as stated before, considerably higher voltage than 500 volts has been used with some success, as at Brescia, the number of such plants are very few. It is a noteworthy fact that on this continent, where the transmission of energy is further advanced than anywhere else, there is not a single plant of any prominence that is transmitting energy by high tension direct current system. It may be interesting to know that three or four years ago, when the Chambly plant was first discussed, a European firm planned out and tendered for the construction of that plant for transmitting the energy by means of this high tension direct current system, but, for reasons as above discussed, that system was not adopted.

How to meet the problem of long distance transmission, commercially and efficiently, has been left almost entirely to the alternating current system. Alternating currents were known about the same time as direct currents, or about 1831, and were explained to the world by the great Faraday, who at that time discovered the elementary principles. From that time on, experiments were made by different inventors on induction coils, but no material progress was attained until May 22nd, 1877, when Jablochkoff obtained British patents for "a new process of producing and dividing the electric light and apparatus therefor." There were also other inventors at about this time who produced "improved induction coils on secondary generators," as some of them were called, but all seemed to have the idea that they could be operated with their primary coils connected in series, and that their secondaries could be independently controlled. In 1878 a J. B. Fuller, of New York, suggested a system of using induction coils or transformers in parallel, but no practical results seemed to have been obtained in this direction until 1882, when Messrs. Goulard and Gibbs exhibited two induction coils at the Electrical Exhibition held in Westminster Aquarium in London, which ran in operation from the Siemens alternator. In the autumn of 1884, Messrs. Goulard and Gibbs gave another exhibition at Turin. In this case, the primary circuit was nearly 50 miles in length. A series of transformers were placed on this line, one being in the Exhibition building, one at the Turin Railway Station at Verine Riesla; another at Lanzo, a small village in the Alps of Savoy; incandescent and arc lamps were supplied at the various places. The first parallel system that was started on this continent was by Wm. Stanley, jr., in 1884, in the small town of Great Barrington, Mass., where light was supplied throughout the town by means of a parallel alternating current transformer system. From about this time commenced the era of alternating currents, although as far back as 1849 alternating current generators were devised. Commencing with 1885 the alternating current system made great strides.

To employ waterfalls as sources of cheap power, high potentials became necessary. For these conditions the A. C. was especially effective; the ability to step up from low potentials to high, and thus transmit power to a given distance, then to step down to safe and convenient voltages, entirely effectively, convenient and without the use of cumbrous and expensive apparatus, rendered the transportation of the energy of water powers feasible and commercial. Probably one of the first high voltage transmission experiments on this continent was in December, 1891, and in January and February, 1892, at Pittsfield, Mass., at which test the writer had the pleasure of participating. The potential used was approximately 15,000 volts. A transmission line about a mile in length was built in an open lot a little way out of town, where a small experimental station was built. The current was received from the local Electric Light Company at 1,000 volts, raised to about 16,000, sent out on the line, and thence returned, again lowered, first to 1,000 volts, and then again to 100 volts, at which voltage energy was consumed in water rheostats. On the line experiments were made with porcelain insulators, as well as the oil type of insulators. At this time, of course, comparatively little was known about electric current at this potential, so that everything had to be handled with gloves, as it were. The experiment proved to be not only useful and satisfactory, but highly successful, and gave considerable encouragement. Although experiments were commenced, and discoveries made pointing to the advancement of A. C. motors in 1879, still practical results of any real value were not obtained until in the year 1890 to 1891, when the poly-phase systems were introduced. From that time it can be truly said that water powers could be utilized for the general distribution of power at distant localities. One of the first and most notable exhibitions of this kind was made at the celebrated Frankfort Exposition in 1891, which proved not only interesting to the town of Frankfort,

but to the world at large, for it taught lessons and set aside errors that would have taken years of toil and hard labor to have done otherwise. Poly-phase generators having a total capacity of 300 h.p. were installed at Lauffen and operated by water power. From these, the current was transmitted a distance of 110 miles to Frankfort; several voltages were tried on the transmission line during the experiment, the highest of which was 31,000 volts; in the exhibition grounds were arc and incandescent lamps and small alternating current motors, all provided with current from the hitherto "wasted energy" of the streams of Lauffen, and with a loss of efficiency in the line of not more than 25 per cent., which, at that time, was certainly a most noteworthy accomplishment.

During the next two or three years manufacturers spent a great deal of time and energy in perfecting their systems. The induction motor has been perfected to that of an ideal, and the usefulness and necessity of synchronous motors have been established. For a few years following 1891, an occasional poly-phase plant was put up in different parts of the world. They were subjected to all sorts and kinds of trials, depending upon the character of the work to be performed at each individual installation, and although there was often much cold water thrown upon them at the start, and obstacles placed in their way, still they always came out ahead and proved a success, not only from the engineering point of view, but to the financial backers. When we stop to consider that it has been only within the past six or seven years that a complete system has been devised for the utilization of distant water powers, and that all of the important transmission plants have been put in during that time, it is no wonder that there are yet some sceptics. But perhaps worse for healthful commercial developments are those who make a wild rush for some transmission scheme, without first considering all of its surrounding conditions, thinking that because someone else has made a certain project successful, their project must be also. It falls upon the engineer to bring the sceptic to lines of true reasoning and to teach him facts in their true light, so that he will see and believe, that with such resources at his command, great things are possible; the engineer must also hold the enthusiast in check and prevent waste of money in impracticable undertakings.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor. Many people think that because water strictly follows certain given laws of nature, and in doing so continually and constantly exerts energy, therefore the energy obtained thereby costs nothing. People with such ideas are fortunately gradually growing less as time progresses, although the engineer often encounters men who have a few hundred h.p., or oftentimes when the true facts present themselves, only 25 or 50 h.p., that they wish to transmit five or even ten miles, in hopes of making vast sums of money by the use of this transmitted power in some small town for lighting and power. The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of h.p. actually sold, will be the actual cost per h.p. for the case in question. Probably the greatest competitor to electric power is steam power. In a few instances, power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded. The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per h.p. may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided again a sufficient market can be obtained for power. When electrically transmitted power does not cost more than $100 to $140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

But what should it cost to harness and utilize water powers? This is a question that has to be figured out for each individual case, for there are hardly two plants where exactly the same conditions exist. The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured. When land is cheap, these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one. The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall and whether it is dependent on natural conditions or requires the building of large dams. Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached. When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable, a number of these wheels must be coupled together in order to get the required power. The speed attainable can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the init. cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency. With higher heads a larger amount of power can be obtained from fewer and smaller wheels with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible. There are many people who are imbued with the idea that it is impossible to build a modern station without direct connecting all of their apparatus, and that belting at no time should be used. Although direct connection is desirable, still it must not be carried to extremes. A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300 k.w. generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5,000. Yet this is sometimes done, burdening the plant with many thousands of dollars on which it has to pay money, for no other reason than that "so-and-so's plant is direct connected and I want a plant just as nice and good as his, and belts are always an awful nuisance." As stated before, direct connected units are always desirable where conditions will warrant them, still it must be borne in mind that belts have been in successful operation now for a good many years, and there are many instances where the maintenance of them has not cost 1 per cent. per annum, and although their use involves a loss of efficiency of somewhere between 2 and 3 per cent., at times of full load, still this loss in a water power plant is not a critical amount, and in fact is almost always inappreciable.

The next item of considerable expense is the transmission line—always rather an uncertain item, on account of its variations in cost for different distances and the conditions of local distribution. The poles, with their appurtenances, exclusive of wire, will cost between $250 to $500 per mile, varying according to circumstances. Rights of way for the placing of poles may often be expensive. The transmission wire must be considered separately. Reference has been made earlier herein to the voltage or size of wire. The voltage at which it is practicable to run now-a-days is reaching vast proportions. There are two or three plants being installed in which 20,000 to 22,500 volts will be used, and a plant is likely to be installed soon that will use 60,000 volts. The use of high voltages in the past has been limited greatly by the insulators. The glass insulator has proven itself insufficient for most climatic conditions. The oil type of insulators was introduced some years ago, and a great deal expected from them. They did give excellent results in the

laboratory, but unfortunately the oil evaporates and the impracticability of renewing the oil, especially when the line is in use, soon put them in disfavor. Porcelain insulators appear to have solved the problem. The trouble at first was to get them properly vitrified, but this difficulty seems now to be overcome, and the insulators have proven all that can be desired when used with the usual voltages now employed. As to whether they will successfully cope with the higher voltages now contemplated is a question yet to be answered. The cost of the transmission wire is often the most important part, but it is always different with each case, dependent, as it is, upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum. It must be borne in mind that with the use of the higher voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant.

All of these items have to be carefully considered before looking into the possible saving of copper on the line. For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S. If these facts are always borne in mind, the question of voltage will oftentimes adjust itself, and the use of very high voltages will not be found necessary unless the transmission be for especially long distances, and the amount of power particularly large. The permissible drop is dependent upon the power obtainable at the generating station and the amount to be delivered at the end of the line. There are a few instances where power is scarce at both ends of the line, and where it is desirable for this reason to keep the loss of transmission as low as possible, but such cases as a rule are rare, and we are more often met with the reversed conditions. To get good results electrically, the loss in the line should not be more than 15 per cent. If it be more, it will, with the other losses that are necessary in the rest of the apparatus, especially where the load is liable to be a fluctuating one, render good service almost impossible. The figuring of drop on transmission lines should always be left to competent engineers, for with A. C. the question in many instances is not a simple one, because it involves other conditions besides the ohmic drop. When alternating current is sent through a conductor, it has to deal not only with the electric resistance of the wire, but also with a resistance due to the fact that the electric magnetic stresses set up at any point of the conductor, create electromotive forces at other points of the same conductor, which oppose and retard the passage of the current, or in some cases, tend to shove it ahead. As to how far power can be transmitted, the engineer can conscientiously say to an indefinite distance, and he would be fully prepared to figure out, and contract for, if necessary, the fulfilment of his statement, but it rests with the commercial men to cry halt. The distances attainable, however, on a profitable basis, have been growing greater from year to year, as the manufacturers have been prepared to extend the limit to which they are willing to build high tension apparatus. At present it would appear that where the distance to be transmitted is over 75 to 100 miles, no matter how cheap the hydraulic development, commercial competition is not practicable with existing power where coal can be obtained for $2, $3 or even $4 per ton.

The step-down station and the distribution of power are the next items of expense, including the cost of the necessary switchboards, transformers, etc. The location of the step-down station and the method of the distribution of power constitute a very important question. Unfortunately, very often this subject is entirely omitted or overlooked by the promoter, but it is one to which should be given considerable thought. The step-down station itself should be centrally located, so as to make the distributing lines as short as possible. It is not generally advisable that transmission lines of very high voltages and large currents be extended through thickly settled communities where they might be liable to disturbance from fire or accidents of similar character, in the immediate locality of the line. In some places, to enable the distribution station to be centrally located, transmission wires are placed in conduits underground, when they pass through thickly settled districts so as to avoid the danger that would otherwise exist, but this, of course, is expensive construction, and the cost of it must always be balanced against the advantages of having the step-down station centrally located, as against its being placed at the outskirts of the town. All the various items require careful study to obtain least cost and avoid unwise economies.

When all these various factors have been properly adjusted and the resulting condition of the water power electric plant is that the power available twenty-four hours every day is at or about the cost of steam power in any given locality, the future profitable operation will be, no doubt, assured, because the popularity of electric power is not due alone to the fact that it can be produced cheaper than power obtained from other sources, but also to its superiority in other directions. This is evidenced by the fact that in mills and factories, where both sources of power have been tried, electric power is displacing the steam plant. Owners having experience with both invariably state that they would not be willing to return to their former power plants, even if power could be produced as cheap or cheaper than they are now obtaining it for electrically. The reasons for this are very numerous. The power is always on tap day and night, year in and year out; there is no waiting for boilers to be fired, nor shut-downs on account of strikes at some distant coal field; less room is required, and consequently floor space formerly occupied by belts and shafting can now be easily sub-divided into any number or sizes of units, and thus independent departments and machinery can be worked separately instead of from one big unit. Overtime work in any department is much cheaper, for by having departments separately operated they can be run independently at will, without running all the other machinery in the mill. The fire risks are less, and rates of insurance less for mills operated electrically than by other means. Removal of so many belts, line shafts, pulleys, etc., secures less danger to life of mill employees, and the mill is lighter and cleaner, and consequently the health of operatives better On account of the extreme simplicity of the A. C. electric apparatus, anybody with ordinary intelligence can start it in motion, and thus avoid depending on one or two men. Moreover, with electric power it is possible to maintain a closer speed, which in many instances enables the turning out of a larger quantity of better product commanding higher price; and so on for most every department and branch of business, some advantage is gained without anything lost. All of these advantages are not evident to the consumer before or when he first puts in electric power, and he often refuses to listen to them, thinking that they are entirely imaginary, but a short experience brings the conclusion that electric power is "cheap at any price." It may be interesting to note here that there is a project now on foot in which it is contemplated to transmit 30,000 h.p. a distance of between 30 to 40 miles; the transmitted power to be used in mills now operated through shafts, gears and belting by water wheels, because of the advantages to be gained by using electric power.

The use of electric power is not confined to driving machinery in mills or factories, for it is fast finding its usefulness in other directions. The use for "electro chemical" enterprises is fast reaching vast proportions, and there are plans now on foot for the utilization of at least 150,000 h.p. in this way during the next two or three years. There are many thousands of h.p. being used in the street railways, while the big trunk lines are seriously considering its use, and are continually asking the manufacturing companies for plans and estimates. Then there is the electric welding, the electric plating, the supplying of energy to horseless carriages and electric launches, to say nothing of the hundreds of thousands of incandescent and arc lamps that are used for general lighting. The utilization of the water power by electric transmission has not stopped with the commercial world, but has forced itself into the privacy of our own homes, not merely with incandescent lamps, but with electric cooking utensils, smoothing irons, electric heaters, fan motors, etc. What would our forefathers say if they were told that to-day we are depending on such and such a river, so many miles distant, to cook our meals for us and to have our boiled shirts laundered; but we had better not laugh now, for the coming generations may have as much occasion to laugh at us.

This paper was so admirably read that A. A. Wright jocularly asked whether the position of permanent reader to the association was open. If so Mr. Browne should be asked to take it. Wm. Thompson, Montreal, regretted very much that Mr. Magie's paper, which covered the whole ground before him, had not reached the hands of the members before the day of reading. He (the speaker) was only about 30 years old, but he could remember his grandfather running a mill in England by one of those lovely water wheels on which the water dropped from a great height above. Some friend came along and said, why don't you put buckets on your wheel and catch the water, thus suggesting an improvement which waited years for adoption. Mr. Magie properly pointed out that water motors for electrical transmission had come to stay, and was wise in pointing out to the investor that there are occasions when an electrical installation cannot pay. It is a pity that the installations near Montreal are not more advanced so that the investor could see what returns are likely to be made. The Lachine plant, for instance, represents a large capital that will be locked up there for years to come. In conclusion he felt like proposing that the discussion of this paper be postponed till next year, so that members might have a fitting opportunity of studying it. W T. Bonner, Montreal, thought that the steam men had been slightly disparaged. He expected that during the coming six months some tests would be made of important existing plants which would educe surprising results in favor of steam. He hoped to submit them at the first opportunity. W. H. Browne, Montreal, objected to the postponement of the discussion as it might bring on new phases of the subject and there were several members present who were capable of discussing the paper. He was perfectly aware that steam plants showed up very well in comparison with electricity, and indeed the paper pointed out that the initial cost in many cases rendered the installation of electricity prohibitive as an opponent of steam. But the use of the steam plant at unaccustomed hours involves extra cost while that of electricity does not. The largest commercial enterprise in Montreal has negotiated for electric power and has altered the working hours so as to recoup itself. A. A. Wright, Renfrew, thought the subject, in this age, of the utmost importance. Small towns in particular would be much benefited if the water powers in their vicinities could be used. A. M. Wickens, Toronto, also regretted that the paper had not been handed in earlier. Much could be said in favor of the steam end of an electric plant. You see, he said, this association reaches from one end of Canada to the other and includes many districts where there is no water power, and in such places the steam engineer will crowd his electrical rival very closely. Even where there is water power the results are not absolutely convincing. Take, for instance, the Cataract Construction Company on the American side of the Niagara Falls. No one knows whether they are making anything or not, or what the cost of transmission is. We know that a vast sum of money is sunk there, and that so far very little power is transmitted to Buffalo. About everything else we are left in doubt. J. J. Wright, Toronto, endorsed much of what had been said, but fancied that the steam engineers were not quite so sure of their facts as the electrical. L. De W. Magie said that if it had been his intention to fight the steam men he should have written a different paper. W. Thompson, Montreal, said that Mr. Magie had made his statements mildly, and agreed with much the writer said. The trouble is we put in 20,000, 30,000, or 40,000 h.p. plants and we are able to find customers only for about one-tenth. Too many people imagine that because the waterfall turns the wheel that therefore power ought to be free. Where large installations have been attempted too much money has been sunk to obtain power vastly in excess of the demand. Montreal is of course exceptional because of its promise and opportunities. Still it is not exempt from the charge. B. H. Reesor, Lindsay, moved a hearty vote of thanks to Mr. Magie.

W. T. Bonner, Montreal, then read his paper on "The Unconscious Ownership of an Important Key."

THE UNCONSCIOUS OWNERSHIP OF AN IMPORTANT KEY.

BY W. T. BONNER, MONTREAL.

The first consideration in exploiting any new suburban tramway is the possible or available passenger traffic. That being found inadequate to guarantee a fair return on the cost of installation and maintenance, the project is usually abandoned for the reason that only passenger traffic can be considered, owing to the high cost of handling goods traffic at the terminals. While a motorman and conductor are sufficient to handle a two or three-car electric train for passenger traffic, with very little expenditure of time or assistance for loading and unloading, all railways under present systems require a large additional force to conduct the hundreds of details attending the reception, checking, loading, transferring, unloading and proper delivery, in good order, of either car lot or package freight. It may therefore be conceded that the whole subject presents two phases of commercial economy, viz.:

(a) From the standpoint of the agriculturalist and land owner; how best to provide a means for increasing the value of remote lands.

(b) From the standpoint of the capitalist; how best to increase the earning capacity of suburban lines.

With the ever increasing centralization of population and commerce, inaccessible property becomes less valuable; all land, whether barren or fertile, suffering alike, according to its distance from the centre of demand for farm products, which we call markets. Such distance is not always measured in actual miles, but rather in accessibility, since in our day we find frequent examples of the long and short haul rates. The Minnesota and Manitoba farmers will deliver their wheat at the seaboard at a lower cost per bushel than the farmer who may live a hundred miles off the coast. The eastern farmer may have just as fertile land as his western competitor, but he is handicapped by having to haul his wheat forty or fifty miles over poor wagon roads to reach the nearest railroad. In either case, the terminal charges, including the cost of loading the produce at the farm, is approximately the same, but the difference in cost of haulage per ton-mile by railroad and wagon road is in favor of the former. It has been stated as a fact that to transport a ton of coal from Buffalo to Chicago costs no more than to move the same quantity of coal across the sidewalk in either city. It is frequently asserted that since the introduction and development of steam railways, they have gradually superseded the earlier methods of transportation and traffic, and as a consequence highways are no longer an indication of progress. This is true only to a limited extent. Railroads have changed the character of suburban traffic, and personal travel is no longer dependent upon the condition of the highways, but commercial intercourse, as represented in the exchange of products, is as much dependent upon the condition of the public road to-day as it ever was, for the reason that it is impossible to construct a railroad to the door of each producer and consumer.

Few people have any knowledge of the real cost of transportation by horse and wagon. The following table shows the cost of moving a load of one ton a distance of one mile on level roadways, with different pavements and under average conditions:

	Per ton-mile
Iron Rails	$ 1.28
Asphalt	2.70
Stone, paving, dry and in good order	5.33
Stone, paving, ordinary condition	12.00
Stone, paving, covered with mud	21.30
Broken stone, dry and in good order	8.00
Broken stone, moist and in good order	10.30
Broken stone, ordinary condition	11.90
Broken stone, covered with mud	14.30
Broken stone, ruts and mud	26.00
Earth, dry and hard	18.00
Earth, ruts and mud	39.00
Gravel, loose	51.60
Gravel, compacted	12.80
Plank, good condition	8.80
Sand, wet	32.60
Sand, dry	64.00

From the foregoing table, and from statistics gathered by both state and national bureaus, it has been calculated that the average cost of transportation by animal power is twenty-five cents per ton per mile. Furthermore, the rate of transportation by animal power is, and always has been, excessively high, and the evidence of statistics shows but slight improvement as compared with the progress made in other departments of industry, and by other means of transportation.

One fact is patent to all, that whereas formerly the distribution of population was approximately equal over the face of

the country, it is gradually becoming concentrated into large cities to such an extent that already fully one-half of the inhabitants of the older sections of the country live in cities. The evident reason for this is competition, the demand for increased output at reduced cost. Concentration indicates increased power for production. Take, for instance, some of our commonest staples, like wheat, beef, pork, molasses, wagons, horseshoes, butter and clothing. Within the writer's memory, these articles were produced at homes, or in small shops and factories distributed, like the population, quite equally throughout the country at cross roads and villages, utilizing crude methods and operated by the old-fashioned treadmill or horse power, and overshot water wheels. The output of flour per man per day in those mills did not exceed ten barrels. At the great Winnipeg and Keewatin mills, and at Minneapolis, the milling business has been so concentrated that to-day the output per man exceeds 100 barrels and the cost of production is correspondingly reduced. But of what benefit to inaccessible property in the interior is this reduced cost of production, unless like facilities for transportation are afforded?

The measure of benefit which any improvement in production in one community bears to another community, depends entirely upon the transportation facilities between the two places.

Concentration of population and production requires for the better equalization of supply, and price of materials and provisions, that such centres must be provided with commercial veins and arteries which shall quickly and cheaply transport or exchange urban and suburban passengers and commodities. While long haul rates of transportation by railroads and steamships have been wonderfully cheapened, there still remains a space of fifteen to twenty-five or even forty or fifty miles surrounding every commercial centre, which has never been covered by any cheap method of transportation. Such distances are beyond the possibility of cheap or efficient service by animal power, and the terminal charges and bulky plant required, precludes any possibility of much reduction in railroad tariffs. What we require therefore is a new system of transportation which shall be alike available for freight and passengers. The problem of handling exclusively passenger traffic is comparatively simple; indeed it has already been solved for those districts where the population is sufficiently dense to support steam or electric tramways requiring no other source of revenue. Experienced railroad men are unanimous, however, in agreeing that no road, whether steam or electric, will pay in a thinly settled district, unless assisted by a bonus or by the addition of freight traffic.

The latest development in the line of providing for goods traffic on electric tramways came to the writer's notice some months ago in the shape of a combination vehicle, so constructed as to be readily convertible for use upon any ordinary roadway or upon a railroad track. It can be shifted from one to the other without the necessity of reloading or rehandling the contents between points of shipment and destination. The wagon proper is patterned after the ordinary improved road wagon, modified, of course, for the special nature of the service contemplated. The running gears and springs are of standard construction, having a carrying capacity of from three to seven tons, depending upon the class of freight to be carried.

The rail truck is not materially different from the car truck in general use upon our electric railways, except that it is provided with special attachments for automatically gripping and supporting the wagon proper. It has cast steel segments or dogs, supported in place horizontally by heavy plate springs, and used for the purpose of engaging the axles of the road wagon as the truck approaches from either direction. As the truck is drawn forward on the level rail by the electric motor, the impact of the projecting dogs against the wagon axles also starts the wagon forward, and as the latter travels down the inclined switch track, the axles gradually settle into the notch provided in the cast iron journal frames.

The actual time required for unshipping the wagon from the truck for road use, and vice versa, is not more than would be required for coupling together cars in making up a train. The weight of the combined wagon and truck is sufficient to insure perfect rail traction and the proportion between carrying capacity and dead weight averages about the same as the ordinary freight car. By establishing a uniformity of dimensions and making the rail truck interchangeable, the wagons can be loaded either end on from either direction, and any number of rail wagons can be connected and moved in either direction as a train, by steam, electric or other motive power.

W. H. Browne said Mr. Bonner had submitted a conundrum. He took it as a suggestion that the railroads should lend their lines for the transmission of parcels free, and thus make unnecessary the aggregation of population in large cities. G. H. Hill, Montreal, said that while the scheme was, no doubt, an interesting one, it was open to question. It proposed to do away with the frequent handling of products and seemed beautiful up to the point where the car is sidetracked. But it means the lying idle of a certain amount of rolling stock, and it is a question whether the producer could not bring his stock down to a certain point where it could be taken up by the train. Then he loses the ownership of the material the moment it leaves his yard. Now the railway company is not going to do the work of a commission agent for nothing. The speaker had run over a number of suburban routes, noticeably that of Grimsby, where the system seems to give first-class results. They run through a most fertile country tenanted by large fruit growers and farmers, who all need a certain amount of power at all times—threshing, pumping, churning, and yet strange to say the suburban company will not even think of taking power from their circuits. In Manitoba and the North-West Territories he knew of a scheme which was being evolved by some engineers who figured out that the farmer of Manitoba, with the straw annually burnt up, could do all the work of his farm by electric power. The discussion was continued by A. A. Wright, J. J. Wright, L. De W. Magie, C. H. Wright and W. H. Browne. G. H. Hill moved and E. D. Ellis (Barrie), seconded a vote of thanks to Mr. Bonner. The president in tendering the vote remarked that before you could get the farmers to use power you must have some model establishment showing what can be done.

A telegram from John Murphy, on behalf of the Ottawa Electrical Association, was read, wishing the association a profitable and pleasant convention in the commercial metropolis of Canada.

In the evening, on invitation of the Montreal Park and Island Railway, the members enjoyed a trip around Mount Royal, where a good view of some of Montreal's handsome suburbs was obtained.

WEDNESDAY, JUNE 29TH.

The first business of the day was the presentation of the Secretary's report, from which it appeared that there had been five committee meetings during the year ending 31st May last. At the first a Committee on Mileage and Transportation was appointed. At a later meeting committees on general arrangements and on papers, and the secretary was instructed to render accounts to members in arrear for fees and make drafts if amounts were not paid within reasonable time. At the meeting of May 25 nine persons were elected to membership and the resignation of ten members accepted. In the early part of this year a pamphlet setting forth the character and purposes of the association was prepared and printed under the direction of the Executive. About 800 copies of this have been judiciously distributed. Particulars of other important work are to be found in the report of the Committee on Legislation. Incidental reference was made to the recent formation of the Maritime Electrical Association, of which F. A. Bowman, of New Glasgow Electric Company, a member of the Executive of the Canadian Association, is the president, to promote electrical interests in the Province of Nova Scotia and New Brunswick. During last year death entered the ranks of the association and caused the loss of Charles Ernst, of Detroit, and Ross McKenzie, of Toronto. During the year there were dropped from the roll the names of 21 members, 12 active and 3 associate members having resigned; 2 having died and 4 having changed their place of residence without furnishing their new addresses. Since the 1st inst. 2 additional resignations have been received and the names of 13 members struck off the roll for non-payment of fees. Thus there have been removed from the membership list since last convention 36 names. During the same period there were added 68 active and 11 associate members—a total of 79, leaving the present total membership at 234. The Financial Report for June, 1897 to May, 1898 shows total receipts $790.82 including a balance at the bank of $410.57. Bringing the financial operations up to June 29, the total at credit of the asociation is $588.75. The report was adopted, and the secretary thanked for the care with which he had prepared it.

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee beg leave to report that in pursuance of the motion passed at the last convention held at Niagara Falls, instructing your Committee to take up the matter of securing legislation in connection with the movement among municipalities in Ontario to enter upon electric light undertakings, in unfair competition with companies already in existence, your Committee held their first meeting at the close of the convention. At that meeting it was decided to procure an opinion from Donald Guthrie, Q.C., ex-M.P.P., of Guelph, and to retain him professionally on behalf of the Electrical Association in connection with the question. Various questions were submitted to Mr. Guthrie, and his opinion in answer to these questions was considered at a meeting of your Committee held in Toronto on the 9th of November.

A bill was prepared which came before the Municipal Committee of the Legislative Assembly on the 12th of January. Your Committee in preparation for the meeting, assembled in Toronto on the 11th, and also on the 12th, and attended the meeting of the Municipal Committee for the purpose of supporting the bill. The Committee had also the assistance of Z. Lash, Q.C., with Mr. Guthrie.

After discussion, those representing us consented to a suggestion of the Honorable A. S. Hardy, Chairman of the Municipal Committee, and other members of that Committee, to allow the matter to stand over for another year. The discussion, however, brought out the fact that there was really no sound answer to the principle of the proposed measure. It also evoked an expression of opinion from the leading men of both political parties to the effect that the underlying principle of the bill was just. The Municipal Committee thought that there was not proper time to consider how the bill would affect places where there were more than one existing plant, also places that derived or may derive power from points outside the municipality, also to consider the length of the life of an electric plant and other questions, and in the judgment of the Municipal Committee any bill dealing with the matter would require more ample public discussion and some modification. The action of your Committee and the discussion the question has received, has tended to bring into prominence the injustice of the present law. The necessity and propriety of some measure of relief may be considered now to be more generally admitted. The work thus inaugurated and which has attained a hopeful position, should not be discontinued. The present law of Ontario is inequitable towards lighting and power companies because it permits a municipality, after it has given its sanction to the formation of such a company and has encouraged enterprising citizens to embark their capital in it for the purpose of supplying the municipality wtih light and power, to turn around and destroy, with public funds, and without public necessity or advantage, the value of the property of those citizens who were encouraged to invest their private means in the enterprise. What evidently struck the majority of the members of the Municipal Committee was that the proposed legislation was just and equitable because, while it did not prevent municipalities entering upon municipal supply of lighting if they so desired, it made provision for extending the existing law regarding water works to the case of lighting companies. This law is to the effect that where a municipality desires to supply water and there is an existing water company incorporated for the municipality, the council shall not levy any water rate until the council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of the Municipal Act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company; the price to be determined by arbitration under the provisions of the Municipal Act. It will be observed that this provision in no way interferes with municipalities going into the supply of water. It simply provides that if they do enter upon such undertaking they are by this law bound first to try to buy at a fair price, or at a price to be fixed by arbitration, existing waterworks. No good reason can be advanced why this law should not be extended to lighting and power companies as well as to waterworks. It is eminently just, and it imposes no hardships on the municipalities; nay, rather, it benefits them, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable, and at all events it puts them in possession, at a fair valuation, of the very plant and material that they would have to purchase from other people if they are going into the business. The proposed legislation is in the public interest, because it will further encourage private citizens to invest their capital in extending and improving existing lighting and power works. It was generally acknowledged by the Municipal Committee that electric light companies as well as water companies have always come into existence with the consent, encouragement and approval of the municipality, which has granted the use of the streets, etc., for these works.

It ought to be mentioned that all the members of your committee paid their own traveling and other expenses in connection with attending the meetings. The movement amongst municipal corporations to enter into the lighting and power business in competition with those who had the courage to be pioneers is growing, and unless regulated in some way by the legislature, will result in the confiscation of a large amount of capital invested in the business, as witness the town of Barrie now preparing to put in a complete plant, including arc, incandescent and power services, to be paid for out of public funds, for the purpose of competing with and destroying the Barrie Company, a private and lawful enterprise.

In the course of the discussion S. Noxon, Ingersoll, expressed his sympathy with the work of the committee and said he believed there was an Act in Scotland providing against municipal confiscation. British law has wisely been taken as a precedent, and it might be so taken now. An electric light plant needed protection in this respect more than a waterworks plant, for the latter was of a permanent kind, while an electric light plant was subject to frequent change from the constant improvement going on, and a plant that is considered efficient now might soon become obsolete. In certain circumstances this might be an argument against us, but in other cases, as for instance, that at Barrie, where the municipality refused to treat at all, the cancellation of existing rights would be a double injustice to private ownership. E. D. Ellis, Barrie, referring to the case of his company, said they had been for two years without a contract with the town. The town authorities would not talk to them at all. His company wrote that they were anxious to be on a proper footing and would even sell out their plant at its proper value. The town told them to put in a tender along with other tenders they were calling for, which was not fair to the company, who protested that this was not fair, and offered to leave it to three competent men as arbitrators. The town would not arbitrate. Other towns were evidently watching the result of this case.

The president said he had followed this subject closely for some years and his experience had been that most people are anxious to reap where others have sown. The first bill provided against this in a way, but the committee were impressed with the conviction that these difficulties have to be openly discussed and fairly met. The committee did not feel inclined to go on with the bill that session but were urged on from various quarters, and a short bill was prepared with the idea of a larger measure in the future. The Hon. Mr. Hardy said he had no doubt that municipalities in the future would submit to arbitration. J. J. Wright, Toronto, said the strongest emphasis should be laid upon the point of arbitration. When a plant is purchased by arbitration it should be at its value, and it is worth as much to the municipality as to the private corporation. The separation of the public lighting from the private and commercial branches would mean ruin in many cases. He could not understand why the electric light industry should be singled out for so many attacks. There seems to be an exasperating glamor about electricity, probably owing to the superstition that there is lots of money in it. The chairman said people in small towns have a notion that a dynamo set up beside a water wheel will produce power for nothing. Mr. Wright—That is what they think in Toronto. Mr. Noxon thought the supply men were frequently to blame for encouraging municipalities in this course. Mr. Wright thought more harm was done by "half baked" dynamo tenders who pose as electricians than by the supply men. B. F. Reesor, Lindsay, said the Municipal Act of Ontario clearly stated that where a bonus is given to a town it shall not interfere with any existing interests, and he believed that taking this as a principle of law, if a test case were made where a municipality attempted to crowd out

a private company without arbitration, the highest courts would affirm the company's rights, even without a special act. The chairman said lighting companies do not get bonuses and free sites like many other industries, and that is one of the hardships of the situation. A. A. Wright, Renfrew, said it was a difficult subject. There were political enemies as well as electrical enemies. An eye should be kept on the electrical supply men, who by telling half the truth to municipal authorities do incalculable harm.

This led to a tilt between the electric supply men and other speakers in which the former said they were "out for business" just the same as the electric lighting men, and it sometimes naturally happens that they cross each others paths.

The following standing committees were then appointed:

Statistics.—J. A. Kammerer, Toronto; A. A. Wright, Renfrew; S. J. Parker, Owen Sound.

Meter Inspection.—A. A. Dion, Ottawa; E. E. Cary, St. Catharines; J. J. Wright, Toronto.

Legislation Committee.—John Yule, Guelph; C. B. Hunt, London; B. F. Reesor, Lindsay; J. J. Wright, Toronto; W. H. Comstock, Brockville; F. Pepler, Barrie; A. L. Breithaupt, Berlin; C. Berkeley Powell, Ottawa.

NEXT PLACE OF MEETING—HAMILTON.

A letter was read from the Cataract Power Company, of Hamilton, extending an invitation to the association to hold its next meeting there. This was heartily endorsed by several members from Hamilton, and on putting it to the meeting the invitation was unanimously accepted.

J. J. Wright proposed, seconded by B. F. Reesor, that the remuneration of the secretary be $125 per year.—Carried.

Geo. H. Hill, Montreal, drew attention to the need of proper inspection of electrical construction, and thought that the Fire Underwriters should provide a competent inspector. At present there was no uniformity in inspecting, and in Montreal electrical men never knew where they were. During the discussion Mr. Browne, of the Royal Electric Co., said his company had already solicited the Government to appoint a competent inspector, but so far without success, and the company had to formulate rules of its own, which were generally accepted. Ald. G. W. Sadler said the City Council were now codifying general rules for building, plumbing, etc., and he would be happy to co-operate with a committee of this association with a view to having a set of rules for electric wiring and fixtures incorporated in these new rules.

On motion of Mr. Wright, Toronto, a committee consisting of A. A. Dion, Ottawa; F. H. Badger, jr., Quebec; P. G. Gossler, Montreal, and Ald. G. W. Sadler, Montreal, was appointed to meet the Boards of Fire Underwriters, and deal with the question.

Dr. J. K. Johnstone, Inspector of Electric Lights, Toronto, then read a paper, entitled "Experiences of an Inspector," which was well received.

EXPERIENCES OF AN INSPECTOR.

BY J. K. JOHNSTONE, INSPECTOR OF ELECTRIC LIGHTS, TORONTO.

When honored by an invitation from the Executive to prepare a paper for the society, I was somewhat in doubt as to the choice of a subject. I wished to furnish something that might be of interest to you and at the same time to avoid any of the important branches of electrical science which might leave me liable to criticism from gentlemen so highly qualified; hence, with your kind permission, I will confine myself to giving you a few impressions as received in my capacity as inspector.

At the introduction of the government inspection of electric lighting, there were a few, as you may remember, opposed to the act, and I acknowledge that it was with some misgivings that I went forth on my duties. However, it is with pleasure that I can now recall every visit made to the electric light stations in my district, and in every instance have I not only been kindly received, but every suggestion of improvement offered by me has been acted upon immediately and with evident pleasure. I need not tell you that in not one instance have I found any attempt on the part of electric light companies to defraud their customers, although occasionally appealed to by consumers on that ground. An investigation usually resulted in discovering old lamps, too few lights for the space lit, wastefulness where a meter was in use, or some other fault in the power of the consumer to correct.

The persistence of many purchasers of electric light in clinging to old and useless lamps is a common source of annoyance to the companies and a difficult matter to overcome. The old lamp is often expected to give as brilliant a light as when first installed, and when unable to do so the charge is frequently made that the company supply a too low voltage. To please these grumblers, a mistake is sometimes made in endeavoring to supply a current sufficient to brighten these worn-out lamps, and this, too, at the expense of new lamps, whose brilliancy is thus deteriorated. As it is impossible to compel the purchase of new lamps, and as the companies are anxious to please their customers, I have suggested, when consulted, that new lamps should be supplied at their actual cost, thus throwing the blame on the consumers when their lights were poor, economising electric current and sparing new lamps.

The question as to the advisability of using meters, where practicable, can only be answered in their favor. By the employment of a meter a just system is accorded to manufacturer and consumer alike; the wasteful man is made to pay fairly for his neglect, while the careful and honest man is charged only for the light needed and current consumed. Under the flat rate system, it is not uncommon to see large shops brilliantly illuminated throughout the entire night. Managers tell me that it is difficult to introduce the meter where flat rates have been charged, but, despite the objections, many are making the change. The several types of dial registering meters which I have inspected are usually accurate, and I am told prove satisfactory as measuring instruments for either power or light.

A lack of uniformity in rates, both by meter and flat rate systems, has been a subject of complaint with some managers. There is evidently no remedy for this unless an arrangement can be arrived at by the manufacturers themselves and a standard charge agreed to.

In several towns in the district visited by me, a system of street lighting by incandescent lamps has been adopted. When properly arranged the appearance is quite pretty and the light well distributed.

In concluding, permit me to tell you that the managers and electricians I have met in my work are, without exception, kindly and intelligent men, and in this favorable opinion I am borne out by other inspectors with whom I have spoken upon the subject. It has been suggested to me that there may be some potent and subtle charm in the electric current which develops the best qualities in a man's character. Can this be so?

W. T. Bonner, Montreal, read his paper on the "Quimby Screw Pump," which has been crowded out of this issue.

Mr. Bowman's paper on "Methods of Illumination" was taken as read, and the paper promised by Mr. Hopkins on electricity in Rainy River was not received.

The afternoon was devoted to social features. The first event was the inspection of the Bell Telephone Co.'s new building, where L. B. Macfarlane, the genial general superintendent, had a staff of the company's employees, who took charge of the visitors in groups and explained the wonderful complexities of the great exchange room, one of the largest and most perfect telephone exchanges in the world. After this the Montreal Street Railway Co., which had provided special cars to bring them down here, conveyed the visitors to the company's great power house, where 8,000 horse-power was observed in operation, the new 4,000 h.p. engine—the largest in Canada—being particularly admired. Four big pleasure vans were in waiting for the company at the corner of McCord and Seminary streets, the distribution station of the Lachine Rapids Hydraulic and Land Company, and after inspecting this building the party were driven to the big power house at Lachine Rapids along the picturesque Lower Lachine Road. Dismounting here the visitors were first shown the sea of rapids that tumbled and roared beyond the embankment at the outer end of the power house, and then they were shown the long gallery of turbines, and four large generators in operation. These generators, which were built by the Canadian General Electric Co., have previously been described in The Canadian Engineer in connection with an account of the Lachine Company's works. The inspection over, the visitors were invited to a cold collation and liquid refreshments which were enjoyed very much. Senator Thibaudeau, president of the Royal Electric Co., in a few

graceful words, conveyed the thanks of the association to the company and said of Mr. Walbank, the general manager, that the longer he had known him the more he esteemed his genial qualities, and he trusted he would be rewarded with all the success his enterprise and foresight merited. Mr. Walbank, replying, thanked the honorable senator for the compliment paid him, which he valued the more coming as it did from the head of a rival company. [Senator Thibaudeau.—Say "elder sister."—Laughter.] Mr Walbank took occasion to correct a member who on the previous day, speaking of unremunerative schemes that supplied more power than was demanded, said this company had only two generators running and not paying. As a matter of fact there was only one generator at present running during the day when lights were not in use, but at night there were three dynamos running, and the company was quite satisfied with the prospects. The visit closed with three cheers for Mr. Walbank, and the visitors were driven to the head of the dam, where they arrived just in time to see the steamer Sovereign run the rapids. The party returned to the city by way of the "Glen" and Dorchester street, and were set down at the Windsor thoroughly pleased with the excursion. The refreshments and conveyances were supplied jointly by the Canadian General Electric Co., and the Lachine Rapids Co.

THE BANQUET.

The annual dinner, which took place at the Windsor on Wednesday evening, 29th, will be remembered as the most successful in the history of the association. President Yule made an excellent chairman and kept the business of the evening moving without any tedious hitches. The dinner itself did credit to the Windsor's well-known reputation. The cover of the programme had the association's monogram and maple leaf in gold, and the covers with menu and toast list were held together by covered copper wire. The menu was as follows:

MENU.

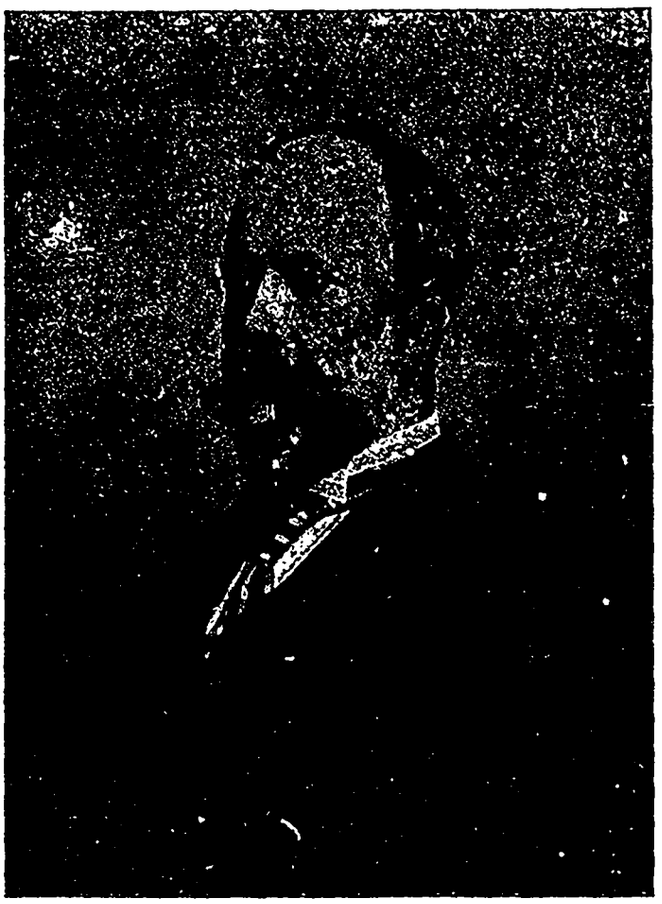
Long Distance Transmission.
Fire Island Cocktail—50,000 Volts.
Internal Resistance.
Cucumbers Radishes
Tomatoes, strain Insulators. Olives tripled Braided
Electric Juice.
Green Turtle, a la Water Rheostat,
Cream of Asparagus, a la Ozone.
Submarine.
Saguenay Salmon, a la Hello. Potatoes, Rachel.
Shunts.
Spring Lamb Cotelettes. Sweet Breads.
Cannon Trimmed,
Asparagus—"Arrester" Points.
Joints—"Soldered and Taped." Filets of Beef, Larded
Relays and Sounders. String Beans.
Boiled New Potatoes, Anchors,
Cauliflower, Asparagus, Sweet Peas.
Trolley off. Punch au Champagne.
Reconstruction.
Roast Philadelphia Capon, Plants, Lettuce and Tomato Salad.
Boosters.
Cabinet Pudding "sound proof,"
Gelee aux Oranges, "insulating compound."
Savarin aux Ananas, "vacuum light,"
Vanilla Ice Cream, "self cooler."
Sponge Cakes, "Leather Belting."
Dessert.
Fruits, "potential currents," Nuts and "wrenches."
Electric heater, Incandescence
Cafe Noir, Cigars.
Transfer. Ring off. Open Circuit. "30."

On the chairman's right sat Mayor Prefontaine, Ald. Sadler, Dr. W. H. Drummond, C. B. Powell, and on his left the Hon. Senator Thibaudeau, W. R. McLaughlin, L. B. McFarlane, D. A. Macdonald, W. H. Browne, C. B. Hunt and P. W. St. George. The others present were: J. A. Kammerer, Toronto; John Carroll, Montreal; Samuel Adams Chase, New York; P. G. Gossler, L. D. W. Magie, Wm. T. Bonner, W. E. Quimby, F. W. Fairman, J. C. McCormick, R. H. Bartholomew, Wm. Smyth and John J. York, Montreal; A. A. Wright, Renfrew, Ont.; C. H. Wright, Alex. Barrie, William B. Shaw and D. W. McLaren, Montreal; Andrew Sangster, Sherbrooke; Geo. C. Rough, T. W. Atkinson, H. J. Gardiner, R. Dobie, H. J. Fuller, James A. Baylis, P. H. Hart, Fred. S. Hickey and James H. Campbell, Montreal; A. M. Wickens, Toronto; J. F. H. Wyse, Brantford; V. B. Coleman, Port Hope; E. J. Kyle, Kingston; H. A. Moore, Trenton; J. W. Campbell, J. S. M. Ridley and E. D. McCormack, Toronto; J. W. Pilcher, Montreal; M. B. Lovell, Coaticook; H. E. Allen, Waterloo, Que.; H. E. Channell, Stanstead; Chas. E. Taylor, Montreal; E. Craig, Montreal; Gordon J. Henderson, Hamilton; A. W. Staveley, P. H. Davidson and J. R. Meadcroft, Montreal; A. L. Breithaupt, Berlin, Ont.; J. K. Johnstone, and J. J. Ashworth, Toronto; W. F. Dean, Thomas Rodger, D. S. Barton, Jas. Hunter, Charles D. Matthews, and H. C. Ross, Montreal; George D. Ellis, Barrie; W. Ahearn, jr., W. G. Bradley and Ed. J. O'Reilly, Ottawa; J. W. Martin, Hamilton; H. W. McLaren, Montreal; E. B. Biggar, J. J. Wright and A. B. Smith, Toronto; Fred Thompson, Montreal; Wm. McCaffrey and Walker G. Anderson, Toronto; J. W. Purcell, Walkerville; C. E. A. Carr, London, Ont.; C. L. Weeks, Toronto; J. R. Wilkes, J. E. Scott and James Kent, Montreal; D. A. Starr, Cornwall; Wm. Campbell, Montreal; C. Thomson, Ottawa; S. Noxon, Ingersoll; P. Morgan, B. F. Reesor, Thos. Sadler and D. McGibbon, Lindsay; G. A. Powell, St. Catharines; R. E. T. Pringle and F. H. Leonard, jr., Montreal; E. E. Cary, St. Catharines; M. P. Cochrane and W. E. Gower, Montreal; Geo. H. Hill, L. Rousseau, Montreal; W. R. Leet, Danville; C. H. Mortimer, Toronto; Henry B. Haigh, New York; L. Robinson and John T. Murphy, Montreal; Robt. Welsford, England; W. F. Simms, Kingston; R. Stanton Wright, Ernest J. Jenking and M. Rubenstein, Montreal; Geo. Black, Hamilton; W. F. McLaren, R. F. Morkill, W. J. Plews, L. A. Howland, J. Fleet and J. W. Morris, Montreal; F. A. Wunder, New York; J. A. Burns, Geo. E. Matthews and Edward Carter, Montreal; W. A. Johnson, Toronto; E. A. Wallberg and R. A. Ross, Montreal; H. G. McLaren, London, Eng.

After "the Queen" had been loyally drunk, the secretary read several letters of regret from absent friends and members, among which was one from F. C. Armstrong, who was then on his way to England, but who desired to assure the company that his thoughts would be with them this evening. Mr. Browne departed from the programme for a moment to propose the health of Mr. Armstrong and wish him prosperity in his new and important field of work, and the rousing enthusiasm with which the toast was received showed how many warm friends Mr. Armstrong had around these tables. "He's a Jolly Good Fellow," was at no time more heartily sung. The chairman then proposed "Electrical Montreal," and coupled with it the name of Mayor Prefontaine, who, he said, ought to be made an honorary member of this association, as His Worship was the projector and proprietor of an electric plant at Ste. Agathe.

The mayor, who was received with hearty enthusiasm, said he would have hesitated somewhat at responding to what was really the toast of the evening had it not been that to some extent he was connected with the electric service. The importance of electricity among the sciences was apparent to all, and it was gratifying to him that so many French names, such for instance, as Ampere, were written in the history of that science. Referring more particularly to Montreal he ventured to say that this city with its population of over 300,000, including suburbs, had made a record that would compare with any city in the world. The pioneer company in Montreal was the Royal Electric Company, which began in 1884 with a dynamo of 12 arc lights capacity and a dozen employees, with a capital of less than $50,000. To-day this company was serving from its two generating stations electric current for 1,500 arc lights, 75,000 incandescent lights, besides 2,000 h.p. in motors. Its new factory has an area of 40,000 square feet, it has over 5,000 employees, and a capital of $2,500,000. In July, 1886, the city gave an order for 133 arc lights for street lighting, which was considered a big contract then, but to-day the city has nearly 1,500 arc lights. One of the latest contracts of the Royal Electric Company is to supply current to the Dominion Cotton Mills Co., to the extent of 1,500 h.p. to operate their large cotton mills in Montreal. The Chambly Manufacturing Company, by which current will be transmitted from the Richelieu River to Montreal by September next, represents a development of 20,000 h.p. He was one of the original promoters of this company, having got its charter through the legislature, and so foolish was the scheme considered that his action in the matter was put down to a desire to win a few votes at the next election. But now this great power is practically ready for trans-

mission. Another enterprise which was a credit to Montreal was the Lachine Hydraulic Works; with a capital of nearly $2,500,000, which has harnessed the St. Lawrence. The enterprise was a vast one. It might not be the complete success at the present time which its promoters expected, but that it would ultimately be a success no one doubted; and it would be a credit not only to the city, but to the gentlemen who had carried out such a big enterprise. In 1892 the Street Railway began operations by electric power, which was first generated at the power house of the Royal Electric Company, with two dynamos of about 500 horse-power; to-day it had 80 miles of track and a plant of about 10,000 horse-power, including an engine built by the Laurie Engine Company, of about 4,000 h.p., one of the largest steam engines in use. In 1894 the Montreal Park & Island Railway Company began operations, and to-day it was running to Back River, St. Laurent, Outremont, Cartierville, etc., and was operating about sixty cars. There were about 8,000 telephones in use in the city, exclusive of about 1,200 belonging to the Merchants' Telephone Company, so that the progress of electrical science in Montreal could easily be seen. He concluded by congratulating the association on the good work it was doing, and said he wished to become a member The mayor was given three rousing cheers. J. R. Wilkes here sang "The Clang of the Forge," and was heartily encored. The toast of "Our Association" was followed by two comic songs from F S Hickey, who made himself a favorite at once. "Sister Associations" followed and R. H. Bartholomew sang "The Anchor's Weighed," and in reply to a hearty encore sang "Maid of Athens." "Our Guests" was replied to by Hon. Senator Thibaudeau, who in acknowledging the honor done him, said, the gentlemen he saw around were the representatives of what was most distinguished in the electrical world. It was to them that Canada owed its great strides in putting into operation the electrical force which had transformed all around us; it was to their energy that everything had been metamorphosed in the Dominion; it was to their accumulation of science that we had to-day those conveniences which contributed to the happiness of this nineteenth century, such as electric tramways, electrical power apparatus, telephones, the lighting so good and so brilliant that one could almost see his conscience better than he could with the "X" rays of the Christian teaching Montreal had felt the magnetic impulse. The Lachine Hydraulic Works, which they had seen that afternoon in their grandeur, and the Chambly Works, which they would visit the next day, would tell them more about electrical progress in Montreal than he could. These works would tell them that the electricians of Montreal well deserved to be members of their association, and were a credit both to the association, and to the city of Montreal. The electricians of Montreal were jolly good fellows; they might ground a wire now and then, but they were seldom grounded themselves. (Laughter and applause). They also had their periods of incandescence, but it was with a good motive. In conclusion, he wished the Canadian Electrical Association and its members every success. Dr. Drummond was then called upon and gave the habitant's description of summer from his well-known book "The Habitant." At its conclusion there were clamorous calls for the "Pap'neau Gun" which was recited with fine effect. E. I. Jenking then gave a song, which was encored. The president proposed "Electrical Research," and coupled the toast with the name of W. H. Browne, who was not "general manager" tonight, but "one of the boys." Mr. Browne, who was received with "He's a Jolly Good Fellow," regretted the absence of Prof. Herdt, the able scientist of McGill, who was to have replied to the toast, but who was kept away by the serious illness of his wife. Disclaiming any pretensions to science himself he nevertheless spoke entertainingly of the advance of electricity within the past few years. It was only ten years ago that the first electric railway—a pioneer enterprise with which he was connected—began operations, while to-day there were 80 miles of track in this city alone. When hotels were being fitted up with electric curling irons in each room for the lady guests, what developments might we not expect in the near future. The farmer who now could grind his corn, chop his fodder, etc., by electricity, might soon be able to milk his cows electrically. Some one suggested that the day would come when we should eat, sleep, walk and talk electrically and man would thus become an automaton governed entirely by electricity --but of course, we wished to defer that day as long as we could. (Laughter.) Messrs. Campbell and Starr then gave a duet which was well received and encored. "Allied Interests" was responded to by Ald. G. W. Sadler, of Sadler & Howarth, Montreal; E. E. Cary, of the Packard Electric Co., St. Catharines; C. Lord Weeks, Toronto, and Duncan Macdonald, superintendent of the Montreal Street Railway. Mr. Sadler referred to the fears of some manufacturers that their business would be wiped out when electricity came into general use, but to-day these lines of business are not only thriving but new lines have



WM. H. BROWNE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

been created, due to electrical development. He referred to the first electrical exhibition in Montreal, and suggested that exhibitions should be held in connection with future conventions. Mr. Weeks entertained the company with some humorisms, and Mr. Cary, who followed, showed how the evolution of electrical work in Canada had opened a field for specialists in manufacturing, and their success had shown that the progress of the country was steady and rapid. The three years he had spent in Canada were the happiest of the fourteen years in which he had been engaged in electrical work. Mr. Macdonald humorously sketched the difficulties of a street railway company. If anything goes wrong in the city the street railway is blamed. If the cars go too slow it is their fault, if they go too fast it is their fault all the same. Speaking of the progress of electricity he believed it would continue and perhaps be surpassed by the rising "generators." If our nearest ancestors could return from their graves and view the improvements and enjoy the blessings brought about by this science they would be astounded, and would lavish praise upon the electricians. In fact they can be called the Deweys of this generation. If the association returned with its convention to Montreal it would be greeted with a thousand welcomes. Mr. Kammerer was then called on and amused "the boys" with a funny story, after which Mr. Wilkes sang "Loch Lomond." "The Press" and the "Ladies" concluded the evening, the latter being replied to by Dr. Drummond, who recited the heroic episode of Madelaine Vercheres. The company separated at 1.30 a. m.

THURSDAY, JUNE 30TH.

The first business of the morning was the election of officers, all except the new members of the Executive being returned by acclamation. Mr. Hunt was nominated for president but declined to stand. The result was as follows:

President—W. H. Browne, general manager Royal Electric Co., Montreal.

First Vice-President—H. P. Dwight, president and general manager Great North-Western Telegraph Company, Toronto.

Second Vice-President—A. A. Dion, Ottawa Electric Co., Ottawa.

Secretary-Treasurer—C. H. Mortimer, Toronto.

Committee—J. J. Wright, Toronto; John Carroll, Montreal; O. Higman, Ottawa; A. B. Smith, Toronto; Wm. Thompson, Montreal; W. McLea Walbank, Montreal; E. E. Cary, St. Catharines; Gordon J. Henderson, Hamilton; H. R. Leyden, Hamilton; George Black, Hamilton.

On moving the new president into the chair the thanks of the association were tendered to ex-President Yule, whose urbanity, tireless industry and sound common sense had done so much to advance the association in public estimation during the two years in which he had held office. A hearty vote of thanks was also passed to the members of the local committee and to the various companies who had shown their hospitality on such a munificent scale. The members then went to visit the electrical and mechanical departments of McGill University, where the numerous electrical machines and delicately adjusted instruments were explained by Prof. Herdt with a lucidity that greatly impressed the visitors. The inspection was concluded by a visit to the physics buildings, where an interesting demonstration of X-rays phenomena was given by Mr. King.

The afternoon was taken up with a visit to the extensive works of the Royal Electric Co., where among a multitude of other work in process of manufacture the visitors saw parts of the big generator now being made for the Cataract Power Co., of Hamilton. From here the company went to Bonaventure station where a special G. T. R. train of four cars was in waiting to take them to Chambly, to see the works of the Chambly Manufacturing Company. Anticipating a large excursion the Chambly Manufacturing Company had requisitioned every vehicle in the town to convey the party from the station to the works. There were cabs and calashes, cabriolets and broughams, grocery wagons and butcher carts, market wagons and buckboards, in all conditions of repair and with all conceivable styles of upholstery. The cavalcade was greeted with cheers and the attack on Santiago was nothing to the storming of these vehicles. The scenery of the quaint old village of Chambly was much enjoyed, and so was the visit to the great dam and power house which have both been described in recent numbers of The Canadian Engineer. The venerable but still active president of the company, S. T. Willett, who has been elected mayor of Chambly continuously since 1873, was present to welcome the visitors, and did it with the sincerity so characteristic of him. After being photographed in a group the visitors were called into the upper story of the power house and beheld a table of interminable length spread with immense dishes of cold meats, confectionery, strawberries and cream, lemonade, claret cups, etc. To say that "full justice" was done to these provisions would be putting it mildly. Mr. Willett, who occupied the chair, welcomed the members and their ladies, and credited the electrical science with the transformation which was now being made in the town and its prospects. Hon. Senator Thibaudeau made a short speech of welcome which was well received, especially by the ladies whom he complimented with a gallantry so natural to a French Canadian. Mr. Browne followed with a few words of welcome on behalf of the Royal Electric Co., referring to the fact that beneath their feet the Chambly Co. had harnessed 20,000 h.p. where the shallows of a river had been running to waste for ages past. On behalf of the association Mr. Dion thanked the company for the handsome entertainment and excursion, which the members enjoyed, and the party returned to the city delighted with their trip, which formed such a pleasant finale to the convention.

A. A. Dion, 2nd vice-president Canadian Electrical Association, was born and educated in the city of Quebec. He commenced his electrical career in the service of the old Dominion Telegraph Co., in 1876. After filling various positions and engaging in railway work for a few years, he was appointed electrician for the Intercolonial Railway system of Canada in 1889. He resigned in 1891 to take the superintendency of the Chaudiere Electric Light & Power Co., of Ottawa, a position which he filled until 1894, when the amalgamation of the three

A. A. DION.

lighting companies doing business in Ottawa took place, when he was made general superintendent of the amalgamated companies known as the Ottawa Electric Company, which position he now holds. Mr. Dion was a member of the Executive Committee of the Canadian Electrical Association for 1897-98. He is a member of the American Institute of Electrical Engineers.

CONVENTION NOTES.

Taken as a whole the convention was the most successful in the history of the association. About 50 new members were elected, chiefly from Montreal and vicinity, and these were not drummed up, but were men who came in from a natural interest in the work of the association.

Secretary Mortimer had a good deal of work to do and got through it very creditably. Mr. Mortimer has one good quality among others, and that is he never fails in civility and courtesy.

The Packard Electric Co., of St. Catharines, kept open house at rooms 11 and 12 in the Windsor, and all were made royally welcome. Their Montreal branch was illuminated and the crowd of conventioners gave three cheers when they passed the place on one of their city trips.

Ald. Sadler's suggestion of an exhibition of electrical machinery in connection with the next convention was a good one, and is worth early discussion. The Packard Electric Co. made a little start on its own account by showing the sections of their new transformer and other goods in their rooms.

Mr. Kammerer gave the members a pretty souvenir in the shape of a little silk bow formed of the Union Jack on one side and the Stars and Stripes on the other. In bestowing it Mr. Kammerer did not forget the ladies. He never does.

"These gentlemen," said The Witness in one of its notes, "are adepts at 'stringing wires,' but it is pleasing to note that they do not—at least at association meetings—go in for 'pulling wires,' for official positions are filled with a view to the advantage of the association.

Among the American visitors was F. A. Wunder, of the New York office of the Fort Wayne Electric corporation. Mr. Wunder was pleased with what he saw in and around Montreal, and is generously leaving a memento of his visit in the shape of one of the company's Watt-hour meters, which will be presented to McGill University. Reference will be made to this in The Canadian Engineer. Besides Mr. Wunder, Mr. Quimby, the inventor of the Quimby screw pump, and Mr. McLaughlin, of The Electrical World, were present from over the border.

Too much praise cannot be given to the individuals who formed the Entertainment Committee and the companies who so liberally contributed their work and money to aid them. It is only another good illustration of the saying that when Montreal men undertake a thing of this kind they do it well.

The Canadian General Electric Co. had what the boys called a very "nifty" idea in the form of a nickel-plated model of a C. G. E. motor to be used as a paper-weight. It was much appreciated by members as a souvenir.

Among the many attractive points in Montreal during the convention, that of John Murphy & Co.'s store, where John Forman made an exhibit of the Upton Midget Enclosed Arc Lamps, held the attention of the delegates probably

as much as anything they had seen. This shop has lately had installed a large number of these lamps, having discarded their old style of arc lighting, and in some places done away with the Auer Incandescent Gas Light, and arranged to have the whole establishment lit with the Upton Midget Enclosed Arc Lamp. After a very careful test of the various lamps of different manufacture in the market, they concluded that the Upton was by far the most economical system of lighting to be had. This store, which is situated on St. Catharine street, (Montreal's principal thoroughfare), has fitted in the fourteen large windows fourteen of the Upton lamps, each arranged with a special bell mouthed shade, and though these lamps are taking but 4½ amperes on 100-volt circuit, the illumination far surpasses some of the window lighting on the same street where ten and fifteen incandescent lamps are used in handsome reflectors on 52 volt circuit, where each lamp would be drawing 1 ampere. In the case of the incandescent, 15 lamps would be drawing 15 amperes of current and giving 240 candle-power, while with one-third of the amount of current on the Upton Midget, the latter were giving 800 candle power, or practically three times as much. Not the least important point in this installation was the fact that the lamps which were ordered from John Forman, 644 Craig street, Montreal, on Wednesday the 22nd, were ordered on from the States, while handsome fixtures were being manufactured in Montreal for the installation, and the whole was in satisfactory working condition on Monday the 27th.

LAUNCH OF THE TORONTO.

Every circumstance favored the ceremony of launching the new Richelieu & Ontario Navigation Co.'s steamer "Toronto," which took place from the shipyards of the Bertram Engine Works Co., on the afternoon of June 21st. A clear, bright day, with a westerly breeze, brought out dozens of sailing craft and row boats, as well as some steam yachts, to view the first floating of the finest steamer ever built in Toronto. The decks of the steamer "White Star" were crowded with citizens who had come at the invitation of the Bertram Co., to view the launching, and about four o'clock the steamer lay to at the inner end of the Eastern Gap, opposite the shipyard where the new vessel stood braced up from stem to stern as if conscious of the impending event and eager to make the plunge. The supports having been knocked away, Madame Forget, wife of Senator Forget, president of the R. & O. Nav. Co., broke a bottle of wine on the bows of the new boat, christening her the "Toronto." A. Angstrom, constructing engineer and designer of the boat gave the command "let go," and when the last block was knocked away the handsome vessel, gay with

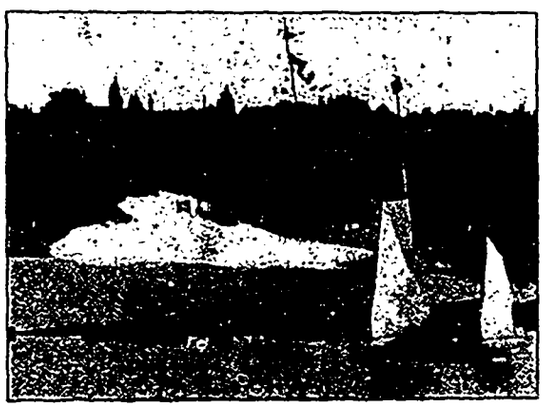


Photo by N. T. Maclaurin, amateur.

THE "TORONTO."

flags and streamers, slipped gracefully down the ways, dropped into the water with a lurch that sent the spray into the air in a vast cloud, and then she bounded upward "as a steed that knows his rider," shaking the water from her decks like a duck and then settled with a buoyant air on her native element. The large crowd upon the docks and on the steamers and boats set up a cheer at the neatness of the performance and the pretty outlines of the boat, while the band on the "White Star" played "Britannia Rules the Waves." The "White Star" then drew off into the bay, where congratulatory speeches were delivered, J. K. Osborne, one of the western directors of the Richelieu Co., presiding. Among the speakers were Sir Oliver Mowat, Senator Forget, Col. Henshaw, Mayor Shaw and Geo. H. Bertram, M. P. C. F. Gildersleeve, the general manager of the Richelieu Co., was present at the function. The company was entertained at a champagne luncheon by Mr. Bertram.

The new steamer, which will probably be ready for "sea" some time in September, will cost $240,000 exclusive of furniture and fittings, or about $275,000 in all, is guaranteed to make an average speed of 17 miles per hour on regular trips, but her estimated power will give 20 miles per hour when pushed. The following is a brief description of her:

The hull, constructed of open hearth steel, and of the following dimensions: Length over-all, 278 feet; length keel, 270 feet; beam, moulded, 36 feet; beam, over-guards, 62 feet; depth, moulded, 14 feet. The engines are of the triple expansion, inclined jet condensing type; cylinders, 28, 44 and 74 inches by 72 inch stroke. The feathering paddle wheels are 22 feet outside diameter, and 10 feet 3 inch face of bucket. The air and feed pumps are attached to and worked from main engine. The boilers are four in number and are of the return tubular type, 11 feet diameter, and 11 feet 6 inches long over heads. Each boiler has two 41½ inch outside diameter Monsom suspension furnaces The boilers are fitted with the Howden Hot Draft, and are designed for a working pressure of 176 pounds. Spacious and elegant passenger accommodations are provided, one hundred and forty staterooms, including four parlor rooms and large Pullman sleeping cabin, furnish sleeping accommodation for 430 passengers. The dining room, placed on the upper deck, has a seating capacity for over a hundred persons. The interior finish and decorations of the spacious halls and deck saloons, are most elaborately executed, the main and gallery saloons being finished in Francis I. Renaissance style, with the dining rooms in Louis XVI. The entrance hall is decorated in Neo Grec, with modern Renaissance details, with the smoking room in Oriental treatment. The refreshment and writing rooms will be in Elizabethan panelling of prima-vera, natural wood finish. The main staircases are Honduras mahogany, with wrought metal balustrades, in hammered leaf work, finished in antique bronze the main newels carrying bronze figures supporting electric torches. A 700-light electric light plant, with ornamental electroliers, in cabins furnishes light throughout the steamer.

ROPE DRIVING.

The subject of rope driving has so far received little or no attention at the hands of our Canadian engineering journals, in fact, we may safely say, that even in the United States, this is a subject touched upon very sparingly by the trade papers, and mechanical publications generally. We fancy the reason of this is that rope driving is a branch of mechanics not so generally taken up by the ordinary run of engineers and machinists, but is as yet more of a specialty, and has so far only been advocated strongly or to any extent by one Canadian firm, the Dodge Company, of Toronto. We believe that rope driving has a field of its own, and is not necessarily a competitor of the belt manufacturers as has been supposed. We have called at the office of the Dodge Co., Toronto, and have learned the particulars of a very interesting piece of work recently completed at the works of the Globe File Mfg. Co., Port Hope, Ont., by the Dodge Co., Toronto. In this instance the power of three 40" Leffel water wheels, under a 12' lead, had been transmitted to the line shafts in shops, by means of bevel gears and crown wheels, on ends of upright shafts from water wheels—power taken from each wheel being about 40 h.p. In one case there were used a pair of bevel gears to carry the power of one of the wheels to a shaft at right angles to the others. In all three upright shafts there was a continual trouble in keeping them in line, owing to the great strain on their upper end, also in the case of the geared shaft at right angles, there was a continual jam either against the boxes, or the pinion on crown gears, thus consuming too large a percentage of the power. The crown wheel on No. 1 shaft had to be re-toothed as often as every two weeks, on No. 3 shaft every three months, and on No. 2 shaft two or three times a year, so that on the whole the power was unsteady, and much time was lost in re-toothing wheels and keeping them in proper alignment. In addition to this the noise from the gears was deafening, and the dirt from oil

dropping, etc., created a nuisance. With a view of a remedy the Globe File Co therefore consulted the Dodge Co., and after the latter company's engineer had made a thorough inspection of the plant, a plan was devised to dispose of all the gears, and to transmit the power of the three wheels to the different line shafts by a system of rope transmission. The Dodge Co.'s men made the change and started up under the new rig without a hitch.

As to how the change has suited the Globe Fife Co., the Dodge Co. has shown us a copy of a letter recently received by them from F. Outram, the manager, he says: "As regards the three rope drivers you put in for us, they are working to our entire satisfaction. We know we are saving considerable power, besides doing away with the noise and rattle and wearing out of wood and iron gears—and it is ever so much cleaner. We would not change back for five times what the change cost us."

Yours truly,
Globe File Mfg. Co.

This letter goes to show that there are many instances to which the rope drive is particularly suited.

There are two systems of rope driving, i.e., what is known as the "American" or single continuous rope with an automatic take up or tightener, and the "English" system, which is a series of independent ropes. The former is the system advocated by the Dodge Co. We understand that some of our largest plants in Canada are run altogether by ropes, and they are found to be economical. The E. B. Eddy Co., of Hull, Quebec, is a great believer in the rope drive, and has several thousand horse power in daily use, installed by this company.

For THE CANADIAN ENGINEER.

FUTURE OF MECHANICAL TRACTION.

As to the future of the autocar industry, space does not permit of more than the briefest summary. The problem of transportation is the largest and most pressing in Canada to-day, whether we view the matter from the standpoint of convenience, speed, good roads or expenditure, the autocar looms up as a most important factor in the problem. Let us summarize a few facts.

The average cost of transport to-day of goods between Liverpool and Manchester, a distance of 35 miles, is over $2.25 per ton, the quantities to be conveyed being at least 15,000 tons per week. There are railways and there is the new and magnificent canal, and yet shippers demand a better and cheaper means of transport; for it must be remembered that although the rates must be high on account of the enormous capital account, both by water and rail, the carrying is not terminal, and three or four trans-shipments are involved in every bale of goods. By a light railway system, which would be inexpensive, compared with the ordinary railway and canal, motor wagons might utilize rails for the greater distance and run off the rail on to ordinary roads at the termini, the goods thus being handled only at each end when being loaded and unloaded, and a large item in the cost thereby saved. With all that can be done by railways or tramways, there are millions of tons of passengers and goods to be provided for between railway stations and destinations. Worby Beaumont, president of the Society of Engineers, points out that "it is not generally known that to-day it costs more to send a ton of goods by rail between some places in this country (England), than it cost formerly to send it by horse on the common roads. . . . The cost of haulage by rail is very small, but the terminal cost and cost of railway establishments, as vast machines, are so heavy, that the cheapness of railway transit disappears." He also points out that the British post office finds it cheaper to send its parcels by road than to pay the rates demanded by the railway companies for that traffic. When the comparatively small cost of autocar and motor wagon equipment for passenger and freight purposes is compared with the immense initial cost of railways, ordinary tramways, and canals, it will be seen that just as surely as the horse-cars have given place to the trolley, so surely must the heavy and expensive cars and rails, with the enormous funds required for maintenance, interest charges, etc., give way to the lighter, cheaper, and easily adaptable system of autocars.

In large cities, such as London, the question of space is another important factor. As Mr. Beaumont points out, there is such a density of traffic in London that nothing but the short distance passenger accommodation must be allowed in the streets, either by tramcar or omnibus. "As early as possible," he says, "the motor cabs and omnibuses must displace horses so as to save the space now occupied by them, and avoid the pounding to pieces of the wood, asphalt and other of the best pavements with the 300-weight hammers of iron-shod horses' feet." He reckons that at least one-third of the space now occupied by the horses can be saved by the employment of motor vehicles. Some idea can be gathered of the pressure on London streets when it is remembered that every 24 hours

	Persons.		Vehicles.
Blackfriars Bridge discharges	69,838	and	8,287
London Bridge discharges	107,421	and	14,367

Then the cost of horses is in itself a very large item. Mr. Beaumont gives a calculation in which he shows that in Great Britain there are at present about 1,200,000 draught horses employed; but assuming that only 500,000 are at work, taking only the cost of keeping these horses, and saying nothing of the destruction to roads, the improvements in the roads which he recommends would result in a saving of £30 per year per horse, or a total of £5,100,000, which capitalized at three per cent. represents £170,000,000 sterling. He argues, "There is no doubt that such a sum might profitably be invested in the roads of Great Britain if we consider the advantages to be derived from mechanical traction."

The solution of the question of transport between towns does not necessarily lie in the direction of street railways or tramways, which Mr. Beaumont emphatically pronounces, "metallic admissions by engineers to the public of the badness of the ordinary roads." He adds that in the future of good roads, "Tram-rails in our streets will be considered nuisances not to be tolerated;" and "the days of toleration only wait for those mechanical road vehicles to prove plentiful as well as successful."

There is no reason, indeed, why the motor wagon enthusiasts should not carry their war into Africa, if they can only get engines with sufficient power; for the power directly applied to the driving wheels of autocars, and the immense tractive power of good roads, as compared with rails, put railcars at a disadvantage, when it comes to the cost of equipment and running. With 6,000 h.p. developed at the power house of a street railway company, the cars can only get what tractive effort the wheels will give them on the line. This is the weak link in the chain. In the case of a snow drift, for example, a motor car with spiked wheels would be able to overcome the obstacle better than the strongest street car plough. With the cars coupled up as they are to-day, the front car is never doing satisfactory work, because it is insulated by the snow, and therefore not getting power. Every few feet it has to be drawn out by the other cars. In the case of motor cars on the roads, they could not be insulated, and a set of three autocars, if hitched together, could be made to develop a total of 60 horse-power steadily applied, with a tractive pull of three tons.

Another element in the discussion of mechanical traction is that of danger to life and limb. In Britain the newspapers make "scare-heads" over every item in reference to accidents to motor carriages and their occupants, but never use the "deadly parallel" in showing the relative danger of motors and horses. In England and France there have been three deaths in connection with motor vehicles—all caused by recklessness and carelessness. The following record of accidents and deaths from horses in the vicinity of Toronto alone during two months is far more appalling:

Killed:—April 9th, Wm. J. Fenton, dentist, Toronto, horse frightened by watering-cart; 16th, Chas. Ralston, farmer, Walkerton, horse frightened by bicycle; 17th, Edward Lee, farmer, London; 19th, Isaac Ferris, St. Mary's, horse frightened by train; 23rd, Thos. Robinson, Omemee. May 1st, Joseph Bailey, farmer, Walkerton; 8th, Dalton McCarthy, M.P., Toronto, horse frightened by sound of church organ; 25th, Anthony Hurley, farmer, Eastwood, horses frightened by railway train. Total number killed in two months—8. Injured:—April 4th, son of David Hastings, Blenheim, badly injured; 16th, son of Chas. Ralston injured (father killed as

above); May 1st, London omnibus party, several ladies hurt; same date son of Joseph Bailey injured (father killed as above). Total number injured, 7.

A closing word as to the present position of the industry.

In France, the home of the autocar (or automobile, as it is called by the French), the industry is going forward rapidly. The principal makers, of whom there are only about four who stand out beyond the general trade, are overcrowded with orders, and some firms are refusing them. Panhard & Levassor, in a recent fortnight, booked $150,000 worth of orders. In Britain, while we write, the trials of mechanical vehicles for heavy traffic are taking place, and the War and Post Office departments are watching them with interest. The industry is slowly emerging from the disastrous stock-jobbing which characterized its early days, and is getting on a business footing. The successful journey of Mr. Sturmey, editor of The Autocar, from John O'Groat's to Land's End, has helped to popularize the autocar, as showing what it is capable of. In the United States, the movement is slower than anywhere else, largely, we presume on account of the bad roads. Col. Pope has been bravely spending money in experiments with electricity, but the Pope electrical carriage has not yet been brought into general use The Duryea carriage, which won the Chicago Times-Herald race, and the $3,000 Cosmopolitan prize at New York, does not seem to have recovered from the dazing effects of success, for we hear and see little of it now, though it is being manufactured in Springfield, Mass. The Winton, of Cleveland, is being pushed with some energy, and the inventor offers to put up $1,000 on a race from Chicago to New York, but stipulates that competing carriages shall carry only two passengers—which looks as though the Winton lacked the essential element of power, as do the other American motors.

The most important recent event is the heavy autocar trials at Liverpool, May 24th—28th, of which we give a summary. As a result, Messrs. Thornycroft are pushing the erection of an extensive factory for autocar manufacturing, at Basingstroke, while the Liquid Fuel Engineering Co. is selecting extensive premises in the Midlands for works for 500 or 600 hands, who will be employed solely in constructing "Lifu" cars.

HEAVY CLASS (FIVE TONS MINIMUM)—ONE ENTRY.

1 Thornycroft Lorry.—Steam Carriage and Wagon Co., Ltd., Chiswick. 6 wheels. Load carried by rear pair of wheels on platform resting on turn-table fixed over the rear wheels of the front portion of the vehicle, allowing motion in two places, so that wheel base could accommodate itself to road inequalities. Speed 5 miles an hour. Available floor space, 110 sq. ft. Tare (English) 3 tons 19½ cwt. (light); with fuel and water, in running order, 4 tons 5 cwt. Underframe and wheels of steel; roller bearings. Heating surface of water tube boiler, 65 sq. ft. Grate area, 2½ sq. ft. Test pressure 350 lbs. per sq. in. Fuel, steam—coal or coke. Engine horizontal compound with cylinders 4 and 7 in. by 5 in. Condenser of small copper tubes brazed together on roof of driver's cab silences exhaust, and blow-off from safety valve. Gearing has two speeds, engine making 9 or 12 revolutions to one of driving wheels. Powerful screw-down hand brake fitted to tires of driving wheels, and independent steam brake with pressure of 2¼ tons acts on wheels of trailing body.

LIGHT CLASS (TWO TONS MINIMUM)—THREE ENTRIES.

1. Thornycroft Car.—Tare, 2 tons 19 cwt. light, in running order, with fuel and water, 3 tons, 4½ cwt. Speed 6 to 8 miles per hour. Boiler, engine and mechanical details same as above, but gearing gives ratio of 8 to 1 from engine to driving wheels.

2. Leyland Van.—Lancashire Steam Motor Co. Platform area 78 sq. ft. Boiler, fire-tube type, with 110 sq. ft. heating surface. Weight, per sq. ft. of surface, is 6 lbs. Working pressure 200 lbs., tested to 450 hydraulically. Steam, which can be raised to working pressure in 18 minutes, is generated by liquid fuel, supply regulated by pressure on boiler, making firing automatic. Condensers on roof of cab make it unnecessary to carry any great quantity of water. In full work burns 1¾ gals. of oil per hour, costing 3½d. per gal. Inside of boiler can be lifted out for cleaning without removing any steam fittings.

3. Lifu Lorry.—Liquid Fuel Engineering Co., Cowes. 16 ft. 2 in. long, 6 ft. 6 in. wide over hubs. Wheels have bronze hubs, fitted with large reservoirs for lubrication. Steering by a handle connected to pivoted axles. Engine compound reversible, runs at 600 revolutions for speed of 8 miles per hour, geared down from 8 to 1. Water-tube boiler, 80 sq. ft. heating surface, capable of making sufficient steam to supply an engine indicating 35 h.p., and will easily indicate 45 h.p. without forcing. Boiler tested to 500 lbs. hyd. pressure, and safety valve set for working pressure of 250 lbs. per sq. in. Supply of oil to patent Lifu burner is automatically regulated by steam pressure in boiler, and set to ease the fire down at 225 lbs. pressure. Regulation of speed by means of h.p. cylinder valve, but when extra power required, high pressure steam is let into the h.p. cylinder. Brakes by reversing, also by foot brake, by steel bands around large gears fastened to rear wheels. Sand boxes are provided for greasy roads, and worked from driver's seat. Two oil tanks of 20 gals. each. Two water tanks, one of 60 gals., under driver's seat, one of 75 gals. under platform, are filled by steam injector. Weight of vehicle, without fuel or water, 38½ cwt.; with full supply, 54 cwt.; speed, 8 miles per hour on fair roads when fully loaded, and can climb grades 1 in 10 at 4 miles per hour.

The cars were loaded up with bags of gravel, and in addition to the "crew" were two "official observers" on each car, while another set of "observers" were placed in charge of the depot. The judges were: Sir David Salmons, Boverton Redwood, F.R.S.E.; Prof. H. E. Hele-Shaw, LL.D., M.I.C.E.; S. B. Cottrell, M.I.C.E., and Henry H. West, M.I.C.E. The competition lasted two days, covering two routes of 40 miles each. Several petroleum-driven smaller vehicles, and a steam wagonette, occupied by interested spectators, accompanied the competitors. The Autocar, to which we are indebted for particulars, says: "The Thornycroft five-tonner led off at a trot, with the Lifu bringing up the rear and dashing away in fine style after the rest, its funnel swaying about. . . . .

One incident of the first day's run was the bursting of a tube in the boiler of the Thornycroft 2½-ton van. This occurred when about half the journey had been made, and was undoubtedly due to the tube getting stopped up; a fact probably to be attributed to oil getting mixed with the feed water. The van was going so well, running easily and lightly with its load, and performed so favorably in other respects that it is much to be regretted this mishap should have occurred. The Leyland lorry lost two tires; the Thornycroft six-wheeler was delayed half an hour by getting a wheel stuck. The arrivals at Liverpool were as follows: Lifu, 5 p.m.; Thornycroft, two-tonner, 8 p.m. The Leyland ran after getting its tires put right, but had one wheel go to pieces entirely, and could not get home. Engineering, the well-known London technical journal, says of the end of the first day's trial "The Thornycroft 5-ton load van got in very late indeed, owing to the tire coming off. This was most unfortunate, as the journey was very nearly completed, and the wagon had gone exceedingly well during the day."

The second day's trial resulted in the following order: Lifu, Thornycroft two-tonner, Leyland. The third day the Leyland did not start on account of damaged wheel. The large Thornycroft kept on slow speed all day, and came in about 11 p.m. The fan of the small Thornycroft got out of order near the finish, but she raced home under forced draught. The Lifu had been injured the previous day by a steam carriage running into her, but she pushed through and finished the day's work at 4.30 p.m. On the fourth and last day, the Thornycroft six-wheeler made the run without accident and finished at 11 p.m.; the Leyland came through in good time, as did the smaller Thornycroft. The Lifu stopped twice to take water, and reached home by 3.30 p.m.

WHY THEY SAW NOTHING.

The report of the Canadian Government expedition to Hudson Bay last year has now been published. As was anticipated by those who knew somewhat of the circumstances under which the "Diana" was sent on her mission, the report is as little favorable to the Hudson Bay route as is possible without expressing too conspicuous an animus. It was currently reported in Canada a few years back that the Dominion Government would not take steps to develop the short northern route until the Canadian Pacific had got a fair start. The C.P.R. has not only got on its legs now—it is pretty well dominating the country, and does not mean to have any opposition if it

can help it; and it has particularly set its face against the Hudson Bay route. It was very unfortunate, therefore, that the secretary to the expedition should have been a son of the secretary of the Canadian Pacific Railway, and that before starting on the expedition he should have had an "interview" with the president of the Canadian Pacific. It was even more unfortunate that Captain Wakeham—admirable sailor though he doubtless is—should have been chosen to command the expedition, as he was notoriously inexperienced in ice navigation, and, on his own confession in the report, this inexperience led him into difficulties which hindered his test passage through the strait.—From the London Saturday Review.

THE MASTER PLUMBERS' CONVENTION.

The convention headquarters was at the Hotel Victoria, Quebec. It opened June 29th, and at 10 o'clock a private meeting of the Executive Committee was held, composed of the following: Jos. Wright, Toronto, president; W. Smith, London, vice-president; W. M. Briggs, Montreal, treas.; W. Mansell, Toronto, financial and recording secretary; J. B. Fitzsimmons, Ontario; A. Picard, Quebec; T. Campbell, New Brunswick; G. A. Perrie, Nova Scotia; T. Stevenson, Manitoba, and Jos. Lamarche, Montreal. In the afternoon at 2.15 a general meeting of the convention took place, and at 8 o clock the business meeting was continued. On Thursday morning all the members attending the convention were photographed in a group, and other business meetings continued till the evening, when a banquet was held at the Victoria, to which the leading civic authorities and architects of the city were invited. Friday morning a drive around the city and different points of interest was indulged in, and a reception tendered the delegates in the City Hall by His Worship, the Mayor of Quebec. On Friday an excursion was made to the shrine of Ste. Anne de Beaupre over the line of the Q. M. & C. R. R. and on returning a stop was made at Montmorency to allow the excursionists to see the Falls. The election of national officers resulted as follows: President, W. Smith, London; vice-pres., J. W. Harris, Montreal; treas., T. Meredith, Toronto; sec., W. Mansell, Toronto; executive committee, A. Fiddes, Toronto; Jos. Lamarche, Montreal; Thos. Campbell, St. John, N. B.; M. Day, Halifax. Provincial vice-presidents, John Highman, Ottawa, for Ontario; E. Lesperance, Montreal, for Quebec; J. Doody, St. John, for New Brunswick; G. A. Perrie, Halifax, for Nova Scotia; W. Stephenson, Winnipeg, for Manitoba; M. J. Barr, Vancouver, for British Columbia.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

At the annual meeting of Kingston branch, No. 10, C.A.S.E., last month, the following officers were elected for the current year: President, C. Asselstine; vice-president, R. Bajies; secretary, J. L. Orr; treasurer, C. Selby; doorkeeper, S. Donnelly; conductor, G. Barrance; trustees, F. Simmons, C. Blomly.

Montreal, No. 1, C.A.S.E., held its annual meeting on the last Monday in May, when the following officers were elected: President, Geo. Hunt; vice-president, Wm. Ware; second vice-president, J. G. Robertson; recording secretary, H. Wilson; financial secretary, H. Nuttall; corresponding secretary, P. McNaughton; treasurer, Thos. Ryan; doorkeeper, John Huntingdon; conductor, Thos. Naiden; trustees, John J. York, John Huntingdon, O. E. Granberg; delegates to convention, Messrs. Huntingdon and Ryan.

The Canadian Association of Stationary Engineers' Unity, No. 5, London, Ont., elected the following officers at the annual meeting: Duncan McKinley, president; W. Blythe, vice-president; G. B. Risler, treasurer; W. Allen, cor. sec.; W. Meaden, rec. sec.; James Harding, conductor; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell.

The following are the new officers of Toronto, No. 1, C.A.S.E.: President, C. Moseley; vice-president, H. E. Terry; rec. sec., J. W. Marr, Davisville, Ont.; financial sec, A. Slute; treas., S. Thompson; conductor, W. Clark; doorkeeper, J. Long; trustees, J. Huggett, W. Webb, J. Fox. The officers were installed by past president Jno. Fox.

The annual convention of the Canadian Association of Stationary Engineers will be held this year in Hamilton, Ont., beginning on Aug. 8th. A most instructive and entertaining programme is being prepared, and the delegates will certainly enjoy a visit to so important a manufacturing centre as Hamilton.

PATENTS TO CANADIANS.

Fetherstonhaugh & Co., Patent Solicitors, of Toronto and Montreal, furnish us with the following list of patents, relating to machinery or engineering, granted to Canadians in the following countries. Any further information may be readily obtained from them direct.

Canadian Patents.—Amalgamators, M. Cross; wire fence machine, A. H. Cook; apparatus for amalgamating and concentrating precious metals, H. H. Earns; apparatus for the production and storage of acetylene gas, R. F. Carter; water heater, R. Rushton; hay presses, R. McLoad; swing and slide farm gates, J. Pratt; shaft attachments, N. Green, automatic running board and guard rail combined, on the top of freight cars, J. Carmichael; seed drill disc shoes, N. Stephenson; cradles, C. Gay; straw cutters, A. Johnston; drain ditching plough devices, W. Hawker; valves, C. H. Volmann, liquid fuel burners, C. M. Cookson; machine for weaving wire fence. J. Roch; section valve for automatic fire sprinklers, E. J. Phillip; fire escape, J. McNeil; earth boring augers, Z. Leroux; tension for the binding mechanism of harvester binders, T. H. King; brakes, A. Desbains.

American Patents.—Motor, T. A. Brennan; grappling-hook, T. David; sheet-metal vehicle-wheel tire, J. Jamieson; brake, A. Desbains; thawing apparatus, R. B. Ormiston; pulley, H. S. Pell; electromagnetic-switch railway, A. Norman; vessel and sail and rigging therefor, C. Twining.

WATERPROOF STONEWORK.

What was at first considered a doubtful experiment, viz., the use of coal tar as a means of rendering masonry impervious to water, especially in positions exposed to direct contact with the latter, has proved a practically valuable resort, says Paving and Municipal Engineering. Used as a coating for masonry, built up of very porous stone, tar renders it quite impervious even at a depth of some fifty feet of water, and, according to the opinion of those whose experience has been extensive with it, the article should be utilized in all public buildings, particularly those designed for the preservation of works of art, the dissolving action of water, even upon mortar of superior quality, being well known, and also the unfavorable effect of the exudation of water charged with lime salts from the mortar. Two different methods of using the tar are named, viz., in a boiling state in one or several layers, this being suitable for surfaces exposed to the air, or it may be made to flame up before using, this being appropriate to surfaces which have to be covered up. It is stated that when boiling coal tar is employed in three coats on masonry, the result is a black and very brilliant varnish, which perfectly resists the action of frost, water and sun, being likewise absolutely impervious; and the tendency of the black coating to absorb heat may be overcome by white-dusting the whole before the tar is quite dry.

ELECTRIC POWER AT SAULT STE. MARIE.

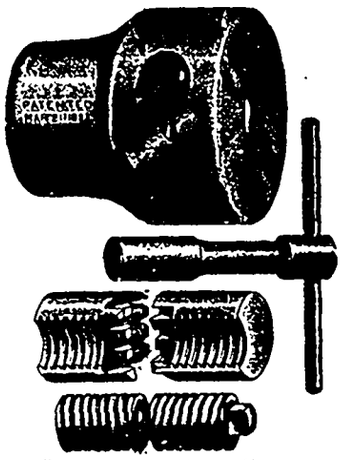
Great things are to be accomplished at the two "Soos," according to F. H. Clergue, president of the Lake Superior Power Company, at Sault Ste. Marie, Ont. Two hundred delegates of the North-West Electrical Convention visited the two towns a short time ago, and Mr. Clergue, addressing the delegates, said: "The Lake Superior Power Company have added to their present investment, the Power Canal at Sault Ste. Marie, Ont., by the purchase of the rights of the abandoned power canal on the American side of the rapids, and have added to the property thus acquired large tracts of land in addition, sufficient to permit of the construction of a hydraulic canal of about 50,000 horse-power. The plans for the construction of this canal have been completed, the specifications have been issued to contractors, and July 1st the tenders will be opened and the contracts awarded. The constructions provided for in the specifications consist of a hydraulic canal 22 feet in depth and 250 feet in width, terminating in a power station constructed of stone, and extending for a distance of

1,200 feet along the water front. This will be the largest hydraulic plant yet constructed, and will contain 80 electrical dynamos, of 500 horse-power each. The cost of this development will exceed $3,000,000, without including the cost of the mills and factories, which will utilize the power thus created. One-half of the entire power generated by the canal has been sold to the Union Carbide Company for a period of 25 years, and the remainder of the power will be devoted to metallurgical uses. The contracts call for the completion of all this work within three years from July 1st, and at its completion it is the intention of the Power Company to continue their operations by large additions to their works on the Canadian side."

Mr. Clergue explained that it was not the intention to begin the construction of a second water power canal on the Canadian side of the river until the end of the work on the American side of the river was completed, which would be in about three years. The new power canal on the Canadian side would have three times the capacity of the present canal, and it would cost about $500,000. The reduction works, which would be constructed at the Canadian Soo, immediately afterward, would not cost less than $1,000,000 more. After the canal and works were completed, the reduction works would give permanent employment to nearly 1,000 men, most of whom would be skilled workmen.

THE HORTON DRILL CHUCK.

As shown by the engraving, this chuck is simple in construction and very strong and durable in all its parts. The body is composed of one piece of metal and the entire chuck of four pieces. Chucks in ¼" and ½" sizes are made of steel, and in the larger sizes the working parts are of steel, the jaws are so constructed that there is no danger of breaking or crimping the drill by gripping as in many drill chucks. The right and left hand screw, which drives the jaws, is set deep



THE HORTON DRILL CHUCK

into the latter so that an end thrust with jaws is obtained and consequently a stronger grip with no danger of breaking the screw. The jaws are cylindrical and the power of the screw, being applied more direct, there is no binding or canting of the jaw when taking a short bite, as is the case with the 2 jaw chucks made with the old-fashioned, angular jaw set in a rectangular slotted body. This chuck is made in six sizes, as follows: ¼", ½", ¾", 1", 1½", 2". The 1½" and 2" sizes are attached to the spindle of the machine by means of a face-plate and screws, the same as an ordinary lathe chuck. These chucks may be had from the Aikenhead Hardware Co., 6 Adelaide St. East, Toronto.

TIDAL MOTORS.

Editor CANADIAN ENGINEER:

Sir,—An article under the heading "The old Tide Mills of Brooklyn," at page 371, of June 11th No. of the Scientific American for 1898, leads me to wonder how engineers are and have been striving after some ingenious automatic float arrangement for utilizing the force stored up in and to be had from the daily rise of tides in Canada and other parts of the world, when it would seem to be so much more simple to follow the practice of by-gone ages, by damming up the water as the Hollanders of yore did at Brooklyn. And if the practice paid there, where the tides, I believe, rise but a few feet, how much more prolific would they not be along the St. Lawrence below Three Rivers, where, as at Quebec, the neaps are 14 feet, and the springs as much as 22 or more; or again, in the Bay of Fundy, N.S., where the rise varies from 30 to 60 feet.

To get sufficient power from a float, it must evidently be of very large size, and therefore, the larger the more expensive; the price increasing as the area or square of its dimensions—while in the barring of a creek or ravine or mouth of a tidal river, the cost would be enhanced only in the ratio of the length of dam, the area of water enclosed increasing in almost any ratio. It would therefore seem that the simplest and most economical mode of utilizing the rise of the tide would be to proceed as in the impounding of water for an aqueduct; establishing all along the face of the dam a series of automatic gates, opening to the rising water and closing at ebb; when side issues from such a body and bearing only a relatively small proportion to the bulk of water held up, could be utilized either through turbines or undershot wheels for a variety of purposes.

CHAS. BAILLARGE, C.E.

It is now about three years since the Syracuse Smelting Works first introduced their Syracuse babbitt metal into Canada. It has since been giving great satisfaction, so that they have been constantly asked by numbers of their large customers to start works in Canada. They have at last done so, and have established works on the corner of St. Thomas and William sts, opposite the street railway power-house, Montreal. With the two furnaces set up they are able to turn out four tons of babbitt metal per day. Finding that they cannot fill their orders on stereo, electro and linotype metal as well as solder they are now preparing to build one more furnace for making babbitt metal and one for solder and other metals. They have laid in a large stock of raw material, such as pig tin, pig lead, antimony, ingot copper, ingot brass, as well as scrap copper, scrap brass, aluminium and numerous other metals, so as to be able to supply all customers with everything in the line of metal that they may require. The business will continue to increase on account of the quality and price of the metals supplied by this company.

THE AMERICAN STOKER COMPANY.

We have been requested by the American Stoker Co. to publish the following letter:

Montreal, June 29, 1898.

The General Engineering Company of Ontario, Limited,
80 Canada Life Building,
Toronto, Ont.

Dear Sirs:—The American Stoker Company, having an office at room 54, Street Railway Chambers, Montreal, have submitted to us your circular letter, dated 26th of May, 1898, in which it is stated that the American Stoker now being introduced into Canada by the American Stoker Company, is an infringement on certain alleged Canadian patents owned by you, and that as soon as the American stoker is installed in Canada, your solicitors have been instructed to take proceedings in the Exchequer Court of Canada against the user as well as against the manufacturer and importer, and warning the public against the use of the American stoker. We are instructed by the American Stoker Company to inform you that the stokers manufactured by our clients are protected by Canadian patents and are not an infringement of any patents legally held by your company.

We are also instructed to inform you that the American stoker company have sold and delivered five stokers to the Dominion Cotton Mills Company, and are about making delivery of stokers to other purchasers in Canada, and are prepared to defend any action for infringement or damages which may be brought by your company in virtue of such sales for the use which may be made by the purchasers of these stokers, and we are authorized to accept service of any legal proceedings which you may bring against the American Stoker Company.

We have further to inform you that in the event of your Company not making good your threats contained in your

circular letter within fourteen days from this date, which are calculated to deter prospective users of the stokers from purchasing from our clients, we are instructed by the American Stoker Company to institute legal proceedings against you for damages, and for an injunction to restrain you from threatening legal proceedings on the ground of alleged infringement of patents. All other rights are reserved.

Your obedient servants,

MACMASTER & MACLENNAN.

FIRES OF THE MONTH.

June 1st—The Union Abattoir Co.'s buildings, St. Henri, Montreal; loss about $150,000.——June 4th—Dixon & Gibbon's spice mill, Winnipeg; machinery destroyed.——June 4th—D. LaLiberte's foundry and machine shop, St. John's, Que.; loss about $3,000.——June 5th—S. R. Foster's pottery, Hamilton, Ont.; loss about $4,000; insurance, $2,700.——June 5th—A. Smith's stove mill, Fesserton, Ont., detroyed.——June 10th.—Jos. Bourque's planing mill, Hull, Que.; loss about $8,000.——June 13th—Acton, Ont., Tanning Co.'s premises damaged to the extent of $500.——June 14th—John McCleary's saw mill, Bristol Ridge, Que.; total loss.——June 14th—Burley & Galligan's foundry and machine shop, Rat Portage, Ont.; loss, $25,000.——June 15th—The Sherbrooke Yarn Mills and C. E. Shedrick's, electrical instrument maker, Sherbrooke, Que; loss partially covered by insurance. C. F. Shedrick's business was continued at once.——June 18th—R. Arnott's cheese box factory, Peterborough, Ont.; destroyed; insurance, small.——June 19th—Oxbow, N. W. T., Milling Co.'s flour mills; no insurance.——June 19th—R. Sloate's saw mill, Tracey's Mills, N. B.; loss, $8,000.——June 21st—The Coleman Lumber Co.'s planing mill, Burlington, Ont.; loss about $10,000——June 23rd—Buck's Stove Works, Brantford, Ont.; pattern shop destroyed.——June 23rd—A. McDonald's saw mill, Peterborough, Ont.; insurance, $3,000.——June 24th—W. W. Doherty's saw mill, Campbelltown, N. B.; loss, $10,000; no insurance.——June 26th—Clifton Hotel, Niagara Falls, Ont., $60,000——June 29—T. Ebbage's planing mill, Acton, Ont.; loss, about $700.——July 2nd—Court house and jail, St. Thomas, Ont.; loss, $50,000.——July 2nd—G. H. Harper & Co.'s flour mill, near Dundas, Ont.; loss, about $20,000.——July 5th—St. Bernard's convent, Antigonish, N. S.; loss, $25,000.

A POCKET VOLTMETER.

The Whitney Electrical Instrument Company, Penacook, N H., is manufacturing a line of pocket voltmeters and milammeters for continous current. They are made in the form of a watch, as will be seen from the accompanying illustration of the voltmeter.

This instrument has a range from zero to five volts, and was designed to meet a demand among battery users for a low reading and convenient voltmeter. The principle of construction is the same as that of the Whitney Company's standard portable voltmeters for direct current, and the instrument is built with the same care. It is accurately calibrated, and the scale is drawn in by hand. The works are mounted in a handsome silveroid case, which will remain bright indefinitely, and is about the same size as a gentleman's watch. With this pocket voltmeter, the operator of an electric vehicle, or the engineer of an electric launch, can quickly determine which of his accumulators are "dead" and cut them out, thereby getting the full benefit of the good cells.

These instruments are being manufactured in Sherbrooke, Que., by C. E. Shedrick, whose catalogue also contains a large number of other interesting features.

STEAM VS. ELECTRICITY.

The report of James Milne, the expert employed by Toronto to make a report on the cost of an electric power supply for street lighting and commercial purposes has been made. Mr. Milne reports that the data received from the users of both electric and steam power is not to be absolutely relied on for the purposes of careful calculations, owing to the different bases upon which the various returns have been prepared. The summary of the steam users shows a consumption of 16,802 horse-power, from which 10,000 may be deducted for the Toronto Railway Company, Toronto Electric Light Company, Incandescent Light and Corporation plants, leaving 6,802 horse-power for commercial purposes. Of this amount he says, nearly 1,000 horse-power could be supplied by electric power or gas as cheaply as at present, but for the remaining 5,800 horse-power it is useless trying to persuade the manufacturers to change from their present methods, because some profess themselves well satisfied with the steam plants already installed; some use refuse for fuel, some require steam for heating, drying, etc., and others wish the source of their power to be independent. Mr. Milne also stated that in many businesses the cost of power was a very inconsiderable part of the expense of production, and the saving to be made by using electricity not sufficient to make the change desirable.

Railway Matters.

Truro, N.S., has voted a bonus of $30,000 to the Midland Railway.

The C.P.R. authorities have increased wages all around about ten per cent. to the trainmen in the Ottawa and Quebec division.

The Grand Trunk Railway has ordered ten hundred and fifty double-deck stock cars from the Michigan Peninsular Car Company.

The city of Brantford, Ont., is asking the G.T.R. to spend $7,000 in extending the bridge in connection with the proposed flood-prevention works.

The C.P.R. is making a large addition to the rolling stock at the Perth, Ont, workshops. There are 250 flat cars, 200 box cars, and 50 coal cars now in the course of construction there for use generally over the road.

The surveys have been completed on the Nelson and Bedlington Railway, which will give West Kootenay's mining centre of Nelson, B.C., direct communication with the United States, via Bedlington, a point near the Idaho boundary of British Columbia.

There are four parties in the field working the surveys for the new C.P.R. line north from Toronto. H. D. Lumsden is chief engineer, and the chiefs of the parties are Messrs. Brunel, Mitchell, Morris and C. B. Smith, whose districts are respectively French River to Sudbury, French River to Parry Sound, Parry Sound to Severn River, and Severn River to Kleinburg.

The C.P.R. is willing to spend $75,000 on yards and shops at Calgary, N.W.T., but object to the conditions which the council sought to attach to the $25,000 bonus. The conditions suggested by the council included the inspection of the company's time sheets and a forfeit if the C.P.R. shops moved from Calgary before 25 years.

The Windsor station of the C.P.R. at Montreal is to be enlarged by the addition, entailing the outlay of a quarter of a million dollars, or possibly more. The extension will be west on Osborne street, and will make the building twice its present size. It will be of the same material and in the same style, and when finished will make one of the most complete railway offices and depots on the continent.

It has been stated that the G.T.R. would shortly commence the construction of a line from a point on the Northern to the Sault. The line will run northwest, crossing the French River in the township of Mowat, and striking the Sault branch of the C.P.R. at Massey. The G.T.R. have running powers over portions of the road from Massey to the Sault. A good deal of grading and rock cutting was done some years ago on the line east of Massey.

The Robson-Penticton Railway has been surveyed to connect with the C. & W. at Robson, thence up the Lower Arrow Lake to Dog Creek; up this stream to McCrea Pass; thence down McCrea Creek and Christine Lake to Cascade City; along Kettle River to Grand Forks; up the north fork and Brown's Creek to Eholt Pass: down Eholt Creek to Boundary Creek, and through Greenwood, Anaconda and Boundary Falls to Midway. The route is 100 miles long and is filled with engineering problems.

The annual meeting of the Quebec Central Railway was held in London, England, on June 6th. It was reported that the gross earnings for the year ending December 31 last, amounted to $457,643, being an increase of $60,537 over those of the preceding year. The working expenses amounted to $309,555, being an increase of $40,761. The net earnings were $148,088, being an increase of $19,776, to which was added interest on balances, etc., $2,830, and there had been written off some items amounting to $2,954, making the available net revenue $147,964. After paying interest on the prior lien bonds, $85,166, there remained a balance of $62,798, out of which a dividend of one and one-half per cent. had been declared and paid on the income bonds, leaving $13,450 to be carried forward. The percentage of the working expenses was 67.64 per cent. as compared with 67.68 per cent. for the previous year.

It has been proposed that the Central Ontario Railway, from Picton to Coehill, be extended into the mining district.

The Alberta Railway and Coal Co of Lethbridge, N.W.T., has ordered two more Munford Improved Boilers of 150 horse-power each from the Robb Engineering Co., Amherst, N S.

The St. Hyacinthe and Granby Railway proposes building a bridge across the Yamaska and a passenger depot The proprietors have petitioned the St. Hyacinthe, Que, council for a grant of $75,000.

The engineers in charge, Lauthier and O'Dwyer, have completed the final location of the Great Northern Railway, between Shawenegan and Montcalm, a distance of 53 miles, which completes the gap between the constructed sections of the railway.

Three hundred men have started work grading the right of way for the proposed railway from Skaguay to the lakes. The work is being done by the Pacific and Arctic R & N. Co., of West Virginia, which is said to have secured the charter and holdings of the British Yukon Company.

The track-laying on the Ottawa and Montreal road, the new C P R short line, has been completed. All that now remains is to make the connection with the Canada Atlantic Railway tracks and complete the ballasting. Some 250 carloads are being deposited on the line every day. The bridge across the Rideau is completed and is being painted. All the stations along the line are ready for occupation.

Electric Flashes.

The town of Thorold will borrow $7 000 to extend the municipal lighting plant

The Great Northwestern Telegraph Company has completed an extension of their line into British Columbia.

The Little Salmon River Telephone Company applies for an extension of its charter powers and it will then extend its lines.

E I. Sifton has been appointed manager of the Electrical Construction Co., London, Ont., in place of S R Break, who has gone to Arizona.

John R. Coffman, who for the past year has filled the position of superintendent for the London Electrical Construction Co., has returned to Detroit.

The Toronto Railway Company has placed an additional order for ten C G E 1,000 two motor equipments with the Canadian General Electric Company

The Montreal Street Railway Company has erected a new brick blacksmith shop at Hochelaga, 75 by 58 feet, the building is also to be used for the company's repairing work.

The town of Acton, Ont., is contemplating the installation of a municipal electric lighting plant The estimates were supplied to the council by Mr R J. Parke, consulting electrical engineer.

The Wm. Cane & Sons Mfg. Co., Ltd., of Newmarket, has placed an order with the Canadian General Electric Company for a 17½ kilowatt four-pole lighting generator and marble switchboard.

Ladies ran the street cars of Cornwall, Ont., on the 15th of June, and a percentage of the earnings of the road on that day, which were large, were given to the General Hospital and Hotel Dieu.

C. E Shedrick, manufacturer of electrical measuring instruments, Sherbrooke, Que, suffered considerable damage from smoke and water when the Sherbrooke Yarn Mills were burnt down, June 15th.

R Prefontaine, Ste Agathe des Monts, Que, has placed an order with the Canadian General Electric Company for a one thousand-light single phase standard ironclad armature type of alternating current generator.

The town of Listowel, Ont, is considering a by-law impowering the municipality to borrow $19,700 for waterworks and electric lighting The plans and estimates for the work were prepared by John Galt, C.E, Toronto.

The Quebec electric railways and the Quebec, Montmorency and Charlevoix railways have been amalgamated and will have a working capital of $3,000,000. It is stated that the company will buy the Montmorency Falls outright.

The Shawenegan Water and Power Co., which has been incorporated to develope and utilize the water power at Shawenegan, Que., will not manufacture pulp at present, it has been decided, confining itself to the production of power. The incorporators of the company are David Russell, Montreal, John Joyce, Boston, William Strachan, Montreal, and others Thos Pringle, Montreal, has the work of development in hand.

The Berlin, Ont., Electric Light Co. has bought a 165-h p. boiler from a London, Ont., firm.

The Hamilton Electric Light and Power Company, Ltd., has placed an order with the Canadian General Electric Company for a 200-kilowatt 250-volt generator which they intend using on their power circuit.

The flow of the river Credit was recently measured by parties interested in electrical development in Toronto. It is hardly probable that the volume of water will be found sufficient to produce any very considerable power.

During May the Galt, Preston and Hespeler Street Railway handled 950 tons of freight, a slight increase over the corresponding month of last year, and carried 18,000 passengers, an increase of about 500 over May, 1897.

The first electric car traversed St. Thomas' streets June 15th. The electric street railway begun March 24 has been completed, and was opened for public travel on the 16th. The road is six miles in length and cost $80,000. The formal opening was held July 5th

The Cornwall, Ont., Electric Street Railway Company, Ltd., in consequence of the increased demands on the freight service, has ordered another freight locomotive and has placed an order with the Canadian General Electric Company for the electrical equipment, consisting of four C.G.E. 1,200 motors.

The Pembroke Navigation Company has placed an order with the Canadian General Electric Company for equipping the steamer "Victoria" with a complete electric lighting plant, which will include a six-kilowatt standard Edison type dynamo, a vertical automatic engine and a search lamp of 4,000 candle power.

Judge McDougall has handed out judgment granting the motion to quash the indictment preferred at the December Sessions, 1897, against the Toronto and Mimico Railway Company, charging the latter with running their cars on Sunday, contrary to 60 Victoria, cap. 14 sec 95, and sec 138 of the Criminal Code. This allows the line to run Sunday cars.

The Canadian Pacific Railway, which has recently acquired the smelter at Trail, B.C., formerly operated by Aug. Heinze, has concluded negotiations with the West Kootenay Power and Light Co. for the supply of electric current to operate the smelter, and have ordered from the Canadian General Electric Co. two 75 k.w. three-phase revolving armature type synchronous motors, which will be operated at a potential of 550 volts. They have also ordered three 50-h.p. induction motors and three 30 h p induction motors which will also be operated at a potential of 550 volts.

The Lang Tanning Co., Berlin, Ont., has recently given an order to the Canadian General Electric Co. for a 100-k.w. multipolar direct current dynamo, which will be operated at a potential of 250 volts. This generator will supply current for the operation of two of the Canadian General Electric Co.'s latest type of multipolar direct current motors, each having a capacity of 50-h.p. and one 10-h.p. motor. The order given to the General Electric Co. also includes the installation of a marble panel switchboard, containing the necessary instruments for the operation of the plant and the wiring up of their factory.

A. E. Carr, superintendent of the London, Ont., Street Railway Company, has been appointed superintendent of the Montreal Park and Island Railway, in succession to A. J. Corriveau, who recently resigned. Mr. Carr still retains his position with the London company, and will, it is said, manage both jointly. When only sixteen Mr. Carr was secretary-treasurer of the sewer department at the Toronto city hall, and had after that experience as private secretary to H. A. Everett, formerly of the Toronto Railway Company He was appointed to his present position in London in 1895.

The Carborundum Company, of Niagara Falls, has commenced the manufacture of its product in Canada under the patent which it holds. It has just built a new factory building at Niagara Falls, Ont., but the electrical apparatus not having arrived in time for the plant to be utilized in accordance with the patent provisions, in order to maintain its rights, the company, with considerable enterprise, erected a furnace in the power house of the Niagara Falls Park and River Railway Company and there made the first carborundum produced in the Dominion. Carborundum has been increasing in popularity, and the output on the New York side of Niagara has been materially increased. Now the company is erecting a three story brick building, 50 x 228 at the foundation, in which they will spread carborundum on cloth and paper, thus bringing carborundum in competition with the flint, garnet and other paper manufactures in the United States, of which, it is said, there are seven or eight. This new branch of the company's business is expected to reach large proportions, and it is expected that it will make necessary a still further increase of the carborundum producing plant. The president of the company is E. G. Acheson.

The Lakeport Preserving Co. has given an order for the installation of a lighting plant for its factory to the Canadian General Electric Co.

The Electric Co. of St. Johns, Nfld., is increasing its plant and has ordered a 150 h p. tandem compound engine from the Robb Engineering Co., Amherst, N.S.

For the rebuilding of the retaining walls of its railway the Hamilton and Barton Incline Company has awarded the contract to Rowan & Elliott, of St. Catharines, Ont.

The Toronto Railway Co., which recently ordered a number of the Canadian General Electric Co.'s well-known type of C G.E 1,000-motors, has given an order for additional equipments.

The Strathroy, Ont., Electric Co, Ltd., has met with so much success that it has recently placed an order with the Canadian General Electric Co. for the installation of another 500-light single-phase alternator.

The Toronto Electric Light Co. has been ordered by the city council to extend its system to the Island at 20½ cents per light, as the Island is part of the city and the company's charter covers the whole city.

The R. Forbes Co., Ltd., Hespeler, Ont., has placed an order with the Canadian General Electric Co. for two 500-light Generators. These generators are to be supplied of the Canadian General Electric Co.'s latest four-pole type.

Hon. John Haggart, Perth, and others, have been incorporated under the name of "The Canadian Electric and Water Power Company," with a capital stock of $150,000, to produce and distribute electricity in Perth, as well as in other towns in Canada.

La Compagnie Manufacturiers et Electrique de Montmagny has given an order to the Canadian General Electric Co. for a 100-k.w. monocyclic generator, which will be operated at a potential of 2,850 volts, together with the necessary station instruments for the operation of the plant.

The West Kootenay Power and Light Co., who have just closed a contract with the C.P.R. authorities for the supply of electric current to operate their Trail smelter, have placed an order with the Canadian General Electric Co. for the supply of three 135-k w. transformers of the well-known air blast sub-station type.

The Lachine Rapids Hydraulic and Land Co., of Montreal, has given an order to the Canadian General Electric Co. for the installation of a seven panel power-house switchboard, which is to be built in accordance with specifications and drawings prepared by R R. Kelsch, superintendent for the Lachine Rapids Hydraulic and Land Co.

The citizens of Hamilton will vote on July 27th to decide the following questions about the street railway: 1. Shall the city purchase and operate the Hamilton Street Railway? 2. If the city does not now purchase the Hamilton Street Railway, should the council extend the franchise of the company for fifteen years, that is until 1928?

The town of Granby, Que., recently gave the contract for the installation of its lighting plant to the Canadian General Electric Co. This plant will consist of a 100 k w. monocyclic generator, complete equipment of station instruments and a 50-light "Wood" arc dynamo. The contract also includes the complete installation of the pole line, transformers and house wiring required.

The city of New Westminster is resisting the proposal of a company, of which F. S. Barnard is a director, to tap the waters of Coquitlam Lake, with a view to electric power. The city authorities believe that New Westminster will need all the water it can get for public uses from the lake, over which it has, under Act of the legislature, rights of user as a city reservoir.

The Hudson Bay Co. has given an order to the Canadian General Electric Co. for the installation of a complete lighting plant for its stores at Calgary, N.W T. The plant will consist of one of the Canadian General Electric Co.'s latest four-pole type generators, having a capacity of 9 kilowatts. The Goldie & McCulloch Co., Ltd., Galt, Ont., is supplying the engine and boiler required for this installation.

The works of the Ottawa Carbon and Porcelain Company are very busy at the present time. This is the only factory in Canada for the production of electrical porcelain and carbon goods, and ever since its establishment in the capital city it has made steady progress. At first the carbons produced were in some cases not up to the mark, but great improvements have been made in the process of manufacturing, and the carbons turned out this year by the company are equal to any imported goods. Besides the carbon goods for electric light purposes, the company manufacture motor brushes, and specialties in carbon for telegraph and telephone work as well. The porcelain goods include door knobs and other goods used in the hardware trade, as well as porcelain insulators, etc.

The Electric and Operating Co., Brantford, Ont., will spend $10,000 in enlarging its plant in consequence of the civic lighting contract recently entered into.

The Electric Co., St. Johns, Nfld., is increasing its plant and have ordered a 150 horse-power Tandem compound engine from the Robb Engineering Co., Amherst, N.S

The Niagara Falls Park and River Railway Company ran their first trolley over the arch bridge July 1st. Mr. Rothery, superintendent of the road, was at the motor; Manager Phillips and Bridge Superintendent Dill, together with a number of other prominent citizens, were inside.

Personal.

J. R. Joughins has been appointed master mechanic of the Intercolonial Railway.

T. C. Keefer, C.E., Ottawa, was elected president of the Royal Society of Canada at its last meeting.

John Kelman, formerly of Galt, Ont., is superintendent of the Stanley Electric Mfg. Co, Pittsfield, Mass.

Thomas Graham, of the Banner File Works, Almonte, Ont., has recovered from his recent very severe illness.

J. Walter Wells, of the Kingston School of Mines, has been appointed to take charge of the assay office at Belleville, Ont.

Jas. Devlin, formerly chief engineer Kingston Penitentiary, is now one of the proprietors of the Albion Hotel, McGill st., Montreal.

C. J. Crowley, Toronto, resident engineer for the Midland Division of the Grand Trunk, severed his connection with the road on June 1.

A. P. Rankin, marine architect and engineer, formerly of Toronto, is now engaged at the works of the Cleveland Shipbuilding Co., Cleveland, Ohio.

T. W. Hugo, formerly of Kingston, Ont., is now consulting engineer for the elevator system in Duluth, Min., as well as for the electrical railway system.

A. K Spotton, for some time draughtsman with the Waterous Engine Co., Brantford, Ont., has secured a similar position with a Toronto firm.

John O'Brien, formerly miiler for Gould Bros., Uxbridge, Ont., was so badly injured by mill machinery at Creemore a short time ago that he died.

Yorke Kirton, who has been in the employ of the Lancaster Machine Works for the past five years, has gone to the works of John Bertram & Sons, Dundas, Ont.

James Stephenson, ex-general superintendent of the Grand Trunk, has, with Mrs. Stephenson, taken up his residence in a pleasant villa in the town of Cheltenham, England.

Dr. Bowen, who has been president of the Thousand Island Carriage Co. since the manufactory started, has resigned his position, and will resume the practice of medicine in Gananoque, Ont.

Henry Penton, formerly of Sarnia, Ont., now holds the position of superintendent of the engineering department of the Chicago Shipbuilding Company, one of the largest institutions of its class on the great lakes.

Wm. Mailing, the Rat Portage, Ont., agent of the Ottawa Powder Company, met with a serious accident recently which will deprive him of the use of one of his eyes. It appears that Mr. Mailing was testing a new electric battery with a percussion cap, when the premature explosion occurred, with the result that the full force of the cap expended itself in the neighborhood of his eyes.

J. H. C. Haldane, C.E., of Liverpool, England, has been travelling in Canada lately with a view of getting up a volume describing the country from the point of view of its engineering possibilities. Mr. Haldane has already published a number of books, among which are "Civil and Mechanical Engineering Popularly Considered," and "Steamships and their Machines from First to Last."

George A. Macagy, for the past three years superintendent for the hardware firm of Peck, Benny & Co, Montreal, died recently in Montreal very suddenly. Mr. Macagy had enjoyed uniform good health during the forty-seven years of his life. However, he complained of a slight indisposition, and died before medical aid could be summoned. He was born in Halifax, N.S., in 1851. Moving to Toronto while quite a young man, he entered the hardware firm of Rice Lewis & Sons, of that city, with whom he remained for seven years. He then came to Montreal, and was for seven years secretary of the Pillow-Hersey Company. Three years ago he became superintendent for Peck, Benny & Co.

W. M. Cathels, for twenty years secretary and manager of the Gas Light Co., Fredricton, N.B., has resigned his position to accept a situation in Brantford, Ont

William Young, who has been for a number of years chief engineer on one of the Pacific mail steamers running between San Francisco and Panama, has retired from active service and returned to his home in Galt, Ont.

Michael Kelly, who died recently in Montreal, will be lamented by a large number of friends. Mr. Kelly had been recently appointed inspector of timber for the port and district of Montreal. In Quebec, Mr. Kelly was recognized as the best inspector of timber in the country, and when the timber trade largely moved to Montreal he was transferred there by Hon. John Costigan.

Ephrem Valiquette, president of the Ingeneurs-Mecaniciens Association Canadienne de Secours Mutuels, who was the winner of the gold medal at the Industrial and Mechanical Course at the Monument National, is the son of a farmer, born on June 18, 1865, at St. Martin, Laval county, Que He is provincial boiler inspector, and also a member of the Canadian Association of Stationary Engineers Mr. Valiquette, who has recently left the employ of W. Rutherford & Sons, was presented on that occasion with a handsome silver water jug, as a token of respect, on his leaving their employ, to become foreman for Lymburner & Mathews, mechanical engineers, of Montreal, where he is now employed.

D. W Crockett, who died a short time ago at Hopewell, N.S., was widely known throughout the province, and particularly in Eastern Nova Scotia, where in former years he had extensive business relations. For many years he had been a government surveyor and was closely connected with the development of gold mining in the Goldenville district, having resided in Wine Harbor and other parts of Guysboro county for several years. He assisted in the construction of the telegraph line from Halifax to Guysboro and was connected with several other important enterprises in Guysboro county. He was one of the chief promoters of the Hopewell Woolen Mill Co , Ltd., of which he was secretary and manager until the property was destroyed by fire ten or twelve years ago. Chas. M. Crockett, a partner in the engineering firm of I. Matheson & Co., New Glasgow, N.S., is a son of the deceased.

Marine News.

The Yarmouth, N. S., Steamship Co., has placed the new steamer "Express" on the South Coast service.

The steamer channel running to the wharf at Depot harbor, Parry Sound, has a depth of 30 feet at the shallowest points.

The contract for the iron work of the hydraulic lift lock in Ashburnham, Ont., has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers.

The contract for transporting the yearly supplies to the Government light-houses in inland waters has been let to the steamer "Seguin," owned by J. B. Miller, of Parry Sound.

Captain Pratt, Cheverie, N. S., is going to place a steamer on the route between that place, Windsor and St. John. The engines are being built at Yarmouth by the Burtell Johnson Iron Company.

The new steamer of Boutilier and Moorehouse, Centreville, Digby County, N. S., is at the works of the Burrell Johnson Iron Company, Yarmouth, N S., having her engines and boiler placed on board.

The contract for the iron work of the hydraulic lift lock in Ashburnham has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers. This is one of the largest contracts, in a single structure in iron work, that has ever been let in Canada.

The Davis Dry Dock Co., Kingston, Ont., is rebuilding at a cost of $5,000 the C. P. R. car-ferry steamer "International," which runs between Prescott, Ont., and Ogdensburg, N. Y. The same firm has a 35-foot steam yacht nearly completed, which has been built for the Muskoka lakes to the order of S. E. Gill, Steubenville, Ohio.

The steamer "Lynne," which made its maiden trip to Depot Harbor, Parry Sound, with a cargo of 214,500 bushels of corn on a draft of 19 feet, served to show what we may expect from the future development of this great port.

James Finney, of St. Thomas, has been awarded the contract for building a bridge over the Otter Creek between Elgin and Oxford.

Bras d'Or Steamboat Company, Limited, has applied for a Nova Scotia charter to carry on a general ship-owning business; capital, $20,000.

A new contract will be necessary for the reconstruction of the breakwater and repairs to piers at Goderich, Ont. The contract was originally awarded to Luke Madigan at $50,099, but he was unable to carry out the work

The Beaver Line steamer "Lake Winnipeg" is to be replaced by the New Zealand Royal Mail Shipping Co.'s steamship "Tongariro. This vessel, which has a speed of 14 knots, can accommodate 120 saloon, 70 second cabin and 250 steerage passengers.

J. D. Reid, M. D., Cardinal, Ont.; G. F. Benson, Montreal, P. Q.; D. Gow, M. D., Cardinal, Ont.; G Hall, Ogdensburg, N. Y.; J. K. Dowsley, Prescott, Ont., have applied for incorporation as The Prescott and Lake Superior Navigation Company, Limited; capital, $100,000.

The "Eurydice," the property of Sylvester Bros, Toronto, has been sold to Campbell & Rosenecke, of Buffalo, for about $6,000. The "Eurydice" has been the subject of considerable liquidation recently. Last summer she was sold to parties at Port Stanley, the price agreed upon being $10,000. The purchasers afterwards refused to receive the boat, however, and took action against the owners. The new purchasers, it is understood, will run the "Eurydice" between Buffalo and Chippewa as an excursion steamer.

J. R. Roy, resident engineer of the Dominion Government in British Columbia, who was sent up with J. L. N. Coste, the chief engineer of the Public Works Department, to examine the all-Canadian route to the Yukon, has returned to Victoria, and reports the Stickine to be a fine body of water, which steamers drawing not more than thirty or forty inches, and having powerful enough engines, may navigate for six months in the year. The trouble this season has been, he says, that several steamers with engines not powerful enough have attempted to ascend the river. The Government boat "Samson," sent to remove obstructions, could only ascend seventy-five miles.

The following have been examined by W. L. Waring, St. John, N. B., examiner of marine engineers, and passed for the following grades: O. T. Berry, St. John, third class engineers' certificate; Wm. Atkinson, Fredericton, third class engineers' certificate; G. G. Miller, Chatham, third class engineers' certificate; E. H. Haviland, Chatham, third class engineers' certificate; W. W. McLaren, Georgetown, P. E. Island, fourth class engineers' certificate; R. A. McHarg, St. John, fourth class certificate; R. S. Pendleton, Deer Island, permit; H. V. Pye, Hopewell Cape, permit; F. W. Richardson, Deer Island, permit; E. H. Strang, Lansdowne, P. E. Island, permit.

The Summer School of the Massachusetts Institute of Technology in Civil Engineering will be held at Lancaster, Mass., this year. This course in geodesy, topography and hydraulics is open to third-year men in the Civil Engineering Department. It is expected that twenty-four men, including six instructors, will attend. The work will cover, among other things, the gauging of the Nashua River below the dam, the use of the meter on the mill flumes at Clinton, the rating of the meters on Spectacle Pond, and the production of a topographical map of the vicinity of Lancaster, based on the State triangulation. Lancaster offers exceptional opportunities, not only for the work above mentioned, but also for the observation and study of the new Metropolitan Dam now being constructed, and the preparation of the basin by stripping and cleaning.

The Manchester-Canadian service is to be augmented by a new screw steamer, which has been built by Sir Raylton Dixon & Co., Middlesborough, Eng., for the Manchester Liners, Limited. Her principal dimensions are: Length over all, 461 feet; length between perpendiculars, 445 feet; breadth, 52 feet; depth moulded to upper deck, 33 feet, and to shelter deck, 40 feet 9 inches; upper bridge upon shelter deck, 128 feet long; height of upper 'tween decks, 7 feet 9 inches; height between upper and main decks, 9 feet 6 inches. The engines will indicate 4,000 h.p. and give 13 knots. The boilers, four in number, are fitted up with Howden's system of forced draught. The ship's deadweight capacity is 8,500 tons on a draught of 26 feet 3 inches, and her measurement capacity, including bunkers, about 13,000

tons. The permanent bunkers have a capacity of 1,052 tons. The "Manchester City" is expected to be ready for sea in about six weeks, and after undergoing her steam trials she will take up the regular service between Manchester and Montreal.

Mining Matters.

W. A. Saunders is to put in another steam pump at the Golden Lode mine at South Uniacke.

A number of productive oil wells have recently been sunk in Lambton county, at Inwood, Ont.

The Calumet, Que., Mining Co., has made another rich discovery on the Upper Ottawa. It is a new mine in which is said to be nearly 40 per cent of silver.

A Willey concentrator is being put in by the Truro Foundry Co., at the Richardson mine at Isaacs Harbor, which will be tried on two batteries as a test.

The Bureau of Mines received a letter from Michipicoten, giving the assay of sand in the placer regions of $1.50 to $6 per ton, in gold. A ton of the sand has been shipped to the Toronto Mining School for experimenting.

The Hillsboro, N. B., manganese works, which have been temporarily closed down for two weeks on account of an accident to the machinery, have resumed operations again. The repairs to the manganese press have been made by J. Weir & Sons, Moncton.

The largest flow of oil since the Petrolea oil discovery was struck last month by Trotter and McHugh of Chatham, while boring on the Herbert farm, situated about two miles from Thamesville, Ont., in the Township of Zone. It is one of a number of wells that have been lately put down in the vicinity of Thamesville. The well when tested yielded 40 barrels per hour.

On June 18 a fire and an explosion occurred in the hoisting and compressor house of the Asbestos & Asbestic Company's works near Danville, Que. Two men were instantly killed, and one other man so badly injured that he died shortly after. The loss to the company's property is heavy, and the detention of operations will be serious, as a number of large orders were being filled. The exact cause of the explosion cannot be ascertained, though it took place by the ignition of dualine.

We observe the application for incorporation of the Eastern Townships Chrome Iron Mining and Milling Company (Limited), capital stock of $50,000, headquarters Montreal; to produce and mill gold, silver, copper, chrome iron, etc.; the parties being R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, M.P.P., Berthierville; J. U. Gregory, Quebec; C. [illegible]ing, Sherbrooke, etc.

The Bureau of Mines has issued a map of the corundum belt in Eastern Ontario, and is sending out a number of circulars, containing in concise form information concerning these deposits. The corundum bearing lands have an aggregate area of 50,000 acres. The mineral rights over nearly the whole of this tract are held by the Crown, and they have been withdrawn from sale and lease pending a report on the occurrence of the mineral and the methods of treating it, undertaken by the professors of the Kingston School of Mining. This report and a map of the region will be issued shortly.

Prof. De Kolb, of the School of Mines, Kingston, has been appointed inspector of mines for Ontario by the Local Government, in place of the Rev. A. Slaght, who died a few days ago. This office is in addition to the professor's present position, as he can perform the duties during the vacation season.

A. P. Lowe, of the Geological Survey staff, Ottawa, has left for eighteen months' field work in the interior of Labrador, continuing the line which he has been engaged upon for some seasons. It has been said that gold exists in Labrador in paying quantities, and an abundance of iron and of coal in different localities.

The first general meeting of the recently incorporated Canadian Mining Institute was held in the Windsor Hotel, Montreal, June 3rd, the president, John E. Hardman, in the chair. The principal business was the establishing of headquarters, with a mining library, in Montreal. The library, which will be located in room 4, Windsor Hotel, will be stocked with books, of which the institute already possesses about 500 volumes, periodicals, papers, maps, etc., relative to mining matters. These will be at the service of those desiring to obtain information relative to the Dominion's mining resources. Reliable information will thus be disseminated. The Dominion Government has made a grant to it of $1,000. A library committee was appointed, consisting of G. E. Drummond, convener; J. Stevenson Brown, H. B. de Courtenay, the president, and B. T. A. Bell, secretary.

—The Canadian Engineer continues as interesting as ever to all engaged in metal, electrical, or mining work. It is monthly, only $1 a year, issued by Biggar, Samuel & Co., Fraser Building, Montreal, and should be in the hands of all mechanics.—Truro, N.S., Daily News.

—The members of the Toronto Astronomical and Physical Society Toronto, had an address delivered before them on "Our Atmospheric Ocean," by F. Napier Denison, June 28th. The lecturer gave the causes of air currents, dealing with special features of cyclones. He pointed out the various effects of aerial movement upon lakes and oceans, illustrating his statements by producing weather charts. The stereopticon views all through the lecture added much to its interest. Mr. Denison leaves Toronto almost immediately for British Columbia, where he will take charge of the weather forecasting department of the Observatory.

—Under the authorization of an act of the New York Legislature, that state will establish a College of Forestry. A conference has already been held at Albany to decide upon the location of 30,000 acres of land to be purchased for the purpose. No particular plot of ground has as yet been definitely picked upon. The conditions which the authorities decided upon as necessary in seeking land for the new college were formulated by Dr. Fernow, formerly chief of the forestry division of the department of agriculture at Washington, now director of the new State College of Forestry at Cornell University.—From the Railway Review.

—The results of the tests of the Roebling system of fireproof construction, in which a concrete arch, strengthened with steel rods, constitutes the floor support, will, we think, be a surprise to those who have not known hitherto the value of concrete as a fire-resisting material. That an arch of this construction of 4 ft. span, only 3 ins. thick in the centre, could support a floor loaded with 150 lbs. per sq. ft., while a fire was kept under it for five hours, reaching a temperature of above 2,300 deg. F., or beyond the melting point of copper and even of cast-iron, and then after this heating and sudden cooling by a stream of water could withstand a load of 600 lbs. without fracture, would, says the Engineering News, be considered highly improbable had it not been proved by these tests. The competitive test between an arch of concrete and one of hollow tile, in which the latter failed, is one of the most important contributions to our knowledge of the ultimate resistance of fireproof floors which has been made for many years. The manufacturers of tile floors will no doubt have something to say in their own behalf in regard to this test, for it was not an official one, but as the matter stands it looks as if the concrete men had shown that in fire-resisting qualities their construction is at least as good as that which has heretofore been accepted as the best standard construction.

—The total supply of manganese ore for the last year, for which returns are available, was 408,079 tons, and of this we in Britain used some 128,000 tons. The quantity required has been steadily increasing, being now five times what it was ten years ago. This is in part due to its more extended use in high-speed engines, where weight is more important than first cost, and where, therefore, it is preferred for its high tensile strength. It is also more largely adopted now for warships, which are wood and copper sheathed, and therefore require manganese bronze, or some other metal which will not readily corrode. The percentage of manganese is in such cases very small, usually 2 per cent. to 8 per cent. of copper and 10 per cent. of tin in engine castings. Stem and stern frames run up to 15 and 25 tons respectively, while propellers often weigh 17 tons. But withal, the extensive use is somewhat surprising, for what is known as naval brass is more in

favor. The proportions for engine parts are 62 per cent. of copper, 37 per cent. of zinc, and 1 per cent of tin. While slightly cheaper, it is, as a rule, more uniformly reliable, and the tensile strength of rods is nearly as high, usually 26 tons to 28 tons per square inch. Still, we use 123,000 tons of the ore, and pay for it the very substantial price of three guineas a ton. The metal itself costs from £80 to £100 per ton, so that only great advantage would justify its use. We have to import this ore, our native production being now under 2,000 tons, although some years ago it was 12,000 tons. That, however, was at a time when copper was dear, owing to syndicate manipulations, and then even manganese ore brought nearly £4 per ton. One-half of our supply comes from Russia, a fourth from Chili, and a considerable proportion of the remainder from France. Of the world's supply of 408,079 tons, Russia provides 240,181 tons, mined in the Ural and Southern districts, but principally in the Caucasus. Ten years ago the output was only a tenth what it now is, and the increment has been steady. Germany occupies second place, with a total of 41,854 tons, taken from the Wiesbaden and Coblentz districts close by the Rhine. The production has increased fivefold in 10 years, yet the value is only double. The price per ton has indeed declined in four years or so from about £5 to about £2 per ton. Chili comes third, due to the output of Coquimbio and Atacama, the ores from which give 50 per cent. of manganese, and for it we pay nearly £4 a ton. Their total output is about 40,000 tons, of which we take three-fourths France has 11 mines, close to the borders of Spain, and the total has increased to 32,239 tons, but is of a low grade, the value being 30s. a ton. Japan, that land of great resource and energy, takes fifth place, and the ore is of high grade. In five years their production has increased from 945 to 13,945 tons. The United States produce 9,547 tons, got principally in Virginia, Georgia, and Arkansas states. Greece has rather decreased her proportion, the total being 9,172 tons. Turkey mined 9,000 tons, while on the borders of Austria-Hungary and Bosnia, there are deposits whence the former get 2,743 and the latter 6,484 tons. Portugal finds 6,848 tons of the world's annual supply, Spain 7,684, Sweden, 3,269, and Colombia 3,950 tons. New South Wales, New Zealand, Queensland and Canada have commenced the mining of manganese ore, and it is to be hoped the colonial supply will increase.

LITERARY NOTES.

We have received from the Association of Civil Engineers of Cornell University the volume of their transactions for 1898 The transactions make a volume of about 200 pages, illustrated by a number of interesting engravings and diagrams. Among the articles of very special importance are those on towns' water supply by E. Kuichling, C.E., and European practice in the disposal of the waste of large cities, by J H. Furtes, Mem. Am Soc. C E., the present and future prospects of gas for lighting, heating and power purposes, by Henry R. Lordly, C E

In 1894 there was published in New York a Canadian novel which Current Literature termed the greatest American book of the year. The New York Herald, Times and other papers paid great attention to it. The title was "The Untempered Wind," and the author Joanna E Wood This novel is now published for the first time in Canada by the Ontario Publishing Co. of Toronto, which house also issued in the early part of the year Miss Wood's subsequent novel "Judith Moore." Paper, 50 cents.

The Hunt cable railways for handling coal and merchandise are described in a profusely illustrated catalogue, No. 9,803, recently issued by the C. W. Hunt Co., 45 Broadway, N.Y. Among the plants of which pictures are given is the locomotive coaling plant of C P R. at Jackfish Bay on Lake Superior. Catalogue No. 9,806 from the same firm gives details of the automatic railways and coal elevators erected by this firm.

George H. Dobson, of North Sydney, C.B., has written a pamphlet, entitled Ocean Routes and Modern Transportation, which is worthy of consideration by the Dominion Government. Mr. Dobson argues that if Canada's ocean transport facilities had been equal to those of the United States during the past sixty years, this country would have secured a large proportion of the emigrants who went to the United States.

"The Chemistry of Paints" is a pamphlet describing the process of manufacturing white lead and paints followed in the works of Harrison Bros. & Co., Philadelphia, Penn. This firm is one of the oldest in the United States, having been in business since 1793.

The International Correspondence Schools, Scranton, Pa., has sent out a handsome pamphlet describing the origin of the schools and their present condition. A good deal of space is given to a description of the various publications of the schools which are now being issued in bound volumes.

The Herald, Halifax, N.S., has issued a forty-page pamphlet on the Canadian possibilities in Atlantic freight and passenger carrying, entitled "Ocean Routes and Modern Transportation."

We have received for review the "Pioneers of the Klondyke," which is an account of two years' police service on the Yukon by M. H. E. Haine. The book is handsomely illustrated.

THE STEAM ENGINE.

BY WILLIAM GOLDING.

If an ordinary vertical steam engine be converted into a steam elevator by removing the cross-head and putting in its place a platform which shall be loaded with bricks or other units of weight, and steam be admitted below the piston, the platform with its load will ascend; if, however, the steam be shut off when the platform has ascended one-eighth the length of the cylinder, the platform will cease to ascend. As is well known, the steam which has raised the platform through one-eighth of the desired distance, is capable of much further duty; but as the load is constant, no utilization of the steam can be effected, unless the load, in some manner, be lightened. If one brick be removed, the platform with the remaining part of the load will ascend to a point where the steam and the load again become equal; where it will remain. If another brick be removed and the operation continued, the platform will continue to ascend and convey some part of the load to the top. Now it is very certain that all of the work done after the flow of steam was cut off, was accomplished by the expansion of the original steam. And this gain or economy as usually computed is sixty per cent.; yet not one-half of the theoretical gain can be discovered in any practice, and none whatever when the load is constant.

It is usual in estimating the power of the steam engine to compute the average pressure that has been exerted upon the piston as the thrust; and to assume that this pressure has been transferred to useful work. The fallacy of computing the average pressure is illustrated in the pumping engine and the direct piston-elevator, and in the locomotive, as in all of these applications the load is constant and the initial pressure always in demand. Where the load is elastic as in the screw propeller or paddle wheel, operated by engines especially adapted to such duty, a large percentage of the average pressure on the piston may be computed. But where uniform periphery speed is required, as in a mill, the percentage of average pressure to be computed in estimating the actual power developed will be governed by the percentage of irregularity tolerated in the periphery speed of the rotary parts. In fact, if the periphery of the fly-wheel travels with absolutely perfect uniformity of speed throughout each revolution, the load is practically constant and no economy can result from expansion, no matter what point of the stroke the steam may be cut off. To maintain a uniform periphery speed of the rotary parts, it is necessary that the power be uniformly applied to each division of the circle. To this end it is suggested that the greatest measure of economy will be attained by using a cylinder with permanent cut-off for each expansion, each piston to follow at equal divisions of the circle. As in this practice the full economy of steam expansion with perfect uniformity of periphery speed and against a constant load will be attained.

The subject of the fly-wheel, as a part of the steam engine, is not generally understood; and, perhaps, more failures to give satisfaction by otherwise perfect engines may be traced to the mal-proportion of fly-wheel than to all other causes. The fly-wheel is nothing in itself. It neither produces nor consumes. It can only store power by running faster, and can only part with power by running slower. To illustrate: if a single engine is to be constructed to run a mill, and is intended to cut off one-eighth of the stroke, a very large fly-wheel will be required, in order to preserve uniform periphery speed. In this case, the pressure on the piston will vary twice during each revolution, from initial to terminal, to such an extent, that in order to insure even an approximation to uniform periphery speed, a fly-wheel of unheard of proportion would be required.

The question now arises what becomes of the initial pressure when the fly-wheel is sufficiently heavy to insure perfect rotary motion; surely it cannot be averaged with the diminishing pressure, and counted as thrust, as is the practice (per indicator). For this would necessitate the fly-wheel slowing down and starting up in speed twice during each revolution, and as the resistance is assumed to be constant, and the periphery speed absolutely uniform, the answer is that "no other than the terminal pressure can be counted in estimating the power delivered." This would be unquestionably true if the piston were thrusting a plunge into a chamber of constant resistance; or against a loaded platform, and when fully understood the conditions will be accepted as being precisely the same. Duly considering the foregoing, it cannot but be admitted that where the resistance is constant, the pressure on the steam piston must be constant. And that where the fly-wheel is sufficient in weight and velocity to maintain a perfectly uniform periphery speed, operated by an engine cutting off at any fraction of the stroke, the resistance becomes practically constant, and only the terminal pressure can be estimated as passing into useful work.

—The paper by James Milne, of Toronto, on the "Steam End of an Electric Plant," was read before the Canadian Electrical Association by C Lord Weeks, of Toronto. Press of matter has obliged us to omit this paper from the present number of THE CANADIAN ENGINEER.

IMPULSE WATER WHEELS.*

By J. T Farmer, Ma.E.

(Continued from May Issue).

In all these particulars there are some modifications which can be more or less exactly stated: (a) The velocity of the impinging jet is reduced in the ratio of a coefficient of velocity depending on the pipe line and nozzle. (b) Instead of striking the vane tangentially, the jet generally, as in the case particularly alluded to, strikes at a point nearer to the nozzle. (c) The force of impact is reduced owing to the velocity lost by the water in passing over the surface of the vane. Some previous experiments on this subject afford data which will be used in approximating to the loss due to this cause. (d) It is impossible, practically, to turn the water completely back on itself on account of the reaction which would take effect on the back of the succeeding vane.

In practice there will be a reduction of velocity, due to two causes: (1) Resistance of pipe line. (2) Loss in discharge from the nozzle. In the trials under discussion the heads given are those measured close to the point of discharge, so that no loss due to the pipe line need be considered. The only loss of velocity is that which occurs in the discharge from the nozzle. In the nozzles used in the experiments the stream issued from a parallel throat, and consequently there would be no appreciable contraction of the jet. The co-efficients of discharge were determined for these nozzles for heads up to 20 feet, above which point the variation becomes very slight. The results obtained therefore give an approximation to the true velocity of the jet. In addition to these determinations the co-efficient of discharge was calculated from the data afforded by each of the trials. These co-efficients agreed very closely with those obtained directly in the case of the ¾-in. nozzle. The mean values were .972 and .980 respectively. The discrepancy is not surprising when it is considered that in the former case the outflow was from the end of a long pipe, while in the latter it was from a large body of water at rest.

The discrepancy is more marked in the case of the nozzle ½-in. diameter, where the two values are .909 and .976. It is suggested that this difference is due to the fact that the interior of this nozzle was covered with rust at the time of its being used in the water wheel, as it had been in place for some time. The coating of oxide on the interior would diminish the actual area of outlet, so that the co-efficient would appear to be smaller than it actually was. In addition to this there can be no doubt that the rough surface of the oxide would diminish the velocity of the outflowing water; this may be partly the reason why the trials with the ½-in. nozzle show a smaller efficiency than those made with the ¾-in. nozzle. If this explanation is correct, it would point to the desirability of having the interior surfaces of the nozzle tips clean and free from rust. To accomplish this, it would probably be worth while to have detachable nozzle tips made of brass or some other metal not so liable to be acted upon as iron in the presence of moisture. It would also be advisable for the user to periodically take out and clean the nozzle tip, especially if made of cast or wrought iron. With a dirty nozzle there is a direct loss of efficiency corresponding to whatever loss of velocity is caused by the rough surface of the nozzle. More than this, there is a diminution in the area of the outlet, and therefore in the discharge, with the result that the power developed by the motor falls off. This may become a serious consideration if the motor is not much more than equal to the demands usually made upon it.

*From a Paper read before the Canadian Society of Civil Engineers.

From calculations made it was apparent that there is still a waste of from 15 to 25 per cent. of the original energy of the water which has not been accounted for. The loss due to friction of bearings would be small in a simple machine of this sort, and the greater part of the 15 to 25 per cent. loss must be due to some departure in practice of the phenomena of action from those assumed. It is suggested that the loss arises wholly or in part from the imperfect action of the vanes or buckets in turning back the water. It will be remembered that one of the functions of the wedge was described to be to cause the water to be discharged to the side of the wheel. A little consideration, however, will show that during a part of the period of action the wedge does not perform this function. When the vane begins to intercept the jet, it is the outer lip or scoop which first comes in contact with the jet. The small amount of water which strikes the blunt edge of this outer lip is scattered, and thus only gives up a proportion of its energy to the wheel. More than this, it probably causes considerable disturbance and consequent loss of energy in the rest of the stream. As the vane passes further into the path of the jet, the water strikes on the interior curved surface of the outside scoop portion of the bucket on each side of the outer end of the wedge. The curve of the bucket at this point is such that the water is mainly deflected in an inward and backward curve in the plane of the wheel, so that it emerges from the vane surface in a plane tangential to the wheel rim: it proceeds in the same direction until it strikes the back of the following vane, producing upon it a force of impact opposite to the direction of motion of the wheel. As the wheel moves into such position that the jet plays upon the central portion of the wedge, the stream is deflected to each side in a plane parallel to the axis of the wheel, and it is then and only then, that the conditions of action assumed are approximately fulfilled. It may be estimated that the action of the water is not what it is assumed to be while the vane moves over from 1-5 to 1-3 of the total arc of action. During this interval the action of the water is more or less inefficient.

It was noticed that the deficit of the actual from the calculated efficiency increases steadily as the speed is increased. It is suggested that this may be attributed to two causes. (1) The best effect of the impact occurs when the sharp edge of the wedge is perpendicular to the line of the impinging jet. This condition only occurs at one point in the arc of action. At all other points the position of the edge of the wedge departs more or less from the perpendicular position, and the deflection does not take place in the manner assumed, with the consequence that the efficiency of the impact is more or less impaired. The higher the speed of the wheel the greater is the arc of action, and consequently the greater will be the departure of the cutting edge of the wedge from perpendicularity to the line of the jet. This would mean that the loss of efficiency of the impact is less when the arc of action is smaller, or the speed small, and that the loss of efficiency increases as the arc of action increases, or as the speed is increased. (2) It was pointed out how the action of the outer lip or scoop at the beginning of the arc of action tended to impair the efficiency of the wheel. It will be seen that if the arc of action is large enough the same effect will take place at the end of the arc of action, as well as at the beginning. If, therefore, the speed is increased to such an extent as to allow this to occur, there will be a further cause of loss of efficiency at high speeds.

It is estimated that the efficiency would not suffer diminution from this latter cause until the velocity reaches a value of 800 revolutions per minute with the 175 foot head, or a value of 900 revolutions per minute with the 235-ft. head.

I.—Nozzle .5277 in. Diameter. (a) Pressure 50 lbs. per sq. inch. Equivalent head = 115 feet. Discharge = 45 gallons per second:

Speed.	Horse Power.	Efficiency.
252	.79	50.7
322	.76	48.5
398	.93	59.1
400	.86	57.0
407	.84	53.5
438	.87	56.7
450	.94	59.9
497	.96	62.8
506	.94	60.4
545	.95	60.6
551	.95	61.0
565	.84	55.7
585	.76	47.3
588	.83	52.6
625	.91	55.7
638	.91	58.3
665	.83	52.2

(b) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 53 gallons per minute.

Speed.	Horse Power.	Efficiency.
345	1.38	49.8
409	1.52	54.9
477	1.68	60.7
523	1.68	61.4
582	1.80	64.7
594	1 79	65.8
632	1.75	64.4
632	1.76	63.1
672	1.78	64.1
677	1.56	55.3
725	1.63	58.3
726	1.65	59.6
737	1.61	59.7
768	1.55	55.1
779	1.57	57.0
847	1.40	51.2
879	1.31	47.7

(c) Pressure 100 lbs. per sq inch. Equivalent head = 235 feet. Discharge = 63 gallons per minute.

Speed.	Horse Power.	Efficiency.
276	1.70	37.9
306	1.85	41.2
345	1.98	44.4
387	1.90	44.5
459	2.22	49.7
470	2.36	52.8
541	2.52	56.0
605	2.67	60.0
644	2.80	63.2
698	2.76	64.0
760	2.96	65.0
834	2.65	59.5
858	2.78	61.8
914	2.76	58.6
939	2.76	57.9

(d) Pressure = 125 lbs. per sq. inch. Equivalent head = 290 feet. Discharge = 70 gallons per minute.

Speed.	Horse Power.	Efficiency.
494	3.25	52.0
536	3.32	53.6
592	3.50	57.5
664	3.79	62.1
702	3.83	63.3
765	4.00	65.2
813	3.89	62.8
867	3.93	64.8
918	3.95	64.0

(Continued in next issue.)

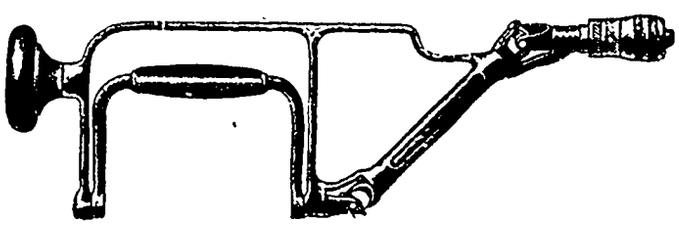
The Geo. White & Sons Co., Ltd., manufacturers of agricultural implements, London, Ont., have completed the new building, 175 x 35 ft., in which it is intended to manufacture threshing machines under rights bought recently from McPherson & Co., Fingal, Ont.

The Hamilton Facing Mill Co. have been running overtime for some months past, and have not been so busy for years as they are now.

The Garlock Packing Co., of Hamilton, have had a very busy season. Among the specialties this company is turning out is a high-grade asbestos covering which is meeting with wonderful success all over the country. The Garlock Packing Co. have won the confidence of engineers and steam users, and this no doubt is one reason why their new line of goods has come into favor so quickly.

THE UNIVERSAL BRACE.

The universal brace needs but little explanation with the practical mechanic, whether he be electrician, plumber, or carpenter; it is rapidly crowding out of the market the old-fashioned and clumsy angle brace, so long the only article of



its kind obtainable. The tool is usually supplied with a bar grip handle, which is specially adapted for overhead and horizontal work. The Aikenhead Hardware Co., 6 Adelaide St., East, Toronto, will be pleased to answer all enquiries as to price, etc., of this very necessary article.