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The Canadian Engineer

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BY THE CANADIAN ENGINEER COMPANY

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This is to certify that we have printed and mailed TWO THOUSAND copies of THE CANADIAN ENGINEER for the month of September.

MONETARY TIMES PRINTING CO. OF CANADA (LIMITED).

Per A. W. LAW, Sec.-Treas.

Toronto, October 1, 1893.

OWING to the large amount of space taken up in our last two issues by the reports of the conventions of Canadian Stationary Engineers and the Canadian Electrical Association, a considerable amount of news and correspondence has been crowded out, but will appear in next issue. Our notices of the Montreal and Toronto Exhibitions are also held over.

PROF. THURSTON, an American consulting engineer, who was officially connected with the Philadelphia Exposition in 1876, says that the Canadian exhibit at the World's Fair shows that the Dominion has made greater progress in manufactures during the time which has elapsed since the former exhibition than any other nation.

STEEL FOR FIRE-BOXES.

An English manufacturer, speaking at a meeting of the Mechanics' Association, at Lakewood, N.J., recommended that plates for fire-box and other purposes should have about .11 of carbon. You may put, said he, from .50 to 55 of ferro-manganese into it, but you should get your sulphur and phosphorus down to as low as .04 to .05. If you do that you will have a material which if properly manipulated from the ingot down to the shorn plate, will do almost anything as regards standing fire and every other manipulation involved in turning it into first-class boilers. In some factories in this country it is thought not necessary to put any work on the ingot. We hold a different opinion. We prefer for the best class of work to hammer the ingot, reducing it from about 15 in. thick to about 5 in. That ingot is hammered on the flat and on the edge and the ends are cut off. It is necessary to exercise care in reheating such a slab, because we all know that we are troubled at times with lamination in the plate. That has been clearly proved over and over again to be caused by the overlapping of one side of the plate on the other. Men who are rushing their work will bring out their slabs not so well heated on one side as on the other, and when such a slab enters the rolls the soft side will run ahead and draw farther than the hard side, and the hard side is, as it were, rolled partially into the soft slate. This may not show itself, even when the plate is short, even when it has been annealed, but still it will show itself in working some day. It will show itself when it comes to deal with the expansion and contraction due to its work in the boiler. We have found by experience that there should be a little difference in the amount of carbon according to the thickness of the plate that you are making. If you are starting with .11 carbon for a quarter-inch plate, and you are going to make half-inch plates which shall bear the 25 tons and not less than 24 tons tensile test, and with the same elongation of 25 or 20 per cent., you must put a little more carbon into the half-inch plate than you put into a quarter-inch plate, and so on. Otherwise you will not get the same tensile strength, because your material is made more dense in rolling down to a quarter-inch plate, than to a half-inch or three-quarter inch plate. These features have led to pretty fair success on our side. If the users of plate in this country were to lay down a standard of purity, and strength, and elongation of plate, this would be the very first thing to do in order to get that uniformity in the fire-box plates which is so much required. Of course, a great many plates would have to be thrown out, but there is nothing like having a lot of material thrown out that will make a manufacturer find out what is the right thing for him to do. We employ a method of determining the amount of carbon which is known as the color test. We take a known weight of a chemically pure iron, or a known weight of steel with a known quantity of carbon. That known weight of pure iron is dissolved in acid and a known weight of water mixed with it, which produces a rather crimson colored liquid. We take our supposed pure iron from the furnace, and weigh the same quantity and dissolve it with the same quantity of acid as the other, and then fill up two test tubes that are graduated with such a quantity of water as will bring both the liquids to the same shade of color, looking at them on a sheet of white paper. The result is, that when you read off the difference in the water on the scale of the two tubes, you know the difference in carbon between one and the other. One is considered to be without carbon entirely, and the other may have a little in it. That process can be carried through in ten minutes. If you want to know what carbon you have in a piece of finished material you treat it in the same way.

TURBINE WATER WHEELS.

BY A. C. M'CALLUM, M. E.

Turbines when correctly designed and constructed are by far the most efficient motors for the utilization of water power, and on account of their comparatively small size, moderate or high speed, regularity of motion, and the slight amount of gearing required, are superior in every respect to the ordinary water wheels of the overshot, breast, etc., class.

The turbine water wheel was the invention of Fourneyron, of France, in 1827, and was introduced into this continent some time later by Mr. Ellwood Morris, an engineer of Pennsylvania. Since that time there have appeared before the public numerous varieties of turbines, each inventor claiming for his wheel improvements over that of his predecessors.

There are many types of turbines, good, bad and indifferent, so that in the choice of one we should not be guided solely by catalogues representing one particular design. Many turbines give fair or good results when working under the full supply of water, but the majority are nearly useless when working at part gate, at say below half gate, hence on streams subject to fluctuations it becomes a matter of primary importance to select a motor that will give a high efficiency, not only at full gate opening, but also at all stages of gate opening.

A turbine water wheel consists essentially of a ring, to which are attached curved vanes or buckets, arranged uniformly round the circumference, revolving on a shaft to which is keyed the hub or boss of the ring. This is encircled by a case in which are placed the chutes or guides, and by means of which a whirling motion is imparted to the water; over this case is placed the dome, or covering of the wheel which, together with the short suction or draft tube in which is to be found the step upon which the wheel or runner is carried, go to make up the wheel. All turbines are made more or less after this fashion, and yet there are hundreds in which the difference is only slight, and yet the percentage of useful effort developed by them, when under test, has shown from 40 to 90 per cent. of useful effect, and from the fact that most streams in our country are subject to fluctuations in the volume of water, it is necessary that in placing turbine wheels from which we derive our motive power, that we place a turbine capable of developing a high percentage of useful effect whether working at part or full gate.

All turbines so far as the behaviour of the water in them is concerned, belong to one of two systems: 1st. That in which one works with all its parts entirely drowned or full. 2nd. That in which free deviation of the water, and the admission of air to the buckets, are required for the proper working of the wheel.

These systems or classes are known among turbine water wheel builders as reaction wheels in the former, and impulse in the latter. In reaction turbines it is required that there be a continuous flow of water to the buckets of the wheel; and they can be successfully used with a draft or suction tube, which in many cases overcomes obstacles to the successful working of the wheel.

In the case of impulse turbines, the buckets are only partially occupied by the water passing through them; the atmosphere has free access to the remaining space, so that the feed to the wheel always takes place under atmospheric pressure. Usually both reaction and impulse turbines are provided with guides or chutes, from between which the water enters the buckets of the wheel, and by means of which the water is caused to enter in the desired direction.

All modern turbine wheels are constructed after one of three types, or of some combination of these types. They are: 1st. The outward flow wheels. 2nd. Inward flow, or centre discharge wheels. 3rd. Parallel flow wheels.

In the outward flow wheel of which Fourneyron's reaction wheel is the earliest type, the water flows usually through a pipe or conduit, and is diverted from its course in an outward direction by means of fixed guides or from the axis of motion; the form of these guides gives the water a whirling motion upon entering the wheel.

In the inward flow the water flows first in the direction of the axis, usually downward, and is then diverted by fixed guide blades inwardly or towards the axis of motion, the fixed guide blades giving the water a whirling motion as it enters the wheel.

In the parallel flow type the water moves parallel to the axis of motion before and after it passes through the wheel, the fixed guide blades again imparting a whirling motion to the water.

These types of wheels are best illustrated: in the first case, that of outward flow wheels, the Fourneyron wheel may be taken; there have been many modifications made upon this wheel, but they are all of the same, and the same principle applies to all. This type finds its greatest field in France, where it originated, and is not used with a draft tube.

In the second case, that of inward flow or centre discharge wheels, the "Rose," the "Francis," "Centre Vent" wheel and others—in this type of wheel the guides or chutes have simply changed places with that of the wheel, the former being placed outside or concentric to the latter. From this type of wheel has developed that of the combined or mixed turbines, in which the previously named systems are combined. It is easy to see how this has taken place, for by a continuation of the guides into that part of the wheel where the water assumes a vertical direction, the radial flow is changed to that of an axial flow, while the water is in the buckets, instead of after it has left them, and it is of this type or combination that the leading American wheels are built, and of which class anything I may say will mostly be directed.

In the third case, that of parallel flow turbines, this type is generally illustrated by that of the "Jouval," so named after the engineer who first introduced them; they are more extensively adopted in Europe than any other type of reaction wheel.

The adoption of the combir . or mixed flow turbine, by American engineers, would appear to be caused by the large volumes of water at their disposal. Economy of water was second to that of first cost of the wheel, and yet their principal aim has been to construct a turbine of the smallest possible diameter, and yet develop the largest amount of horse-power for the amount of water consumed. How far they have succeeded in this is shown by the efficiency course table exhibited. Impulse turbines seem to have been discounted by American engineers, and such is perhaps due to the fact that reaction wheels, when running at their best possible speed, and using the full volume of water for which they were designed, develop a better percentage of useful effect than that by the impulse type of wheel. Each of those classes of wheels have their useful spheres, and to point out which I am afraid would take up too much of your valuable time.

One of the important features of a turbine water wheel is the curves or forms of the buckets, and in the construction of which it must be confessed that the American inventor's plan can only be called that of the "cut and try" method, while the curves of wheels constructed in Europe have been mainly perfected by careful study and mathematical reasoning, the result of which is that the guides and buckets are of the best shape in the type of wheels they build there.

In the case of an American engineer, should he look to the works of Rankin, Weisbach, Bresse and others, for suggestions that would help him in the construction of a wheel, he would look in vain. In the construction of turbine wheels the bucket shapes have depended entirely upon the whims and notions of the inventor. He makes his wheel after his idea, has it tested against some old timer; changes are perhaps made first in one part and then in another, and so on until the wheel is brought to a stage of perfection satisfactory to the engineer or inventor. From results that have been obtained from all wheels of all shapes of buckets, that shape in which the bucket at its upper part recedes from the water, gradually curving downward, and then receding backward in a direction at almost right angles to that of the bucket's upper form, has given the best results, and wheels with the double bucket device do not attain the same proficiency. In a vertical section of a bucket of this kind, the line of the bucket facing the water or termed the receiving side would be somewhat parabolic in shape, the buckets would be so placed upon the hub or cone of the wheel as to be almost tangent to that body. The discharging point of the bucket or lower part, and in which the reaction of the water mainly takes place, is so made that the water in discharging from the bucket will be delivered in greatest volume from the outer radii of the wheel. The back of the bucket at its top part requires the placing of what is termed a "Y"; this prevents any water from being lodged there and carried round by the wheel, which would be simply load carried for no purpose, although such might not be much. The idea of forming the bucket with a downward curve is that the friction of the water passing downward against the buckets is helpful, together with that against the cone upon which the buckets are placed, in easing the weight off the step upon which the wheel is carried; wheels constructed after this fashion are not troubled much with steps that burn out, a source of great annoyance to the user of such wheels as this occurs in. Buckets in which the upper part presents a vertical plane to that of the inflow have often proved to be injurious to the wheel, because of the fact that the friction of the water acts upon the bucket in a contra direction to that in a bucket where the top part is curved in a direction to the motion of the water.

Wheels with buckets constructed upon the former lines have made the best tests of any kind yet made. We have the "Victor," "Hercules," etc., which have developed in sizes of wheels of from 15" to 48" diameter, from 82 to 89 per cent. of useful effect, and when it is considered that many wheels do not develop more than 60 per cent. of that of the power due the head under which they work, wheels of this build must find favor with water-wheel users who do not consider the first cost the essential feature in wheels.

Turbine buckets have been and are made of sheet iron, steel plate, of brass and of bronze, but experience has shown that wheels in which they are of one homogeneous casting are the best that have yet been produced. Wheels in which the buckets, together with the band, are made separately from the cone or hub, either of cast or wrought iron, are decidedly the worst kind. Wheels built in this way often have the buckets sheer off, whereas in wheels of one casting this never takes place, providing the wheel is properly proportioned.

Care should be taken in purchasing a wheel to see that the discharging orifices of the buckets are all of one area; wheels in which these orifices are not of a uniform area produce effects not at all to be desired when imparting motion to a dynamo; irregularity of speed, and not being easily controlled by a governor, are points to be considered by the purchaser.

The distribution of the water as well as the direction and velocity of flow must be taken into account, and this leads me to another important part in the construction of turbine wheels, namely, the method of regulating reaction turbines. There are various methods of doing so; we have wheels placed in scroll cases, in which the water is applied to the wheel through a single long chute which extends in a continual narrowing radius around the wheel. Such constructions are subject to serious defects. Owing to the manner of the application of the water the step is almost in all cases worn to one side; this defect is caused by the pressure of water being greatest at the first point of contact and growing less as it passes around the wheel. Wheels with cases of this style generally have adjustable steps to permit of this being centered, a feature which is not necessary in wheels in which the water is applied to all points in equal volume. The method of regulating the water at part gate is faulty, similar to that of throttling a steam engine. By means of a large gate the water is admitted or shut off from the wheel. This gate being placed at the outer end of chute or case, the water when admitted at part gate, immediately upon passing the gate in this style of regulator, has a great expansion and breaking up of the water, and in which the diminution of pressure and velocity is much greater than would occur from a corresponding loss of head, and perhaps their only redeemable feature is their first cost. Another method of regulation is by means of what is known as fly-trap or hinged gates, which consists in attaching the guide vanes to pivots, so that by changing their inclination with respect to the wheel, the area of the guide passages can be varied at will.

One of the objections to gates of this kind is, that in all positions of the guides but one, the water enters the wheel with impact, the result of which causes a corresponding loss of energy.

In the construction of this gate many parts are required; the tendency is to wear and become leaky. The rods and other devices used to operate the gate sometimes bend and wear until they fail to open the gate but partially. The Leffel, the Success, the Angell, of Providence, R.I., etc., illustrate this style of gate.

Some wheels are regulated by means of a cylinder gate, a round hoop or band, like the rim of a pulley, which is raised or lowered, either outside or inside of the stationary chutes that direct the water on to the wheel when the gate is out of the way. The advantages of such a gate are simplicity, strength, durability and tightness when closed. Defects are found in them to quite an extent.

They are hard to govern, have to be counterbalanced by means of weights, and usually require high decking over the wheel case to cover the gate when it is raised, adding to the cost of the wheel. The stationary chutes of this class of wheel are easily clogged by means of weeds, sticks, leaves, &c., which become wedged into the narrowest part of the wheel. The guides not being movable, this rubbish can only be taken out by hand, a very disagreeable task.

This type of wheel gives very good percentage at from full to part gate. The "Hercules" and "Risdon" are fair types of this kind of gate. This style of gate is not, however, suitable for this country, Canada. Especially in the winter here are our streams subject to anchor ice; and these wheels between the stationary guide get packed solid with anchor ice, and require the application of muscular force and crow-bars to make a clearance, a task not to be entreated on a cold winter's day.

The last style of gate I shall mention is that of the Register gate, which consists of a ring or cylinder fitted concentric between the stationary guides and the wheel, and containing a series of openings corresponding to that of the orifices of the guide passages, and by turning the regulator cylinder, the guide passages can be covered. This style of gate contains all of the good points of the other styles of gates, and is found to have fewer defects than the others. It has the least number of parts, is of great strength, is always a tight gate, is not easily clogged, for the movement of the register will usually release any obstructions that will pass through a properly constructed rack. Gates of this style give perfect admission of the water to the buckets at full gate, and maintain a good result at part gate.

Wheels with gate of this type have few tender parts, and practically nothing to wear and are easily governed, not subject to be choked by anchor ice, and are probably the nearest to perfection of any type of wheel built. It is often argued against this type of wheel gate that they do not give the same percentage of useful effect as some of those built with fly-trap and cylinder gate. You will notice by the efficiency curves of the different types of wheels what they are doing. They are characterized by fewness of parts, simplicity of construction, and above all are not easily clogged, and can be closely regulated. This gate tends to close itself by the action of the water, which is a desirable feature where close regulation is demanded as in electrical work, and the cost of the motor, even if three or four per cent. is wanting in efficiency, at part gate; they will still recommend themselves to users of water power in this country as the best type of water wheel of any built for all round work. Wheels of this type are best illustrated by the "Victor," the "Boss," the "Flenniken," and others.

I have endeavored to present to the members present an impartial sketch of an American type of turbine wheel. Some of my remarks may be open to criticism; they are entirely founded, however, upon practical experience amongst water wheels, and as one finds things so must he speak. But I can hardly leave off here, and yet I fear I encroach upon your good nature, for the placing of our turbine is a most important matter. It seems to me that this matter is one which all users of water power should be thoroughly acquainted with. The necessity of large tail race and wheel pit is of great moment to the success of the turbine. There are many wheels upon the vast number of streams on this continent that are developing only from forty to sixty per cent. of useful effect, when seventy or eighty per cent. or more might be obtained if the wheels were placed properly, and the flumes and penstocks were of proper dimensions.

No hard and fast rules can be given to regulate the dimensions of the flume, penstock and tail race.

In many instances where the head is high or moderately so, the adaptation of turbine wheels on horizontal shafts has been successfully carried out, and without any sensible loss of power by this arrangement, and when it is considered that the loss of power by transmission through gears is wholly saved, and no loss of head is sustained by the use of the draft or suction tube, the advantage of this arrangement must find favor with electrical engineers. In situations which admit of the use of turbines mounted upon horizontal shafts, they make a specially desirable arrangement for driving dynamos, the power being generally transmitted directly by straight belt to the motor from the wheel shaft; the neat appearance and the small space occupied by them, and the ease with which repairs can be made to them, are advantages that more than compensate for the extra cost in the first place. In fact, nearly all moderate or high heads which are used to develop power for electrical purposes are having horizontal wheels placed.

For many kinds of work where the changes of load are light, or where there is a considerable load upon the wheel at all times, there is seldom a wheel that cannot be successfully regulated. But when the load is subject to heavy changes, and at times only a small per cent. of the power is used, as is frequently the case in electrical work, it then becomes important that the wheel should have a proper gate and run at proper speed.

In order that the governor may act upon the gate without loss of time, it is necessary that the gate and its connections should have little or no lost motion. Those gates are to be preferred which tend to close themselves, either by their own weight or through the action of the water. Good results may, however, be obtained with others where the lost motion is reduced to a minimum.

Another point not generally understood, but which has an important effect upon the regulation, is the speed at which the wheel is run, depending, of course, upon the size of wheel and head under which it works. In order to control a heavy change of load with the least variation of speed, it is necessary that the governor should operate the gate as quickly as possible without running by or racing. Now the faster the wheel runs, the faster the governor may be made to operate without danger of racing. Ten per cent. increase in the speed of the wheel, will permit of the governor operating nearly twice as fast. Again, the faster the wheel runs the less it will be affected by a change of load. Given any water wheel and any head of water, there is a speed at which it will develop the most power. It will readily be seen that if the wheel be running at a speed above this point of maximum efficiency, when the motion is reduced by an increase of load the efficiency will increase and tend to retard the reduction, while if the wheel is running below this point of maximum efficiency, the efficiency will be reduced by any reduction in speed and tend to further reduce it.

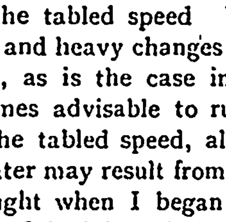
The speed of the periphery of the wheel should be about 65 to 70 per cent. of the velocity of the water due to the head acting upon the wheel.

The greater the load upon the wheel at any time the easier the regulation becomes, so that, while in many cases wheels may be successfully regulated while running somewhat below the tabled speed of the builder, in others, where the load on the wheel is very light at times, it becomes important to have the wheel run fully up to the tabled speed When the load is subject to sudden and heavy changes and good regulation is important, as is the case in electric railway work, it is sometimes advisable to run the wheel considerably above the tabled speed, although some loss in economy of water may result from this.

I had no thought when I began my paper that it would extend so. I had hoped to give many useful rules regarding water power, wheels, flumes, etc., not generally known among users of water power, but time will not permit. I trust that some of my remarks on the subject may have been interesting and profitable; if so, I feel that I am more than repaid for the time spent in writing upon this subject.

A PROBLEM.

Robert Bell, engineer and electrician of the Welland Electric Light Company, operates two American 30 in. water wheels as the source of power for his electric lights. The penstocks are on a direct line with the flume which feeds both, and as will be seen by the accompanying sketch, the head of the second penstock



is sufficiently below the first to give a good flow of water when both are in operation. But what puzzles Mr. Bell, and all who have seen his wheels, is that when the second wheel is stopped and the water is backed up on the first, less power can be got from the first than when both are working. And yet when the first wheel is stopped, there is no difference in the power to be got out of the second wheel. Mr. Bell will be glad to have an explanation of this through THE CANADIAN ENGINEER from any reader who thinks he has the right theory.

BOILER COMPOSITION.

The composition known as "Liquid Anti-Scale Vegetable Boiler Composition," for locomotive, marine and stationary boilers of every description, is manufactured in England by J. C Taylor & Co., Ltd., Bristol, who have had thirty-five years' experience in the manufacture of boiler compounds. This, their latest invention, is claimed to be very effective, in fact it is one which will satisfy a long-felt want amongst engineers who experience trouble with already formed scale in their boilers or are desirous to prevent the same forming without injury to the boiler plates, tubes and fittings, at the same time acting as a preservative and lessening the cost of fuel. Reports strongly in favor of this article can be furnished, and it is deemed only necessary for engineers to give it a trial, as its quality proves all that can be said of it. It is purely vegetable and free from all chemical matter.

This compound is being introduced in Great Britain, France, Germany, India, and Australia, also Canada and the United States, with the intention of extending to other countries. This company is represented in Canada and United States by Samuel Fuge, 464 Dundas street, London, Ont., who will be pleased to receive enquiries from all interested, and endeavor in all ways possible to prove that the article he offers will stand the strongest test of experts. The cost is now competitive with other compounds offered at a low price; it will, therefore, be found effective at a most moderate price, and in the interest of all steam users to give it a trial.

Within the past twelve months "Anti-Scale" underwent a strong practical test in two of the largest boilers of large Hamburg (Germany) manufacturers, resulting in great satisfaction, and the prediction of its being favorably received amongst steam users after testing its merits.

LITERARY REVIEW.

F. W. Helmick, music publisher, of 265 Sixth Avenue, New York, has favored us with a copy of a new popular song which seems likely to "reach the heart of every Christian in the land." It is called "Deal Gently with the Erring" The melody is very touching, and the publisher has thought so well of it that he has paid $2,000 in gold for the right to publish it in America. The price is 40 cts per copy, but readers of THE CANADIAN ENGINEER are to be favored by getting it at 20 cts., which may be forwarded in stamps.

The *Engineering Review*, published at 29 Great George Street, London, Eng., has begun a new series with some important changes. It will now be the aim of our contemporary to provide in the engineering field what the *Review of Reviews* does in the literary realm—a summary of the leading developments of engineering all over the world, rather than the publication of original articles. The idea is a good one, and in the large budget provided in the first number of the new volume, an admirable beginning is made. The subscription is seven shillings a year.

Hawkins' "Handbook of Calculations for Engineers and Firemen," has now gone through seven editions. The seventh edition, published by Theo. Audel & Co., 91 Liberty St., New York, makes a volume of 330 pages, and contains a large variety of information for ready reference for the engineer. The subjects include the elements of mechanical philosophy, mensuration, geometry, etc., with tables of weights and measures, money and wages tables, with calculations and many helpful rules. Besides these are elaborate tables giving the weights of metals, pipes, tables of steam pressure, and such a quantity of miscellaneous information as must make it a highly prized manual for any engineer. It is evidently compiled with great care.

The first edition of the "Year Book" issued by the Imperial Institute of London, Eng, is a most valuable handbook of information on all the colonies of the Empire. In this volume of 824 pages will be found an immense mass of statistics relating to every colony in the British Empire, prefixed in each case with a short historical and descriptive sketch. The statistics are elaborated with great care, and the descriptive introductions are not only very interesting, but, as a rule, impartial. Canada and Newfoundland together take up 65 pages, receiving fair treatment generally. No doubt in future editions many of the statements will be modified, when the compilers have acquired fuller knowledge. For instance, it hardly does justice to this section of Greater Britain to state that "the manufacturing industries of Canada are still in their infancy." An industry which has existed for over two hundred years, as the Canadian iron industry has, can hardly be referred to as "infant," while the products of some branches of it, as, for instance, agricultural implements, are now finding a market in every large country in the world. The same will soon be said of Canadian furniture, which is now being exported in increasing quantities to Great Britain. At the same time an industry which entirely supplies a home market of 5,000,000, cannot be set down as really insignificant, and we have many such industries. In some instances later statistics might have been got. As an instance of this the statistics of the Canadian cotton mills for 1889 are given, while the *Canadian Textile Directory* could have afforded returns for all the textile industries to 1892. But with allowance for these defects—which are to be expected in a first edition—the Imperial Institute "Year Book" is an admirable compilation.

THERE was a tug-of-war recently at the World's Fair between a 600 horse-power electric locomotive, weighing (on the drawing wheels) twenty-five tons, and a modern Baltimore & Ohio steam locomotive weighing 30 tons. The latter won the contest with ease.

Electrical Department.

THE STORAGE BATTERY.

Those who are watching the progress of electricity have followed with interest the experiments and improvements being made in the storage battery, which is now attaining such perfection as to attract the attention of the electrical world. The complete development and its application to every-day purposes of this system has been the goal sought by most students of electricity. As we have pointed out before, one reason the storage battery has not come into practical use in Canada is that we seem generally to follow the lead of the United States, and there the evolution of the system has been delayed by litigation as to patent rights. It is not our purpose now to give a complete *resume* of the storage battery from its inception by E. Julien, of Brussels, Belgium, but to draw the attention of miners to the latest use to which this system has been successfully applied. One of the largest coal mines in Europe, La Societe d'Amercœur at Jumet, has lately been making trials with the storage battery (Julien system), by using an electric locomotive, and has obtained such success that this system will revolutionize the work in all mines. We hope to be able in our next number to give our readers the result of a public exhibition given by the manager of the mine referred to in one of their galleries, before the head engineer of the Government of Belgium and the managers of the largest collieries.

The saving made by the doing away of horse traction, the greater speed obtained, and the vast increase in the work done, make the adoption of this system only a matter of a short time. We might say here that previous trials of this system in mining operations met with but little success. It is only lately that, owing to the high capacity given by the improved accumulators, and the lessening of their weight, it has proved a success. One of the advantages of the system is that the cost of installation is small. If a mine is already using electric light, it is only necessary to use a conduct wire in the galleries in order to charge the batteries. These are placed in a small engine which draws, say fifteen wagons of 1,350 lbs. each, at a speed of five miles per hour. The weight of the battery in the engine is one ton, and the rails may be, say 30 lbs. to yard instead of 56 lbs. as in the trolley system. Batteries last for ten hours. The experiments made by the above company prove that the cost by new system is 7 francs per wagon, compared with 35 francs per wagon, by the horse traction. These figures show in one way the advance being made in the storage battery system. It remains for the future to prove whether the improvements so far made will stand the test of general use.

EYESIGHT AND THE ELECTRIC LIGHT.

Many people have the idea that the electric light injures the eyesight. How far, however, this is wrong may be seen by the following concensus of opinion, obtained by *Lighting* from leading English oculists:—

1. No authenticated case of injury to eyesight through the incandescent electric light has ever been recorded.

2. In point of purity, sufficiency, absence from heat, steadiness and adaptability, electric light is preferable to either gas, oil lamps or candles.

3. The only eyes which are likely to be injured by electric light are those already suffering from weakness or derangement, for which a dark room is necessary.

4. In less serious cases, a change from gas to electric light has been found decidedly beneficial.

5. In its constitution, electric light very closely resembles sunlight, and has a far smaller proportion of harmful rays than any of the rival illuminants.

6. The extreme ease with which it can be managed makes electric light capable of being perfectly shaded and placed.

7. Electric light under proper conditions of use, is the best form of artificial lighting known.

Then, apart from the essential qualities of the light itself, there is another point to be considered. A gas burner or an oil lamp is continually using up the air's oxygen, and substituting for it the poisonous products of incomplete combustion. At large establishments it has been noticed more than once that the improvement in health and attendance of the employees resulting from a change from gas to the electric light has soon paid the whole cost of the installation.

RECENT experiments show that for a given pressure the radiation of positive light from Geissler tubes is proportional to the intensity of the current; the composition, however, of the radiation is constant and independent of the current.

A THERMO-GALVANIC battery has been invented which, when applied by means of wet sponges to the surface of the body, sets free from the water in the sponge pure oxygen or ozone. The inventor claims that by this system the curative effects of these agents make themselves felt in the blood.

A NEW high-speed electric rock drill has been introduced with, it is said, good results. Upon the cradle, which is made of cast-iron and is about three-quarters of a yard long, is fixed a small motor completely enclosed in a brass case. The motor is exceedingly compact and well made, to enable it to withstand rough use. It is wound to work at about 90 volts, and takes about four amperes, which is about a half horse-power, when doing its work. The armature is made up in 16 sections, with the same number of segments in the commutator of phosphor bronze. The speed of the motor is 2,000 revolutions per minute, and it transmits its power to the drill through two cog-wheels, which reduce the number of strokes to about 240 a minute. The drill is also given a slow revolving motion. By a spring arrangement all shock is taken from the drill when the blow is given, thus enabling the motor to work smoothly and without a jar. The whole is fixed upon a tripod stand, which can be inclined at any angle, and fed by a wheel at the upper end of the cradle.

ELECTRIC STREET RAILWAYS.

A PAPER READ BEFORE THE CANADIAN ELECTRICAL ASSOCIATION BY E. CARL BREITHAUPT.

It is not intended to make this paper one of a purely technical nature; we shall endeavor rather to present a general review of the subject in hand and a systematic consideration of the problems and difficulties involved, omitting also detailed estimates of cost.

Until comparatively recent years street railways were operated almost entirely by animal power; steam engines of various forms were used, but the objections to the ordinary form of engine or dummy have confined them to the sparsely populated districts. Cable traction has come into extensive use, and lately also electric traction. Other methods are, however, also competing for public favor; in Toledo, Ohio, a plant was recently installed in which the motor was operated by compressed air, while another company in Chicago have been experimenting on the merits of compressed steam as motive power. In this system, water is to be heated at a charging station to a temperature corresponding to about 200 lbs. steam pressure, and each car is to have a well-jacketed reservoir to carry a supply of compressed steam and water; the motor is a small steam engine of special design to exhaust at a low pressure and operate noiselessly.

Electricity as a motive power for street railways possesses so many advantages over all other systems that it is at present recognized as the best method of propulsion for the great majority of cases. The speed of an electric car can be varied at will; power is consumed according to load and rate of speed, and there is no constant factor of loss as in the cable system; the cars can be moved forward or backward, they can be started and stopped with surprising rapidity, and are not liable to get beyond control. The system has also its points of inferiority; the method of transmitting current to the car by an overhead wire line is severely criticised, and the accounts furnished by the daily press of the accidents and destruction to life caused by the "deadly trolley" have come to be an old story, though in point of fact only a small proportion of these are attributable to purely electrical causes. The dangers of a street railway service naturally increase as the rate of speed maintained is advanced, and the greatest number of accidents are due to this cause. Cable railways are in reality a greater source of danger than is the line wire of a trolley road.

In electric railway work one of the chief problems involved is how to supply current to the moving motor. A number of different methods have been proposed, all of which resolve themselves into two distinct types, and since these affect changes in the entire operation of the road, we may classify the whole subject under the same headings, viz.:

1. Where the current is generated at a central station and transmitted directly to the car motor by means of a wire line and moving contact.

2. Where a certain quantity of energy is stored up in some form or other and carried on the car itself, there to be supplied in the form of electric current to the car motor. In this case the accumulator is usually an electric storage battery, though other plans have been proposed, in some instances very complicated.

In the first type the transmission of current may be accomplished by an entirely overhead line, or by an entirely underground line, or by a modification of these, as, *e.g.*, in the case of the Buffalo street railway, where, we believe, all the feeders and mains are buried and only the trolley wire is overhead. The term "trolley roads" may be applied to all of these. Theoretically considered, the second method is no doubt the more desirable one, since it eliminates entirely the difficulties of a transmitting line, but as yet it has not proven itself altogether successful; in fact the only electrical method which has so far stood the test of a number of years in all kinds of climate is the overhead trolley system of the first type.

The three essential points of any electric road naturally are:

1. The generating plant.
2. The transmitting plant.
3. The motors and car equipment.

Let us consider these more in detail.

GENERATING PLANT.

The location and design of the power station is a matter which should be studied with much care. For roads of the first type it should be as central as possible with reference to the territory covered, in order to economize copper and minimize losses on the line. If it be a steam plant it will be of advantage to place it where an abundant supply of water can be obtained for condensing, and near to railway lines and steamship wharves, so that fuel may be brought in without extra outlay for cartage. On the other hand, property values must also be considered; accurate estimates of all the quantities involved must be prepared, and to determine where it will be advisable to add to first cost in order to save in working expense, the interest on the extra capital so invested must be balanced against the decrease in working expense thereby effected. That it results in economy to utilize water power for electrical purposes cannot always be taken for granted. Such natural sources of power are generally found at locations more or less inconvenient, often at some distance from the centre of distribution, and the extra outlay for copper and other items of primary investment, as well as the increased loss in transmission may assume such large proportions as to bring the nc cost per horse power per year above what it would be if steam were used. Moreover, where the load is a variable one, the water power plant will not accommodate itself so well to the fluctuations, and the smoothness of operation obtained in a steam plant cannot be acquired; this entails a further loss as will be shown later.

In electric railway work of the first type, viz.:—Where the car motors are supplied with current directly from the generators by means of a transmitting line, the service required of the motive power is much more exacting than in ordinary cases; the load fluctuates between very wide limits and with great rapidity, particularly so on small roads. This causes not only unusual strains on the machinery, and which must all be allowed for in construction, but unless the regulating apparatus responds promptly to a change of load, satisfactory results cannot be obtained. Take for example a road operating six cars altogether, weight 8 tons per car, average speed 9 miles per hour, roadbed rather hilly but grades not over 3 per cent. The power required at the car axle to propel one of these cars on a level would be about 4 h.p., 2 per cent. grade 11.5 h.p., 3 per cent. grade 15.5 h.p. If now two of these cars be simultaneously started on ascending grades of say 2 and 3 per cent., while two others are running on level tracks, the remaining ones drawing no current, the load will be increased a little more than three fold, not counting the extra energy required to start, and unless the regulation be prompt they will start slowly.

The ratio between maximum load and mean load is a factor which enters largely into the determination of the prime mover to be employed, both as to size and kind. Taking the same example, the maximum load would be somewhere about 100 h. p. at car axle, while the mean might be 35 h. p., depending, of course, on local circumstances, a ratio of 3 to 1; as the total number of cars operated increases, the variations due to a few cars being thrown on or off become relatively smaller, the load tends to even itself and become steadier, and the ratio between maximum and minimum may approach unity. It thus appears that the duty required of a prime mover on a small road is more severe than that of a plant of considerable size, a fact which may at first sight seem somewhat surprising. The prime mover employed ought, therefore, to be one capable of very sensitive and quick regulation, and which, while able to develop the power required for maximum load, should work at its best efficiency at about the average load, and further, this efficiency figure should not vary much for small changes of load.

Of all the different sources of power only two, viz., steam power and water power, are made use of to any extent in electric railway work, and of the prime movers of these two classes the steam engine best fulfils the required conditions. In point of operation its two great advantages are:

1. Its regulation, which, though far from perfect, is vastly superior to that of any water wheel.

2. Its range of power; a steam engine can much exceed its rated output for a short period, while a turbine can never develop more than a certain fixed quantity. For this reason a water power plant will usually show greater friction losses.

The style of engine best employed, whether high speed or slow speed, will be determined by the sizes of the power units and the ratio of maximum load to mean. It is a matter on which there exists much difference of opinion. High speed engines regulate quicker and they do not require intermediate pulleys to bring up speed; for these reasons they are mostly used where the power of the station is subdivided into a number of smaller units, or where the total output is comparatively small. If each engine be directly belted or directly coupled to one or two dynamos, the losses due to counter-shafting are entirely eliminated, and if we install several sets of units more than are actually necessary the liability of a breakdown is reduced to a minimum. Slow speed engines, on the other hand, better utilize the expansive power of steam and operate more economically, especially where they are used compound condensing and where the units are large. The usual method is to connect all the engines to one countershaft, from which in turn all the dynamos are driven, thus enabling any set of dynamos to be driven from any engine, a consideration of some advantage, but we must now also allow for the extra losses due to shafting and we cannot provide so well for a breakdown.

Of the steam generating plant we need not make special mention.

The objections to the use of turbines as prime movers are, as already stated, their slow regulation, and the fact that since they cannot exceed their rated output they must often be worked at a low efficiency. The power they exert does not vary strictly in accordance with that required on the line, since their regulation is not only slow, but is also hindered by a factor which may be called the time lag, and which is due to the slow action of the governors; when the external load is suddenly changed the momentum of the station machinery is largely drawn on, and by the time the governor action is felt, its speed may be so much accelerated or reduced that an extra shifting of the gates is needed to restore normal speed. In the tests of the Neversink Mountain Railway made during the summers of 1891 and 1892, under the direction of Messrs. H. S. Hering and W. S. Aldrich, the general working of turbines as prime movers for railway service was well shown. The existence of the time lag was clearly demonstrated. In one instance the electric horse-power dropped abruptly to zero, then rose again to a maximum in fifteen seconds, while the turbine horse-power showed a corresponding minimum 35 seconds later and a maximum 45 seconds later; during forty-four minutes consecutive running a maximum difference of 140 horse-power was shown between turbine shaft and dynamo terminals, and a minimum of only 12 horse-power. The speed variations were found to be great and sharp, showing at the turbine shaft a maximum of 104 and a minimum of 78 revolutions per minute during thirteen minutes The voltage keeping pace with the changes of speed, rose to a maximum of 550 and fell to a minimum of 260 during the same time; the load during this period was about 45 per cent. of the capacity of the station, and the gate varied from 41 per cent. to 8.5 per cent. of full gate. These fluctuations are of course extreme examples. Two vertical turbines were used at that time, coupled to the same shaft, but individually governed; the governors did not always act simultaneously, and it happened occasionally that one turbine was driving the other.

In the case of accumulator roads the required conditions of the generating plant are materially changed. The load is now a constant quantity approximately equal to the mean power required to operate the cars, and the rated output of the generating station need therefore only be large enough to accommodate this load. In a paper lately presented before the American Institute of Electrical Engineers, by Charles E. Emery, Ph.D., the author compares the working expense of engines for constant and variable loads. Assuming that for the latter case the power plant is required to be fifty per cent. larger and that a somewhat greater allowance must be made for depreciation on the machinery account, other conditions being the same, he estimates that for a case where the total cost per horse power per year amounts to $52.66 for the variable load, it will only be $47.27 for the constant load, both reckoned for 365 days of 20 hours each. A water power is admirably adapted for storage battery roads. The turbines can be operated at their best efficiency, and, if the source of power be inconveniently situated, we can easily transmit current to the car barns or any other convenient charging station.

As to the question of cost of steam power or water power we beg to refer to the very exhaustive paper by Dr. Emery already mentioned.

TRANSMITTING PLANT.

In all electric railways of the first type the transmitting plant is of the same form, viz., that of a trolley line with its mains and feeders all radiating from the generating plant and extending over the entire route. In most cases the wires are carried overhead on poles, but where the street traffic is heavy, as in large cities, this causes some encumbrance and danger to the public, especially in case of fire, so that it may be found necessary to carry the feeders and mains underground, a matter which entails considerable difficulty and extra expense; the wires must be better covered and good insulation is much more troublesome to maintain. Since a good conducting path is offered from the trolley to the earth, lightning will be more apt to do injury to the line, though the risk of damage to the station machinery should not be so great as in the case of an entirely overhead line.

A variety of conduit systems were early proposed, but the difficulty of properly insulating a bare wire lying below the surface, or of providing other suitable means of contact, was found to be so great that they received little attention. Lately, however, a number of conduit roads have been constructed on plans which seem to promise better success. The Love system has undergone a series of experiments in Chicago, and a short line was also installed in Washington, D.C., last fall. The conduit used at the latter place is 17 inches deep by 14 inches wide, very similar in general construction to that of cable roads, and connected to the sewer at frequent intervals to secure proper drainage. A complete metallic circuit is used that leakage may be easier detected and kept as low as possible. Full descriptions of this, as well as several other new conduit systems, have appeared in the engineering journals and need not be repeated here. We are informed by one of the engineers of the Washington Road that it has so far given good satisfaction, and that during the severe wet weather of the past winter no trouble was caused by water, the leakage being quite small.

In the European cities there are a number of conduit roads in operation, which we believe are showing good results, the one at Budapest being perhaps the best example.

Induction systems in which primary coils are to be imbedded just below the surface at regular and short intervals along the track, while a secondary is carried low down on the car, have also been proposed; this would overcome the difficulty of moving connections between car and line, but it carries with it other sources of trouble, and we have as yet no suitable alternate current railway motor.

As to the construction of the line for trolley service, we want, of course, to secure as nearly as possible the same potential difference between trolley wire and ground at all points, and to obtain this we must run feeders from the station to different points on the line. We may run out one continuous feeder and connect it to the trolley wire whenever necessary.

The trolley or main may or may not be connected directly to the station.

In this case the diameter of the feeder is decreased as its distance from station increases; a better method is to run out separate feeders.

To determine the location and sizes of feeders we must find the amount of current required at certain parts of the route, and to do this we need of course to know the particulars of the case. Given then:

The profile of the road,

Car speed and time intervals between successive cars,

Total weight of car and number of passengers it is intended to carry,

we can determine the horse-power required by any car at any part of the road from which, assuming a certain efficiency for each of the different parts of the plant, we deduct the current required on any portion of the line *for the given case* and the mechanical horse-power required at the station.

The proper calculation of feeders is nevertheless a difficult problem, as the alteration of any one of the given data will change the result. Take, *e.g.*, cars A, B, and C running at such intervals that their distance from each other is 2,000 feet, drawing respectively 40, 50 and 60 amperes. If now another car D, drawing also 60 amperes, were to follow closely after C, the current required on that section would be doubled, and the line loss increased four-fold; *i.e.*, the available pressure and efficiency would both be materially lessened. Where the feeders had been calculated just to accommodate a certain service, a change in the running schedule of a road might thus entail rather unexpected results in efficiency of operation. The necessity of having a properly constructed ground return is sometimes overlooked, and complaints of corrosion of lead or iron pipes by electrolytic action are not uncommon. Rails should always be properly bonded and grounded at regular intervals by a wire running into permanently moist earth; in some cases it is advisable to put down a return wire.

In the case of roads of the second type, the accumulators must be considered as the transmitting plant, and these have been the one weak point in storage traction. The barriers mostly used have been the lead and acid cells, of the types originally devised by Plante and by Faure, or modifications thereof. The difficulties in their operation are many and well known; the positive plates do still warp and form a short circuit in spite of all efforts put forth to keep them in line, and grid plugs still continue to swell and drop out. The Waddell-Entz Electric Co., of New York, have been experimenting on a French alkaline battery which shows considerable probability of success. The metallic elements used are copper and zinc and the electrolyte caustic potash. The electromotive force of such a couple is quite small, being only eight-tenths to nine-tenths of a volt, while that of the lead cells is 2· to 2·4, but its chemical action is almost completely reversible, and its weight is only about 60 pounds per horse-power hour, stored, while that of the lead type is about 100 pounds; its efficiency is claimed to be fully equal to that of the best lead battery. The motor used in connection therewith is especially designed for low voltage, and has a Gramme ring armature of large diameter with internal field, thus securing a longer power arm and better ventilation. It is wound to take heavy currents so that a powerful torque may be exerted to make up for its slower speed.

MOTORS AND CAR EQUIPMENTS.

The style of motor employed for electric traction work is substantially the same for all of the different systems now in use. In the earliest forms it was carried above the car floor and connected to the car axle by means of belts or chains, but this method was soon abandoned. Link connection between armature shaft and car axle, like that of railway locomotives, was used to some extent, and the method may yet in a modified form come into use, though at present spur gearing is employed almost exclusively, motors being always placed under the car floor. The first spur geared motors were built with two or more reductions, but these have been largely displaced by a gear of single reduction. From a mechanical standpoint, the best construction would be to utilize the car axle as armature shaft and do away with all gearing, but electrically this involves some difficulty, since the armature speed must now be comparatively lessened, and the armature must have a greater turning moment to make up for the leverage of the gear wheels. In the Short gearless motor this is secured by increasing the armature diameter and strengthening the field. Mr. Short claims that a double reduction spur gear consumes about 15 per cent. of the energy supplied to the motor. ("Practical Operation of the Gearless Motor."—S. H. Short, *Electrical World*, April 16th, 1892.)

For regulating the armature speed of a traction motor a number of different methods suggest themselves. For a given armature revolving in a magnetic field of a certain fixed strength the torque varies as the current supplied, and the speed varies as the potential difference between its terminals; if, however, the field strength be varied both these quantities will be affected. We can, therefore, regulate the speed by simply interposing a variable resistance in the external circuit or by changing the strength of the field, *i.e.*, varying the ampere turns on the field coils. In the Edison system a combination of these two methods was used. The fields were wound with a number of separate coils, and by means of a controlling switch different combinations of these were affected so as to vary their total resistance and number of turns. Where two or more motors are used, an efficient regulation can be secured by throwing the machines in series or in parallel; an external resistance is also used and different combinations can again be produced. This method is now adopted on the Thompson-Houston and Westinghouse equipments and a large saving of power is claimed for it. In this connection we would refer to some interesting curves on motor tests having reference especially to different methods of speed control, by Prof. Shepardson and Mr. Birch. (See *Electrical World*, July 9th, 1892).

Where storage batteries are employed we can regulate quite efficiently by changing the relative arrangement of the cells. We can thus form any number of combinations between all cells in series and all in parallel, and so vary the current supplied to the motor both in quality and pressure. The method should be a very efficient one.

On electric cars we can secure a very powerful brake by short circuiting the motor armature and making the machine act as a dynamo. If properly applied the method is an excellent one; it is not subject to any of the evils of ordinary friction brakes, and where storage batteries are used, a part of the energy expended in driving the car can thus be recovered. If the road be hilly this results in an appreciable saving of power. The method is used in the Waddell-Entz equipment and gives very good results.

EFFICIENCY OF ELECTRIC TRACTION.

The vital questions in any commercial venture of this nature are of course first cost and operating expense. The cost of construction of an electric road, especially the outlay for line and track construction, can be increased or decreased largely as the circumstances of the case will warrant, and even where the most expensive equipment is called for, the total cost need not equal that of a cable road. In operation the general efficiency obtained is also a fair one. Railway generators of the types now built, have an efficiency approaching 90 per cent. even at half load, but we shall take it at 85 per cent. to be within the limit, while an average of 70 per cent. may be claimed for motors and gearing. Allowing a drop of 5 per cent. on the line, we should have a total efficiency of 57 per cent. between dynamo pulley and car axle. These figures are averages and must be expected to vary widely, particularly so in case of the motor losses. From special car tests made during the test of the Neversink Mountain Road already referred to, we have taken the following table to show the performance of the motors:

Remarks.	Grade %	Mean car speed	Total load pounds.	Mechanical h.p. at car axle.	Electrical h.p. at motor term.	Efficiency.
Different positions of regulating switch.	3 5	7.5	23,800	21 6	36.8	58.8 mini.
	3 5	12.2	23,800	35 3	45.	78.5 maxi.
Under heavy load.	3.64	7 7	32,900	31.5	51.	62. mini.
	3.64	9.	32,900	40.2	53.3	75.3 maxi.

Car equipped with two twenty five horse-power Edison single reduction class "B" motors.

Weight of car 22,000 pounds.

The total efficiency of the plant was found to be rather small. At 35 per cent. of full load it was found to be about 14 per cent. between hydraulic horse-power and car axle: 30 per cent. between power delivered to station machinery and car axle, and about 50 per cent. between dynamo pulley and car axle. At 45 per cent., of full load these figures were respectively 23.1 per cent. 39 per cent. and 57 per cent. These results show that the turbines themselves and countershafts consumed a large amount of power; the electric part of the plant was operated with a fair degree of economy considering the circumstances of the case.

For electric road of the second type where electric accumulators are used, the efficiency figure will be higher for some parts of the plant and lower for others; station losses should be smaller than those for trolley roads, and motor losses, considering the fact that a part of the energy can be recovered by operating the motor as a dynamo, should not be quite so large. The principal waste of energy is in the double conversion from electrical to chemical and back to electrical energy in the storage batteries, and this loss is no doubt a considerable one. Accurate figures have as yet not been published, but the total efficiency of such a road is probably somewhat below that of a trolley road.

An injunction against the Merchants' Telephone Co. to prevent them from erecting their poles in Montreal has been dismissed, on the ground that J. G Ross, the applicant for the injunction, had not proved that any special damage to himself would ensue from their erection.

A new electric cloth-cutting machine, weighing only 35 lbs., but capable of cutting thicknesses of cloth 3½ inches, and being run on an incandescent light circuit, was shown this month at H. Shorey & Co.'s clothing factory, Montreal. It is exhibited by Capt. A. H. Gunn, of Edinburgh, who informs us that though of European invention, the first exhibition of it has been made in Montreal. It is now to be brought before the army departments of the principal European governments before being sold to the trade, or sold in the old country. Capt. Gunn has taken it to New York, but will probably return to Canada before leaving for home. He thinks there's millions in it, and no doubt there will be if the company he proposes to form sell many at the price he suggests—$1,000 each.

HISTORY OF THE TELEPHONE IN CANADA.

By L. B. McFarlane.

As the object of this Association is not only to foster the science of electricity but to conserve its records, I have ventured to deviate from the usual plan adopted by members in their papers, of dealing wholly with the scientific aspects of the subject, and offer instead a brief historical sketch of the telephone in Canada—the country that can with truth be called the birthplace of the telephone.

Professor Alexander Graham Bell's home was, for several years prior to the invention of the telephone, at Tutello Heights on the outskirts of Brantford, Ontario, and it was there that many of his experiments in multiple telegraphy, and some of the earliest in telephony, were made.

The first experimental telephone line erected in Canada and used in this connection, extended from the residence of the inventor's father across his garden. This line being found workable, it was afterwards continued on to the residence of the Rev. Thomas Henderson in Brantford. Its successful working soon became noised abroad, and the novelty of the invention attracted many visitors from various parts of Ontario to listen to the then wonderful performance of the electric telephone; and presently Brantford became known as the "Telephone City." At this time the much condemned "Hello" had not come into use as a signal for conversation to begin; the words "Hoy Hoy" were considered most satisfactory. We must give a discriminating public credit of choosing the less objectionable word, and be thankful that "Hoy Hoy" did not survive.

When the Canadian patent was issued to Prof. Bell, he presented it as a gift to his father, Prof. Melville Bell, and the latter, believing a company or partnership unnecessary, appointed a general agent to exploit the Bell telephone. The latter visited the principal cities and towns and exhibited the old-fashioned box telephone, with but little commercial success, however, as the difficulty of hearing the voice clearly rendered problematic its future value as a means of communication.

The first commercial telephone line was established at Hamilton, Ontario, in October, 1877, by the District Telegraph Company, who were quick to appreciate its value, and they therefore secured control of the invention for that district. This line connected together the residences of Messrs. Baker and Cory.

Mr. Edison at this time was not neglecting Canada as far as telephony was concerned. He had opened up correspondence early in 1877 with the city electrician of Montreal, and forwarded two sets of his telephones for trial. These were placed on the telegraph line between Montreal and Quebec, a distance of two hundred miles, and worked with remarkable distinctness, notwithstanding the presence of several relays in the circuit.

On the 15th September, 1877, a contract was entered into between these gentlemen, whereby the latter secured the sole and exclusive right to the telephonic inventions in Canada of Mr. Edison for a nominal sum, with the option of purchasing outright the patents for the sum of $10,000.

The element of competition was thus introduced at the outset of the business. Both parties claimed priority of patents, and threatened suit against all and sundry users; but while this rivalry continued until 1880, it was not known that Edison, as early as 1877, had admitted Bell's claim to priority. This he did in a letter to his Canadian representative, under date of October 13th, 1877, wherein Mr. Edison stated that:

"Bell has done absolutely nothing new over Reiss, except to turn Reiss' from a contact breaking into a non-contact breaking telephone with permanent magnet, and worked the thing up to a success. The records of the patent office will show that myself (Edison), Bell and Gray started nearly together on acoustic telegraphy for Morse working, that Bell and myself dropped this for speaking acoustic, and that I dropped it first and was working on it for Bell. However, Bell got ahead of me by striking a principle of easy application, whereas I have been plodding along on the correct principle, but harder of application."

The cry of infringement failed to deter lessees from using the telephones, and numbers of private lines were erected in Montreal and Toronto. These lines formed the nucleus of exchanges in these cities, which were first put into operation in 1878.

Montreal was equipped with the Edison apparatus, while the local company operating at Toronto adopted the Bell instruments. The Blake and Edison transmitters having been introduced, the business began to show some development.

The Western Union Telegraph Company, through its ally the Gold and Stock Telegraph Company, secured in 1878 control of the Edison patents for Canada, and the Montreal Telegraph Company were appointed agents for Ontario and Quebec, and the agents of the Western Union Telegraph Company in the Maritime Provinces were ordered to look after the telephone in the lower Provinces In telegraphic circles it was thought that whoever could control the telephone, could command the bulk of the telegraph business, and the telephone was used principally as a lever to this end. The Dominion Telegraph Company then in fierce competition with the Montreal Telegraph Company, became alarmed at the apparently shrewd move on the part of its rivals, and immediately set about securing exclusive rights of the Bell telephone as a weapon of defence. Negotiations resulted in a contract between the patentee and the Dominion Telegraph Company, and the three telegraph companies started in a race to secure subscribers to their Exchanges in the cities and towns from Windsor to Halifax, where Exchanges inaugurated by local companies did not already exist. Some cities were, however, slow to appreciate the use of the telephone, notably Ottawa and St. John, N.B. At Ottawa an active canvass was commenced, but in order to save time a complete telephone exchange outfit was shipped there; the canvass was unsuccessful; no subscribers were forthcoming, and the plant had to be stored until the public could be educated into the use of the telephone. At St. John only one subscriber could be secured after two weeks canvassing. A brilliant idea then occurred to the manager of the opposing company at this point and was carried to a successful issue. It was to open a free Telephone Exchange on trial. This at once demonstrated the necessity for an Exchange, and soon two competing Exchanges were working, and unable to keep pace with the paying orders offered.

This struggle between the telegraph companies, which signally failed in its main object of diverting telegrams to any one company, resulted not alone in cutting telephone rates to absurdly low figures, but in doing business absolutely without charge. To such competition there could be but one end, and it was soon reached. There had been a large capital outlay, and the revenue did not by any means meet the expenses. A proposition at this time to form a separate telephone company, independent of all telegraph companies, was made by Mr. Charles F. Sise, the present chairman of the Bell Telephone Company of Canada, and Mr. Hugh C. Baker, manager of the District Telegraph Company of Hamilton. The suggestion of these gentlemen was gladly accepted by the interested companies and patentees, and by the public at large, who were suffering in most cities from the annoyance of two Telephone Exchanges The Bell Telephone Company was thereupon organized and incorporated in 1880, when it took over all the existing plants and patents, reorganized and consolidated the Exchanges, and began the manufacture of all kinds of telephonic apparatus.

The work of constructing lines connecting adjoining places was begun on a single wire plan, and towns and villages within a radius of one hundred miles were given direct means of telephonic communication. This added to the value of the Exchanges, and as the business prospered, a question was raised by interested parties, anxious to embark in the business, as to the validity of the Bell patent. Two telephone companies were formed by these parties, and local competition at a few points ensued. The patent dispute was brought before the Minister of Agriculture at Ottawa, and as you all know, the patent was lost to the Bell Telephone Company in 1885. A similar fate befell the Blake Transmitter Patent, and as the Minister's decision was final and irrevocable, the telephone field was opened to all comers. Notwithstanding this blow, the Bell Telephone Company continued to rapidly increase its list of subscribers and revenue, and their competitors were left to the tender mercies of their creditors, who found the venture, while it succeeded in breaking the patents, had proved an unprofitable financial undertaking. Later on competition appeared in several localities, but as the connections of these opposing concerns were necessarily limited, they again demonstrated the inutility of working a duplicate telephone system in a city or town, by disappearing from the scene without ever having paid a dividend.

A local company was formed in Nova Scotia and New Brunswick, and after a short struggle with the Bell Telephone Company an agreement was arrived at whereby each of these provinces would have a separate telephone company, the Bell Telephone Company withdrawing from the field, but retaining an interest in each company. These companies have covered their territories with Trunk Lines and Exchanges.

The local company of Prince Edward Island, which had previously been formed by the Bell Telephone Company, has, however, reached the highest stage of expansion, it having a network of wires which reaches every town and village on the Island.

The Bell Telephone Company were early in the field in Manitoba and the North-West, and have kept pace with the development of this territory, by opening stations at all points where business would warrant.

British Columbia is served by local companies, using the same type of instrument as Eastern Canada. These companies have been most energetic and progressive in their policy. As an indication of this we can note the fact that Vancouver, B.C., was the first Exchange in Canada to alter its entire system at great cost, and give each subscriber a separate metallic circuit line.

Canada has kept pace with all the advances in the art of telephony. Metallic trunk lines between towns in Ontario and Quebec were erected and put in operation when the system was first introduced into the United States, and all the best and most modern switching and signalling appliances have been furnished, thus ensuring to the public a most reliable service. On some points it may be said that Canada is in advance of other countries, notably in the system of duplexing telephone trunk lines, which is now in operation in Toronto.

The vast number of country trunk lines, both metallic and single, in the older provinces, show that the service is appreciated and used by all classes of the community.

In a brief paper of this nature many interesting and instructive facts must necessarily be omitted. Those that have been touched upon will not only show the rise and progress of the telephone industry in Canada, but should prove that we are in the van in this branch of electricity.

Electric Flashes.

PREPARATIONS are being made for heating the St. John, N.B., electric cars by electricity.

THE Thousand Island Railway, at Gananoque, will perhaps be converted into an electric road.

ARRANGEMENTS are being made for the construction of an electric street railway in Truro, N.S.

THE Kingston, Ont., electric railway on Princess street was successfully inaugurated on Sept. 23rd.

TROLLEY cars have now been introduced on the Winchester route of the Toronto Street Railway system.

THE Brush Electric Co. are going to locate a branch of their business in Canada, very likely in Trenton, Ont.

THE I C. R. electric light station, at Moncton, N.B., have just ordered a 125 horse-power Robb-Armstrong engine.

THE proposed electric railway connecting St. Thomas and Port Stanley, Ont., will probably soon become an accomplished fact.

BURLINGTON, Ont., is to be lighted by electricity. Arrangements are being made by the Ball Electric Light Co., Toronto.

THE Royal Albion Hotel, Quebec, has just been fitted with 270 electric lights. The generator is a high pressure Stevenson engine.

THE electric railway, eight miles in length, connecting Port Arthur, Fort William and West Fort William, is now in working order.

THE Hamilton Street Railway Co. have entered upon another contract with the Post Office authorities to carry the postmen on trolleys.

C. F. STILLWELL, late of the Edison Lamp Works, is raising capital for a new company to manufacture electric lamps in Hamilton.

SANFORD FLEMING, the engineer, is on the way to Australia, which country he is visiting in connection with the proposed Australian cable.

THE St. John's, Que., Electric Light Co. have purchased a new dynamo, with a capacity for 1,000 lights. They have also put in a new engine.

CHAS. PIGEON has taken an action for $1,000 damages against the Montreal Street Railway Co. for the injuries received by his wife in a collision last July.

D. W. CLARK & SONS (Ltd.), Lancaster, N.B., have been incorporated. They will carry on a business as electricians, carpenters and contractors.

BY the time the Presque Island and Houlton line is finished, which will be in a few weeks, practically all Aroostook county will be connected by telephone.

The St. Clair Tunnel Co. have, owing to the difficulty of ventilation attending the use of coal-burning engines, decided to introduce some form of electric transit.

The Toronto and Scarboro' Electric Railway have contracted with the Toronto Railway Co. for the right to run freight cars over the latter's lines into the centre of the city.

It is said that the French language is better adapted to the purpose of the telephone than the English, owing to the larger number of sibilant sounds used by the latter.

The Niagara Park and River Electric Co. are making extensive improvements and extending their track to the Michigan Central station and also along the Niagara River.

Electric ambulances are to be built in London, Ont., for use in street car and other accidents. The street railway company will supply power and will give free use of their lines.

The Nova Scotia Power Co., Halifax, have asked the council for permission to erect poles, relay the track with new rails, etc., preparatory to operating the street railway by electricity.

The following officers were elected the other day for the Montreal Electrical Club: President, W. B. Shaw; vice-president, J. A. Farlinger; secretary and treasurer, Jas. Burnett.

The Bell Telephone Company have brought an action against the Sherbrooke, Que., Telephone Association on the ground that they had cut the former company's connecting wires in that town.

In Kingston, since the starting of the electric railway, the lighting seems to have been affected, and considerable dissatisfaction has been expressed at the insufficient capacity of the electric system.

Lilian Reece, the young girl who lost an arm by being knocked down by a trolley in Hamilton last July, has taken an action against the street railway company to recover damages for $10,000.

The Montmorency Electric Power Co. are making application to the Quebec Legislature to amend its Act of Incorporation and to authorize it to sell or let any portion of its property with the consent of the company's bondholders.

Peterboro council has passed a by-law granting a bonus of $5,000 to the Canadian General Electric Light Co. on condition that they remove all their Canadian branches to that city. It is proposed to remove the works now at Hamilton to Peterboro.

The Chaudiere Electric Light Co., Ottawa, have decided to put in their new plant themselves, although several tenders for the supply of machinery, etc., have been opened. They will equip their new station with a 1,200 horse-power plant to start with, allowing room for extensions.

During the past year the St. Charles Omnibus Co. of Belleville have delivered to the Montreal Street Railway Co. 45 electric cars This company are shipping this month a handsome hose wagon to Vancouver, B.C., and are also delivering to the new C. P. R. hotel at Quebec two stylish hotel busses.

The Brantford, Ont., Electric Light and Power Co., who were the successful tenderers for the electrical lighting of the city for the past year, now offer to supply light for twelve months at 28 cents each lamp per night. If for a term of five years, the company's offer is 23½ cents per lamp, which was the same rate as in the last contract.

The Standard Light and Power Company of Montreal, amalgamated with the Citizens' Light and Power Company, who have lighting privileges, are discussing what is to be done in the matter of the former's railway privileges. It has not been decided whether the company will build a railway from Montreal to Lachine, or whether they will sell their rights altogether.

The St. Jean Baptiste Electric Light Co. of Montreal are making further extensions to their plant. They are now putting in two large Westinghouse dynamos and one generator. The steam-power also will be greatly augmented, three new engines of 500 horse-power each now being put in. The Westinghouse dynamos are from the well-known works of Ahearn & Soper, Ottawa.

Referring to our item in last issue to the effect that Eugene Baldwin was building a windmill at Dixville, Que., for the purpose of furnishing power for electric lighting, the *Sherbrooke Examiner* says that this is the only electric light plant in Canada which utilizes the wind as power. The first attempt at lighting was made the other day, says our contemporary, and resulted very satisfactorily. The mill itself stands 67 feet from the ground, the wheel being of steel 16 feet in diameter. In the base of the tower are situated the dynamo and other appurtenances necessary for lighting by electricity.

CANADIAN ELECTRICAL ASSOCIATION.*

The third convention of this association took place at the Industrial Exhibition, Toronto, on Tuesday and Wednesday, September 12th and 13th. Besides President J. J. Wright, who presided at all the sessions, the members present were as follows:—W. A Johnson, J. H. Kammerer, Hugh Neilson, F. C. Stannard, H. P. Dwight, A M. Wickens, Norman Smith, C. E. McManus, John Langton, W. J. Jones, Chas. Dwight, W. T. Rutherford, H. F. Dennis, Jas A Baylis, F. J B Seaver, K J. Dunstan, C. H. Mortimer, John Galt, C.E., A. B Smith, W. A. Tower, Frederic Nicholls, J. H. Armstrong, W. A. Martin, E. B. Merrill, T. R. Rosebrugh, F. C Robertson, Toronto; Alfred C. Lavelle, Kingston; W. B. Evans, Napanee; H. W Kent, Vancouver, B.C.; L. B. McFarlane, F Thomson, John Carroll, D. A. Starr, Montreal; B. J. Throop, R. G. Black, Geo. Black, D. Thomson, W. F. McLaren, Hamilton; H. O Fisk, A. C. McCallum, J. S. Knapman, Peterboro'; A. A Wright, C. H. Wright, Renfrew; John Yule, Guelph, J. H. Thompson, Ottawa; E. Carl Breithaupt, Berlin; Alex. Taylor, Edmonton, N.W.T.; R. G. Moles, Arnprior, C. F. Medbury, and W. G. Fraser, Petrolea.

President J. J. Wright opened the convention by reading an address as follows:—

PRESIDENT'S ADDRESS.

Gentlemen of the Electrical Association.—It has again become my pleasing duty to meet you in convention assembled, and at this our annual session to congratulate you on the progress we have made as an association, and on the success which has attended our efforts to advance the interests of the electrical fraternity.

It is not necessary for me to elaborate any platitudes on the wonderful progress being made in the utilization of electricity. This is evident enough to impress even the most thoughtless. The multiplicity of electric cars on our streets, the telephones in our houses and the electric motors in our workshops, are eloquent realities that impress the fact upon our notice. Apart from the rapid increase of what may be termed the standard uses of electricity, the most notable development appears to be in the increasing use of alternating currents, especially of higher tension than has heretofore been considered practical or advisable. The use of these currents for purposes of light and power will increase with the advent of a practicable motor, and it is possible in the near future that current for arc and incandescent lighting and motive power will be distributed from one source of supply. The chief obstacle to a complete and comprehensive distributing system is the difficulty in running these generators into the mains in multiple arc, though even in that line what is now experimental may become in the near future a practical method of operation. We are looking for further developments on this line, as it appears to be at present the most promising field for the enterprising inventor After the consideration of the various papers that will be presented for discussion, the most important duty of this convention will be the election of officers to administer the affairs of the association for the coming year. I would like to remind you of the importance of this duty The continued success of the association depends on a judicious choice On your part you should endeavor to select progressive, vigilant men, prompt to grasp an opportunity as it presents itself, and with ability to use it to the best advantage. On the part of members who may be chosen to take part in the administration of affairs, I would urge upon them to accept the honor attached to an executive function and to do their best to attain success along the lines laid down, but on no account to accept an office unless prepared to give proper time and attention to its necessary duties. I also wish to impress upon the members of this association, if they would become a power for usefulness, the necessity of taking hold of questions as they arise and dealing with them on new and original lines. It is the duty of an organization of this calibre to lead, not to follow. I am still hoping that you will take in hand and endorse with your authority a standard of illuminating power for arc lamps, one that shall be recognized, in this country at least, as authoritative and final, and shall be referred to as the Canadian Electrical Association standard. If this had been done at the Hamilton convention when first proposed, we should have led the world. The opportunity still exists, however, as the Chicago Congress failed to take definite action. It still exists, though not to the exclusive extent that it might have done. It will not do to be satisfied to fall in at the tail of the procession and take a back seat, as we did, simply because the cross roads village of Podunk has had a four ampere system palmed off on it for 2,000 candle power. If we

* Our report is condensed from the official notes of the stenographer appointed by the Association.

are to adopt nothing but American ideas, or Chinese ideas, or antediluvian ideas, we may as well cease to exist and let other people do our thinking for us.

It will not be out of place, I think, to refer to the most recent scheme that has the use of electricity as an important factor in its development. I refer to the "*multum in extenso*," the Hurontario ship canal. I mention this because of the unbounded opportunities it is to open up for electrical operations. The power to be developed, I think it is a million horse power, would appear to offer unlimited possibilities. Of course if the flow of water down the canal to produce all this power made such a current that vessels could not sail up it, that would be a minor consideration. Perhaps a portion of the power could be turned into electric locomotives and made to tow the vessels up against the stream. It might not be quite salubrious to drink the water after it had been well greased by the refuse from the many vessels that are expected to use the canal, but that also would be a minor consideration. We might again suggest the use of electricity in the form of a slight addendum of Jersey lightning, if it was found that too many microbes were disporting themselves to the square centimetre. It is unfortunate that more details are not forthcoming as to the method of combining the various uses of the canal, so that we should not be compelled to speculate how it is all to be done. The necessity of much electrical transmission might be avoided by building the canal as nearly level as might be, so that all the fall would be at this end where the power is wanted. True, there would be the trifling drawback that the lower twenty miles or so of the canal would have to be built on trestles, but as probably nothing is impossible to the mind of the enterprising projector, we confidently wait the development of the scheme.

You will have before you a report of the Committee on Statistics. It is to be regretted that the returns are not more complete, but sufficient has been gathered to be of considerable interest. It is probable that when the different concerns realize that this information will be a benefit rather than an injury to their interests, the returns may be made more full and comprehensive.

Before proceeding with the business of the convention, I wish to express to you my deep sense of the honor conferred upon me by my election as president of this association during the last two terms. If I could express in words how much my ability to serve you has fallen short of my will, I would do so, but you may rest assured that the two years of my incumbency will remain as a pleasant recollection to the end. I hope that my successor in office will find his paths as pleasant and his burden equally light.

The secretary-treasurer then read his report.

SECRETARY-TREASURER'S REPORT.

During the half year which has elapsed since the last convention of the association held in this city, the attention of the executive officers has been largely engaged in making the necessary preparations for the present meeting. At an executive meeting held on the 17th of May, the place and time of convention was considered, and it was decided that if arrangements could be made with the Exhibition authorities, it would be advisable that it should be held during the second week of the Industrial Exhibition and on the exhibition grounds. The courtesy of the exhibition management has made it possible to carry out the proposed arrangement.

As the result of a discussion of the subject of an electrical exhibition to be held simultaneously with the sessions of the convention, it was deemed wise that the association should not assume any responsibility in connection therewith, but that manufacturers should be invited to exhibit on their own account. The display which the manufacturers have made in response to this invitation is most gratifying to the association and creditable to the exhibitors.

An invitation was extended by the Executive to Mr. Nikola Tesla, to deliver on the occasion of this convention a popular lecture on Electricity. It is much regretted that Mr. Tesla felt unable to accept.

In response to the invitation of the Executive, the gentlemen whose names appear on the programme very kindly consented to prepare papers for this convention. In variety of subject and ability of treatment, it is believed these papers leave little to be desired, and that their authors will receive the recognition which their valuable services on behalf of the association merit.

Some interesting data regarding the electrical industries in Canada have been collected by the Committee on Statistics appointed for that purpose at the first convention, and will be laid before the association at this meeting.

To Capt. Carter, Mr. W. A. Grant, manager of the Niagara Falls Park and River Railway Co., the Niagara Navigation Co., the Niagara Falls Business Men's Association, and Mr. Burbank, chief engineer of the Cataract Construction Co., the thanks of the association are due for the pleasant and profitable outing which is in prospect on Thursday.

During the past year the membership of the association has increased from 109 to 133.

The treasurer's statement showed that while the receipts of the association for the year ended May 31st, 1893, were $515.24, the disbursements amounted to $411.76, leaving a balance in hand of $103.48.

Since the first of June last there had been received 33 active members' fees and 13 associate members' fees, making the cash balance at the present time $275.23. The fees now due and unpaid amount to $243. Members who have omitted to pay their fees for the present year are urged to hand the amount to the treasurer at as early a date as possible.

John Yule then read the report of the Committee on Statistics, which was incomplete owing to the failure of a number of electric companies to respond to the committee's request for information. In view of this it was decided to accede to the committee's request for an extension of time in which to collect further data necessary to complete the report. The incomplete figures were not made public.

The president invited members to speak upon any matters of general business which they might desire to refer to; no one rose, however.

F. C. Robertson then read a paper upon the "Causes of Interruption to Telegraph Circuits," a report of which will appear in our next issue.

At the conclusion of this paper, A. B. Smith said that the writer had not touched upon some of the interruptions to which telegraph lines were subject, such as those occasioned by electric light and trolley wires. He could not help thinking of the old days before these sources of interruption existed, and how much easier things were then. Many would be surprised to learn that in the large offices during lightning storms the instruments were not cut off, notwithstanding which it was a very rare thing for them to lose an instrument. He heartily concurred in Mr Robertson's remarks regarding paraffined wire; it should be absolutely prohibited.

F. Nicholls thought Mr. Smith might go further by giving some data with regard to what was a new adaptation of electricity in this country. He understood that the G.N W. Telegraph Company had discarded batteries in its Toronto office, and was now running the telegraph instruments by means of motor generators. The problem had been a most interesting one theoretically, and he felt sure if Mr Smith had not time now, or if the subject was too intricate to be disposed of in a few words, he would favor the association at some future time.

Mr. Smith said that he had made some remarks on the motor generator, which was really becoming an old subject now, at the last convention.

The president suggested that Mr. Smith might invite the members of the association to inspect the system now used.

Mr. Smith expressed his entire willingness to do so at any time convenient.

Mr. Nicholls inquired how many thousand batteries were displaced by the two small motors in use.

Mr. Smith replied that they had been using about 2,000 cells, but that was very small. In Buffalo they had something like 15,000 cells, and he would undertake to do their work with the same plant in use here.

L. B. McFarlane referred to that part of the paper in which was mentioned the working of a quadruple circuit arrangement with a metallic return, and thought that that was the first time it had been successfully accomplished in Canada. This was something quite new in telegraphy, and he thought much credit was due to the C.P.R. people. The interruption caused by a recent magnetic storm was so great that they were unable to work their ordinary lines, and they sent a man north of Lake Superior to make tests, and succeeded in working the system. This afforded them great relief, and enabled them to work their lines when they could not have done so under the ordinary conditions. It was also stated in the paper that a wire could be worked during a magnetic storm by disconnecting the ground at each end and substituting a wire return. It had always been held that that was possible, but he believed that in the last storm it was found ineffectual, and therefore, some other method would have to be found. He then moved a vote of thanks to Mr. Robertson for the very valuable paper he had contributed.

G. Black seconded the vote and said that very many of the interruptions spoken of were due to causes of comparatively recent origin. There had been a time when such a thing as switch-boards and lightning arresters were rare.

The vote of thanks having been carried, A. C. McCallum, of Peterboro', read a paper upon "Turbine Water Wheels," which appears elsewhere in this issue.

The President remarked that the subject of the paper just read was one which might become of considerable importance in Toronto when the big ship canal now being talked of became something more than the figment of the imagination it now was.

T. R. Rosebrugh said he had heard it stated that in the case of electric railways, especially in small towns where only a few cars were used, trouble was experienced with the regulator, the effect being that when the cars were all stopped the turbine was running at its highest speed, the regulator never being rapid enough. He would like to know whether the regulator could be made to do better than that, or if any other means were known of making the regulator keep pace with the turbine.

Mr. McCallum replied that he did not think it possible with the style of regulator in use. The only way it had been successfully operated was by speeding the wheel up, and then there was a loss of power while speeding up. If the wheel was speeded up and the governor applied in the way he suggested, he thought it might then be successful. Still, in a small town where there were only four or five cars, the trouble of regulating would always be a serious annoyance, and he fancied there would be no method of controlling it except from the motor itself, and from that it would be necessary to regulate back to the wheel again, instead of using the ordinary governor on the shaft driven by the water wheels.

H. O. Fisk inquired what was meant by "speeding up" a wheel? Did Mr. McCallum mean to put in a larger wheel than was ordinarily required?

Mr. McCallum answered that most builders of water wheels tabled their wheels to run from 65 to 70 per cent. of the head under which the wheel was working, and of course the gear applied to the wheel between the wheel and the pulley shaft was placed so that the speed might be brought down to the proper place on the table The only way, therefore, would be to put a smaller gear on and bring it to a higher speed.

John Galt said that the water wheel, as would be known to any one who had a little experience, was a very imperfect machine for the regulation of power. In past times water power had been very valuable, but with the great improvements in machinery and the greater economy and perfect regulation with which steam engine boilers are at present run, water wheels had become less desirable The design of a water wheel was to have a head of water, and this water had to fall in a vertical direction. Wheels had been largely designed to operate vertical shafts, and therefore the water in coming downward had to exert its force in a horizontal direction, and consequently to descend upon it in the current direction forward and back in the outflow. More time and money had probably been spent in experimenting on this type than any other form of water wheel. The question of regulation was one of some importance to electrical engineers, because a certain degree of regulation must be obtained, and that was where so far it had ailed. At Ottawa and other places it had been seen that the services of some person are constantly required to assist the regulation. Water being an incompressible fluid, it was impossible to bring it up in the same way as a steam engine could be regulated. A certain amount of regulation could be obtained, but in addition to that automatic regulation attendance was required He believed it was the experience of all who had used water power for any great length of time, that although the very large first cost was somewhat against steam, taking all things into consideration, if they had the same thing to do over again they would go back to steam power. He did not wish to speak disparagingly of water power or water wheels, but merely desired to show that in this aspect they were not viewed as favorably by electrical people as a steam engine plant. Improvements would perhaps be made which would render water wheels valuable; very large central powers developing and transmitting for long distances might eventually become very serviceable, but for isolated plants, distributing power over small areas, he did not think water power possessed the advantages imagined by some people. There had been a great deal of talk about the project referred to by the president, the Hurontario ship canal, which they all knew was mere folly.

A. A. Wright inquired what the writer meant by "burning out," and also what was to be understood by a double bucket.

Mr. McCallum explained that the step upon which the wheel shaft rested was made of lignum vitae, and that the more easily the wheel sat upon it the less liability there was of its burning out.

A. A. Wright asked if water wheels had ever been made of aluminum.

Mr. McCallum had not heard of such being the case. He believed that American engineers would before long depart from the principles they had followed, and would adopt impulse as the motive power; wheels of the kind were being brought to the tunnel station at Niagara Falls, of the Swiss pattern. These wheels were found very useful in Switzerland, where they had large heads and small volumes of water.

Mr Galt said where larger heads and smaller volumes of water were the rule, regulation could be reduced to a finer point; but in many cases in Canada the condition was large volumes of water passing through a wheel of large diameter, and regulation was consequently difficult to attain.

H O. Fisk enquired whether it was not the best practice to drive two separate wheels on one shaft instead of regulating on the one wheel.

Mr. McCallum said it was found that wheels of small diameter gave a better percentage of useful effect Two wheels of 30 inch diameter gave a better percentage than one of 60 inch or 70 inch diameter working to the same head. The best plan seemed to be to divide up the power.

Mr. Fisk believed that before long a governor would be devised to obviate the trouble. He could not see why a machine could not be made to do what a man could, and with a man who understood his business at the wicket, the voltage could be kept within fifty volts—from 500 to 550—without any trouble.

The president said that the question of water powers was coming into more or less prominence, owing to their utilization and the transmission of their force for long distances. He endorsed the views of those who thought that there was very little to choose between them when it came to driving electrical apparatus.

Mr Galt moved, and Mr. Wright seconded, that a vote of thanks should be given to Mr McCallum for his paper.

The president called attention to a notice by Mr. Carroll that the term of office of members of the Executive Committee be one, two, and three years, instead of the whole board retiring each year, as at present.

The meeting then adjourned.

WEDNESDAY MORNING.

The President stated that the motion of which notice had been given the previous day would require, in order to be introduced, a two-thirds vote of all the active members present.

It was moved by John Carroll, seconded by D. A. Starr, that the term of office of members of the Executive Committee be one, two and three years, instead of the whole board retiring each year, as at present.

After a good deal of discussion as to the reasons for a change an amendment was moved by Mr. Nicholls, seconded by Mr. Kammerer, that the number of members forming the Executive Committee of the association be increased to ten, five retiring each year, and five members to constitute a quorum. This amendment was carried.

The President announced that the next business was to determine the place of the next meeting.

Mr. Kammerer moved that the next meeting be held in Montreal His reason for so doing was that there were a number of members from that city who might be called very active members, who took a very active interest in the association throughout the year, and whose interest never flagged. He thought some recognition of this fidelity might be given by holding the next meeting at Montreal.

Mr. Nicholls, in order to bring the matter fully before the association, and to induce a full discussion of the matter, seconded the motion.

A. B. Smith remarked upon the fact that both the mover and seconder were Toronto men.

Mr. Starr said he had had considerable conversation with several Montreal people, directly or indirectly connected with the association, and he could assure those present that if the next meeting, or any meeting at any time, were held in Montreal, they would have as pleasant a time as it was possible to give them. He thought the reputation of Montreal, as an entertainer, was sufficiently established to assure them of that.

Mr. Yule moved that the next convention of the association be held at Niagara Falls.

Mr. Armstrong seconded the motion.

Mr. McFarlane said he was an active member of the association, and a resident of Montreal, and he would be very glad to invite the association to bring the convention there. He feared, however, that very few of the members would come down there. He thought the organization was hardly large enough yet.

Mr. Taylor thought the association would gain strength by going to Montreal, that a great many additional members would be secured by a visit to that city

A. A. Wright was in favor of going to Montreal. That city had in connection with McGill College one of the finest, if not the finest electrical department on the continent of America.

Mr. Kammerer thought some consideration was due to the Montreal people for the interest they had evinced in the Association, and even if it did cost a few dollars more he was sure all would be well repaid for the extra expenditure.

Mr Merrill said it would be two years before the plant at Niagara Falls would be in running order, perhaps three years. It would, he thought, be better to wait until a later period than next year for holding a convention there.

W A Johnston thought it would be better to hold the meeting in Toronto There were a great many electric light men who had not taken the active interest in the Association that they ought, and the principal following of the Association was from Ontario.

Mr Starr thought if the meeting was held in Montreal a great many Montreal people not now included would become members. Three conventions had now been held in the west, and he thought a meeting held in Montreal would result in the addition of more members than if another took place there.

F. Thompson said there was a little Electric Club of 25 members in Montreal, who, if the meeting were held there, might join in body. He thought the meeting ought to be held in Montreal next year, and after that at St. John, N.B., and the membership and influence of the Association would in that way be extended all over the Dominion.

The President then put the amendment—that the next convention be held at Niagara Falls. The amendment was lost.

The motion, that the next convention of the Association be held in Montreal, was carried almost unanimously.

Mr. L. B. McFarlane then read a paper on the "History of the Telephone in Canada," which will be found elsewhere.

Upon the completion of the paper, Mr. McFarlane explained that much of it had been written from memory, but that after he sent the manuscript to the Secretary he had met Professor Bell in Montreal, and had questioned him on some of the points dealt with in the paper, and had been told that as a matter of fact he and his uncle, Professor David Bell, worked the first telephone line between Brantford and Paris, that is the first practical telephone working any distance. At that time they did not know how they could work long-distance lines, and Prof. Bell went up to Paris and borrowed the lines of the Dominion Telegraph Company, taking with him a few large resistance coils, and by inserting these he found what would make a workable telephone. He said that was practically the first workable telephone line they had. It was a private test—not made publicly—and it was quite successful, although the battery was at Toronto, some sixty or seventy miles away.

K. J. Dunstan thought the thanks of the Association were due to Mr. McFarlane for the paper just read, which, valuable as it now was, would become more so as a record of facts in connection with the invention of the telephone.

Mr. Thomson asked in what year the experiments were made.

Mr. McFarlane stated it was in September, 1875, when Prof. Bell's home was at Brantford.

Mr. Thomson said he believed Prof. Bell gave his first public exhibition of the telephone in the United States, in September, 1876, in Philadelphia during the Centennial.

Mr. Kammerer seconded the motion for a vote of thanks to Mr. McFarlane, which was then carried

The next item on the programme was a paper by E. B. Merritt, on "The Education of the Electrical Engineer." This paper will appear next month.

Mr. Nicholls having been asked to make a few remarks upon the paper just read, proposed a vote of thanks. Mr. Merrill had evidently considered the matter from the point of view of the student or university graduate. He could quite understand, indeed he had met with the same difficulties in his own business, that a student after having spent a long time at college in a scientific course, felt considerably at sea on going into employment at such an office as the one of which he was manager. They had received a valuable theoretical training, but they were completely at a loss until they had received that practical training which alone would enable them to fill the office of superintendent or to guide the progress of an electrical enterprise. It would be interesting, he thought, to hear from Prof. Rosebrugh, whose presence he noticed in the room, as to the full extent to which the electrical course was carried in the School of Practical Science. In the company with which he himself was connected they had a student course, lasting from eighteen months to two years, during which time the student passed through every department of electrical industry, and not only in the machine shop, but in practical operation and construction on the road, because they had to spend at least three months on outside construction; and by the time they were through with that course they generally were capable young fellows. If they had had previous training in the School of Practical Science, the university, or some other technical college—the practical course was very much simplified, because they commenced with an understanding of the principles, and it was well known that where the principles are not understood of any mechanical piece of work, it is much harder to gain a proper appreciation of the undertaking.

Geo. Black said that the paper was one to which he had looked forward with a great deal of interest, and the subject was one which he thought would engage a very large share of attention on the part of members of the Association. Some three or four years ago, he had begun the collection of the calendars of the different technical colleges which engaged in teaching electrical engineering, and he had been very much struck by the difference between the various courses, no two of which exactly agreed; in fact some were very wide apart, and no two agreed upon the necessary qualifications for entering the college. There were great differences in the workshops and apparatus possessed by the different colleges In some a fair knowledge could be obtained of the rules and working apparatus connected with engineering: others unfortunately were deficient and had no apparatus whatever, nothing even of a repair shop. Our own School of Practical Science had adopted a middle course; it supplied considerable apparatus for testing purposes, but there was no machine shop. It was thus a very difficult matter to decide from the calendars which college to attend. The courses after entering were also very wide apart. The essay stated that Lord Kelvin had laid down the rule that the electrical engineer should be nine-tenths mechanic and one-tenth electrician. Some reversed this, and held that he should be eight-tenths electrical and two-tenths mechanical. He thought the discussion of these papers at the conventions, and the consideration of them by members between the conventions, was very useful to the profession at large. Here in Canada we had two special schools for training, one at McGill College, where they have recently adopted a mechanical or workshop course, and one in the City of Toronto, where they give theoretical training and provide testing machinery, etc. Members of the Association who wished to send their young friends to these institutions would have to study the two systems up and choose between them.

Mr. Galt said he had no doubt in his mind that the question of educating electrical engineers should be from the theoretical standpoint followed in the colleges. There was danger in introducing into the college work manual or machine work. He doubted the desirability of colleges taking up this practical branch, and held that it was wrong to inculcate the idea that young students were able to gain at colleges both a theoretical and practical knowledge. The tendency of the present age was to specialize as much as possible, and he thought one who desires to become proficient as an electrical engineer should not devote two years to acquiring a smattering of mechanical engineering, or any other branch of engineering. In cases where he desires to avoid blunders the electrical engineer should rely on some expert mechanical engineer if it was a matter of a mechanical character that was being dealt with. He thought that course would be much better for all parties. He was not inclined to agree with Lord Kelvin's dictum, that the electrical engineer should be nine-tenths mechanical and one-tenth electrical. He believed that the electrical engineer must be largely electrical, having sufficient mechanical knowledge to enable him to appreciate the necessity of seeking expert help to keep him out of trouble in that branch.

A. A. Wright asked.—"What do you send your boy to College for anyway, what are you going to do with him? You send him there so that he may earn a living. The question is, when he comes out of college, what is he going to do." A man who lived in England wanted one kind of an education, and a man here in Canada another kind. Here in Ontario it was necessary to know a great deal about everything. At the present time it was necessary for a man to know a great deal about everything. He needed to be able to go into an electric light station and take charge of and handle the plant and run a dynamo, and to know a good deal about everything. He thought the proper course was to send a young man to the high school until he knew a great deal about mathematics because he could not get along in electrical studies without that knowledge. Then he should learn French, because it would be of great service to him by enabling him to read electrical literature published in France, which was a great electrical country. Then he would have him go to work and run a dynamo and look after the plant, and it would not take him long to acquire a knowledge of the work. Then he believed he should take up this course, this three years course should be identical with a mechanical and electrical course. The fourth year he could take up either electrical or mechanical engineering as was preferred During vacations he could do as was suggested in the paper read, get into some workshop where he could see the kind of work he was going to be engaged at, and in that way become a real practical man, and that was the kind of men wanted—men who were not afraid to tackle practical work. The sooner our young men knew they had to work the better for them. He wished to second the motion for the vote of thanks to the writer of the paper read, because it was a really valuable one, and too much credit could not be given to the gentlemen who prepared these papers for the benefit of their fellow-members of the Association.

Mr Johnson remarked that by the time a young man had passed through a scientific course he was perhaps a little too old to take hold of shop work He considered the practical part absolutely necessary. There were occasions when an electrical engineer might be called upon to fix some part of an engine or dynamo in a town where he would not be able to secure the services of a good machinist. He thought, therefore, that after a young man had obtained a high school education in mathematics, he ought, if possible, to take a machine shop course of practical training, and after that a year or two spent in higher thoretical training would be of advantage to him, or even before taking the machine shop course he could take the course of the School of Practical Science, then the machine shop, and then one or two years in the best college he could find.

Mr Breithaupt thought the machine shop training should be obtained very largely outside of the college, that the theoretical course should be distinct from the machine shop training.

Prof. Rosebrugh said the members might be interested in hearing what was the course at the School of Practical Science, in Toronto The work in the mechanical engineering course was much the same as in the purely mechanical course for three years, and in addition to this, running through the entire course, starting at the very first term, was a course of electricity, which ran in this way. In the first year was a course at the university by Prof. Loudon, on electricity and magnetism, taking a rapid run through the whole range, giving the student who had never considered the question a good general idea on the subject, probably as much as any ordinarily educated person who had made no special study of it could be expected to know Immediately following this was a course in the School of Science on the flow of electrical current. Following that in the second year, a course was given in electrical measurement of currents and resistance Then the third year the subject of dynamos and motors and storage batteries was considered, the continuous current only, alternating currents being left to the fourth or post graduate year, on account of the extra mathematical difficulty involved. In the fourth year, which was not taken up by all the students, nearly the entire time was spent in laboratory work. With regard to the machine shop work, that was entirely outside of the four years work of the school. In order to obtain the diploma of the school it was necessary to present a certificate of having had one year's practice, so altogether it involved a complete course of five years.

F Thomson said the question had often been asked in Canada whether an electrical engineer was required to run these electric plants. He thought the average pay of electrical engineers running plants would be about ten dollars per week. There were in the Province of Quebec quite a number of colleges that professed to turn out electrical and mechanical engineers. Many of these institutions possessed only the most rudimentary and antiquated appliances, and the professor who instructed the student knew practically nothing of what he was talking about The question seemed to him to be, would the use of electricity develop to such an extent as to make room for all those who were crowding into the business?

John Langton said on the point referred to in the paper regarding students spending the summer vacation in machine shops, he did not see how they were going to do that In most shops the apprentice was regarded somewhat in the light of a nuisance for the first six months or a year, and he did not think any great alacrity would be shown on the part of machine shops to take in a boy for five months and then let him go Undoubtedly it would be the best way to combine theoretical and practical work, but great difficulty existed in carrying out that arrangement. He fully agreed with all that had been said regarding the necessity of practical work. A certain degree of this practical knowledge could be imparted at the colleges. For instance, the foundry branch taken at college was very useful; though the student worked at moulding impossible forms which he would never mould in practice, he learned what to avoid. But the attempt to produce actual machines in the machine shop at college was certainly a very great waste of the student's time. Any extensive development could only be looked for in the field of commercial adaptation of electricity.

The President said he had frequently wondered what was going to become of the large number of electrical engineers manufactured, but he supposed that, as in the case of the lawyers and doctors, it would be a case of the survival of the fittest.

Mr. Nicholls said he hardly thought so. To be a lawyer or a doctor, one had at least to have a certificate of competency, and they were obliged to serve a proper term and pass a rigid examination. In the electrical business the term of electrical engineer as applied to Canada was a misnomer, for they were very few and far between.

Mr. Langton said he had forgotten one point he intended to have mentioned, that was that in Canadian establishments a better opportunity was afforded of studying the practical work in detail than in the larger concerns of the United States. In these latter the student was moved about and saw various operations, but not very much personal attention was given him, and he only saw one thing at a time, whereas in the smaller shops he saw all varieties of work and that on a smaller scale, and came into more immediate contact with the various difficulties and points arising. He therefore thought that Canada offered a better field for education in electrical engineering than the United States did.

A vote of thanks to Mr. Merrill for his paper was then carried.

The President then asked F. Thomson to give a few remarks on the result of his experiments on alternating currents of high tension, and as to the possibility of getting up an alternating current of sufficiently high tension to use in the way proposed by the parties who were exploiting these large power works, and also as to the possibilities of constructing a dynamo that would stand tension of such a character.

Mr. Thomson replied that he could not say much as to how the experiment referred to would turn out. He had intended to prepare a paper on the subject, but had not been able to do so for want of time.

The meeting then adjourned until the afternoon.

AFTERNOON.

Some discussion having taken place as to the time at which the next meeting should be held, it was decided to leave the matter in the hands of the Executive Committee to nominate a date about the end of August or the beginning of September.

The next business on the programme was the election of officers. A list of these appeared in our last number. They may also be found in another place in the present issue.

Mr Nicholls moved, and Mr. Thomson seconded, "That the thanks of this Association be tendered to the Industrial Exhibition Association for the use of the Directors' room and other courtesies extended to it, and that a copy of this resolution be forwarded to the Industrial Exhibition Association."

On motion of A. B. Smith, seconded by Mr. Taylor, the sum of $25 was voted to the Secretary-Treasurer for his services during the past year

The next paper read before the convention was by John Langton on "Direct Connected Dynamos and Steam Engines," which is printed in another part of this issue

Mr. Thompson asked Mr. Langton if he considered the slow speed multipolar machine as efficient as the bi-polar machines.

Mr. Langton said the question was rather a wide one, as there was considerable variation in different makes, and the question of the efficiency between the two types was so mixed up with the makes various as to make a general answer impossible.

Mr. Galt thought that the more directly the power could be applied the better, and the whole trend in every part of engineering was in that direction. As illustrating this, he referred to modern practive in locomotive and marine engine construction. The proper plan was direct motion without gearing. Belting, he said, was gearing, and if it could conveniently be dispensed with, it was proper to do so. But owing to the complexity of conditions it was hardly possible to lay down any broad rule. There were conditions frequently prevalent which would make it absurd to make use of direct coupling, and again there were other conditions under which it would be equally absurd to use gear. The advantages of direct work were that it simplified the machine to some extent, occupied less space, making it easier to attend, and effected a saving in wear and tear, for it was well known that belting is likely to give out and necessitates constant attention. With regard to street railway motors, he thought the day was not far distant when there would be found direct dynamos on the car axles. It was well known that gears were very troublesome, taking much oil to keep them in order, and very liable to break. For these and other reasons, the more direct the work could be made the more advantageous. But in the present state of electrical and steam engineering it was hardly likely to always get a direct connected engine to suit the speed at which armatures generally run. With a Corliss engine, either vertical or horizontal, usually running about 100 revolutions per minute, it was impossible to run direct unless you multipoled your dynamo.

C. F. Medbury said there was a decided demand by purchasers for slower running electric machines, and this demand was being met by the larger companies. This tendency towards slower speed was very evident in the electric exhibit at the Chicago Fair. Direct coupled engines and dynamos were seen in all the most prominent displays of dynamo machinery, directly in line and eventually leading up to direct coupling were the relatively slow speed machines shown for belt connection. The Thomson. Houston, Fort Wayne, Brush, and Westinghouse companies showed both direct current machines and alternators of greatly reduced speed. The Westinghouse Co., for example, offered a 600 light alternator with a speed of only 900 revolutions per minute. For an alternator of this size this was a remarkably slow speed, the usual speed of such a machine being about 1600, a 1200 light alternator ran at 600 revolutions per minute. Besides the advantage of lower angular velocity and the reduction in belt speed, with its saving in belts, the resulting lower periodicity rendered the alternator a serviceable and satisfactory machine from which to run arc lamps, these being operated on the same circuit with incandescent lamps. The great difficulty in introducing slower speed machines, whether for belt or direct connection, lay in the fact that the average purchaser would not pay the slight difference in first cost, the tendency being in general to buy, so far as the electrical apparatus went, as cheaply as possible, regardless of quality. But as purchasers become more accustomed to consult consulting engineering concerns, disinterested parties in whom they have confidence, they would not look altogether at the first cost, but also at the cost of maintenance, and there would be more slow speed and direct coupled dynamos.

A vote (moved by J. Galt, seconded by D. Thomson) was passed thanking Mr. Langton for his paper.

E. Carl Breithaupt then read a paper on Electric Street Railways,' particulars of which will be found elsewhere.

Mr. Langton thought the figures in the paper regarding total efficiency very interesting, and said that although the loss would seem very large to an ordinary consumer, it was probably much less than from any other form of transmission. It was rather a misfortune for electrical transmission that owing to electrical power being so easily measured the loss was always readily ascertainable, whilst the greater loss by power in other methods of transmission was seldom so accurately known. He remembered a case of a small establishment running by water power. It was discovered that it took 18 horse-power to run the shafting and machinery, and 12 horse-power to run the shafting alone.

Mr. Breithaupt asked Mr. Langton for a few remarks on storage batteries.

Mr. Langton said that storage batteries of different makes had been tried in many different places, and had universally failed for traction, and always from the same three causes. the weight was too great, the ampere hour efficiency dropped with heavy load, and the heavy load also caused mechanical deterioration of the plates. Unless the storage battery could overcome these difficulties it was no use for traction He was interested in a storage battery himself, and if it turned out as was expected he would be happy at some future time to give a description of it, but at the present time he thought it would only waste the time of the convention to talk of storage batteries.

Mr Medbury called the attention of the members to the important part which the rotary transformer seemed destined to play in electric railway work. Generators might be installed at the power house which would give either 500 volts direct current for feeding directly into the trolley line, or two-phase currents for transmitting electric power at high pressure to some distant part of the line. In fact both the direct simple current and the two-phase current might be taken off at one and the same time. At the distant point, say seven or eight miles or more would be installed the rotary transformer, a machine similar to the generator, this would receive the two-phase current and transform it into a direct current of 500 volts There were on exhibition by the Westinghouse Electric Co., at the World's Fair, a two or three hundred horse power rotary transformer of this type which is driving a 60 k w. Westinghouse Alternator, a pump with belt connection, and also at the same time delivering direct current at 500 volts to a large direct current motor, and an air compressor working a rock drill A machine of this type obviated the necessity of having two different types of apparatus in the power plant, or where an ordinary alternator was used to transmit power at high voltage to an alternating current motor which drives a direct current generator. Moreover, the rotary transformer was more efficient, having an efficiency of about 95 per cent. A rotary transformer of this type was not a dynometer in the generally accepted meaning of the term, for there was but one armature winding, being of the ordinary type and connected in the usual way to a commutator, and also being connected at four points to four collector rings, by which the two-phase currents entered A dynometer, as generally understood, had two separate armatures, or two separate, independent windings on the same core, one acting as a motor to drive the other as a dynamo.

On motion of Mr. Langton, seconded by Mr. Galt, a vote of thanks was tendered to Mr Breithaupt for his interesting paper.

A vote of thanks to the Press of Toronto for reports of proceedings having been passed, the convention adjourned.

On the following morning the members of the association made a visit to Niagara Falls. The fine steamer "Chicora" took them as far as Queenston, where they arrived at about 10 o'clock. On alighting, they found a special train waiting to convey them to Chippewa, over the Niagara Falls Park and River Railroad Company's line—a part of the trip which was much enjoyed for its own sake, not only on account of the magnificent peeps of scenery the route affords, but because of the fine equipment and good management which distinguished all the company's arrangements. At the Falls, the association inspected the power-house, where additional plant, it was understood, is to be put in this winter to provide for the double-tracking of the road. Luncheon was served to the party at the Cliff House, after which they crossed the river in the "Maid of the Mist," landing on the other side at the end of the inclined railway. Special electric cars then conveyed the members, under the care of Mr. Harrington, of the Niagara Falls Business Men's Association, to where the work is going on with the object of utilizing the water power of the great cataract. The wheel pit is 170 ft. deep and contains room for six inverted turbines, from which a development of 50,000 horse power is expected. After visiting the top of the 300 ft. high observation tower by means of electric elevators, the party once more went on the deck of the "Maid of the Mist," which carried them to within a few yards of the Falls. The members then returned to Toronto, and after resolutions had been passed thanking the Niagara Navigation Co., the Niagara Falls Park and River Railroad Co., Captain Carter (of the "Maid of the Mist"), Mr. Harrington and the executive officers who had made arrangements for their reception, the convention broke up.

DIRECT CONNECTED DYNAMOS WITH STEAM ENGINES.

BY JOHN LANGTON.

Dynamos directly connected to steam engines have been not uncommonly used in Europe from the first introduction of electric lighting, so much so that the custom has been noted as a distinguishing characteristic of European practice compared with the almost exclusive use of belt driven machines in America.

The early direct connected dynamos were, however, generally uneconomical in material and were in fact high speed dynamos run below their most efficient speed, with a corresponding reduction of output in proportion to their cost. The advances made in the design of multipolar dynamos brought the efficient speeds of this type down to the point where the revolutions per minute compared with the speeds that can be efficiently obtained by modern steam engines, and so made direct connection a general commercial question. The credit for this is very largely due to German engineers and builders, who at the time of the Paris Exhibition in 1889 had brought the type to a high degree of perfection, and had built direct connected dynamos as large as 300 K. W. The general introduction of similar machines into the United States from the Paris Exhibition, and since then the rapid increase in their use, has been a marked feature in the history of electrical progress on this side of the Atlantic. And although the principal use of machines of this class has been in large sized units, suitable only for large power and lighting stations, the practice has been gradually extended to machines of small power. Under these circumstances the subject would seem a fitting one for consideration by the Canadian Electrical Association, and the object of this paper is to bring the matter before the Association by briefly attempting to discuss in what manner the essential peculiarities of direct connection as compared with belt connection, affect the main items which go to make up the cost of producing electrical energy.

The high speed automatic steam engines which are now generally used, belted to dynamos without intermediate shafting, are all suited to direct connection They thus afford means for an immediate comparison between direct and belt connection which will apply to the majority of cases, and which is divested of all considerations of steam economy by the use of identical engines in both cases. Any conclusions drawn from this comparison, to which the present paper is devoted, may then be taken into account in conjunction with the totally distinct question of steam economy with different types of engines This is so, even for the case of slow speed engines, which in general are not suited to direct connection. The cost of production with high speed belt connected engines may be compared, on the one hand, with high speed direct driving engines, and on the other, with slow speed engines, belt driving through intermediate shafting. The question of steam economy has been recently exhaustively treated in a most valuable paper on "The Cost of Steam Power Produced with Engines of Different Types," read before the American Institute of Electrical Engineers by no less an authority on steam engineering than Dr. Charles E. Emery, whose paper gives the items of cost analyzed and tabulated so that special corrections for special cases may be readily applied. (Dr. Emery's paper was republished in the *Canadian Electrical News* of May and June, 1893).

The subject for present consideration is then narrowed down to the general cases of identical or equally good dynamos, in the one case belt connected and in the other direct connected, to identical or equally good steam engines, used in plants which do not present any special conditions of location or operation. The items of cost to be looked at are:

In the first cost of plant :

Cost of generating machinery complete, ready for operation.

Cost of real estate and building to contain generating machinery.

In the operating cost of plant :

Repairs and small supplies.

Attendance.

Fuel.

Notwithstanding some saving in labor and material due to the use of a combined bed plate, the saving of two pulleys, of the whole cost of the belts, and (in situations where they would otherwise be used) of dynamo foundations; it does not seem probable that the first cost of direct connected dynamos and engines erected ready for operation will ever be less than or even as low as belt connected combinations. Any saving of material will be fully counterbalanced by the increased cost of testing the combined machines, whether the engine be brought to the electrical works for this purpose or whether the combined test be made where the plant is erected. Boilers, engines, steam-piping, pumps, condensers, and electrical apparatus outside the dynamo itself, are all unaffected; but for the dynamo connected to the engine the advantage in first cost is at present with the belt connected machine, an advantage it will probably continue to retain.

The principal difference between the two classes affecting first cost is in the engine-room space required. This is most marked, and is in all its bearings the most important characteristic of direct connection. Dynamos belted to engines on the same floor occupy from two to three times the floor space of direct connected combinations, giving the latter a considerable advantage in the first cost of land and buildings required. Where the engines are on the ground floor belted to dynamos on the floor above, the total floor space is about twice that required for direct connection. In this case, the real estate covered is the same for both, but the building cost is increased, not only by the extra cost of the second story, but also by the much more substantial character of the work necessary to support the weight and prevent injurious vibration. The double story arrangement of station also presents special difficulties of its own with the belts and bearings, even where dynamos not larger than 100 horse-power are used. Where the individual machines are of comparatively small power, as in an arc lighting station, the double story arrangement seems to give satisfaction. By completely separating the engines from the dynamos it also probably somewhat increases the cost of attendance. In every case the saving in first cost of land and buildings has a definite assignment value and can always be taken accurately into account to determine whether it is worth saving It becomes a matter of fact and not a matter of opinion—a fortunate circumstance in an item which presents greater variations in value than any other single one of those which must be taken into account, varying between such extreme cases as the business portions of New York, where the annual rental of floor space is $5 per square foot, and the small country town, where building lots can be bought outright for 5 cents a square foot.

It is surprising what can be done by direct connection in the way of concentrating power. In one plant the writer examined, 20 feet in length of an engine-room 18 feet wide and 8 feet high, contained four 75 horse-power engines direct connected to four 50 K. W. dynamos and the switch board for the whole plant, leaving comfortable room for the attendant to move about the machines and to get at and remove any part of them.

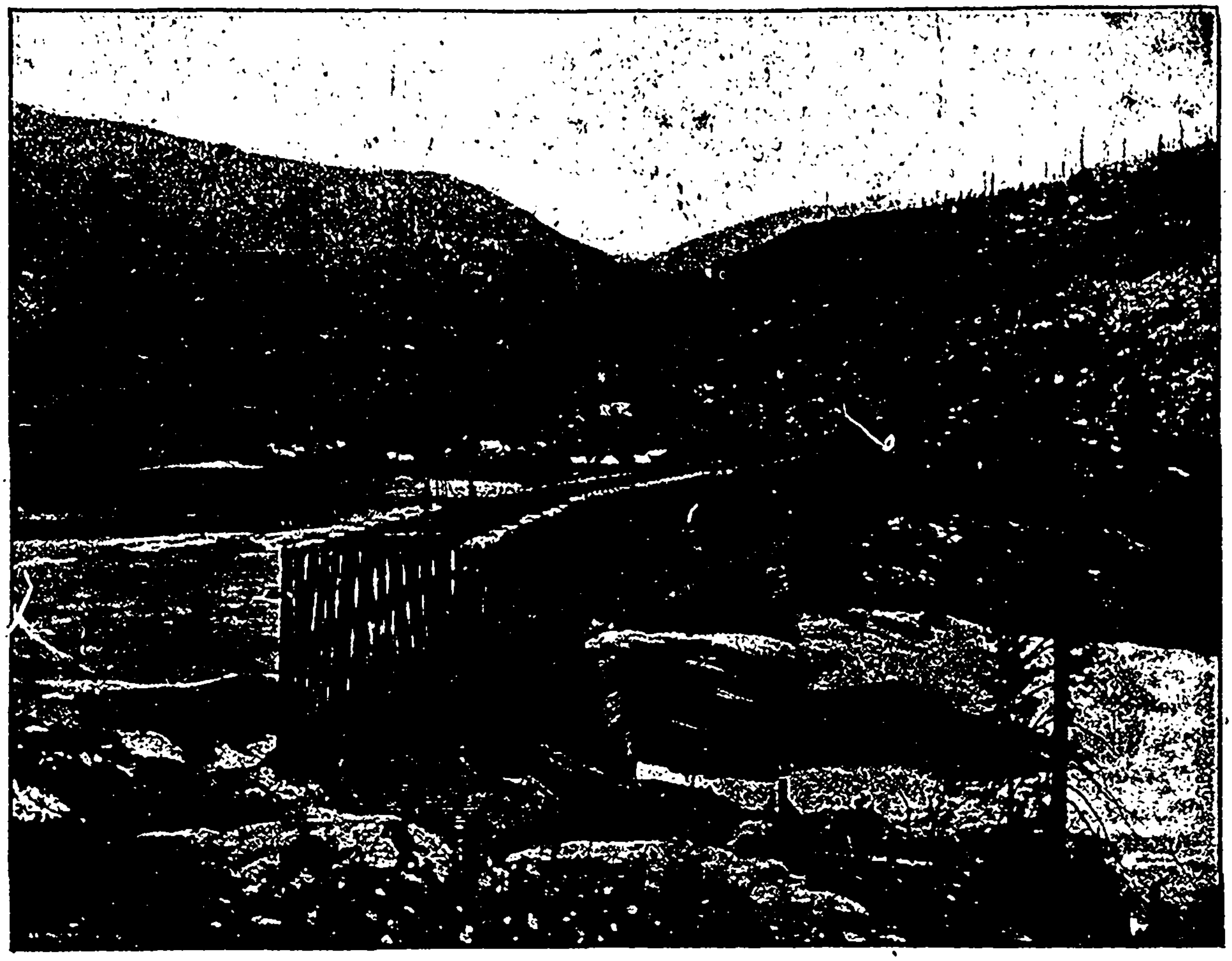
Turning next to operating expenses. On our present assumption that equally good machinery is used in both cases, there seems no ground for any difference in the cost of repairs and small supplies, except such repairs as may be required to the belting itself.

In the cost of attendance, whatever difference there may be should be in favor of direct connection, owing to the greater compactness of the engine room plant obtainable by this method.

The weights of the rotating parts of dynamo and engine, the train on the belt connecting them, and the thrust on the crank pin, will determine the resultant pressures and the consequent friction in the main bearings of a belt connected combination. With direct connection the weights are reduced by the absence of the armature pulley and the driving pulley on the engine, there is no belt strain, and the friction is that due to the reduced weight and the thrust on the crank pin, making the direct connected more efficient than the belt connected combination. What saving in fuel this means is a very interesting and important point which could be definitely determined only by an actual fuel test. But there is a most regrettable scarcity of any published engineering data on the subject, and the writer has been unable to find any records of tests which would determine this point. In the absence of such records we may attempt to form some idea of the possible fuel economy by calculation, but for a general consideration of the subject it helps us but little. In the engine the weights and the total belt strain are constant, and act each constantly in one direction at all loads, but the pressure due to the thrust on the crank pin changes its direction each revolution, varies with the load, and not only varies at different points of the stroke, but varies differently for different loads. Without indicator diagrams and without accurate dimensions and weights of the reciprocating parts of the engine, calculation becomes so approximate as to be of little use. Without these we must leave on one side the friction of the belt connected engine, and with it the whole friction of the direct connected dynamo and engine, which at most cannot be greater than for the belt connected engine alone, since the crank pin thrust is the same for both, the belt strain is absent in direct connection, and the weight of the rotating parts of the engine is but slightly increased by substituting the direct connected armature for the driving pulley on the engine shaft. A rough comparison of weights shows an increase of weight on engine bearings for direct connection, averaging ten per cent. for 8 sizes from 25 to 225 horse power, and five per cent. for five sizes from 40 to 125 horse power.

We may then take the friction of the belt connected dynamo as the minimum amount saved by direct connection. Now, this is the same actual power whatever the load on the dynamo may be. It depends on the weight and the total belt strain, which are the same at all loads; as the load increases one side of the belt slackens just exactly as much as the other side tightens. Consequently, the per cent. loss in the bearings increases as the load diminishes. If the saving by direct connection is at full load 2½ per cent. of the output of dynamo, it is at half load 5 per cent. of the output of dynamo, and at quarter load 10 per cent. of the output of dynamo. Hence the total saving during a run depends, amongst other things very much upon the average load on the dynamos during the run.

Reference has been already made to the dearth of published records of the performance of direct connected dynamos or of data concerning them. This is matter for surprise in view of the early use and subsequent development of the type in Europe. But it is still more surprising that such a large amount of capital should have been invested in them in the United States during the last three years, with so little public notice of the reasons leading to their adoption, or the advantages expected to be gained by their use, and a complete absence of information as to what results have been actually realized; and this paper has been prepared in the hope of eliciting some discussion by this Association which will assist in throwing further light upon the subject.



RAILWAY CROSSING OF THE KOOTENAY, NEAR NELSON, B.C.

GOVERNORS AND REGULATORS.

BY F. G. MITCHELL, PRESIDENT LONDON BRANCH CANADIAN STATIONARY ENGINEERS' ASSOCIATION.

The matter of governing steam engines for uniform speed and economy in the use of steam becomes more difficult as the size of the engine is increased. It would be safe to say that this device has absorbed more thought and more attention from the engineers and practical inventors than any other adjunct of the steam engine.

In the ordinary governor, the principal part of the apparatus consists in a pair of balls revolving round a vertical axis, generally driven by a mitre-gear. The principle of centrifugal force as embodied in the old fly-ball governor by Watt, has been more resorted to than any other, but aside from this the governor has been so improved, altered, and reconstructed since his time, as to be almost unrecognizable, but still the old principle is there and also the prominent defects, which so materially interfere with its efficiency.

The first of these is friction, which arises from joints, etc. The second, unbalanced force, that is to say, the same force that would support the balls in any plane would not raise them to a higher one. The third, the resistance offered to centrifugal force by weight or spring being not adjusted to the varying load and steam pressure. This is a point on which I wish to be understood, and I might say that a great many builders and practical men have overlooked it; for example, take a 200 h.p. engine running at 75 revolutions per minute, and a 40 lb. spring offering a resistance to the centrifugal force of the governor balls. The balls are revolving in their normal plane, and the spring is expanded or drawn one inch; that simply means that the balls had to store 40 lbs. momentum to move that spring one inch.

Suppose the steam is cut off at half the stroke, and part of the load was thrown off enough so that the steam would have to be cut off at quarter the stroke, then the balls would have to reach a higher plane and the spring expanded say another inch; this would mean that the balls would have to store 40 lbs. more momentum, which calls for a great increase of speed in the engine. But there would not be so great a variation in the engine if the resistance offered to the centrifugal force was uniform, and still less if the resistance was decreased as the centrifugal force increased, or in other words, if the resistance offered to the balls would balance them at any plane, then the slightest variation would be maintained. It may be illustrated in this way: If we place 100 lbs. on the platform of a scale and balance it on or with the beam, it is quite consistent that if we take 10 lbs. off the platform we will have to decrease the weight of the beam accordingly, if we wanted to balance. Now, we will endeavor to see why the weight, or resistance, is applied to counteract the centrifugal force of a governor if the balls are revolving in their normal plane (and of course centrifugal force tends outwards). When the load is thrown off the engine, and no resistance offered to the governor by means of weight or spring, at the slightest variation the balls will ascend to the proper plane, but should the load be thrown on the engine the ball will again have to come to a lower plane. Their re-action depends upon the gravitation of the balls, which does not overcome the momentum without a great reduction in their speed, therefore we will have to place resistance to assist the act with the gravitation.

The economy of a good governor should be appreciated by owners of steam engines, because the extra amount of steam required to drive a heavy addition of load on an engine is surprisingly small, provided that the engine can get the steam at the very instant the load is applied and before the momentum of the machinery becomes much reduced, but let the engine once get below the speed, the circumstances will be very different.

STATIONARY ENGINEERS' ASSOCIATION.

Montreal No. 1, Canadian Association of Stationary Engineers, held their regular meeting on the 5th inst. in their now very popular hall. A large amount of business was got through with. One new member was made, and one honorary member—Mr. Laine, of Carrier, Laine & Co., Levis, engine and boiler makers. This branch also looks forward to other honorary members next meeting, showing conclusively that manufacturers are interested in the association. Past President Ryan read an interim report on the Souvenir, showing that it would finally turn in from $250 to $300 to Montreal after paying all expenses, including expenses of the convention. Montreal No 1 means to keep in the band wagon.

At the last meeting of the Toronto branch, a committee composed of Bros Griffiths, Sutton, Thompson, Kinsey and Blackgrove was appointed to consider the advisability of interviewing the city council to ask for a city license law for engineers, or for a recognition of the Ontario license law.

The last meeting of the Hamilton branch C. A. S. E., on the 6th inst., was well attended. One of the most interesting events was the report of the delegates to the Montreal convention, read by Bro. Robertson, who gave a most glowing account, paying a tribute to the Montreal brethren for their hospitality. A letter was read condoling with the wife and family of the late Bro Angell, of Guelph, who was called away so suddenly after his return from the convention. Another letter of condolence was read to Bro. J. Nil, Hamilton No. 2, who had the misfortune to lose his little child. Bro. Birmington was elected vice-president to succeed Bro. Johnson who has removed to Laprairie, Que., and Bro. Arthurs was elected assistant financial secretary. This association intends to hold special meetings for mutual improvement this winter.

GENEROUS TO "THE ENGINEER."

MORE WORDS OF WELCOME.

NEATLY printed, and designed to supply engineering news of a Canadian character.—*Montreal Witness.*

SOME suggestive facts regarding the enormous forces of nature which science has not yet utilized are given in the first number of THE CANADIAN ENGINEER. Those interested in engineering work should have this paper.—*Toronto News.*

THE first number is most creditable. Its original matter, illustrations, selections, industrial and other notes, give promise of a home journal of practical worth and mechanical excellence, and it will attain undoubted success.—*The Week.*

THIS is a most interesting and instructive number, and THE CANADIAN ENGINEER is, we believe, the only one in the Dominion devoted to mechanical and sanitary engineering. It is ably edited, well printed, and deserving of success.—*Toronto News.*

THE CANADIAN ENGINEER, published at Toronto and Montreal, Canada, is a well printed and well conducted journal, devoted to the mechanical, mining and other branches of the engineering trades. We welcome its appearance among our exchanges.—*California Architect.*

THE CANADIAN ENGINEER, for August, sustains its reputation. This is the fourth number, and an excellent periodical like this should find its way into the office, workshop and home of practical engineers, machinists, electricians, manufacturers and contractors. —*Eastern Chronicle, New Glasgow, N.S.*

THE CANADIAN ENGINEER is a new trade publication with a future before it. In an artistic sense it is one of the most perfect productions of its kind published in Canada, and indeed for get-up, bulk, and general excellence, it can give a long start to a great number of similar American journals.—*Capleton (Que.) Miner.*

WE are pleased to welcome a newcomer in the ranks of technical journalism in THE CANADIAN ENGINEER, the first number of which reaches us from Fraser Building, Montreal. It is a monthly engineering journal (1 dol. a year), embracing all branches of the subject. Considerable attention is given to electrical engineering, and, besides many notes, a description is given of the direct electric elevator constructed by the Fensom Elevator Company, of Toronto, which has many points to recommend it. An interesting article on the first "Canadian Engineer"—the beaver—brightly introduces a first number. There are some suggestive editorial notes, besides descriptive and technical articles, and a wealth of short Canadian notes. The paper should have success, as it fills a distinct place in colonial journalism.—*Electrical Engineer, London.*

WE have also received a copy of the first number of THE CANADIAN ENGINEER, published in Toronto and Montreal. The new journal, in addition to many technical and illustrated articles, contains a large amount of matter relating to the mechanical, mining, and general manufacturing trades of Canada.—*Industries, London.*

THE first number of our new monthly contemporary makes an excellent appearance, and contains a variety of interesting matter. It purposes to devote its attention to the interests of Canada, especially in the department of mechanics and mining. The field is large enough to occupy our contemporary's full attention, and it evidently means to deserve the success which we cordially wish it. —*Engineering and Mining Journal, New York.*

Nous recevons le premier numero d'un nouveau journal industriel qui paraitra simultanement a Montreal et a Toronto, THE CANADIAN ENGINEER. Son titre indique qu'il s'occupera principalement des arts mecaniques, des mines, de la marine et de l'outillage des manufactures. C'est un journal qui s'appliquera particulierement aux interets canadiens; le premier numero que nous avons sous les yeux est bien illustre, d'une bonne typographie et il contient des articles d'un interetreel pour tous ceux qu'interessent les arts mecaniques et industriels. Le journal est mensuel et coute $1.00 par an.—*Moniteur du Commerce.*

JOSEPH EARNSHAW, whom many of our readers will remember as the landscape and sanitary engineer who designed and laid out the beautiful Prospect Cemetery, of Toronto, writes from Banff Springs: "Stopping a few weeks at this place on my return from Alaska, I find a copy of THE CANADIAN ENGINEER, with which I am much pleased. I shall be glad if you will mail to my office, Cincinnati, a copy of all the issues since May, and consider me a regular subscriber thereafter." Mr. Earnshaw, who is now a partner in the firm of Earnshaw & Punshon, landscape and sanitary engineers, Cincinnati, adds that he still feels a kindly interest in Toronto and in the Dominion generally.

IN the first number of THE CANADIAN ENGINEER, which is just to hand, there is evidence of a welcome spirit of enterprise, upon which the publishers are to be congratulated. Until now, it seems, the mechanical, mining and other branches of the engineering trades, in whose hands, to a large extent, lies the future development of the great Dominion, have been without an organ in which their special needs and requirements could find expression. The various technical and trade journals of England and the United States covered this ground to a limited extent only, and, though these have their scope and their influence, it was felt that there was ample room for a paper dealing solely with things Canadian from the Canadian point of view. The newcomer is admirably printed and illustrated, and contains, beside a large amount of news of interest to the trades concerned, articles of a scientific and technical character. Should the high standard of excellence evidenced in its first number be maintained, there can be little doubt that THE CANADIAN ENGINEER has a useful as well as a prosperous career before it. The offices are at 62 Church street, Toronto, and Fraser Building, Montreal.—*Hardware Trade Journal, of London and Birmingham.*

A. C. MCCALLUM, writer of the able paper on "Water Wheels" at the Electrical Convention last month, is chief of the draughting office of the Wm. Hamilton Manufacturing Company, Limited, Peterboro'. Mr. McCallum's paper evoked a great deal of discussion, and his answers to the numerous questions put to him, showed that he knew exactly what he was talking about.

W. G. ROCHESTER, the young Ottawa engraver whose new lithographic process recently created such a sensation in the trade in New York, has sold the right of the patent in Germany for $60,000. By this machine as many as thirty colors can be printed at once. Mr. Rochester is a cousin of Ed. Rochester, another inventor, whose electric car fender was described in the August CANADIAN ENGINEER.

Industrial Notes.

A NEW drill shed is to be erected at Halifax, N S.

PILOT MOUND, Man., is to have an oatmeal mill.

W. T. HORTON, builder, Halifax, N.S., has assigned.

PEOPLE at Kingston, Ont., are agitating for an elevator.

JOHN CLARK is going to build a large five-storey hotel at Galt, Ont.

THE machinery is being put in for the new saw-mill at Nakusp, B.C.

J. F. CARROLL is erecting a woodworking factory in St. John's, Nfld.

THE new sewer extensions in Carleton, N.B., are nearing completion.

FOWLER & BOWE, architects, Montreal, have dissolved partnership.

A SCHEME is being worked out for a system of waterworks at Glencoe, Ont.

NEW tenders are asked for the Gore Insurance Co.'s new building at Galt, Ont.

TENDERS will shortly be asked for the proposed new leper hospital at Tracadie, N.B.

GAUTHIER & FRERE'S paint store, St. Roch's, Que., has been a good deal damaged by fire.

THE Thompson Shoe Company, Montreal, has been incorporated with a capital of $100,000.

THE flour mill, elevator and engine house at Indian Head, Assa., have been burned down.

F. VANCAMP & Co's hardware store at Hastings, Ont., has been completely destroyed by fire.

MRS. P. DIDIER, Montreal, has registered as a contractor under the name of Didier, Goudreau & Co.

THE Water Power Company, Sherbrooke, Que , are constructing a new dam across the Magog River.

DUMAS & Co 's shoe factory at St Roch's, Quebec, has been almost destroyed by fire. Insurance, $14,500.

ARCHITECT PERREAULT, of Deschambault, Que., has the contract for a new aqueduct for Beauport Asylum

THE brick smoke stack and engine house at E. W. B. Snider's flour mill, at St. Jacob's, Ont., are now complete.

JOSEPH AND ALFRED BERNARD, Montreal, have registered as contractors under the name of Bernard & Fils

S. BUSCHLEN'S rake factory, at Port Elgin, Ontario, has been destroyed by fire Loss, $6,000, no insurance

W. B. DERBYSHIRE'S planing mill at Westport, Ontario, has been burned down. Loss, $2,500; partly insured.

ONE of the new Canada-Australian Line's boats recently carried 24 car loads of agricultural implements to Australia.

THE contract for heating apparatus for the new drill hall, at Toronto, has been given to Bennett & Wright, Toronto.

THE Canada Paper Company, of Fraserville, Que., propose increasing their electric light plant of a fifty arc light dynamo.

R. McCULLOCH is making some alterations to his mill at Hawkesville, Ont., and is putting in a lot of new machinery.

A SAW-MILL is being erected at Fort Ingalls on the Temiscouata R.R.

A. C. GORDON'S planing mill and lumber yard at Dutton, Ont., have been burned Loss, $5,000; insurance, $1,000. The cause of fire is unknown.

PRIOR & CO.'S hardware store at Kamloops, B.C., has been burned down. Loss, $50,000, little insurance. The fire started in Vair's tinsmith shop adjoining.

A GENTLEMAN named Bouthellier proposes to establish a wood window blind factory at Richmond, Quebec, and is asking the town to lend him $20,000 in debentures.

THE new Toronto glass factory will be exempted from taxation for 10 years, provided they operate for eight months in each year and employ not less than 35 men.

EKER'S brewery, Montreal, has been burned down. A new storey in course of erection was almost completely destroyed. Loss, $10,000; not insured. The fire was caused by the overheating of some malt dust.

THE old tannery at Barrington, N.S , has been burned down.

HAYFORD'S lumber mill, St. John, N.B., has closed down for the season.

MURRAY BROS.' saw-mill at North Bay, N.W.T., has ceased work for the season.

SEVERAL G.T.R. locomotives have been sent to the Stratford, Ont., shops for repairs.

THE St. John, N B., nut and bolt works, in liquidation, have been ordered to be sold.

THE by-law to raise $40,000 by debentures for waterworks at Hull, Que , has been defeated.

AT WOODSTOCK, N.B., a great deal of work is being done this season in laying asphalt sidewalks.

C. C. ROCK is rebuilding his saw mill at Brodhagen, Ont., and putting in a good deal of new machinery.

MILLAR & MCAULEY'S evaporator at Wellington, Ont., has been destroyed by fire. Loss partly covered by insurance.

THE *Kootenay Star* says that during the last six months over $35,000 has been spent in Revelstoke upon building operations.

HAMIOTA, Man., is offering a bonus of $5,000 and exemption from taxation for the erection of a grist mill and small elevator.

THE Wilkinson Plough Works at Toronto Junction have closed down for a time. About 250 men are thrown out of employment.

THE plaster mill at Plaster Road, N.B., is nearly finished, and is expected to be in operation in the course of a week or two.

A STEAM-PIPE at Framan's saw-mills, Three Rivers, Que , burst the other day, and badly scalded the engineer and a workman.

BLENKHORN & SONS' axe factory and coal sheds at Canning, N.S., have been burned down. Loss, $10,000; insured for $1,000.

NORVAL (Ont.) Mills have closed down to allow of the dredging of the mill race and the erection of a new stone breakwater and flume.

A NEW bridge across the Ox Bow Hollow, New Hampstead, N.B., is nearly complete. It consists of five steel bents, 37 feet high.

AT Alexander and T. D. Crow's saw-mill at Portapique, N. S., a shingle machine is being put in. A planer will probably be added shortly.

DUNN'S gang mill at South Bay, N.B., which was burned down last year, is being rebuilt and will be equipped with the most improved machinery.

ROSS & MCPHERSON, of Sussex, N.B., manufacturers of church and other furniture, have put in new machinery and begun the manufacture of hay presses.

THE Cobban Mfg. Co., Toronto, are offering $800 per year rent for a site on the Esplanade, which they wish to make use of in extending their premises

BURNS & MCCORMICK, Toronto, have the contract for paving a portion of Broadview avenue, Toronto, with cedar on a concrete foundation, the price being $6,849.

THE Atwood, Ont., roller flour mill has just been extensively improved by the additions of a large brick boiler and engine house and a new 60 horse power Wheelock engine.

DOUGLAS & Co., iron founders, have lately removed from Halifax to Dartmouth. The main building is 90 feet long by 30 wide, and the works are situated near the ferry.

THE William Hamilton Mfg. Co., Peterboro, have just fixed a large and powerful water wheel at the Peterboro Milling Co.'s mill for running the machinery and elevators

THE Public Works Committee, Toronto, have awarded contracts for work on the new car tracks to the following: Charles Farquhar, E. M. Cathro, and J H. McKnight & Co.

IT is reported that negotiations are progressing regarding the purchase of a site on Front street, opposite the new Union Station, at Toronto, to be used for the erection of a new palace hotel.

THE masonry of the side walls and lock gates of the Canadian Sault canal have been completed this month, and it is now confidently expected that the new canal will be ready for the opening of navigation next spring.

GILLIES & MARTIN'S new foundry, at Listowel, Ont., will consist of five buildings, viz , a machine shop, 65x40 feet, two storeys; paint shop and show room, two storeys; blacksmith shop; moulding shop; and boiler and engine house. They will be built of brick, except the engine house, which will be of stone. All will have stone foundations and fire-proof roofing.

Toronto City Council has asked the Executive Committee for $20,000 for the purpose of widening streets where the trolley is in operation.

M. Brousseau and J. P. Presseau, Montreal, have formed a partnership as contractors, under the name of Brousseau & Presseau.

The contract for the North Ward graded school, at Victoria B.C., has been awarded to Elford & Smith, Victoria. The price is $24,636.

A fire started the other day in the Jenckes Machine Co.'s foundry at Sherbrooke, Que., but was extinguished before much damage was done.

A new grain elevator is to be built next spring at Montreal. The capital of the company which is being formed to take the matter in hand is $100,000, and it will have the support of the C. P. R. and G T. R.

Fifty members of the Friendship Steam Fire Engine Co., of Reading, Pa., were the other day entertained at Toronto by the City Fire Department.

John McConachie's saw mill, at Peninsular Portage, Ont., has been burned down, together with 500,000 shingles. Loss, $3,000; not insured.

The Dodge Wood Split Pulley Co. have removed their Toronto office and stock-room to larger and more convenient premises, No. 68 King Street West.

The Robb Engineering Co. are now making an iron tower 100 feet high, for use in connection with the boring through the bed of Northumberland Straits.

Two contracts, each for 2,500 tons of steel rails for the Intercolonial Railway, have been awarded to J. R. Hutchins and Chas. Cassils respectively, of Montreal.

The Peterboro, Ont., Milling Company's flour mill has been renovated and extended. The new machinery, of which there is a very large amount, has now been put in position.

Gowenlock's elevator and engine house at Griswold, Man., have been burned down. The elevator was insured, but the wheat of which there were 25,000 bushels destroyed, was not.

The value of buildings erected in Winnipeg during the last year is phenomenal, being $1,800,000, which is just twice as much as during the previous year, and three times as much as during 1891.

M. Reighton's roller grist mill at Comber, Ont., has been burned down. Loss on building alone $12,000; insurance, $6,000. The fire is supposed to have been caused by spontaneous combustion.

The Government steam dredge "Laval" has been seized by the sheriff at the instance of A. Hurtu, of Montreal, who supplied some of the lumber used in its construction and who got a judgment for $3,000.

D. Clemens' grist mill at Winterbourne, Ont., has been burned down. The fire is supposed to have started in the engine house, owing to the overheating of some shafting. Loss, $15,000 mostly insured.

The St. John, N B., Stone Chinaware Company are asking that town for a bonus of $2,000 a year for ten years, provided that, in re-establishing the industry, the company employ at least a hundred and fifty hands.

W. F. Sterritt, of Yarmouth, N.S., is building a lumber mill in Newfoundland, and has ordered a complete rotary saw-mill, with a 60 h. p. engine, and all necessary appurtenances, to be shipped to Placentia Bay.

Shannon, Whillans & Co. and D. L. Van Vlack have been awarded contracts for laying vitrified brick pavements, with scoria toothing, in Toronto. The amounts are $10,552 and $17,365 respectively.

The employees of the Cornwall, Ont., Manufacturing Co. have presented D. McEwan with a handsome field-glass and tea service as an expression of their regret at his contemplated departure from Cornwall.

The Central Bridge Works, Peterboro', have just shipped three large sections of steel tube 8 feet in diameter, to Sault Ste. Marie, and two patent flexible joints, the largest of their kind, for the Toronto Waterworks.

McKeown & Co., contractors, Toronto, who had a paving contract in that city, for $25,000, declared they were unable to carry it out, and the Board of Works, on the ground that collusion between contractors had been frequent of late, have declared that the firm must forfeit their $700 deposit.

Neveux, Clinton & Baxter's hardware store, at Windsor, Ont., has been burned down. Loss on stock and building, $20,000. Insured. The fire started in the basement, but its origin is unknown.

The Dresden, Ont., Canning and Pickling Co.'s factory has been destroyed by fire, caused by an explosion of gasoline. Five carloads of goods ready for shipment were destroyed. Insurance, $9,100.

The building formerly owned by the Fraserville Boot and Shoe Company is now the property of the town council, which is offering it with a bonus for the establishment of an industry. The plant cost $25,000

The new Drill Shed at Toronto will be finished before Christmas. Four million bricks have been used in the construction of the building, the roof of which is the largest, with no central support, in the Dominion.

The suit of Thomas McIlroy against Sylvester Neelon, John H. Taylor, James Pearson and Malcolm Macpherson for $7,200 of additional stock in the Toronto Rubber Company, or $10,000 damages, has been dismissed.

The Economical Gas Apparatus Construction Co., of Toronto, have recently put in two of their patent water gas outfits, one at the Toronto works and one at Ottawa. In both cases the results shown are all that were anticipated.

Ald. Bell, of Toronto, suggests that the authorities should deposit clean ashes and other such material under the bridges in Arthur Street. He says this would fill up the ravine to the street level, and save an outlay of $25,000 on new bridges.

A fire broke out a few days ago at the Edge Tool Works at Galt. It is supposed to have originated near the boiler. With the exception of the main shop and boiler-house, most of the departments escaped with slight injury. Loss about $2,000; insured.

The Dodge Wood Split Pulley Co., of Toronto, have in work at present several very large belt pulleys for one of the leading cotton mills, the largest pulley being fourteen feet in diameter, with 38 inch fan They report a great increase in their business of late.

The engine purchased by the I.C.R. authorities to run their electric light station at Moncton, having proved unsatisfactory, they have decided to replace it by a 125 horse-power Robb-Armstrong engine, from the Robb Engineering Company, Amherst, Nova Scotia.

Geo. W. Dawson, manufacturer of stamps and dies, Montreal, has moved from 765 to 747 Craig st., a few doors nearer Victoria Square. Mr. Dawson's new premises are more suitable to his work, and his new shop, which is a very well equipped one, is exceedingly busy just now.

Efforts are being made in St. John's, Quebec, to induce the town to give a bonus of $20,000 for the purpose of rebuilding the potteries there on a large scale. It is probable that a company will be formed to operate them with a minimum number of one hundred and fifty hands.

A company with a proposed capital of £60,000 stg. is now being formed in Manchester, Eng., for the purpose of establishing smelting works and a glass factory at Fraserville, Que. The silica will be got on Pilgrim Islands, seven miles distant, where immense deposits of the finest quality exist.

The Mercer Company, of Alliston, Ont., have issued a writ against the Harris Co., Toronto, and F. Rice, agent for the Nova Scotia Steel Forge Company, New Glasgow, for $100,000 damages, on the alleged ground that the latter firms had maliciously conspired to injure the Mercer Company by purchasing claims against them, etc., with the design of lessening their competition in the manufacture of agricultural implements and of having them placed in liquidation.

The Allan line steamer Sardinia will be converted into a freight boat.

Flemming & Son, St. John, N.B., have finished a steel plate-girder bridge, 84 feet long, for Palmer's Pond, near Dorchester, N.B. The bridge was, with a good deal of labor, put in position on Sept. 17th, and trains were running across on the following day.

The new Cunard steamship "Lucania" is 620 feet in length, with an extreme beam of 65 ft. 3 in. and a depth of 43 ft. She is driven by twin screws of manganese bronze, and each blade of the propellers weighs 8 tons. The engines are triple expansion, with five cylinders each.

Mining Matters.

PURE carbon has been discovered in Frontenac county.

Two new coal mines will shortly be opened at Estevan, Man.

JAMES KING has discovered a seam of iron pyrites near Amherst, N.S.

A NEW deposit of silica has been discovered near River du Loup.

THE Thunder Hill Mining Co., Victoria, B.C., have decided to close down.

AT the "Slocan Star," B C., six hundred tons of ore are on the dump.

THE Imperial Oil Company, Moncton, N.B., are extending their premises.

COAL is being bored for on the Chignecto seam near Maccan Junction, N.S.

AN investigation is being made as to the mineral resources of Alvinston, Ont.

THE "Mountain Chief," B C., is putting out eight or ten tons per day of good ore.

A VALUABLE vein of asbestos has been discovered at Kippewa, near Sarraganagie Lake.

A. Dow is leasing land in Fort Gratiot township for the purpose of sinking oil wells.

IRON has been discovered at Barclay Sound, B.C. The vein is said to be 75 feet thick.

WORK is going to be carried on vigorously this winter on the Dardanelles Mine, near Nelson, B C.

PROSPECTORS returning from Mount Moriarty, B. C., bring down rich samples of gold-bearing ore.

THE "Morning" Claim Mine, in the Slocan district, assays 89 ounces of silver and 24 per cent. copper.

THE Truro Gold Mining Company's mine at Caribou is closed and the mine is partially filled with water.

ANOTHER rich strike of silver has been made on Siwash Creek, in Yale District, B.C. The ore assays $130 per ton.

A TWO-FOOT vein of steel galena has been struck at the Margaret claim, on Carpenter Creek (north fork), B.C.

A CHARTER is being applied for for the Hamilton Iron and Steel Company (Ltd.). The capital stock is $1,000,000.

THE Hamilton, Ont., Natural Gas and Mining Company is about to begin boring a new well in the rear of Copp's Block.

WM. MILLER has located two gold claims on Healey Creek, near Nelson, B.C., which are said to give very good assays.

THE silver vein recently found in the Bush River District, B.C., is about 80 feet wide, fully one-third of which is solid ore.

BOUNDARY CREEK, B.C., ore, at present carries, at current quotations, over $160 per ton in silver, and $100 per ton in gold.

A STRIKE has been made near the Haskins Group in the Lardo-Duncan district. Assays range from 145 to 184 oz. silver, 32 per cent. copper and sometimes 75 per cent. lead.

FIFTEEN thousand ore sacks have just been ordered from a local dealer by the proprietors of the "Washington Mine, B.C. Forty men will probably be employed in this mine all winter.

THE St. Andrews, N.B., *Beacon* reports the discovery of a valuable quarry of black granite in Bocabec. The stone closely resembles the well known red granite.

AN important find of hyalite has been made at Trout Lake, near Nelson. This mineral, though of no great value in itself, is supposed to indicate the proximity of several varieties of opal.

Two 30 h.p. boilers and engines, a 12 h.p. hoist and some pumps are being made for W. J. Magee's gold mines on Slough Creek. Work will be commenced as soon as the machinery is placed.

A. D. WHITTIER, the owner of some valuable mining property on Williams Creek, B.C., has succeeded in forming a company with large capital for the purpose of working the claims. Work has already begun in fixing machinery.

THE idea of forming a company for the operating of the St Simon red sandstone quarries owned by the Estate of the late Mr. F. C Dulce, of River du Loup, Que., has been postponed till next winter on account of financial crisis in the States.

THE Longford, Ont., Quarry and Lime Company the other day cut one piece of stone seventy-five feet long by six feet wide and fourteen inches thick. This was afterwards cut in squares and shipped to Toronto to be used in the new Union Station.

Railway and Marine News.

THE north abutment of the new bridge at the Narrows, N.B., is finished.

THE new roadway and breakwater at Vaughan's Creek, N.S., are now completed.

TENDERS are still being advertised for for a jetty at Ashbridge's Bay.

A NEW wharf on the Washademoak, near Cole's Island, N.B., is nearly completed.

THE C. P. R. are laying a new siding at Carman to facilitate the loading of crops.

A NEW steamer is being built for service on Lakes Winnipegosis and Manitoba.

THE C. P. R. have decided to build a bridge over the Grand River at Galt next season.

A NEW steel-girder railway bridge is going to be built at Mount Stewart, P.E.I., across the Hillsborough River.

THE Montreal Transportation Co., Kingston, Ont., are building a new lake boat with a capacity of 60,000 bushels.

HUGH RYAN has the contract for the steel superstructure of the bridge at Sault Ste. Marie. The price is $25,000.

A PIER 14 feet long and a glance boom 110 feet long are to be put in at the upper end of the canal at Bobcaygeon, Ont.

WORK is progressing on the new dam near the Bonnechere Bridge, at Renfrew, Ont. Three piers have been already erected.

THE portion of the O. A. & P. S. Railway lying between Ottawa and Arnprior was opened for passenger traffic on September 11th.

THE Canadian Atlantic Steamship Company has purchased the steamer "St. Pierre" to ply between Halifax and Boston during the winter.

THE contract for the steel superstructure required for the Soo Canal Railway bridge, has been awarded to the Hamilton Bridge Company.

ALL the Government structures along the Scugog River, including lock gates, swing bridges, etc., are now in course of being repaired.

A MOTION in the Toronto council favoring the Hurontario Canal scheme was defeated, the mayor giving his casting-vote against it.

THE steam yacht "St. George" was lost on Lake Temiscouata during a recent gale. She was the property of the Dulce Estate of Fraserville.

THE booms and piers are being rebuilt at Fenelon Falls About 600 feet of three stick boom, 800 feet of two stick and 1,200 feet of single stick will be required.

SERPENT REEF, off the coast of Gaspe, is now marked by a buoy painted black, about a mile from the shore and seven and a third miles from Fame Point lighthouse.

A PROPOSITION has been made to connect Lakes Traverse and Big Stone by canals, thus forming a continuous waterway between Lake Winnipeg and the Gulf of Mexico.

THE mason work on the Trout Creek, N.B., bridge, on the Albert Railway is now finished. This will make the third new bridge on that railway built this summer.

GOVERNMENT engineers having inspected the Chambord branch of the Quebec and Lake St. John Railway, they have approved it and the subsidy will be paid at once.

THE London, Eng., *Times* says that the Milford Haven will probably be the British point of departure for the projected line of swift steamers between Canada and Great Britain.

THE C. P. R. are looking into the probable cost of extending the Dalhousie Station, Montreal, which would entail large alterations, including the carrying of a portion of Notre Dame street across a viaduct. As proposed the station would extend so as to give an entrance on Craig street.

THE largest coal carrier in the world is the Dominion Coal Company's steamer "Turret," which arrived in Montreal a few days ago She is an English type of whale boat, altered as required by Lloyd's and to resist the heavy seas of the Atlantic, with a straight stem like an ocean liner and a large turret like a man-o'-war.

SIR HENRY TYLER will continue negotiations regarding the L. & P S. Railway only on condition that the city of London will build $135,000 worth of bridges. He will then agree to pay 30 per cent. of the gross receipts as rental.

THE engineer's estimate for the Sault Canal lock-gates was $80 000, and the estimate of the Hamilton Bridge Works (whose tender was the lowest) was so much below this that there exists some diffidence about accepting it.

THE G. T. R. are going to put in a curve at Hamilton to connect the main line with the branch running up to the King street station. This curve will do away with the backing which is now necessary in changing from one line to the other.

THE Richelieu & Ontario Steam Navigation Co. are still undecided where to rebuild their workshops, which were burnt down at Sorel some days ago. They consider themselves entitled to a bonus, and will build in the city which offers the best inducements.

MR. DE BERTRAM, who purchased the Buctouche & Moncton Railway, is going to rebuild the Buctouche bridge, and is also making arrangements for constructing a branch to Richibucto. He is employing engineers to inspect the road with a view to a thorough overhauling.

THE steamer "Boyrou Trevice," plying between Rondeau Harbor and Cleveland, was burned the other day at Leamington, Ont., dock. The fire is supposed to have been caused by the explosion of a lamp. Two of the crew were suffocated and the cook was drowned. Loss, $25,000.

Brief, but Interesting.

A GUN has just been tested in France which is over 47 feet in length. The velocity surpasses all previous records, being 4,000 feet per second.

A MACHINE has been invented for electrically forging round shapes. Its manufacturers claim that it can roll successfully steel, from that of the highest grade down to open hearth and Bessemer steel, it can also manufacture anti-friction steel balls from ⅛ to 2 inches in diameter.

A GOOD cement for leather belting may be made by dissolving two parts (by weight) of gutta percha in five parts of carbon bisulphide and one part of oil of turpentine, and then adding two parts of Syrian asphalt, and allowing the mixture to stand. Before application, the leather should be washed with benzine on the side to be cemented, so as to get rid of any fat.

A RECENTLY invented air-bag has just been successfully tested in the anthracite coal mines in Pennsylvania. The apparatus consists chiefly of a bag, made of stout canvas, from the top of which a rubber tube runs to the wearer's mouth. Its usefulness is made manifest after an explosion, when it is dangerous to enter a mine owing to the rapid accumulation of fire damp.

REVIEW OF THE METAL TRADES.

Montreal, Oct. 11th, 1893.

There are no special new features in the market report. Business does not show very much improvement, although in some lines considerable activity prevails. The miners' strikein England continues to affect importations to quite an extent. This is more marked in some metals than others. The importations of pig iron are small, and we hardly think that much stock will be stored here this winter. Prices are a little too high, and buyers do not seem inclined to purchase at the present figures. But very little business is doing, only an occasional order, and dullness is the characteristic of the market.

Some good orders for galvanized iron have been placed, and there has been quite a good sale for this metal during the past week or two. This, however, may not continue long, and in the course of a month or so but little will be done, excepting the usual number of small jobbing orders.

We know of some large orders for steel sheets for importation that have been placed, but notwithstanding the advance in the price of sheets in England, buyers here are talking a figure that leaves but little margin to the importer, and prices obtainable are just about the same as have ruled the market for the past summer. Of course, as the season of navigation draws to a close and winter freights have to be paid, prices must necessarily advance accordingly. This is applicable to all importations.

In rolling mill stock nothing is doing. There has been an enquiry out for 400 or 500 tons of steel scrap, but no business has resulted.

Taking a general view of the market, there is not the usual amount of business that is generally put through at this season of the year. We think, however, that the volume of trade during the winter months will be larger on this account than is usual, and we don't think, taking the whole season, that metal merchants have much to complain of. Collections are much better and there appear to be more funds in circulation, and an easier feeling pervades the trade, although the practical results of this are not felt much yet.

When trade in Great Britain is once more placed on a proper footing by an amicable adjustment of the miners' strike, which we can only trust will soon be brought about, and the industries in the United States again in active operation, we cannot but expect the result to give an impetus to trade here This market appears to have lost some of its usual activity through these two causes, but we hope to report in our next issue that the metal trade shows more signs of improvement.

TESTS FOR STRUCTURAL STEEL.

Alfred E. Hunt, of Pittsburgh Testing Laboratory, says that the disadvantages of the present methods of testing structural steel are the time, the expense, the lack of a sufficient number of tests in any given case, the varying results obtained by specimens from different parts of the ingot and from varying methods of testing, as, for example, in the time and the method of application of strains. A further disadvantage, although not inherent, is the narrowing of the allowable limits of results to an excessive exclusion of material. This is unjust to the mills, unsatisfactory to the shops, and is actually prejudicial to the interests of the engineers who draw the specifications, and sometimes to the quality of the metal entering into the structure, as it tends to lower the ideas of the "practical men" as to the utility of specifications. Again, bending and drifting tests do not give results in numerical quantities convenient for reference and comparison. Mr. Hunt proposes a method of punching or otherwise shearing, cutting or drifting pieces of a given thickness, and comparing the force required in this work with that required to treat standard pieces in a similar manner. The comparison can be made also with the work done at different stages of the punching, etc., with results obtained in treating standard pieces in a similar manner. He uses the term "work" to express the force necessary to punch a given hole, to cut a given notch or drift a given hole, multiplied by the space through which the force moves, and by the time during which the force acts. In practice a combination of the first o these factors with the second or third is often used, and it is the combination of force and space that so far has been found to be the best and most accurate way of using the method. The most convenient application of this method is by plotting curves in which the ordinates represent the force in pounds and the abscissæ represent the increments of space, and he uses a mechanism by which the curve is drawn as the work is done. By this method tests can be readily made on crop end of pieces rolled from each ingot in any given lot, or crop ends taken from each end of large plates or bars, and this ease of getting samples and making tests is a great practical advantage. In fact, it will be practicable to equip the punches used in shops in actual practice with some device for measuring the work done in punching, and so a record can be kept of the characteristics of every piece of metal punched. The characteristics of the metal developed by this method are ductility as compared with its tensile and shearing strength; and experiments show that the means of selecting good structural steel and discarding that which is unsuitable can be devised by this method of testing its quality. Mr. Hunt does not claim that this will give in all cases the tensile strength of the metal, but that it suggests a means of testing for that combination of strength and ductility desired in structural steel. It does not, for instance, distinguish steel of 65,000 pounds from that of a higher tensile strength, unless the ductility is correspondingly low. Steel of 70,000 with 27 per cent. elongation in eight inches, might be accepted by this method in place of steel 65,000 pounds on account of its exceedingly good ductility, but steel of 70,000 pounds tensile strength and an elongation of 18 per cent. in eight inches would be rejected. In his judgment this system of testing the quality of steel can be safely and conveniently used for structural material, and that it is sufficiently sensitive to exclude all questions of bad steel and that which is unsuitable, but that it will take a large amount of testing and experience to develop all the facts regarding this.

The Patent Review.

RECENT CANADIAN PATENTS.

The following are recent Canadian patents of interest to the mechanical trades:—

43,362 James Tittle, Johnstown, Penn., waterback for furnace.
43,364 Frederick Cudney, Toronto, Ont., printing device.
43,365 James Bernard Sweeney, Johnsbury, Vermont, power hammer.
43,367 Vincent Paul, Edmond Martinette, Quebec, device for locking the seats of blinds.
43,369 Octave Lagarie, Hamilton, Ont., cycle or other wheel tires.
43,370 Daniel Reley, Brooklyn, N.Y., relief valve for balanced slide valves.
43,371 John Thomas Edwards, Kamloops, B.C., stump and tree puller.
43,372 John Skinner, Flint, Mich., mixing machine for concrete, mortar, etc.
43,373 Wm. McMahon, Rahway, N.J., dumping cart.
43,374 Theodore Albert Schlueter, Oakland, Cal., self-regulating liquid discharge, for closed vessel.
43,376 Alvin C. Kanneberg, Canton, Ohio, sheet-metal roofing.
43,377 David S. Patterson, North Platte, Nebraska, driving-gear for locomotive engine
43,378 Michael von Dolivo-Dabrowolsky, Berlin, Prussia, Ger., transmission of alternating currents of different phases.
43,380 James Dicks, Toronto, Ont., burner for crude oil.
43,383 Jacob Krumschied, Boston, Mass., device for preventing waterpipes from freezing.
43,387 Samuel George Curry, Toronto, Ont., ventilator for car.
43,391 Harry Hawkins, Birmingham, Alabama, lumber carrier.
43,392 Massey-Harris Company, Ltd.; Lyman M. Jones, Toronto, Ont., seeding machine.
43,393 Jabez Lones, Smithwick, Stafford, England, tire of wagon and other road vehicles.
43,394 Bernard McEvoy, Toronto, Ont., disinfecting apparatus.
43,395 Christopher Columbus Bradley, Syracuse, N.Y., thill coupling.
43,396 George H. Masson, Rochester, N.Y., rail brace.
43,397 Charles James McLeod, Chicago, Ill., garbage receptacle.
43,398 Maurice W. Bresnaham, Lynn, Mass., boot and shoe levelling machine.
43,399 Thomas Henry Noxon, Ingersoll, Ont., cultivator.
43,400 John D. McEachren, Galt, Ont., feed water heaters.
43,402 Frans H. R Wauner, Stockholm, Sweden, construction of wheels cast in iron or steel for railway and other purposes.
43,403 Alfred Hurst Read, St. Louis, Miss., nut lock.
43,405 Albert Bradfort, Morden, Manitoba, wind mill.
43,408 Wm. Joseph Still, Toronto, Ont., transmuter for electric current.
43,412 John Adams, Ottawa, Ont., paper roll holder and cutter.
43,414 Milton Josiah Palmer, Toledo, Ohio, apparatus for making soap.
43,418 Alexander Elswoorth Keith, Chicago, Ill., electrical switch device.
43,420 John J. Becker, Fort Wayne, Indiana, self-measuring pump.
43,421 Reece Hurff Alexander, Fort Wayne, Indiana, steam generating boiler furnace
43,422 Alonzo W. Cram, Haverhill, Mass., drain pipe.
43,423 Waltham Leroy Baber, Corvallis, Oregon, amalgamator.
43,424 Joseph Brinsley Sheridan, Toronto, Ont., heating furnace.
43,425 John Waring, Manchester, Connecticut, electric lamp.
43,429 James Patterson, Halifax, N.S., improvements in steam boilers, both marine and land boilers, to wit, a new movable forced and inclused draft arrangement or air heater.
43,430 Francis Jackson, Raisonville, Mich., device for converting a reciprocating into a rotary motion.
43,431 Delzin G. Hobby, Albion, N.Y., gauge running attachment.
43,432 Robert Joy, Oswego, N.Y., steam boiler.
43,433 Gardner Clish, Truro, N.S., machine for jointing shingles or short boards.
43,436 Robert Fullerton, Martin, Tenn., steering device for road engine.
43,437 James Pellow, Grand Rapids, Mich., combined water heater and shower bath.
43,442 Bernard Theodore Steber, Montreal, P.Q., metallic tube.
43,445 Samuel Stephenson, Hampton, N.B., wooden box fastener.
43,446 Jay Chas. Richardson, New York, N.Y., gas regulator.
43,447 James B. Sheldon, St. Louis, Miss., underground electric railway.
43,448 Gardner Clish, Truro, N.S., shingle machine.
43,449 Jean Francois Chazotte, Montreal, P.Q., garbage cremating furnace.
43,451 Louis McCarthy, Boston, Mass., insulator.
43,452 Hans James Caulfeild, Toronto, Ont., bicycle tire.
43,460 Robert Wellington Biggar, Hamilton, Ont., wood heating furnace for heating buildings.
43,461 Hugh Thompson, Thompton Studley Park, Road Kew, Victoria, valve for fire plugs and hydrant, and means for operating same.

AMERICAN PATENTS.

H. B. Willson & Co., patent solicitors, Washington, report the following patents as recently issued in the United States to Canadians:—

Daniel Currell, Hamilton, Ont., nozzle for fire-extinguishers, No. 504,564.

Daniel Currie, Montreal, Que., taper attachment for lathes, No. 504,565.

John M. Dunn, Toronto, Ont., boiler tube cleaner, No. 504,569.

Salyer R. Earle, Belleville, Ont., combined air injector and exhauster, No. 504,334.

Gerard B. Nagle, Revelstoke, B.C., spitton-carrier, No. 504,607.

John B. Armstrong, deceased, Guelph, Ont.; R. Torrance, administrator, road cart, 504,771.

John H. Crocker, Shelburne, Ont., cornice-brake, 504,710.

John A. Gibbons, Toronto, Ont., advertising device, 504,919.

Frederick W. Mount, St. John, N.B., electric switch board, 504,738.

Thomas Guilfoyle, Collingwood, Ont., cigar attachment, 505,401.

James G. Malcolm, Toronto, Ont., refrigerator, 505,114.

Theodore Marshall, Wallaceburg, Ont., nut lock, 505,365.

Thomas W. Ness, Montreal, Que., telephone switch, 505,170.

GERMAN PATENTS.

The following list of new German Patents is supplied to The Canadian Engineer by Brockhues & Cie., patent solicitors, of Cologne (Germany):

Class 3—Hooks and eyes which are hooked on to each other parallel to the edges of the cloth; Ch. E. Barnes.
" 5—Arrangement for turning over and calendering the crape in smooth or flowered stuffs, in order to obtain a fur-like border; firm of Bartels, Dierichs & Cie.
" 13.—Arrangement for fastening boiler-fittings to the boiler plates; Rudolf Meyer.
" " —Tubular boiler with separate series of tubes and circulating tubes; Max Seipp.
" 25.—Disconnecting apparatus for tape-covering machines; Eduard Hoschberger.
" 47.—Mechanism for reversing an oscillating rotation with intermittent pause; Dr. O. Wettstein.
" 54.—Metal corner-fastening machine; Aug. Bartel.
" 59.—Mechanism for regulating the amount of fluid raised by pumps and force-pumps by means of a brake applied to the suction-valve; Emil Riegelmann.
" 85.—Fluid-meter with float-gauge; T. Missong.
" 86.—Beetle for mechanical looms; Schmitz Bros.
" " —Process for the manufacture of colored woven stuffs; Eduard Eck.

Personal.

THOS. G. GIBSON, superintendent of Galt, Ont., water works, has resigned.

ALD. WM. BELL has been appointed chief engineer to Dominion Government buildings in Toronto.

J. H. KILLEY has been appointed consulting engineer at London (Ont.) of the Boiler Inspection and Insurance Co.

C. A. CARUS-WILSON, professor of electrical engineering at McGill University, and Mrs. Carus-Wilson, have arrived in Montreal from England.

THE will of the late Chas. Gurney, iron founder, Hamilton, has been entered for probate. The personalty is valued at $439,135 and the realty at $14,750.

THE boiler of a steam thresher on Mrs. Hunt's farm at Big Point near Chatham, Ont., exploded the other day and two persons were dangerously injured.

THE will of the late Mr Griffith, manager of the Hamilton Street Railway, has been entered for probate. The estate's gross value is stated to be $108,000.

MAJOR MUIRHEAD, of Woolwich (Eng) Arsenal, is visiting Ottawa in order to consult with the Minister of Militia and Defence regarding the Esquimalt fortifications.

T. P. PEMBERTON, late business manager of the *American Mechanic*, has resumed his former position on the editorial staff of the *Stationary Engineer* of Chicago.

F. W. MARTIN has been appointed to take charge of the Hamilton Electric Light Company's plant. He has been for some years in the employ of the Toronto Electric Light Company.

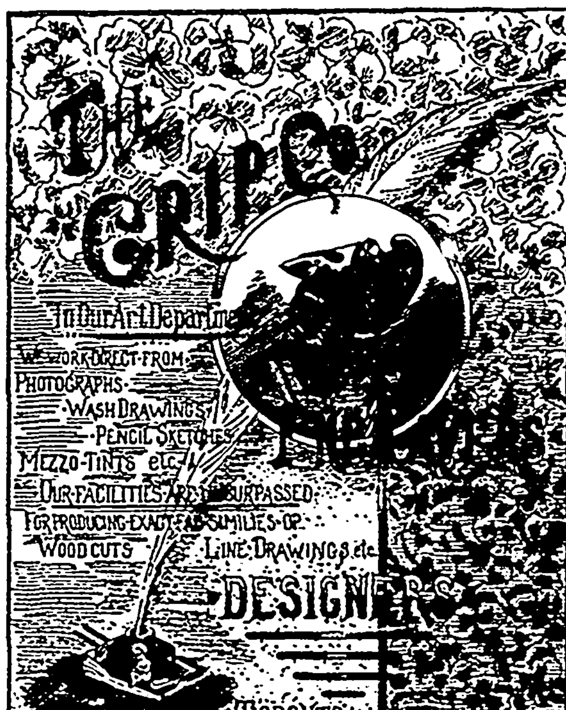
J. A. PAINCHAUD, of the firm of Painchaud, Squire & Co., hardware manufacturers' agents, Montreal, is on his way to Europe, where he is going to visit the manufacturing districts of England, France, Germany and Belgium.

WILLIAM H. IRWIN, member of the firm of Irwin, Hopper & Co., miners and dealers in asbestos, died at his home in Montreal on the 1st inst., the cause of death being pleurisy. Mr. Irwin was only 38 years old.

AFTER revising the sessional papers of Applied Science in McGill, it was found that W F. Carter, of Cowansville, Que., who was mentioned as the second at Convocation last year, is first in civil engineering in the sessional examinations.

WM REID, one of Hamilton s old manufacturers and merchants, died this month at the age of 76. After being for years in the coal business, he became chief member of the firm of Reid & Barr, engine and boiler makers. He had lived in Hamilton 30 years, and was a very prominent Mason.

E. O CHAMPAGNE, boiler inspector for Montreal, was presented the other day with a gold watch, chain and locket; the occasion being his election as president of the International Association of Boiler Inspectors for the United States and Canada, which meets in Montreal next year.



Engineering and Kindred Societies.

Canadian Society of Civil Engineers.

President—John Kennedy.
Vice-Presidents—Wm. T. Jennings, Thos. Munro and Peter A. Paterson.
Treasurer—Herbert Wallis.
Secretary—Clement H. McLeod.
Librarian—William McNab.
Assembly Room—112 Mansfield Street, Montreal. Meets every alternate Thursday from October to May inclusive.

Mining Society of Nova Scotia.

President—H. S. Poole, F.G.S., M.E., Stellarton, N.S.
Vice-Presidents—J. E. Hardman; S. B. Oldham, N.S.; R. G. Leckie, Londonderry, N.S.; David McKeen, Sydney, C. B.
Treasurer—T. R. Gue, Halifax.
Secretary—H. M. Wylde, Halifax.
Council—B. C Wilson, Chas. Archibald, G W Stuart, G Fraser, Chas Fergie, D. W. Robb, R. H. Brown, A. E. Sjostedt, J. H. Austen.

Canadian Association of Stationary Engineers.

EXECUTIVE BOARD.

President—G. Hunt, Montreal.
Vice-President—Wm. Sutton, Toronto.
Secretary—J. J. York, Board of Trade Building, Montreal.
Treasurer—W. G. Blackgrove, Toronto.
Conductor—T. King, Dresden.
Door-keeper—F. Robert, Ottawa.

ONTARIO.

Toronto Branch, No. 1—W. Phillips, President; H. E. Terry, Secretary, 19 Hayter Street. Meets 2nd and 4th Fridays of the month, at 8 p.m., in Room D, Shaftesbury Hall.

Hamilton Branch, No. 2—W. Sweet, President, W. Morris, Secretary, Wellington Street. Meets 1st and 3rd Fridays of the month in Maccabees' Hall.

Stratford Branch, No. 3—No report.

Brantford Branch, No. 4—J. Ogle, President; J B Forsyth, Secretary, Box 206. Meets 2nd and 4th Fridays.

London Branch, No. 5—F Mitchell, President, Geo Taylor, Secretary, *Free Press* office. Meets 2nd Tuesday in the month in Sanford Hall.

Guelph Branch, No. 6—C. J. Jorden, President, J. L. Dixon, Secretary, box 396. Meets 1st and 3rd Wednesdays, in Knights of Labor Hall.

Ottawa Branch, No. 7—J. H. Thompson, President; Wm. O'Brien, Secretary, corner Florence and Bay Streets. Meets 2nd and 4th Tuesdays in Oddfellows' Hall.

Dresden Branch, No. 8—O. S. Merrill, President, Thos. King, Secretary. Meets 2nd and 4th Saturday evenings.

Berlin Branch, No. 9—W. J. Rhodes, President; G. Steinmetz, Secretary.

QUEBEC.

Montreal Branch, No. 1—Joseph G. Robertson, President; John. J. Yorke, Recording Secretary, Wm Wilson, Financial Secretary. Meets 1st and 3rd Thursdays in Engineers' Hall, Craig Street.

St. Laurent Branch, No. 2 (Montreal)—Rosaire Drouin, President, A Latour, Secretary, 306 Delisle Street. Meets 1st and 3rd Thursdays in Oddfellows' Hall, Craig Street.

Brass Manufacturers' Association.

President—Robert Mitchell, Montreal.
Vice-President—James Morrison, Toronto.
Secretary—A. W. Glassford, 784 Craig Street, Montreal.

Canadian Electrical Association.

President—J. J. Wright, Toronto.
1st Vice-President—K. J. Dunstan, Toronto.
2nd Vice President—John Carroll, Montreal.
Secretary-Treasurer—C. H. Mortimer, Toronto.
Executive Committee—D. Thomson, Hamilton; D. A. Starr, Montreal; H. O. Fisk, Peterboro, George Black, Hamilton, A. B. Smith, Toronto, L. B. McFarlane, Montreal; T. R. Rosebrugh, Toronto; E. C. Breithaupt, Berlin; John Yule, Guelph; Thos. Ahearn, Ottawa.

SAND FOR MOLDS.

A good sand should be refractory to the highest degree; it should neither crackle in contact with the liquid metal, nor set free too much gas; it should neither split nor become too compact on extreme dryness, as the withdrawal of the castings would become too slow and difficult. There are several mixtures of refractory materials, more or less plastic, capable of furnishing good casting molds for steel. The following is one formula: 52 per cent. of the debris of broken crucibles, 43 per cent. of the debris of refractory bricks, 5 per cent. of clay.

Sometimes, when this mixture is found to be too close, coke-dust is added, which thins it out and increases its porosity. The casting sand for steel is ground up and mixed in the ordinary manner for molds for pig. A little molasses is sometimes added to render it more workable to the hand. After the model has been removed, the molds are washed over with plumbagin and then dried in a stove. When the form of the casting permits of a regular shrinking, it is left to cool in the mold, but most frequently there would be risk of fractures and the removal must be at once proceeded with. The castings are thrown, while still red hot, into a furnace to cool, brought to red heat, and recooled along with the furnaces. By operating in this way fractures are almost always avoided.

SEVERAL small passenger steamers plying on the Miramichi River, have been disqualified by the Marine Department Inspector, on the ground that their captains do not hold masters' certificates.