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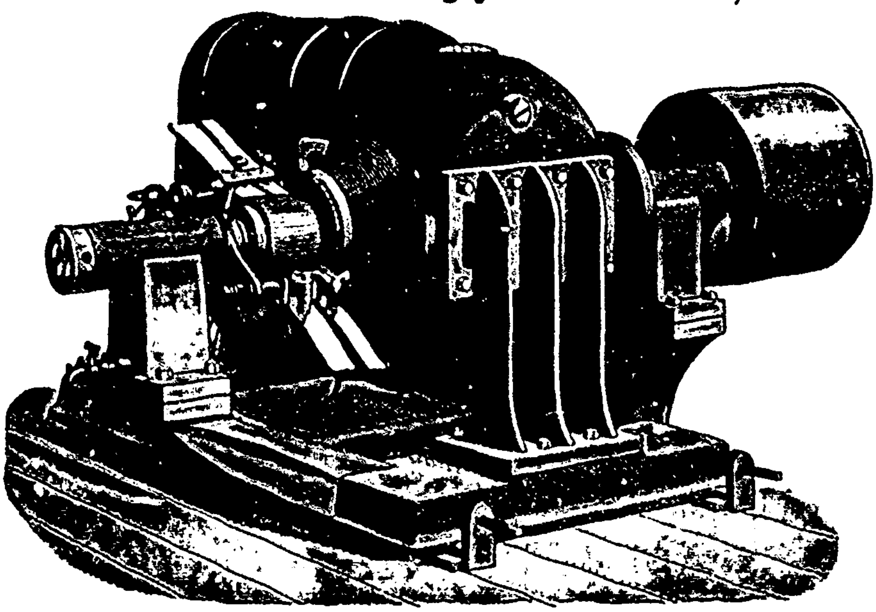

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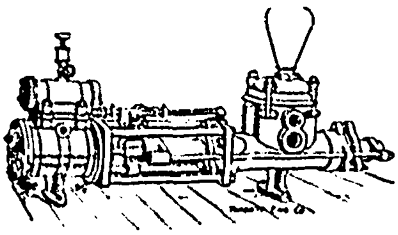

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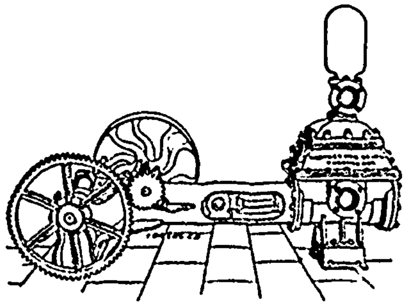

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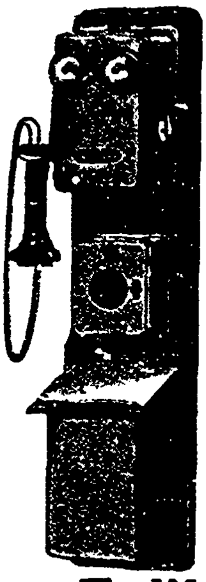

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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. III. OCTOBER, 1893 No. 10.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE THIRD CONVENTION.

THE third convention of the Canadian Electrical Association opened at 2 o'clock p m. on Tuesday, Sept. 12th, in the Directors' Hall on the Industrial Exhibition Association's grounds, Toronto. An hour previous the Executive Committee met and elected a dozen new members. Mr. J. J. Wright, President of the Association, presided at the executive meeting, and also at the subsequent meetings of the Association. At the latter there were present the following members:

J. J. Wright, 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, 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, Toronto; 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; W. G. Fraser, Petrolea; Alfred C. Lavelle, Kingston; W. B. Evans, Napanee, H. W. Kent, Vancouver, B. C.

The convention having been called to order, the President delivered his 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 2000 candle power. If we 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.

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 has 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 following is a statement of the receipts and disbursements for the Association year ending 31st May, 1893:

Receipts.

Cash on hand, June 1st, 1892		$ 20 25	
Cash in bank " " "		199 99	
41 active members' fees		205 00	
14 associate members fees		28 00	
Balance of active fees for W. A. Tower, J. H. Greer, E. B. Merrill and Geo. Sadler		12 00	
Cheque from Bell Telephone Co.		25 00	
" " G. N. W. Telegraph Co.		25 00	
			$515 24

Disbursements.

Expenses of Convention at Hamilton		$ 94 00	
" " " " Toronto		61 00	
Use of chairs	$ 1 00		
Daily papers, etc.	70		
Fee to waiters	6 00		
Fee to caretaker	5 00		
G. S. McConkey	47 00		
Rent of Walker House room	2 00		
Reporting proceedings at Convention at Hamilton		20 00	
Reporting proceedings at Convention at Toronto		30 25	
Grant to Secretary		25 00	
Postage		17 80	
Printing and Stationery		124 11	
Certificates and badges		32 40	
Register, stamp and receipt book		2 65	
Exchange on cheques		35	
Cotton sign		3 50	$411 76
			$103 48
June 1st, 1893.			
Cash on hand		$ 6 30	
Cash in Merchants Bk.		97 18	
			$103 48

Since the first of June last there have 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.

The report of the Committee on Statistics was read by Mr. Yule. The report was stated to be 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, and in the meantime that the incomplete figures should not be made public.

The President then called for anything under the head of general business which members might desire to bring forward.

There being no response, he called upon Mr. F. C. Robertson, who read the following paper:

SOME OF THE CAUSES OF INTERRUPTION TO TELEGRAPH CIRCUITS.

BY F. C. ROBERTSON.

A telegraph system, with its lines stretching over country in different directions, connecting cities, towns and villages, is to some extent at the mercy of the elements, with its batteries, instruments and wires, it is constantly subject to disturbance from various causes. The substance of this paper is a brief description of some of the common forms of interruption (usually called "troubles") which are experienced on telegraph circuits.

The troubles usually met with in the operation of telegraph circuits are of three kinds, and are known as "the break" (or open), "the ground," and "the cross." The circuit is said to be "open" when its continuity is broken and the current prevented from circulating, "grounded" when there is an abnormal electrical connection between the ground and the earth, and "crossed" when the line is in connection with another line upon which there is a current of electricity.

A circuit may be opened in various ways, for instance, by the breaking of the line, breaking of the magnet wire of a relay outside of bobbin, a loose connection at a binding post, displacement of plugs in switchboard, or by a key being accidentally left open. A break in the line wire generally occurs during very cold weather when the wire is contracted by the low temperature, causing a greater strain in it, and is often found at a point where the wire had been kinked, or at a joint which in making had been twisted so tightly as to cause the wire to be partially severed. Breaks are frequently caused by a tree falling on the line, which usually takes place during a violent wind storm, although sometimes through carelessness of woodmen in felling trees. Sleet storms are very destructive to the lines, owing to the excessive weight due to the ice adhering to the wires, which frequently causes them to break, or the alignment to become distorted. Poles carrying a large number of wires have frequently been known to break down under the extraordinary weight due to ice on the wires. Sleet storms general over a large area of country, of such severity as to damage lines, are fortunately of rare occurrence. The circuit is sometimes found to be open in an office, and might be traced to a broken connecting wire, broken relay wire, loose binding screw, but more frequently to an open key, or a plug out of position in switchboard. The circuit is sometimes found to be open in the battery, due to a jar breaking and allowing its solution to escape, a zinc falling from its hanger to the bottom of the jar, or the wire connected to the copper element becoming detached. There is a kind of trouble which takes the form of an extraordinary and variable resistance in circuit, which is sometimes met with on old lines, the source of which usually is a rusted joint, or a joint on a portion of the line in which there is no tensile strain. During dry weather these joints cause the resistance of the wire to be much increased, but during a rain the joints become wet, improving their conductivity.

Grounds on the wires are of more frequent occurrence than breaks or crosses. All ground faults contain more or less resistance; when the resistance of a fault is very small, the connection of the line with the earth caused thereby is comparatively perfect, practically dividing the line at that point into two circuits and preventing the current from the battery at either end of the line from passing further than the fault, but when the fault contains considerable resistance the connection with the earth caused thereby is not sufficient to prevent a portion of the current from either battery from passing the point of fault, the working margin of current being that which finds its way past the point of fault. The circuit in such case is not totally interrupted and signals may be exchanged between terminal offices on the circuit by properly adjusting the receiving instruments. Such a fault is called a "partial ground," or more commonly termed an "escape."

Although "single" (or simplex) circuits may be worked fairly well with a considerable and varying escape on the line (as the adjustment of receiving instruments can quickly be changed by the operator to correspond with the variations of the current), quadruplex circuits cannot be worked successfully under the same conditions; the varying escape causes the balance of the instruments to become disturbed, producing a mutilation of the signals on the receiving instruments.

A large percentage of the number of grounds which occur are found either on the lines in the towns through which they pass, or in the offices, only a small proportion being found on the lines in the country. The wire coming in contact with a foreign wire, such as a telephone, call bell, or guy wire, is a very frequent source of the trouble, though the circuit is very often grounded at the switchboard during a thunderstorm by lightning fusing the metal at the air-gap of the lightning arrester in passing over to ground. Partial grounds, or escapes, are often due to the wire touching the branches of trees, and are more susceptible during wet than dry weather, the effect of the moisture being to magnify the escape. Highway lines are more subject to escapes of this kind than lines located on the right of way of a railroad, owing to the numerous shade trees which they encounter and the difficulty experienced in keeping them trimmed to clear the wires; owners of the trees as a rule object to any extensive cutting of limbs which would tend to disfigure the appearance of the trees, consequently to maintain a clearance the branches have to be frequently pruned. If this operation were neglected for a long time the effect would be manifested by the insulation of the line deteriorating. In cases where trimming cannot be done, in order to clear the line it becomes necessary either to replace the poles by higher ones, so that the wires will pass above the tops of the trees, or to divert the line by setting the poles out.

Crosses are not of such frequent occurrence as grounds, and in many cases occur through some material defect in the condition of the lines. Wires become crossed usually during the prevalence of a wind storm, which causes them to sway, at long stretches, especially where the wires happen to be slack they more easily cross. Frequently crosses occur in consequence of a pin or tie wire breaking at an angle in the line, an insulator working loose and rising, or a pin being pulled out of cross-arm at a depression, allowing the wire to depart from its parallel position relative to the other wires. Crosses caused by a piece of small wire or other metallic object being thrown amongst the wires often occur, and on account of its obscurity the cross is with difficulty found by the lineman. I know of several instances where wires were found to be purposely connected with a piece of fine wire (evidently by persons bent on mischief), in such a manner that the fine wire could not be seen from the ground. Eventually in each case a galvanometer test was made and the cross approximately located, the lineman sent out to the supposed locality of the trouble was obliged to climb a number of poles before finding it.

When the nature of an interruption is such that the trouble does not remain on the wire constantly, but comes in and disappears again at intervals, it is called a "swing," and when the intervals are long and the length of time the trouble remains is short, the interruption, though of not so much consequence as regards impeding the working of the line, is more difficult and slow to locate than if the interruption were constant.

When two or more wires are crossed one of them can be cleared by opening the others at stations on each side of the cross. In case a through and a way wire are crossed it is customary to clear the through wire by opening the way wire at the stations between which the cross occurs in such a manner that said stations may have communication on the way with their respective terminals and intermediate offices. Such an arrangement is accomplished in the following manner: Suppose two wires, number 1 and 2, running west from terminal station A to terminal station D, are crossed between way stations B and C, of which B is east and C west of the cross. It is required to clear No. 2 (the through wire) and ground No. 1 (the way wire), so that B can work with A and C with D respectively. B opens the west end of No 1 wire at the switchboard and grounds the east end with instrument in circuit east of the ground, C opens the east end of No. 1 at his switchboard and grounds the west end with instruments in circuit west of the ground, thus that part of No. 1 between stations B and C will be "dead," causing no interference with the working of No. 2. At the same time the circuit in the portions of No. 1 between A and B and between C and D, will be closed by means of the ground connections.

Lightning coursing the wires during a thunderstorm has a strong tendency to do damage to the instruments, and were it not for the presence of that valuable arrangement called the "lightning arrester" (which forms an adjunct to modern cut-outs and switch-boards), many relays would be burned out. Before the lightning arrester was invented the custom was to cut out the instruments during a thunderstorm, but now it is considered quite safe to leave the instruments cut in, regardless of the storm, where the switch-board is provided with this protection, and it rarely happens that a relay is found to be damaged by lightning. The tendency of lightning to do damage is not confined to the instruments alone, poles on the line in the country being shattered and cross-arms splintered. In this connection it may be apropos to remark that the custom of modern line builders to provide the poles at intervals along the line with ground wires may be regarded as commendable, the arrangement appears to give good results in the capacity of lightning-rod protection to the poles.

Office main wires, especially if insulated with paraffined cotton covering, where allowed to rest in contact with a gas pipe or grounded object, are liable to become grounded by lightning penetrating the insulation and carbonizing it in its path, producing a conducting medium and creating a permanent connection between the main wire and grounded object.

During the brilliant display of luminous streamers exhibited in the heavens occasionally, and known as the Aurora Borealis, the telegraph circuits throughout the continent are more or less affected by earth currents, which become so severe at times as to entirely interrupt communication. These earth currents constantly vary both in intensity and polarity, making it impossible to keep the instruments adjusted on circuits having an earth return. It may be of interest to mention that some tests were made by Mr. William Finn, of the Western Union Telegraph Company, on a No. 6 gauge iron wire 213 miles long, extending from New York to Boston, during the magnetic storm of July 16th, 1892, which showed that the abnormal current in the wire reached the strength of 133 milliamperes, and the maximum difference of potential of the earth at New York and Boston was 492 volts—such a high voltage had not been observed during any previous storm. A wire can be worked during a magnetic storm by disconnecting the ground at each end and substituting a wire return instead, thus forming a metallic circuit. I beg here to state that a quadruplex circuit arranged with a metallic return was successfully worked by the Canadian Pacific Telegraph Company between Toronto and Montreal during the magnetic storms of last year.

The foregoing mentions only a small portion of the troubles to which telegraph circuits are subject; to enumerate all would occupy much space and time.

In conclusion I beg to mention a few conditions which, when complied with, have a tendency to prevent trouble to a great extent. The line should be constructed in a substantial manner, only first-class material being used. Poles should be sufficiently stout in proportion to their height, set well in ground, placed close enough together to render the spans not too long, so as to well support the wires and to prevent them from crossing. At corners the stretchers should be much shorter, the poles well braced or guyed, double cross-armed and straight grained pins used. The wires should be stretched tight and the joints soldered. At crossings of other lines it is best to go above them, but if this cannot be conveniently done, the wires in passing underneath should have a good clearance and be protected by guard wires to prevent other wires from falling on them. At a low point in the line where there is an upward strain the pins should be nailed in, and loops or hooks secured to cross arm over each wire so as to catch it in case it should raise through an insulator coming off pin or a tie-wire breaking.

All limbs of trees liable to come in contact with the wires should be removed. Special attention should be given to the wires in cities and towns to guard against crosses with electric light or railway circuits. Office cut-outs and switch-boards should be provided with lightning arresters, and the wires where they enter terminal offices be supplied with automatic line openers to act in case a cross with an electric or trolley wire occurs. For inside wiring it is preferable to use waterproof insulated wire, but if paraffined cotton covered wire be used, it should not be laid in grooved boards, but secured by cleats and placed where it will be free from moisture, and where the insulated covering cannot become abraided. The batteries should be placed in a dry place easy of access for frequent examination. Binding screws should be examined occasionally to see that they do not work loose. A vigilant and industrious lineman will prevent the occurrence of much trouble by frequent and careful examination of the lines in his charge, making repairs promptly when required and keeping the lines generally in such shape that the apparent liability of their becoming interrupted is reduced to the minimum.

DISCUSSION.

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

Mr. Nicholls said the thanks of the meeting were due the last speaker for his efforts to set the ball rolling by discussing the paper, and 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 by preparing a paper on the subject, which he felt sure would be heard with great pleasure.

Mr Smith said that some remarks of his on the motor generator, which was now really becoming an old subject, would be found in the report of 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 2000 cells, but that was very small. In Buffalo they had something like 15000 cells, and he would undertake to do their work with the same plant in use here.

Mr. L. B McFarlane, referring to that part of the paper in which was mentioned the working of a quadruple circuit arranged with a metallic return, said he thought that was the first time it had been successfully accomplished in Canada. If he remembered correctly, it had been done not only between Toronto and Montreal, but between Winnipeg and Montreal. This was something quite new in telegraphy, and he thought much credit was due to the C.P.R. people. The interruption caused by the 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 had much pleasure in moving a vote of thanks to Mr. Robertson for the very valuable paper he had contributed.

Mr. Black in seconding the vote, said 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 switchboards and lightning arresters were rare.

The vote of thanks having been carried, the President introduced Mr. A. C. McCallum, of Peterboro', who read the following paper:—

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, &c., 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 effect 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 is 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 water 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 flow 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 combined 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 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 "V", 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," &c., 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 this way often have the buckets shear off, whereas, in the 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 their being centered, a feature which is not necessary in wheels in which the water is applied at 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 tightnes when closed. Defects are found in them to quite an extent.

They are hard to govern, have to be counter-balanced 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 moveable, 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 gates 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 3 or 4 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 the 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 40 to 60 per cent. of useful effect, when 70% to 80% 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 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 a 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 is 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, &c., 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.

DISCUSSION.

The President said 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.

Mr. 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 desired to know if 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. He thought that if the wheel was speeded up and the governor applied in the way he suggested that it might 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.

Mr. 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; so the only way would be to put a smaller gear on and bring it to a higher speed.

Mr. Galt said he thought it would be known to anyone present who had a little experience in water wheels that the water wheel 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 out-flow. More time and money had probably been spent in experimenting on this type than any other form of water wheel. He was sorry that Mr. McCallum had not included the Pelton water wheel, which was capable of being used with great efficiency and regulated fairly satisfactorily for electrical work. 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 failed. 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, which was a somewhat objectionable feature. 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 desire to speak disparagingly of water power or water wheels, but merely to show that in this aspect they were not viewed as favorably by electrical people as a steam engine plant. He would not say that improvements would not 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. Mr. McCallum's paper is one well worthy of the attention of electrical engineers who in their practice meet with prime movers of this kind generating power for electric lighting and street railways. Having himself had some experience in putting in power at different places, it was his conviction that steam was preferable to water power, although in places having water powers people sometimes felt insulted at any suggestion of not utilizing that which was the pride and glory of the place. In connection with electric lighting, where water power was utilized, the question of regulation was a source of annoyance and expense, yet they were working fairly satisfactorily, but on the whole not to be compared with steam, unless under some special circumstances.

Mr. A. A. Wright inquired what Mr. McCallum 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.

Mr. 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.

Mr. Fisk asked if 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. In Gananoque, where he had been designing a plant for Mr. Campbell, they had put in two smaller wheels on a horizontal shaft, which he believed would operate very successfully.

Mr. Fisk said he had been running a plant for seven years, and had experienced no trouble as far as lighting was concerned, although, of course, there was more trouble with power. He believed, however, 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 was glad to find that there were one or two present who endorsed his ideas in regard to the relative value of water and steam powers—that there was very little to choose between them when it came to driving electrical apparatus.

On motion of Mr. Galt, seconded by Mr. Wright, a vote of thanks was accorded 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, to meet again at 10 a.m. to-morrow morning.

SECOND DAY.

MORNING SESSION.

The President called the Convention to order at 10.30 a.m.

He then stated that the motion of which notice had been given yesterday 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. Was it the pleasure of the Convention that the motion be introduced.

Mr. Fred. Nicholls: It might be interesting before voting on the amendment to have it explained, and the reason given why the change was regarded as desirable.

The President said it was unfortunate that the proposer of the resolution was not in the room. He himself always made it a point in cases of this kind to go straight ahead; if the persons who desired the change were not present they should take the consequences of their absence. He thought the Convention should not wait for any individual member. However, if they felt disposed to hold it over to a later stage it could be done.

Mr. Nicholls said he thought Mr. Starr was the mover of the resolution.

Mr. Starr replied that he was only the seconder.

Mr. Nicholls thought the amendment of any part of the constitution of an organization was always a more or less important matter. Some of the members did not know what were the advantages to be gained by the change, and would like to hear the reasons and arguments in its favor, so that they might not vote upon the question blindly.

Mr. Starr said he thought Mr. Carroll's intention was simply to follow generally existing precedents in such matters.

Mr. Kammerer said he had had some conversation with Mr. Carroll regarding this matter, and he gathered that the object of the resolution was to obviate the possibility of the whole of the Committee going out of office at one time, leaving in the hands of an entirely new Executive unfinished business with which they were not in touch. The plan proposed would result in there always remaining in the Executive two or three members familiar with such business.

Mr. A. A. Wright saw both advantages and disadvantages in the proposed change. There was the possible contingency that a man might remain in office for three years who would not do anything, which would be a disadvantage. The advantage was that a man acquainted with the routine of the work grasped the subjects being dealt with more readily than could a stranger. The method proposed by the resolution was the one followed in High and Public schools. As for himself, he did not think he should vote either way.

Mr. Nicholls thought there was a great deal in the argument advanced by Mr. Kammerer, that it was usual for Executive Committees to be elected in a manner similar to that proposed, but, as Mr. Wright had pointed out, it would be quite possible to clog the wheels of progress by electing to office for three years members who failed in their duty to the Association. On the other hand, if through any combination of circumstances it should happen that an entirely new and inexperienced committee were elected, the members having no previous knowledge of the projects of the Executive then in progress, it would be a great disadvantage. He would suggest as an alternative that the members be elected for one and two years, so that there would always be a sufficient number to carry forward any year, but no one would be elected for a term long enough to enable his possible inattention to hamper the business of the Association.

The President said that while the constitution was being amended in this respect, it was within their province to alter the number of members, and make it either eight or ten.

Mr. Nicholls said, that being the case, he would move that the number be increased to ten, five of whom should retire each year; any or all of these retiring members might be re-elected if it was the pleasure of the Association in general meeting assembled.

Mr. Kammerer seconded the motion.

Mr. Carroll inquired if it was not necessary to have a notice of the motion.

Mr. Nicholls rose to a point of order; the proposal was an amendment to a motion of which notice had already been given.

The President ruled that the objection was well taken. He then put the amendment as follows

Moved in amendment by Mr. Fred. 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.

Mr. Starr pointed out that in that case, there being ten members, either five of them might form a quorum.

Mr Carroll said the Executive Committee of the National Electric Light Association was composed of nine members, which seemed enough to carry on the business. Their plan of election was for two and three years.

Mr. Nicholls said that the Canadian Electrical Association, being a new organization, many of the practices of older Associations might prove neither desirable nor wise in it. It was desirable to centre as much interest in the Association as possible, and this would be effected by having as many as possible of the eligible men engaged in various electrical enterprises executive officers of the institution. The territory to be covered was very wide; it was the aim of the organization to be a Dominion Association, though he thought all would admit that at present it had not assumed much more than a Provincial character. There should be offices enough so that when another province was found taking an active interest they would go all round.

Mr. Taylor said he would like to ask the President how the Executive Committee meetings had been attended.

The President said there had usually been a quorum in attendance, but that was about all.

The amendment was then put and carried.

NEXT PLACE OF MEETING.

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 doing so 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 might mention the names of Mr. Carroll and Mr. Starr, who came up for the purpose of attending meetings of the Executive. He thought some recognition of this fidelity might be given by holding the next meeting at Montreal. Last year the matter had been brought up and the Montreal people decided that they did not desire to have the present convention held there, they not being ready at the time as they thought to give such a reception to the Association as they would like. He understood, however, that Montreal was now ready, and was prepared if the convention was held there next time to give the members a good time.

Mr. Nicholls, in order to bring the matter fully before the Association, and to induce a full discussion of the matter, seconded the motion. He thought "the greatest good to the greatest number" was a consideration always to be remembered in matters of this kind.

Mr. 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. On behalf of the city of Montreal, he was pleased to tender to the Association an invitation to hold its next convention there, and speaking for himself and others, they would do everything they could to promote the success of the meeting.

The President remarked jocularly that he supposed it would hardly become necessary for the Christian Endeavor young men of Montreal to organize for the protection of the Association in the event of their paying a visit to Montreal.

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. If he was sure there would be a good attendance he would be only too happy to have the meeting held in Montreal, but under the circumstances he thought it wiser to wait until the Association had more members.

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. He was very much in favor of going there.

Mr. 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. He wished those who were at the head of affairs in Ontario could go there and see it, and be ashamed of themselves, and endeavor to do more than they were doing at present to advance electrical education. He admitted they had done a good deal, but he would like to see them doing more for this branch of industry, the greatest industry in the world he would say. In regard to the motion to hold the next meeting at Niagara Falls, they would be having a little meeting at that place to-morrow, and he thought that would have to be sufficient at the present time. He believed it would be in the best interests of the Association to hold the next meeting in Montreal.

Mr. Kammerer said that for members living in Ottawa, Renfrew and other eastern points, Montreal was more convenient than Toronto, and just as near for nearly all except those living west of Toronto. He 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 urged as a reason for not selecting Niagara Falls the fact that it would be two years before the plant there would be in running order, perhaps three years. The first turbine would be placed in position about February or March, but that was only the starting point, and it would he thought be better to wait until a later period than next year for holding a convention at the Falls.

Mr. 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. The telegraph and telephone companies were very well represented. While it was no doubt true that the Montreal members had been very attentive at meetings, it must be remembered that the principal following of the Association came from this section, and for that reason, while he might otherwise be inclined to favor Niagara Falls, he thought it would be better to hold the next meeting in Toronto, and after that the Association might be in such a position as to take a large following to Montreal.

Mr. A. B. Smith suggested a plebiscite to see how many members would go to Montreal in the event of the meeting being held there next year.

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 would be gained by one held in the west.

Mr. Thomson said there was a little Electric Club of 25 members in Montreal, who, if the meeting were held in that city he thought would join in a 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 original motion, that the next convention of the Association be held in Montreal, being then put, was carried.

The following paper was then read by Mr. McFarlane:—

HISTORY OF THE TELEPHONE IN CANADA.

BY L. B. M'FARLANE.

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 the 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 before 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 organised 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 the 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 net work 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 use of 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.

After reading the paper Mr. McFarlane said that a great deal of it had been written from memory, but that after he sent the manuscript to the Secretary he had had the pleasure of meeting 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.

Mr. Dunstan said he thought the thanks of the Association were due to Mr. McFarlane for the paper just read, which, valuable as it was now, 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 put to the meeting and carried.

The following paper was then read by Mr. E. B. Merrill:

THE EDUCATION OF THE ELECTRICAL ENGINEER.

BY E. B. MERRILL.

Though the subject of the education of the electrical engineer has received considerable attention from electrical societies, and in the electrical press of other countries, it has not so far been discussed in our own society; so that in view of its importance to the rising profession it may not be fruitless of good results to those of us interested in the education either of ourselves or of others, if we spend a short time in considering it here.

Like everything else electrical, the scope and methods of electrical education are continually changing, and on the whole in the direction of improvement. In no profession are the instructors so closely connected with the practice, and to this vital contact they owe a great deal of their strength. This helps to keep them abreast of all advancements and greatly increases their value to the student engineer.

In the widest sense of our subject we should have to do with more than a college education. That is only one phase of it. It neither begins nor ends here. There must be a preparation, and afterwards there must be a continuous advance if one is to retain or better his position. We must not get the idea that a graduate is an electrical *engineer*, though he may have earned the distinction of such a degree. He is in reality merely in a position to make a start, but if he has faithfully cleared up the work behind him he is able to make a good start and a rapid advancement. A college training is necessarily one-sided and needs the addition of practical experience to complete it.

However, let us limit ourselves to the consideration of the college education. And first, is it necessary? and if so, what should be its aims and in consequence its important features? Is a college education or an equivalent an essential part of the equipment of the electrical engineer?—we say an equivalent, for it is quite possible, though generally attended with great difficulty, for a man to follow out a course for himself by making use of spare minutes and taking advantage of every opportunity. But the instances of those that have accomplished this satisfactorily are not many.

A few years ago the answer to this question would perhaps generally have been different from what it must be to-day. We have little hesitation now in answering it in the affirmative. An adequate training in mathematics and electrical and mechanical principles must be had, however it is obtained. The college course itself is not all important but it offers great advantages. Besides the guidance and help of the instructors, the fact of the time being carefully mapped out for employment, and the familiarity gained with the use of apparatus and machinery not often accessible elsewhere, the student has also the assistance derived from association with others and the encouragement of emulation between those working along the same lines—factors whose importance is not often overestimated. It is true that a good man, by himself, may do more than a poor man at college, but the same man will do much better with the assistance to be derived at college. A college training will not always make a good man out of a poor one, but it will make a better man out of a good one.

Of course we cannot overlook the many examples of men who have done well, and some who have met with great success, who have never entered college or taken up advanced mathematical and scientific work; but if you were to question these, you would find that most of them regret that they did not see the value of such an education sooner, or that they have not had the opportunity or time to avail themselves of it. It is a sufficient indication of its value to glance over the foremost names in the electrical field and to note the proportion of them that have received this training. That it is being appreciated is shown in the demand of the large companies for graduates of engineering schools, some admitting none but such men to the special student courses established by these works for the purpose of training men to look after the installation and running of the machinery they manufacture.

There are still some, however, who advocate the merits of the machine shop, the repair shop, the dynamo and motor room, field and armature construction and winding, the test room, &c., as an ample schooling, but the weight of opinion is now that the electrical *engineer* needs something more. A man who is trained only in this way and has not obtained a pretty good working acquaintance with the elementary laws of electricity and magnetism, is liable to make ridiculous if not serious mistakes, which the man properly grounded in these principles could not possibly fall into. As a case in point it came within our notice not so long since, where three men trained in this way agreed that a certain connection of the shunt fields of an Edison dynamo was wrong and had it changed because they had not seen it made in that way before, and although it was pointed out to them that the current had to circulate in exactly the same direction in the coils as it did with the connections with which they were satisfied.

And what are the essential elements of this college education? This brings us to another important question. It is that of—*specialist or generalist?* or, to what extent should one specialize?

Is the electrical engineer to be a mechanical engineer as well? Some have answered "yes" and others more recently have said "no," with considerable emphasis. Sir Wm. Thomson, now Lord Kelvin, gave as his opinion that the electrical engineer should be nine-tenths mechanical and one-tenth electrical; some of the best educationists across the line would now reverse these figures. Perhaps both are extremes, at least they appear to be so for the requirements of the average electrical engineer of the present and for some time to come. Conditions have somewhat changed since Sir Wm. Thomson gave this advice, although there are still some engineers not even one-tenth electrical. A more even division would, however, better meet the present requirements.

The man who is working along advanced lines has need for economy. The electrical field is now so wide and extending so rapidly that many may well occupy all their time on special work. Such men are able to do with only a slight acquaintance with mechanical engineering. However, the general electrical engineer is not a specialist. As the general practitioner in medicine, he must cover a wider field. In installing plants for lighting, power supply, &c., he has to do with steam engines and boilers and all their accessories, with shafting and bearings, belting and gearing, fly wheels, driving pulleys, &c., with water turbines and their control, with the fitting and running of construction and repair shops, &c., &c. He should therefore be familiar with at least the mechanical principles of the construction and running of ordinary machinery, the running conditions of the steam engine and the utilization of water power. It is not necessary that he should be a practical machinist. Most engineering colleges, therefore, either combine the two courses, or else require the electrical student to cover a good deal of the work in mechanical principles. A large part, such as the mathematics and mechanics, is necessarily the same in both.

In the planning of a college course, one of the first difficulties met with, is in deciding the relative importance, with regard to the time table, of the theoretical and practical work, and this is what different colleges disagree upon most, some devoting considerable time to foundry work and pattern making, forging, machine shop work, such as vise work, turning, &c., while others restrict the practical work to draughting, electrical testing, engine and boiler testing, dynamo and motor testing, &c., which involve the application of the more difficult principles and assist to illustrate and impress them. We think it a safe rule to follow in college to sacrifice practical work to theoretical when the former involves chiefly those operations which one can pick up readily in practice, or the mere acquiring of skill in a mechanical operation. In engineering, and especially in electrical engineering, the mathematical and scientific training necessary is becoming wider and wider. Once an engineer has started out in practice he has little time and usually less inclination to go back and work up mathematics. If he has not had a good mathematical training he finds himself unable to read and to keep abreast of the greater part of the electrical literature in the periodicals. He is not *up to date* in electrical matters, probably becomes disgusted with advanced electrical work, and the plums of the profession, the introduction of new applications, the perfecting of methods, designing and inventing, he resigns to others. With the man, however, who has devoted three or four years to a careful study of mathematics and the direct and related principles underlying the science of electricity it is different, for though he still may have some difficulty in following electrical advancement he is not wholly at sea. It is best therefore that the college student should pay special attention to those parts of his work that are usually classed under the head of theory. It is true that he may not do as well at first when he starts out in his profession as the graduate of a school where more attention is given to the practical side, but he will more than make it up in the long run. It is a case of slow but sure.

Another objection to the class of practical work before mentioned—foundry, machine shop work, &c., is that, in college, it is usually under too artificial conditions, and is therefore not of as much value to the engineer as if he had obtained the experience in actual machine shops, &c., under normal conditions, and especially is this true in questions of the commercial value of the work done. Moreover, students may obtain this practical experience, or a large part of it, before graduating, for in most colleges there is a long summer vacation; in our own in this city they have five months, and the students are especially advised to, and most of them do, obtain employment in various works, mechanical and electrical, and so supplement their course in a valuable way. An electrical student should, if possible, obtain his experience in an electrical machine shop for construction or repairs—the more general the work the better—and in this way he will be obtaining mechanical and electrical practice at the same time.

We have not the time now to go with more detail into the work of the college, or consider what subjects should or should not be included in the course and how they should be dealt with. The importance of the laboratory as an educational aid is generally recognized; a good library is also a great help, and in our day of such rapid advancement the electrical journal is indispensable; but a wide-awake staff and students that *mean business* are the chief factors in the success of any college.

A member suggested that Mr. Nicholls, owing to his position and experience, should be able to make some remarks on the subject of Mr. Merrill's paper, which could not fail to be instructive.

Mr. Nicholls said if the gentleman would indicate on what line he desired him to speak he would have pleasure in doing so. The paper just read by Mr. Merrill was a most able treatise on the subject, and while on his feet he would propose that a vote of thanks be given him for preparing and reading it. 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. He noticed Prof. Rosebrugh in the room, and he thought it would be interesting to hear from him 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,—and he thought we had as good facilities of that kind here as any in the United States—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.

Mr. 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 were unhappily 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. Cornell University might be taken as an example of the colleges in which they gave, or profess to give, a thorough drilling in the use of tools and machinery. They had a plant there which cost millions of money, driven by hundreds of horse power and they had a 600 horse power water wheel, as well as steam. Lehigh had nothing in the way of machinery at all, but had arrangements with certain shops by which the students could go in and see the work. They professed to give them sufficient manual training by a foreman or superintendent. He observed by reading electrical papers that the professors in the leading electrical colleges of the United States were not agreed as to the necessary training, some recommending one course, some another. The University of Wisconsin, where they attempted to specialize, had three or four different courses, and advised students to take a special course. Some of the courses, as railroading, were more mechanical, others more purely theoretical in connection with the telegraph and telephone. 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. No doubt in the course of time a more uniform system would be arrived at. Here in Canada we had two special schools for such training, one at McGill College, where they had recently adopted a mechanical or workshop course, and one in the City of Toronto, where they gave theoretical training and provided 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, except as an auxiliary in connection with final testing 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. Much attention had been paid by educationist to this line, and there was no reason to complain of the facilities afforded in this line in Canada, there being two large establishments, that in connection with McGill, and the Toronto School of Practical Science, as well as minor institutions. In these a first rate theoretical training might be had, and he thought the correct idea was for the students to go out from these places and acquire practical knowledge in the way Mr. Nicholls had spoken of, in work shops connected with general electric work, in which way they would become thoroughly efficient.

Mr. 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. A man who went to Oxford went to be a specialist, a mathematician, a modern language man or something else. Here in Ontario it was necessary to know a great deal about everything. At one time when a man took charge of a high school he had to be acquainted with mathematics, Latin, Greek and foreign languages, but that was changed now. One master taught modern languages and another classics, and so on, and he believed a time was coming when there would be nothing but specialists. But 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. It seemed to him that a man who attended college ought to know a great deal about everything; he believed that when a young man went to one of our colleges and took up practical work he ought to know a great deal when he got through. 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 said 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 thought that as had been suggested, they should take advantage of their vacation to acquire a knowledge of practical work, which would be of the greatest advantage to them. 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 theoretical 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.

Mr. 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 laobratory 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 years practice, so altogether it involved a complete course of five years.

Mr. 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. A number of graduates of the schools had presented themselves to him seeking positions, with a certificate stating they were thoroughly qualified to take hold of almost any electrical plant. 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. The large firms were combining, and many of them had at their head half a dozen electrical engineers well versed in the business, and these firms had no room for students. These latter were obliged to take some very minor position at a small salary, and many of them eventually left the electrical business and entered into some other pursuit. It was his experience of what became of the electrical engineers trained in some of the colleges that there was no work for them to do.

Mr. 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. He quite agreed with Mr. Thomson that many of the young men now making their way into the electrical profession would be disappointed, because they were paying too much attention to the electrical part rather than the engineering part of their training. Any extensive development could only be looked for in the field of commercial adaptation of electricity. He did not quite agree with the definition of Lord Kelvin, but in commercial electrical work, in engineering and railway work, a man required to be as much, if not more, a civil or mechanical engineer as an electrician.

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, although there were no doubt numerous aspirants, one had at least to have a certificate of competency, and they were obliged to serve a proper term and pass a rigid examination before being allowed to assume the duties of those professions. 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 such as that at Lynn, Mass. In these latter the student was moved about and saw various operations, but not very much personal attention was given to him, and he only saw one thing at a time, whereas in Canada, in such a shop as that of the Canadian General Electric Company at Peterborough, 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.

The President then put the motion for a vote of thanks to Mr. Merrill for his paper, which was carried.

The President then said that, as there were a few minutes to spare before the time for adjournment, and as he understood that Mr. Thomson had been experimenting to a certain extent with alternating currents of high tension, he would ask that gentleman to give a few remarks on the result of his experiments, 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 experiments 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 adjourned for lunch from 12:30 to 1:30.

AFTERNOON SESSION.

The Convention was called to order by the President at 2 p.m.

Some discussion took place as to the time at which the next meeting should be held, and 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.

ELECTION OF OFFICERS.

Mr. Kammerer inquired if the nomination of officers was now in order.

The President having replied in the affirmative :—

Mr. Kammerer nominated the present President, first and second Vice-Presidents to fill the same offices next year. These gentlemen had made a success of every meeting thus far, and as there was a little doubt as to whether next year's meeting was going to be a success or not at Montreal, he thought it would be well to retain their services.

Mr. Nicholls seconded the motion.

Mr. A. A. Wright thought this method of nominating *en bloc* was not a regular mode of procedure.

The President said the fact of the nomination being made in that way did not necessarily imply that they would not be balloted for separately.

After some further discussion, no further nominations being made, the three officers nominated by Mr. Kammerer were declared elected to the same offices for the forthcoming year.

The President then said that the course taken was one not at all anticipated by him, and he would have preferred that some one else had been elected President. He had always done all that lay in his power to advance the interests of the Association from its commencement to the present time, and it did seem to him that it would have been better that some one else should now relieve him of the duties of the office. However, as it seemed to be the wish of the Convention, he had no alternative but to fall into line. The success of the Association was what he desired to see, and he could be relied on to do everything in his power to further its interests.

Vice-President Dunstan said in view of the fact that the next Convention was to take place in Montreal he felt rather strongly that the officers should have been of that city. If the Convention thought otherwise, however, he bowed to their wishes, and would do all he could to make the Montreal meeting as great a success as possible.

Vice-President Carroll also spoke briefly, stating his intention to do everything possible to insure the success of the meeting at Montreal.

Mr. C. H. Mortimer was then nominated for Secretary-Treasurer by Mr. A. B. Smith, and no other nominations being made, was declared elected.

Mr. Mortimer suitably acknowledged the honor conferred by his unanimous re-election, and assured the members present that in the future as in the past, he would bend all his energies to secure the success of the Association.

The President then stated that there were ten members of the Executive Committee to be elected. According to the amendment made to the Constitution, five of these would hold office for one year and five for two years. It was thought as well by several members that the members should be elected at the present Convention, and the question as to which five shall continue in office be determined at the next election. If that is the pleasure of the Convention it could be so ordered.

Mr. Nicholls asked how that would be determined at the next meeting.

The President explained that the first five members of the Executive Committee would be elected for a second year, and then five more would be elected to fill vacancies.

The nominations were then received as follows :

Mr. Dunstan nominated Mr. A. B. Smith, of Toronto.

Mr. Nicholls nominated Mr. John Yule, of Guelph.

Mr. Yule asked to have his name withdrawn.

Mr. Nicholls said a nominee could not withdraw without the consent of his nominator, and he declined to consent to the withdrawal of Mr. Yule's name.

Mr. John Carroll then made the following nominations : Hamilton, Mr. D. Thomson and Mr. Geo. Black ; Toronto, Mr. A. B. Smith and Mr. J. A. Kammerer ; Ottawa, Mr. T. Ahearn ; Peterboro', Mr. J. W. Taylor ; Montreal, Mr. L. B. McFarlane and Mr. D. A. Starr ; Owen Sound, Mr. S. J. Parker ; Guelph, Mr. John Yule.

Mr. A. A. Wright expressed his surprise at this wholesale nomination. It seemed to him a very strange method of procedure.

Mr. Nicholls then nominated Mr. A. A. Wright, of Renfrew.

Mr. Wright said he had more business than he could attend to, and although Mr. Nicholls had raised the point that Mr. Yule could not withraw without the consent of his nominator, it took two to make a bargain, and he must positively decline the nomination.

Mr. Yule nominated Mr. Rosebrugh, of Toronto.

Mr. Taylor, of Peterboro', asked to withdraw his name, and to nominate Mr. Fisk, of the same place.

Mr. Nicholls nominated Mr. C. P. Dwight and Mr. K. J. Dunstan.

Mr. Dunstan nominated Mr. Fred. Nicholls, of Toronto.

Mr. Nicholls said that as a matter of principle he would prefer that his name should be withdrawn. Much as he appreciated the honor, he did not think that a man interested from a business stand-point in dealing with a large class of active members in such an Association as this should accept an office in it. Since its inception he had done all he could to help forward the work of the Association and would continue to do so. But if the Association was to be successful it should be managed entirely by active electric light, telegraph and telephone men, and not by any one who had axes to grind. He had taken that position from the first, and he felt just as strongly as ever on that point to-day. He was happy to be present at the meetings of the Association as an active private member, but at that point he thought his interest in it should cease.

Mr. A. B. Smith nominated Mr. John Galt.

Mr. Carroll nominated Mr. John Langton.

Mr. Langton said he thoroughly agreed with the views just enunciated by Mr. Nicholls—that officers of the Association should be buyers and not sellers. He must therefore decline the nomination.

The nominations were then closed.

The President and Mr. Carroll were appointed to act as scrutineers, and proceeded to take the ballot.

The ballot resulted in the election of the following gentlemen to compose the Executive Committee : A. B. Smith, T. R. Rosebrugh, Toronto ; S. B. McFarlane, D. A. Starr, Montreal ; John Yule, Guelph ; D. Thomson, Geo. Black, Hamilton ; E. Carl Breithaupt, Berlin ; H. O. Fisk, Peterboro' ; Thos. Ahearn, Ottawa.

Mr. Nicholls moved, seconded by Mr. Thomson, "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 Mr. 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 following paper was read by Mr. Langton :—

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 dates 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 assignable 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 favour 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 strain of 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 10% for 8 sizes from 25 to 225 horse power, and 5% for 5 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 % of the output of dynamo, it is at half load 5 % of the output of dynamo, and at quarter load 10 % 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 a 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.

Mr. Thomson 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 various makes as to make a general answer impossible.

Mr. Galt thought the President, from his experience in running dynamos, would be able to give some very important information on this subject. For his own part, he thought the more directly you could get the power applied the better, and the whole trend in every part of engineering was in that direction. As illustrating this he referred to modern practice 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. Speaking of street railway motors, he said 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. In England, Germany and France where large powers were developed, it was convenient and economical to have special designs and it was done in that way. 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.

After some further discussion by Mr. Medbury, Mr. Galt moved, seconded by Mr. Thomson, that a vote of thanks be accorded to Mr. Langton for preparing and reading the paper.

Mr. E. C. Breithaupt then read the following paper :—

ELECTRIC STREET RAILWAYS.

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 has 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 favour; 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 criticized 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 complicate.

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 steam ship 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 net 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 fulfills 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 objection 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 fourty-four minutes consecutive running a maximum difference of 140 h. p. was shown between turbine shaft and dynamo terminals and a minimum of only 12 h. p. 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 13 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 Inst. 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 50 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 were 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 similiar 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

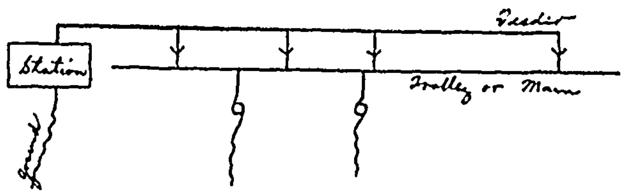


FIG. 1.

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 as in figure 1.

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 as in figure 2.

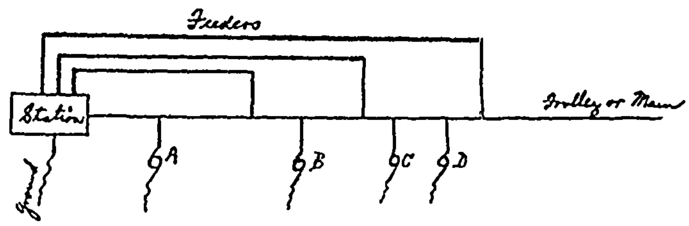


FIG. 2.

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 distances from each other is 2000 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 batteries 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% 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 Thomson 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 quantity 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% even at half load, but we shall take it at 85% to be within the limit, while an average of 70% may be claimed for motors and gearing. Allowing a drop of 5% on the line we should have a total efficiency of 57% 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 minimum
	3.5	12.2	23,800	35.3	45	78.5 maximum
Under heavy load.	3.64	7.7	32,900	31.5	51.	62. minimum
	3.64	9.	32,900	40.2	53.3	75.3 maximum

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% of full load it was found to be about 14% 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%, 39% and 57%. 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 roads 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.

Mr. Langton said the figures in the paper regarding total efficiency were very interesting and although the loss would seem very large to an ordinary consumer it was probably much less than from any other form of transmission. He said that 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 expressed a desire to hear some remarks from Mr. Langton on the subject of 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 it was only wasted time of the Convention to talk of storage batteries.

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

A vote of thanks to the Press of Toronto for full reports of proceedings having been passed, the Convention adjourned, to meet on the steamer Chicora at 7 o'clock to-morrow morning.

THE EXCURSION.

The excursion to Niagara Falls on Thursday was looked forward to with anticipations of pleasure, not unmixed with anxiety however lest Jupiter Pluvius should insist upon exercising sway over the elements and also for fear that the majority of the members would prove unequal to the task of getting down to the wharf by seven o'clock in the morning. Both these fears proved groundless. The heavily overcast sky which greeted the early risers, dropped a slight shower, but afterwards donned a more amiable mood, and throughout most of the day smiled cheerily down upon the company. For some time after reaching the deck of the handsome steamer "Chicora," members were engaged in trying to discover who of their friends had succeeded in getting aboard. In some instances a laugh was indulged at the expense of those who were supposed to have failed to make connection, but the joke was on the other side when the absent ones shortly after hove in sight. In fact had the roll been called, there would have been found but a small number of those in attendance upon the convention who would not have responded to their names, and the places of these were filled by ladies, quite a number of whom graced with their presence the occasion.

Queenston was reached shortly before ten o'clock. On disembarking from the steamer the company found a special train in waiting to convey them over the Niagara Falls Park and River Railroad Company's line to Chippewa. A description of this unique and well equipped road having appeared in the ELECTRICAL NEWS for July, it will be unnecessary to enter into details here further than to say that the route follows the windings of the Niagara River for a distance of twelve miles and affords the passenger the best view it is possible to obtain of the historic battlefield of Queenston Heights, the Rapids, the Whirlpool and the Cataract itself, as well as the wealth of magnificent scenery for which the locality is famous. It need scarcely be said that the company found the trip full of interest and pleasure. Half an hour was profitably spent after returning from Chippewa in making an inspection of the power house at the Falls. The building is a most substantial stone structure, and the plant and the manner in which it is installed are most admirable. As yet there is much unoccupied space in the building, but in view of the intention to double track the road, additional plant will probably be put in during the coming winter. A feature of much interest was the method adopted of regulating the current by means of resistance boxes, thus doing away with the necessity of keeping a man constantly employed at a governing wheel as has heretofore been the practice in water power stations. By the new method much more perfect regulation is secured.

From the power house the party was carried to the Cliff House, where luncheon was served. Then a descent was made of the steeply inclined and winding roadway leading down to the river, where, lying alongside her wharf, lay the steamer "Maid of the Mist," in charge of her cheery commander, Capt. Carter, who gave everybody a most hearty welcome, and piloted them safely over the river, landing them at the foot of the inclined railway on the American side.

For a time the apparatus for hauling the cars up the incline refused to work, and quite a number of the members and some of the ladies undertook to make the ascent on foot. Their appearance, especially of those having to carry an abundance of avoirdupois, as they neared the top of the stairs, indicated that they had not fully counted the cost before making the attempt. Eventually however they, with their fellow travellers, whose patience had been rewarded by a speedy ascent in the cars, found themselves once more on the level. Here they were taken in charge by Mr. Harrington, secretary of the Niagara Falls, N. Y., Business Men's Association, and conducted via Prospect Park and a special train of electric cars, to the locality where the great tunnel is being constructed with the object of utilizing the vast water power of the cataract. It is impossible within the compass of this article to enter into a detailed description of this work, which is so unique and gigantic in character as to be the object of world wide attention. The members of the Association were given a look into the wheel pit, which is 170 feet deep, and will contain half a dozen inverted turbines, which are expected to develop 50,000 horse power. The financial results of this undertaking, in which the faith of the construction company is represented by millions of dollars expended in excavation, masonry and plant, will be eagerly looked for.

From this interesting scene the company were conveyed back to the town, and thence by electric elevators to the top of the observation tower, a height of about 300 feet, from whence a magnificent view is obtainable up and down both sides of the river. Having descended from the tower, a few minutes sufficed, aided by the inclined railway to again reach the deck of the "Maid of The Mist," where, doffing hats and bonnets, and encasing themselves in rubber suits provided for the purpose, the excursionists were carried by the powerful little steamer to within a few yards of where thousands of tons of water fell each minute from the crest of the precipice nearly 200 feet above their heads. From this situtation the beauty, grandeur and power of this great exhibition of Nature impress themselves most deeply on the minds of the beholder.

Taking leave of the steamer and re-embarking on the electric cars, the return trip to Queenston was commenced, the terminus being reached at 5 o'clock. Here three rousing cheers were given for Mr. W. A. Grant, Capt. Carter and Mr. Harrington, and subsequently on the return trip to Toronto on board the steamer, a series of formal resolutions were passed expressive of the thanks of the Association for the courtesies extended by the Niagara Navigation Co., the Niagara Falls Park and River Railroad Co., Capt. Carter, representing the owners of the Maid of the Mist and the Niagara Falls Business Men's Association. A resolution was also adopted appreciative of the services of the Executive officers in making the arrangements for the trip.

The unanimous verdict is that a more interesting and profitable feature of the Convention could not have been devised.

ELECTRICAL EXHIBITS.

Below are printed particulars of interesting exhibits of electrical manufacturing Companies at the Industrial Exhibition.

BALL ELECTRIC LIGHT COMPANY.

This company had at the Exhibition the following apparatus: one 1000 light alternating current dynamo with transformers, and complete switch board, fitted with station transformer, ammeter, volt meter, potential indicator, and high and low potential lights, indicating the exact pressure of the current by red and blue lights without the necessity of coming close to the switch board to observe the volt meter. They also had one 800 light direct current generator operating both 110 volt incandescent lights and 220 volt motors. This generator was connected on to a three wiring circuit delivering all the current to the Main Building both for incandescent lights and motors, also operating all the incandescent lamps in their exhibit and five or six motors, among which were a 10, 7½, 5, 3, and 1 horse-power. One of the motors was belted to a 15 light 4 amp. dynamo operating the arc lamps in their exhibit. Connected to the direct current incandescent dynamo were their arc lamps for direct incandescent circuits, and on the alternating dynamo, their alternating current arc lamps. Among the other apparatus shown were recording watt meters, lamp hour recorders, electric heaters, electric curling irons, etc. The exhibit was driven by a Doty high speed engine, the 1000 light dynamo being close belted to one drive wheel by the L. P. D. transmission device manufactured by Darling Bros., Montreal. In another space in Machinery Hall, the dynamo for supplying about 100 Ball arc lamps to the Main Building and Music Pavilion were located, power for these being furnished from a Wheelock engine. It may be noted here that the arc lights for these buildings were in operation constantly from the opening night until the closing without any hitch whatever. The Ball Co have illuminated the Main Building since 1883 or 1884 with the exception of one year, and whenever their lamps have been used in this building it has never been left in darkness. This speaks well for the reliability of the system as it would be a serious affair to have all the lights go out in this building when it is crowded as it usually is.

ROYAL ELECTRIC COMPANY.

The neat and tasty exhibit made by the Royal Electric Company in the Machinery Hall is worthy of more than passing mention. All their apparatus exhibited was in active operation, showing in service their arc, alternating and direct current systems, as well as their motors. The large switch or show board, 24 feet long and 12 feet high, was artistically laid out with all the different articles usually appearing on a switch board, as well as some artistic designs worked out with the various electrical supply articles and incandescent lamps. A large bank of transformers were located at the foot of this board and from which the various lamp signs were operated, giving some very pretty effects Within their enclosure was a large table on which were arranged the different classes and kinds of electrical supplies which this company deal in, and the exhibit was very complete. Last, but not least in point of show and general interest, was the exhibit of electrical cooking and heating utensils, which comprised sad irons, goose irons, polishing irons, tea kettles, tea and coffee pots, stew pan, chafing dish, broilers, toasters, pan cake griddles, heaters, etc. The centre of attraction for old and young was the electric curling irons where moustaches, whiskers, bangs, frizzes and back hair were curled free of charge. Credit is due the Toronto staff of "the Royal" for the taste displayed in the decorations and arrangements for running the machinery and apparatus.

KAY ELECTRIC WORKS, HAMILTON.

The Company's exhibit attracted much notice, consisting as it did of constant potential dynamos and motors in all sizes and voltages. Their motors are adapted for either lighting or power. Each motor is supplied with an automatic self-lubricating journal, the motors are also self-lubricating, so that they are capable of being operated by any person of intelligence.

PETERBOROUGH CARBON AND PORCELAIN CO.

An attractive and interesting exhibit of goods of their manufacture was made by the above Co., Mr. J. W. Taylor, the manager, being most of the time personally on the ground.

BELL TELEPHONE COMPANY.

A prominent feature of the Main Building was the exhibit of telephones, annunciators, fire alarm and police signal telegraph systems, made by the above company. The exhibit was in charge of Mr. N. C. Marshall.

BENNETT & WRIGHT.

This firm, which has recently engaged in the business of electrical contracting in Toronto, had a tasty exhibit of electric apparatus, of which the Eddy motors were a prominent feature and attracted considerable attention. They also had an exhibit of Okonite wires, knife switches, cut-outs, etc.

T. W. NESS & CO.

The exhibit of this Company was illuminated by a magnificent electrolier and a bank of 50 colored incandescent lamps. It embraced a most unique assortment of telephones, switch-boards, &c., (one of the leading lines of goods produced in their factory), main line instruments with Blake or carbon transmitters, for local exchanges and private lines. Several new features in these are shown, one with arm rest which makes the circuit instead of the ordinary hook, another with pull down attachment in place of the side crank. Several styles of desk telephones find a place, also special instruments for affording communication between the different departments of a business house. Special mention must be made of their new patented automatic warehouse 'phone, the invention of Mr. Ness, having an automatic switch attachment which immediately returns to its normal position after being used and receiver replaced. A very large electro mechanical gong is shown, this is part of fire alarm system the firm is installing at Dundas, but all kinds of electric bells, batteries, push buttons, medical batteries, electric fans, incandescent lamps, electric light sundries are exhibited, also a fine assortment of house annunciators of their manufacture. These are filled with gravity drops.

The firm manufacture a full line of telegraphic apparatus and a spring motor for running the phonograph. A very convenient and inexpensive electro medical generator "The Hill" was kept busy giving shocks to the visitors.

The firm handles the Reliance electric lighting and power apparatus and exhibited a 100 light Reliance dynamo and 500 Reliance motor. The firm had also an interesting exhibit at the Monsreal Exposition. The factory and head offices are located at 749 Craig street, Montreal. The Toronto Branch is located at 106 King street West.

JOHN STARR, SON & CO.

John Starr, Son & Co., of Halifax, N. S., made an attractive display of "Unique" telephones, annunciators, etc., of their own manufacture, as well as general electric supplies. The "Unique" telephones are now in universal use in Canada, both for exchange and private use, and are giving perfect satisfaction. The principal advantage claimed for these is in the transmitter, in which there is no spring or screw adjustment to work loose or become affected by atmospheric changes, etc. The "Star Automatic" annunciator is a great improvement over the ordinary drop, there being no drops to require re-setting, and the vibration shutter is more readily discernible than the ordinary drop or needle. The well known "Simson" Battery, for which this house is sole agents for North America, occupies a prominent position.

This Company manufacture and control a number of excellent specialties, in which they do a large business in Canada, among which is the "Starr" Incandescent Lamp for which a number of points of excellence are claimed.

THE STEAM ENGINE GOVERNOR AND ITS REGULATOR.*

BY FRED. G. MITCHELL, LONDON.

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 absorbed more thought, and received 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 apparatuses consists of a pair of balls revolving round a vertical axis, generally driven by mitre-gear. The principle of centrifugal force as embodied in the old Fly-Ball governor of Watts, has been more resorted to than any other, but, aside from this the governor has been so imwroved altered and re-constructed 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 the 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 the centrifugal force by weight or spring being not adjusted to the various load and steam pressures.

This is the 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 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 pounds 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 pounds 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 pounds 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 on the beam accordingly, if we want it to balance.

Now we will endeavor to see why the weight or resistance is applied to the centrifugal force of a governor, if the balls revolving in their normal plane and of course centrifugal force tends out. When the load is thrown off the engine and no resistance offered to the governor by means of weight or springs, at the slightest variation the balls will ascend to the proper plane, but should the load be thrown on the engine, the balls will again have to come to a lower plane. Their re-action depends on 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 and 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 suprisingly 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.

*Paper read at the annual convention of the Canadian Association of Stationary Engineers, Sept. 7th, 1893.

DYNAMOS RUN BY GAS AND OIL ENGINES.

As yet very little has been done in the United States in the way of running dynamos by gas or oil engines, says *Electrical Industries*. Many types, however, of both of these are shown in Machinery Hall. Among those deserving special mention is the safety oil engine, a three and a half horse power machine after the Hornsby-Akroyd patent, and made by R. Hornsby & Sons, Limited, of Grantham, England.

This engine using crude petroleum of 300 degrees flash test is said to consume but three-quarters of a pint of oil fuel per horse power per hour, and as run at this exhibition fuel for it is said to cost less than a cent per hour. The supply of oil is carried in a tank forming a part of the foundation box, and is automatically pumped into the combustion chambers as needed after the machine is started.

The engine is somewhat like the Otto gas engine, and works on the Otto-cycle principle. A hot combustion chamber at the rear end of the cylinder receives oil and air, vaporizes the former, and after mixing it with the air the gas thus formed is exploded by the compression of the piston forcing it into and against the hot combustion chamber. To start the machine, a lamp underneath this combustion chamber is lighted, and a blower provided for the purpose is turned by hand to heat the chamber up to a cherry red. When this is accomplished, which takes but three or four minutes, the light is extinguished and and the chamber is kept hot by the compression and explosion of the oil gas, an explosion taking place once during each two revolutions of the fly-wheel.

This particular engine is belted to a castle dynamo of 24 lamp capacity, and the regulation of speed is very perfect, no variation being noticeable when the load is all cut off or all thrown on. The dynamo was built by J. H. Holmes & Co., of Newcastle-on-Tyne, England, and is of much the same type as the Crocker-Wheeler Dynamo of this country. It is very slow speed for the size, running at not over a thousand turns per minute. There is a large field here for engines of this type as the Americans have scarcely become aware of the fact that oil engines are very useful as well as inexpensive for producing electric currents. The foreign firms at the Fair have already noticed this fact and are preparing to supply the demand.

BOILER COVERING AND THE CONSUMPTION OF COAL.

Some experiments on the influence of boiler coverings on the consumption of fuel, says *Scientific American*, have just been concluded on the railways of south-west Russia. It was found that cooling was more rapid while working than when stationary save when a double covering of felt was used. The heat lost in 24 hours by a boiler was 30 square metres of surface containing water at a temperature of 144°, and exposed to an exterior temperature of 8·5°, corresponded to 133 kilos. of coal if the boiler were uncovered, to 155 kilos. if there were a thin metal covering, to 130 kilos. if there were a double felt covering, and to 103 kilos. in the case of a cork covering. For an average daily consumption of 1,164 kilos., the covering of the boiler represented about 24 per cent. and 8·1 per cent. of the consumption of coal.

TELEGRAM—DELIVERY—SUNDAY LAW.

The Supreme Court of Georgia held, in the recent case of Willingham vs. Western Union Telegraph Company, that where a telegraphic message delivered on Sunday for transmission did not show on its face that it related to a subject matter which would render transmission and delivery a work of necessity or charity, and where there was no averment in the declaration either that the dispatch in question did relate to such a subject matter, or that the telegraph company, its agent or servant, was informed that it had relation to any such matter, the failure to transmit and deliver it on Sunday was not actionable.

A large deposit of white mica has been discovered by Mr. John Wallingford, of Templeton, at Eau Claire, Ont., on the line of the C. P. railway. The quality is said to be equal to the Carolina No. 1 mica.

THE LIFE AND CONSUMPTION OF ENERGY OF GLOWLAMPS.

Messrs. Siemens & Halske have made a large number of accurate tests on this important subject with their own lamps as well as with those of other makers.

From the results which are given in the following table it seems perfectly clear that lamps consuming less than 3 to 3½ watts per candle cannot be recommended for practical use.

The final figures in the first column give the average life of the different kinds of lamps.

Burning Hours.	1·5 Watts. Candles.	1·5 Watts. Watts.	2·0 Watts. Candles.	2·0 Watts. Watts.	2·5 Watts. Candles.	2·5 Watts. Watts.	3·0 Watts. Candles.	3·0 Watts. Watts	3·5 Watts. Candles.	3·5 Watts. Watts.
0	16	1·50	16	2·00	16	2·51	16	3·00	16	3·50
5	13·1	1·85	—	—	—	—	—	—	—	—
10	10·2	2·36	15·3	2·09	—	—	—	—	—	—
15	8·4	2·77	—	—	—	—	—	—	—	—
20	7·8	2·81	13·5	2·38	15·8	2·53		—		—
25	7·3	2·90	—	—	—	—	—	—		—
30	5·7	3·56	12·5	2·52	—	—	—	—		—
35	5·6	3·66	—	—	—	—	—	—	—	—
40	5·5	3·70	12·1	2·67	15·7	2·54	—	—	—	—
45	5·6	3·65	—	—	—	—	—	—	—	—
50	—	—	11·9	2·62	—	—	16	3·00	16	3·50
60	—	—	11·2	2·72	15·7	2·55	—	—		—
70	—	—	10·7	2·85	—	—	—	—	—	
80	—	—	9·7	3·06	14·8	2·67	—	—	—	—
90	—	—	8·1	3·58	—		—	—	—	
100	—	—	7·8	3·70	14·0	2·82	16	3·00	16	3·50
110	—	—	7·0	4·03	—	—	—	—	—	—
120	—	—	6·5	4·31	11·2	3·45	—	—	—	—
130	—	—	6·4	4·35	—	—	—	—	—	—
140	—	—	6·4	4·36	10·5	3·61	—			
150	—	—	5·9	4·68	—	—	16	3·00	16	3.50
160	—	—	5·7	4·80	9·6	3·91	—	—	—	—
170	—	—	5·4	5·12	—	—	—	—	—	—
180	—	—	5·4	5·20	9·1	4·10	—	—		—
190	—	—	5·3	5·20	—	—	—	—	—	—
200	—	—	5·2	4·24	9·1	4·13	15.6	3·10	16	3·50
220	—	—	—	—	8·5	4·36	—	—	—	
240	—	—	—	—	8·3	4·46	—	—	—	—
250	—	—	—	—	—	—	14·1	3·36	16	3·50
260	—	—	—	—	8·0	4·64	—	—	—	—
280	—	—	—	—	7·6	4·86	—	—	—	—
300	—	—	—	—	7·3	5·02	13·2	3·56	15·4	3·62
320	—	—	—	—	7·1	5·13	—	—	—	—
340	—	—	—	—	6·9	5·28	—	—	—	
350	—	—	—	—	—	—	12·5	3·72	15	3.71
360	—	—	—	—	6·7	5·34	—	—	—	—
380	—	—	—	—	6·7	5 41	—	—	—	
400	—	—	—	—	6·7	5·41	12·2	3·79	14·9	3·73
420	—	—	—	—	6.7	5·41	—	—	—	—
440	—	—	—	—	6 7	5·41	—	—	—	
450	—	—	—	—	6·6	5·47	11·7	3·03	14·7	3·79
500	—	—	—	—	—	—	11·4	4·05	14·5	3·82
550	—	—	—	—	—	—	11·1	4·17	14	3·96
600	—	—	—	—	—	—	10·4	4·36	13·7	4·02
650	—	—	—	—	—	—	10·1	4·50	13·4	4.09
700	—	—	—	—	—	—	9·8	4·61	13·4	4·09
750	—	—	—	—	—	—	9.6	4·70	13·3	4·11
800	—	—	—	—	—	—	9·2	4·70	13·3	4·11
850	—	—	—	—		—	9·2	4·87	13·3	4·11
900	—	—	—	—	—		9·0	4·94	13·1	4·16
950	—	—	—	—	—	—	8·8	5·05	12·9	4·21
1000	—	—	—	—	—	—	8·4	5·27	12·5	4·32

The average life of glow lamps, therefore, is:

Lamps of 1½ watts per candle............ 45 burning hours.
" 2 " .... 200 " "
" 2½ " .... 450 " "
" 3 " .... 1000 " "
" 3½ " .... 1000 " "

SPARKS.

The City Engineer of London, Ont, has prepared a statement of the probable cost of an electric light plant for street lighting.

The Brantford City Council has resolved that the contract for street lighting be granted the Brantford Electric and Power Company for five years, at 23 cents per lamp per night.

The Nova Scotia Power Company has given notice of its intention to operate its lines of street railway by the electric system of motor power.

At the annual general meeting of the shareholders of the Montreal Park and Island Electric Railroad Company, held recently, the following directors were elected: Hon. Louis Beaubien, president, Hon. J. R. Thibeaudeau, vice-president; R. L. Gault, treasurer; Maurice Perrault, secretary, David Morrice, Henry Hogan and M. S. Lonergan.

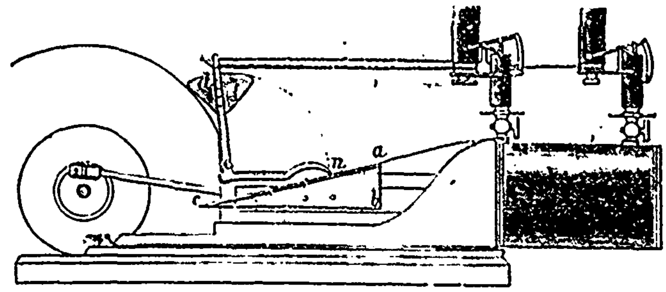
WORKING STRENGTH OF BOILERS.

The following table gives the safe working strength of single riveted and of double riveted boilers of various thicknesses and diameters, allowing a factor of safety of six, and using iron of 50,000 pounds tensile strength per square inch. The single riveted shell is assumed to be 56 per cent. as strong as if non-riveted; the double riveted, 70 per cent.:

DIAM.	THICKNESS	SINGLE RIVETED.	DOUBLE RIVETED.
Inches	Inches.	Pounds.	Pounds.
48	¼	49	62
	5-16	61	76
50	5-16	58	73
	⅜	70	88
52	5-16	56	70
	⅜	67	84
54	5-16	54	68
	⅜	65	81
60	5-16	49	61
	⅜	68	71
66	⅜	53	65
	7-16	62	76
72	7-16	57	71
	½	65	81

A NOVEL INDICATOR GEAR.

In testing an engine at Sibley College, as described in *Cassier's Magazine*, Prof. Carpenter employed a form of indicator gear which, to us, is novel, and as it has some features which should make it useful and convenient, we append a description of it with illustration. To reduce the motion of the piston to the travel of the indicator barrel, there is attached to the cross-head of the engine an inclined plane in the form of a triangle, *a, b, c*, the side, *c, b*, of which, is made slightly longer than the stroke of



the engine, and the side, *a, b*, is made a little longer than the desired travel, or diagram length. Pivoted at the end of the slide bar is a bell crank lever, *d, e, n*, in which *e, d*, is equal to *e, n*. The angle, *a, c, b*, is thus such that its tangent $= \frac{t}{s}$, s being the engine stroke and *t* the diagram length. This, of course, on the basis of the bell crank lever being equal armed.

The end, *n*, of the bell crank, slides on the sloping face of the cam, and the indicator cord is attached at *d*, and the arm *e, d*, is of course to be exactly vertical when the engine is at mid-stroke. The motion is not exactly correct, as shown, for the point *d* rises and falls as it traverses its small arc of motion, but this may be corrected by adding a curved rim to the lever on which the cord may wrap; this rim to be stuck from the centre, e. We have added this circular segment, *f*. Theoretically, too, *n* should be a knife-edge, to ensure accuracy. The convenience of this device is felt when taking many diagrams. The lever, *e, d*, may always be held back, so that *n* is held clear of the cam, and no movement is given to the indicator, and it can be as easily released into working position again. There is no fumbling with cords or taking up slack, and no frantic grasping after the cord hooks or the little tent rope tighteners; but once fixed to length, the indicator cords may be left undisturbed. The inertia effects are said to be small, and there is not a great deal of cord to stretch and render the diagrams untrue. Brass wire is said to be a very unstretchable material for the cord, and we have tried it though not with special success in general work. The device, however, with its fixed and continuously stretched cords, appears to offer a chance for using wire without the disadvantages which, perhaps, others than the writer have found to appreciate it.

A charter has been applied for the formation of a company to build an electric street railway from Galt to Berlin. Mr. T. M. Burt, manager of the Berlin and Waterloo Street Railway, is one of the directors.

The Port Arthur Electric Railway is now completed. It connects the three towns, Port Arthur, Fort William and West Fort William, and is eight miles in length. Trains run between these towns at intervals of one hour.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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Information regarding examinations will be furnished on application to any member of the Board.

THE Toronto electric light and gas companies are said to be greatly agitated by the statement of Mr. E. A. Macdonald that when his canal scheme materializes the millions of dollars invested by these companies will not be worth 5 cents on the dollar.

In order to present our to readers full reports of the recent electrical and engineering conventions, it has been found necessary to add twelve additional pages to the size of this number of THE NEWS. After having done this we are compelled to hold over a number of interesting articles, including most of the papers read at the engineers' convention, and the second instalment of Mr. Tesla's lecture.

The Convention of the Canadian Association of Stationary Engineers in Montreal last month was the most important that has yet been held. A new and valuable feature of the two last conventions was the papers on engineering subjects and the discussion thereon. This feature is one which is directly in line with the main object of the Association, namely, the improvement of the educational status of engineers. To the western delegates the visit to Montreal was one of much pleasure and profit, and the generous hospitality meted out to them by their Montreal brethren, and by the citizens of Montreal, impressed them with pleasant recollections of the occassion. The success of the Montreal meeting should prove an incentive to the officers and members of the Executive and Subordinate Associations to push on with increased earnestness the work in which the Association has already achieved such encouraging success.

THE third Convention of the Canadian Electrical Association, to a report of the proceedings of which much space in this number is devoted, was in every way a most emphatic success. The papers were of a high order, and gave rise to interesting and valuable discussions. By means of papers such as the one presented by Mr. McFarlane, the Association will be the means of collecting much interesting data concerning the early history of electrical matters in Canada which might otherwise be lost, and which will form a valuable record in years to come. The Association was fortunate in having present at this Convention, not only members from all parts of Ontario and a good delegation from Quebec, but also representatives of the Northwest Territories and British Columbia in the persons of Mr. Alex. Taylor, of Edmonton, and Mr. H. W. Kent, of Vancouver. Next year when the Convention shall be held in Montreal, it is hoped that Nova Scotia and New Brunswick will also be represented. The decision to have the next Convention in Montreal will no doubt tend to give the Association a more cosmopolitan character. Our advices are that the selection of that city for the Convention of 1894 has given rise to a feeling of much pleasure amongst the electrical fraternity, and doubtless no effort will be wanting on their part to insure its success. The re-election of the chief executive officers for a third term was to them at least a quite unexpected turn of events, and must be regarded as implying entire satisfaction on the part of the membership with the manner in which they have discharged their duties. The steady increase in membership is a gratifying sign of progress. If during the coming year members will individually put forth effort, the Association at the next Convention will show a membership of 200.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

PROCEEDINGS OF THE FOURTH ANNUAL CONVENTION.

THE Canadian Association of Stationary Engineers met in annual convention in Engineers' Hall, Craig street, Montreal, at 10 o'clock a.m. on Thursday, Sept. 7th. The proceedings, in pursuance of the programme published in the ELECTRICAL NEWS for September, extended over three days. The delegates from the various associations outside of Montreal were met by the local brethren on their arrival in the city and escorted to the City Hotel where arrangements had been made for their accommodation. The various Associations were represented by the following delegates :

Montreal, No. 1.—Bros. J. J. York, H. Nuttall and J. G. Robertson.

Montreal, No. 2.—Bros. A. Latour, R. Drouin and J. A. Hartenstein.

Toronto, No. 1.—Bros. G. C. Mooring, G. Gilchrist and W. Sutton.

Hamilton, No. 2.—Bros. P. Stott and D. Robertson.
Brantford, No. 4.—Bro. T. Pilgrim.
London, No. 5.—Bro. H. Gildhart.
Guelph, No. 6.—Bro. R. W. Green.
Ottawa, No. 7.—Bros. J. ' . Thompson and F. Robert.
Dresden, No. 8.—Bro. T. King.
Berlin, No. 9.—Bro. Angell.
President.—Bro. A. E. Edkins.
Vice-President.—Bro. Geo. Hunt.
Secretary.—Bro. W. G. Blackgrove.
Treasurer.—Bro. R. Mackey.
Conductor.—Bro. C. Heal.
District Deputy (Montreal).—Bro. Thos. Ryan.
" " (London).—Bro. F. Mitchell.
" " (Guelph).—Bro. J. A. Angell.
Doorkeeper.—Bro. F. Robert.
Also Bros. A. M. Wickens and Chas. Kinsey.

The convention opened with the following address of welcome from District Deputy Bro. Thos. Ryan.

"As District Deputy of this city, I am called upon by the brethren of Montreal No. 1 and St. Laurent No. 2 to address a few words to you previous to the opening of this convention.

"At last year's meeting in Hamilton it was decided that the convention of '93 should be held in Montreal, and the brethren here were very much pleased at this decision and thank you for it. I know it is a long distance for many of you to come, but I sincerely hope that when you return you will not regret the labor and inconvenience it has caused you.

"As the humble representative of Montreal No. 1 and St. Laurent No. 2, I now bid you all a cordial and a hearty welcome to our city and our hall. I am pleased to see so many of you present and would be still better pleased to see a larger number. I trust your stay here will be a pleasant one. A committee has been appointed to look after your comfort and entertainment, and I hope they will do their duty. This committee has also published a Souvenir Number of this convention, which we trust will meet with your approval and acceptance. A copy will be placed in the hands of each member of the association. The programme of the three days' proceedings is in your hands, and will be carried out as far as circumstances will permit.

"I hope that the deliberations of this convention will be the means of improving the working of our subordinate lodges, and tend to strengthen and combine the whole body in the bonds of brotherly love and friendship. As a district deputy I have not much to say. Unfortunately this district of Quebec is so far composed of but Montreal No. 1 and St. Laurent No. 2. I hope in another year it may be different. With regard to the two associations of this city the utmost peace and harmony have prevailed between them. They are slowly but surely progressing, not so much perhaps in the way of numbers as in the quality of the material.

"I will not detain you further, but simply close by wishing that you may all have a good time and enjoy yourselves thoroughly, and that the convention of 1893 may always be looked back upon with pleasure and profit to all."

After the appointment of a committee to draft a reply to the address of welcome, and the reception of the report of the committee on credentials, the President, Mr. A. E. Edkins, delivered the following address :—

PRESIDENT'S ADDRESS.

Another year has been added to the life of this organization, since we met last in convention to advise each other and to legislate for the different associations which we are again here to represent.

It is then, brethren, with no small degree of pleasure that I take this opportunity of addressing a few remarks to you, at the commencement of what has every prospect of being the most successful convention that this association has yet held.

When I look around in this hall and see the well-known faces of such old friends of, and indefatigable workers for, our association, as are here assembled to-day, I am at once convinced of the fact that the subordinate associations have used good judgment in their selection of delegates to represent them on this occasion. I am pleased to be able to report that during the past year the work of organizing new associations has progressed favorably, owing chiefly to the able assistance which has been rendered me by the District Deputies. New associations have been organized at Guelph, Ottawa, Berlin and Dresden; all of which are now good, strong associations, and are pushing the good work in their several localities.

A large amount of work has been done towards organization in Deseronto, Galt, Seaforth, Goderich, Halifax, N. S., and several other places, which we trust may be productive of good results in future.

There has been for some time past an Association of Stationary Engineers working in Kingston, Ont., and I have tried to induce them to take out a charter from the Executive Council, and thus become one of us, but unfortunately (I consider both for you and us) I have not yet been successful in doing so. I am given to understand that the Kingston Association is working on precisely the same lines as the C. A. S. E., and will, I trust, be working under one of our charters in the coming term.

I took on myself the responsibility of inviting our brother engineers in Kingston to send a representative to this convention, and I have every reason to believe that in the event of their doing so he will be heartily welcome among us. I trust that during this meeting the members and delegates will be on hand promptly, at such times as may be arranged for the transaction of business, in order that the work of the convention may not be delayed.

I notice in looking over the programme that ample time has been set apart for pleasure and recreation by the Entertainment Committee, so that there will be no need to allow that to interfere with business. There will, I have no doubt, be several matters of importance to the association brought up during this meeting for your consideration, and I would ask you to give the same your most careful attention, keeping in view at all times the fact that you are here as the choice of your respective associations to legislate for and in their best interests, and in doing this you will keep in view the best interests of the C. A. S. E., as a body.

I would respectfully ask this convention to take some steps for the payment to Toronto No. 1 Association of the amount due it for the supplies and stock which were handed over to the Executive when that body was formed. This is a matter which should have been attended to long ago, as it now appears to have assumed the shape of a grievance between some of the members of Toronto No. 1 and the Executive, and is always brought up in the event of an account being rendered by the Executive against Toronto No. 1. I would therefore suggest that this convention take steps towards the payment of said claim. I have noticed during the past year that we are gaining ground with the manufacturers, many of whom have, when requiring an engineer, sent to the association in place of advertising in the daily press. This should be very gratifying to us; and I trust that during the coming term each member will make it his business to bring the association and its work to the notice of his fellows in some way or other. It appears to be a hard matter to gain the confidence and good-will of the Canadian steam user (with of course some exceptions).

We are building up an organization of which we can be proud. Our motto is Safety, Reliability, Economy and Intelligence. Each of these characteristics is indispensable to a competent engineer. The objects of our association are the elevation of the stationary engineer, helping each other in time of sickness, and the education of each other in the most approved and economical methods of steam engineering. We leave the matter of wages to be settled between each individual and his employer, as we recognize the identity of interest between them, and we do not, neither will we, countenance any project or enterprise that may interfere with perfect harmony between them.

One would suppose that any organization working on these lines would at once receive the hearty co-operation of all steam users. Yet such is not the case, and why I am at a loss to apprehend. We invite our employers to become honorary members of the association and attend any or all of the meetings, and see for themselves as to the work we are trying to do. Yet in the face of all this, many of them appear to look on us with a certain amount of distrust. I know for a fact that in the Province of Ontario a great deal of harm has been done by some of the members of the Local House, who, after wasting their own time in filling an arm-chair during the session, have gone back to their constituents and told them how the stationary engineers' "Labor League" had tried to pass a law to compel all steam users to employ only engineers holding certificates, whose services would be worth so many dollars per day. This has been done to my own knowledge, and has been the means of raising much opposition against us in some places.

But this association can afford to ignore such things. We are, as I said before, gaining ground, and a good cause must triumph eventually. We can now count as our friends many steam users and engineers also, who, at the organization of the association, were very much opposed to us, and I firmly believe there is a great future for this association.

I trust to see the day when there shall be an association in every town in Canada where fifteen engineers are employed. The great difficulty in organizing new associations appears to be owing to the fact that in many towns the engineers themselves seem very indifferent toward their own education and advancement in their chosen calling; and in such cases we can only wait till their eyes are opened, so that they can see things in their proper light. In some towns associations might be formed but for the fact that some of the engineers will not join, and try all in their power to throw cold water, as it were, on the scheme, in order to discourage the rest. And some complain of the cost of maintaining an association, and give as their excuse that they can't afford it. This, as you all know, is a mistake, as the associations wherever formed have eventually been the means of doing an amount of good largely in excess of the cost of maintenance. In localities where engineers themselves have no ambition in the way of self-improvement, it would in my estimation be a mistake to start an association, as it would soon be suspended. But in places where even ten good members can be enrolled, who will meet together for mutual instruction in their calling, I believe that such associations would be productive of much good to all concerned.

Now a few words in reference to the future prospects for engineers. It has been said frequently during the last few years that no engineers would soon be required owing to the electric motor coming into use for driving machinery. That many small steam engines have been replaced by electric motors I am well aware; but as a rule no engineer was employed in charge of these small engines, and therefore (with few exceptions) few engineers have been thrown out of employment. It amounts to this: For every h. p. of work performed by an electric motor there might be an amount of power generated somewhere, somewhat in excess of that h. p., owing to loss in transmission, and with very few exceptions, where water power is available, we find the prime mover is a steam engine of the most approved type, and often of from 500 to 1,000 h. p. and upwards, in a central station. Now, from the very fact that these small power steam engines are being supplanted by motors, and large central power stations are being built and fitted up with engines and machinery of the most approved type, there must naturally be a demand for engineers capable of taking charge of such machinery; and those engineers who have made a study of their work and can handle the indicator and demonstrate in a practical way their ability to secure the best results from a given quantity of fuel, will have no difficulty in securing positions at a good salary. I must also, in considering the question, draw your attention to the thousands of engines and plants which are being erected in all parts of the civilized world to supersede that most faithful friend of man, the horse, in operating street and suburban railway cars.

These things and many others, point to the fact that the old reliable machine known as the steam engine is still rising, and even though it has done so much for the human race in the past, the day has not yet come when the inventive genius of man has produced anything to take its place.

Every little while some genius will startle the world with the announcement that he has invented a machine that will work wonders, produce something from nothing, or produce a revolution in steam engineering, but it generally commences in wind and ends in smoke, and the usual result is that after the end, there are some people in the world who have more sense for the future, but sometimes much less money to their credit in the bank.

The Secretary and Treasurer will in due time present their reports, when you will have an opportunity of seeing the financial and numerical standing of the Association.

In conclusion, I must congratulate you on your choice for a place for the meeting of this convention. Montreal is a city of which we all as Canadian citizens feel proud, and we accord her the honor of being the commercial capital of this, the best and most prosperous country on the face of the earth. There is much to be seen in this city to interest engineers, and this, together with the arrangements which our worthy brothers of the Montreal Association have made for our enjoyment during our stay here, will I am sure prove no small factor in making our visit enjoyable. And when we shall again return to our homes we shall bear with us fond and tender recollections of our Montreal brethren, her citizens, and friendships formed and renewed, during the C. A. S. E. convention of 1893.

SECRETARY'S REPORT.

The report of the Secretary, Mr. Geo. Blackgrove, is as follows:—

"In presenting to you my annual report, I regret that I am unable, owing to the neglect of the secretaries of two or three associations, to give you as good a report as I would like. The negligence of secretaries in this respect was referred to at our last convention, in Hamilton. It is both tiresome and annoying having to write frequently for reports from the various associations, and to receive them half filled out. Bro. F. Robert, of Ottawa No. 7, deserves great credit for the manner in which he has written up his report. I wish I could say the same of all secretaries. It must be understood in future that when the Ex. Secretary writes for a report of an association he should receive it, and not be delayed till the last moment and in some cases till the convention has opened. I would recommend that the Ex. Secretary have power to order blank forms, and each association be supplied with the same for making out their semi-annual reports, and to be forwarded to the Ex. Secretary within thirty days.

The past year has been one of success as regards the formation of new associations, no less than four having been instituted, mainly through the efforts of Bros. Edkins, Mitchell, Angell and others. The names of the new associations are as follows: Guelph No. 6, Ottawa No. 7, Dresden No. 8, Berlin No. 9. It is very encouraging to know that engineers are awaking to the fact that something must be done in order to better the condition of steam engineering, and that that can best be done by banding themselves together and helping each other in the knowledge of steam and everything pertaining to the same. I think it will not be long before we will have other associations formed throughout the country.

I have had several letters from engineers asking the necessary information in regard to becoming members of an association.

The associations now in existence have prospered during the year just passed, and it is the wish of your humble servant that they may continue to do so."

On motion of Bro. J. J. York, a resolution was unanimously adopted congratulating the President upon his able address.

The report of the Treasurer showed that the Association's income during the year ending August, 1893, had been $284.89, and the expenditure $108.53, leaving the balance in hand $221.71. The report was referred to the Auditing Committee.

Committees were appointed as follows:—"Constitution," Bros. King, Pilgrim, Sutton, and Gildhart; "Correspondence" and "Good of the Order," Bros. York, Mooring and Latour; "Mileage," Bros. Stott, Hunt and Angell.

It was decided by resolution that the valuable services performed on behalf of the Association by Bros. Edkins and Wickens should be recognized by the presentation to them of suitable testimonials, and that the presidents of associations on retiring from office in future should receive an appropriate jewel.

A committee consisting of Bros. Ryan, D. Robertson, Thompson, Heal, King, Drouin, Angell, Green, Mitchell and Devlin was appointed to devise means of carrying out the wish of the association in these matters.

This concluded the business of the first session.

The afternoon was pleasantly and profitably occupied with a drive about the city, and in making an inspection of the Dominion Line Steamship "Vancouver" and the Montreal Exposition. The members were welcomed and entertained on behalf of the Exhibition management by Messrs. G. W. Sadler and S. C. Stevenson.

EVENING SESSION.

At the evening session Bro. A. M. Wickens read a most interesting paper on "Wasted Heat."

Bros. Heal and Mooring were of opinion that Bro. Wickens would better have interpreted the meaning had he used the word "convection" instead of "radiation," and Bro. Wickens after some consideration, came to be of the same opinion.

In reply to the enquiry of Bro. Mooring, what engine it was that would give one-horse power for each 12½ lbs. of water evaporated, Bro. Wickens stated that the triple expansion engines on some ocean liners showed efficiency at the rate of 12½ lbs. of water per horse-power. Many engines carrying steam at 160 or 170 lbs. pressure showed a consumption of water equal to that rate; many on the other hand, with a pressure of say 130 lbs., did not make such a great showing. Some, even at the present day, showed a consumption of 60 lbs. per horse power.

Mr. Chas. Kinsey then read a paper on "The Duties of Engineers Twenty Years ago as Compared with the Present Day."

A hearty vote of thanks was tendered Bro. Kinsey for his paper.

Mr. Fred. G. Mitchell followed with a paper on "The Steam Engine Governor and its Regularity."

Bro. Edkins stated that the author of the paper to which they had just listened was himself the inventor of a very efficient governor.

Bro. Wickens expressed the opinion that a governor was wanted which would have no spring; such a governor would be more reliable than those at present in use. The slightest inefficiency on the part of a ball governor rendered it valueless. He advised engineers to study carefully the action of governors, and by so doing they would frequently be able to increase their efficiency.

Bro. Mitchell said that if the balls were revolving in a normal plane and if there were no equilibrium created by a spring, the slightest variation caused the balls to ascend to a higher plane. Something was necessary to act in unison with the gravitation, to offer sufficient resistance to centrifugal force.

Bro. York expressed his high appreciation of the value of the papers to which they had listened, and thought the Montreal associations had not paid sufficient attention to the discussion of engineering subjects.

Bro. Green said a spring with sufficient tension to draw back the governor was essential.

Bro. Hunt's experience with engines of various kinds lead him to believe that a spring was necessary where the speed was variable.

The session closed with a vote of thanks to Bro. Mitchell for his instructive paper.

SECOND DAY.

Fraternal greetings were read by the President from the National Association of Stationary Engineers in convention assembled at Cleveland, Ohio. A fitting response was wired to Cleveland.

The report of the Mileage Committee showing the mileage of delegates to amount to $105.15, was received and adopted. To this amount was added on motion of the President the mileage of the delegate of the Kingston Engineers' Association, Mr. Devlin, who attended the convention by invitation of the Executive.

The report of the Auditors was adopted.

Bro. Hunt suggested that the Association should publish each year a souvenir book, similar to the one got up by the Montreal brethren for this convention.

Bro. Mackey moved that a Committee consisting of one member from each Association be appointed to canvass for advertisements and supervise the publication of the book.

This motion was defeated in favor of an amendment by Bro. York that the matter be left entirely in the hands of the Executive.

Bro. Robertson suggested the desirability of forming engineering libraries in the various localities for the benefit of members of the different Associations.

A letter of acceptance of the kind invitation tendered the Association by Prof. Bovey to inspect the buildings and laboratories of the Department of Applied Science of McGill University, was ordered to be forwarded to that gentleman.

A photograph of the London Association was presented by Bro. Mitchell to the Montreal Association.

At the afternoon session the convention adopted the report of the Committee on Constitution and By-laws which recommended that the article regarding the sending of delegates to the Convention should be amended to read "Each association of twenty-five members should have one delegate, and one delegate more for any fractional part of twenty-five, always provided that the fractional part should not be less than ten, and always provided that no association have more than three delegates."

It was resolved at the suggestion of Bro. York, and on motion of Bros. Thompson and Latour, that a fine of $1.00 should be imposed on Secretaries of subordinate associations who may fail to send in proper returns, and that every member should understand that it is regarded as his duty to address the meeting once at least on some subject.

To the Secretary and Executive was delegated the appointment of a committee to print the "constitution" in pamphlet form, which the subordinate associations might purchase at 10 cents per copy.

In a discussion which took place at this stage on the best class of steam engine, Bro. Wickens said that only those who had had especially good opportunities for observing could feel justified in saying which was absolutely the best. The report of the manufacturers was scarcely to be relied upon. He believed that for railway work the upright triple expansion engine was the best.

Bro. Hunt remarked that at Chicago, where they had all sorts of engines, it was a growing conviction that the triple expansion was not entirely satisfactory. For railway work no doubt it was good, but recent tests showed that the moment the load was thrown off the intermediate cylinder formed a drag upon the high pressure. For this reason engineers were beginning to look with doubt upon this form of engine for general purposes.

After the close of the session the delegates were taken to Lachine and given a run down the rapids.

THIRD DAY.

The first business before the convention was the election of officers which resulted as follows :—

President, Bro. Geo. Hunt, Montreal, (by acclamation); Vice-President, Bro. Wm. Sutton, Toronto ; Secretary, Bro. John J. York, Montreal ; Treasurer, Bro. Geo. Blackgrove, Toronto ; Conductor, Bro. T. King, Dresden ; Door-keeper, Bro. F. Robert, Ottawa.

Votes of thanks were passed to the retiring secretary, Bro. Blackgrove, and to the Scrutineers, after which the delegates visited McGill University, and under the guidance of Prof. Nicholson were shown many objects of interest.

On the opening of the afternoon session, Mr. W. B. Shaw read an instructive paper on "Electric Motors."

In reply to Bro. Wickens' request for an easy method of testing the loss in motors, Mr. Shaw said that many instruments were required for the purpose. About 80 per cent. was he thought about the present average efficiency of motors.

Bro. Wickens in moving a vote of thanks to Mr. Shaw for his paper, said he did not think engineers need fear the introduction of electricity. No doubt in some places where but little power was required, motors were decidedly coming into use, but it was only in such comparatively small places.

Bro. Kinsey said a 15 h. p. engine would cost about $750 per year. But according to Silvanus P. Thompson, who certainly would not be inclined to minimize, the ordinary efficiency of an electric motor is sometimes 60 per cent., very often 70 or 80 per cent., and by no means infrequently as low as 50 per cent. A 15 horse-power motor often really means, therefore, a 7½ horse-power motor, and at this rate would cost $1,500 a year. An engine would heat, or help materially in heating, a building in winter, whereas when electricity was employed this was an extra expense. Armatures also were so liable to burn out. An armature of a 15 horse power motor in one year would cost as much as an engine in twenty years, and it was not nearly as reliable as an engine. In small shops where only two or three horse-power was required, the motor was a fine invention ; also in places where shafting could not be put up. But a motorman's time was entirely taken up, whereas an engineman had plenty of time in which to do other work.

Bro. Edkins wished to know what time the previous speaker considered that engineers had for other work.

Bro. Kinsey stated that he had intended to refer to engineers in charge of small plants.

Bro. Mooring said that a plant of over 10 horse-power was certainly cheaper than electricity, and electricians admitted this. With regard to the heating of an ordinary building by means of the engine, only a part of it could be heated by exhaust steam.

Bro. Sutton did not think engineers had much to gain from the study of electricity. Steam was easier to handle than electricity, and if ever he touched electricity, he trusted it would be with only one hand at a time.

Mr. Shaw responded by saying that for his part he never cared to come near a steam engine unless there happened to be a stone wall between it and himself.

Bro. Hunt said that in the use of both steam and electricity precaution was necessary.

Bro. York referred to the need for better ventilation in manufactories. As a remedy he suggested that steam pipes be put in the basement, all in one room and a pipe carried from there to the room requiring heating, the air being propelled by means of a fan. From the top of the room a pipe should carry the foul air to the outside. This would secure good ventilation, as well as heating. Some might think the above was an expensive way of heating a building. The first cost was perhaps greater, but the cost of maintenance afterwards was certainly less. The association should endeavor to induce manufacturers to initiate methods of heating their buildings. The object of keeping the windows of factories hermetically sealed seemed to be to save heat.

Bro. Nuttall thought it was rather due to ignorance of health requirements.

Bro. Robertson instanced a case which had come under his attention in which the heating of a factory building was done by means of a coil consisting of 7,500 feet of one inch pipe, and a fan running 210 revolutions per minute, which induced a constant supply of freshly heated air in the building, and in moderate weather was very effective and easily regulated.

A unanimous vote of thanks was on motion of Bro. Mooring, seconded by Bro. Wickens, accorded to Mr. Shaw and Bro. York.

On motion of Bro. Mooring, seconded by Bro. Gilchrist, the Executive was instructed to pay on account of its indebtedness to Toronto No. 1, the sum of $25 per year.

The City of Toronto was selected as the place for holding the next annual Convention.

The newly elected officers having been installed and votes of thanks passed to the retiring officers, Bros. Edkins and Wickens were each presented with a testimonial in pursuance of the resolution passed at a former session.

District Deputies were appointed as follows :

Prov. Dist. Dep. for Ontario—Bro. A. E. Edkins.
" " " Quebec—Bro. Thomas Ryan.
Dist. Dep. for Hamilton—Bro. R. Mackie.
" " London—Bro. F. G. Mitchell.
" " Guelph—Bro. J. A. Angell.
" " Montreal—Bro. J. A. Hartenstein.
" " Toronto—Bro. A. M. Wickens.

The Committee appointed to draft a reply to the address of welcome submitted the following :

"In reply to the address of welcome tendered the Executive Council and visiting brothers by Dis. Dep. Bro. Thomas Ryan to this great, prosperous and beautiful city, the commercial metropolis of our fair Dominion, a city whose fame for hospitality is not excelled in the world, we desire to express our sincere and heartfelt thanks. That our visit will be instructive, profitable and pleasurable we feel confident. The arrangements made for our comfort and convenience and for the transaction of our business show great forethought on the part of your committee appointed for that purpose, and we are sure that they have not been excelled or even equalled in the annals of our conventions. That the convention of 1893 will be long looked upon as a landmark in the history of our progressive order is a certainty. One of the many pleasurable surprises, which is a new feature of more than ordinary merit, is your beautiful souvenir. For its compilation and mechanical work it cannot be excelled, and in circulating it among our employers and brother engineers, we have no hesitation in stating that the results for the benefit of our Order will be immeasurable.

(Signed) CHAS. HEAL.
A. M. WICKENS.

Bro. Edkins stated that a balance of $50 remained in the treasury.

After having passed a vote of thanks to the Entertainment Committee, the proceedings of the convention terminated.

THE ANNUAL DINNER.

Of the many features of the Stationary Engineers Convention none possessed half as much attraction from either an instructive or pleasure point of view, as did the banquet on the evening of the 8th, tendered to the visiting delegates by Montreal Association

No. 1. There was a large attendance and the speeches of the evening were both practical and interesting. In all 60 persons sat round the festive board in the spacious dining hall of the City Hotel. An excellent menu was provided by Mr. Lewis, proprietor of the hotel, and nothing conducive to the thorough enjoyment of the evening was omitted. Everybody was good natured, and soon caught the spirit of the occasion, and from the first word spoken in opening the entertainment until the last note of the National Anthem died away, the programme was carried out in a delightful manner. Mr. Joseph G. Robertson, President of Montreal No. 1, occupied the chair. On either side of him at the head of the table were, President A. E. Edkins; Past President, A. M. Wickens; Vice-President, Geo. Hunt; Secretary Jno. J. York; and Mr. Wm. Furgeson, Mr. Fred. Lytle, Mr. Frank Boyd and Mr. Thos. Clarke, representing the Brotherhood of Locomotive Engineers. Among the invited guests were, Messrs. Hugh Valance, Walter Laurie, P. Cowper, O. E. Grandberg, W. B. Shaw, J. A. Darling, W. E. Gower, S. Fisher and others. Letters of regret at not being able to attend and bearing good wishes to those present, were read from Messrs E. O. Champagne, A. Holden and Captain Wright.

At 10.30, ample justice having been done to the bill of fare, the chairman opened the after proceedings by proposing the toast "Queen and Country," which was honored in usual style. With the next toast, "Steam and Electrical Engineering," were coupled the names of Messrs. Walter Laurie and W. B. Shaw. The toast was honored with gusto and cheers. Mr. Laurie replying on behalf of steam engineering expressed his pleasure at being present. He had attended the first dinner ever given by Montreal No. 1, and had attended several since. Each was an improvement on the preceding ones and kept pace with the general progress in engineering. "My greater reason for accepting the present invitation was knowing that there were to be so many outsiders present, I thought of hearing something of valuable interest and did not expect to be called upon to say anything myself. I can only congratulate you on the progress your association has made. You deserve great credit for the immense strides you have made. I believe those here have those qualities necessary to make competent engineers. Younger men think that when they get into an association they can get such wages as they want. This society is not of that kind, but the members are studying to advance the interests of themselves and their employers alike. Young men are apt to think that so long as their bosses take notice of them they are all right, but the only true way to get along is to render yourselves indispensable to your employers." (Applause).

Mr. Shaw in reply said: "The toast you ask me to reply to is one I should have preferred to have been replied to by some older member of the electrical fraternity, but like the old lady and the pill, the sooner taken the sooner over. To my mind Steam, Hydraulic and Electrical Engineering are like Faith, Hope and Charity. They go hand in hand. To cite a close alliance between them, I might mention the equipment of the Crocker-Wheeler Co.'s factory in New Jersey, where one large engine in the basement is used to drive an electric generator, the power from which is conveyed by means of wires direct to each machine. I mean there is absolutely no shafting or belting. The motors which operate the lathes and other machinery are located in the head-stock and are indirectly coupled, the speed being controlled by a regulator attached to its supports. In this way each machine is under individual control. Higher efficiency is claimed for this over the old method of belting and shafting. Electrical engineering will call for higher efficiency in steam engineering. Mr. Shaw concluded by promising a hearty welcome to any of those present who should attend any of the meetings of the electrical club of which he was honorary president.

The toast "Manufacturing Interests," was next responded to by Mr. Hugh Valance. He thought it was taking advantage of guests to invite them to the banquet to have a good time and then take it out of them in speeches. On several former occasion he had been called upon to deliver addresses and lectures on steam boilers and engineering to the members of the Montreal Association. At first they did not seem to understand what he was talking about, but the last time he had been met with a shower of questions from his audience which clearly proved that they had been educating themselves. Now they were leading engineers. At first they did not seem capable of taking the capacity of an engine and boiler, but now they were capable of doing anything necessary around an engine house. Speaking once to a manufacturer who had an engineer from this association, but who was just then away, this manufacturer confessed that he had been forced in the meantime to employ an incompetent man. This man was burning 300 pounds of coal more and not keeping up steam so well as the absent engineer. There should be a Dominion license law for steam engineers. There was one for marine engineers. A certificate was required to run even the smallest yacht, but any man can take hold of a stationary engine to the imminent danger of human life. He urged the Association to petition the government to enact a license law. Continuing Mr. Valance said, "I agree with Mr. Shaw that electricity will not interfere with steam engineering. I believe that so long as grass grows and water runs steam will be necessary. Engine makers need have no fear of making too many engines or losing their trade. There was a complaint that the western men were building too many cheap engines. Well all I can say is, that if our western friends make cheap engines and cheap boilers we have men here capable of running them" He urged the association to ask the city council of Toronto to appoint one of its members to assist the boiler inspector. There were a great many needless questions asked by the civic board of examiners. All these things are very well to know, but not nece ry for the running of an engine. When a man is refused a certificate for not being able to tell the strength of a seam of a boiler it is high time that other examiners be appointed. (Applause).

Mr. Darling expressed himself as surprised that manufacturers did not take more interest in the association. Engineers are and must be better qualified to-day than in former days. The engines were of a higher grade and more skill was required to run them. (Applause).

"Our Sister Associations" brought the first reply from Bro. Wm. Sutton, Toronto No. 1. He said: "I was just making the remark a while ago to my left hand neighbor here, Brother Mitchell, that I was placed in an awkward position. It is the lot of all of us to be sometimes placed in an awkward position. The reason of my making this remark was that on each side of me was stuck a bottle of beer, and as I don't use it, you can see that I was in a very awkward box indeed. I thought the best way out of the scrape was to leave it alone. Well that is just what I am going to do now. I am in an awkward shape with regard to my speech. I will not, like the brothers who have spoken before me, say that I did not expect to be called on to speak. I did expect to be called upon the moment I knew that I was coming to Montreal. With that expectation I went to work to prepare a speech. When I came home I found the ELECTRICAL NEWS lying on the table. I took it up to read it —I generally do so before supper—and happened to see the programme for this convention in that journal. I looked at it, and looked again. I deducted as I thought all the typographical errors and exaggerations and then considered what was left a pretty good programme. I tried my speech but could not think of anything but programme. Well, I said, I will let it go, I can prepare it on the train. I got on the train for Montreal without any speech; I could not fix it. I arrived in Montreal and I had no speech, so I gave it up. I came, here, and what do I find? Why instead of errors and exaggerations in the programme, it has been carried out to the letter, and far exceeds my greatest expectation. With regard to Toronto No. 1, I should be able to make a good speech. When it had been organized about a month I applied for admission and was accepted as a member. Toronto No. 1 had, if you will allow me the expression, "a hard row to hoe" But we were determined to conquer or die, and to-day Toronto No. 1 is recognized in Toronto by our steam users. When they want an engineer upon whom they can rely to earn his wages they apply to our association. They are satisfied to-day that their interest depends on the knowledge and ability of their engineer. Toronto No. 1 is now in a prosperous condition, and I am glad to know that Montreal is in the same if not a better position. The day has come when the manufacturers recognize the importance of the Association. The day must come when we will have a regular engineers' license law. It was in Toronto No. 1 that the idea of the examining board originated. Brother Edkins and myself tried to get the government to give us a compulsory law. They would not do so. The next best thing to do was to get legislation for examination of voluntary applicants. We succeeded in this. At first very few came up for examination; now they go by dozens, (I was going to say hundreds), and we have now certificates hanging up in a number of engine rooms. I would like to see a compulsory law. It would benefit both the engineer and the manufacturer. I believe that the prosperity of our manufacturing enterprises depends largely on their having intelligent engineers. If we could examine the books of failing manufacturers we should find that the great cause springs from the engine room or boiler room. I have reasons for holding this opinion. When you visit a factory and it is necessary to stumble down into a dark cellar to the engine room and find a dirty engineer who, when he has put a few coals on the fire, if he has any time to spare, is required to pile up lumber and rubbish here and there, to assist in packing and boxing, and has no time to do anything about the engine, you will generally find that that manufactory has not been so prosperous as it might have been. I have made these remarks just as they came to me, and if I have not made a good speech it is not my fault. I shall, if I live a hundred years longer, always remember this visit to Montreal. When I go back I shall tell those in Toronto of the great kindness shown me by our friends in this city. I feel fully ten years younger than when I reached here. I thank you for the way you have honored this toast and for the attention with which you have listened to my remarks.

Bro. Mitchell replied on behalf of London No. 5. He said there was nothing for him to say on the general aims of the Association, but as to the London Association he would say that it was progressing well. They were getting new members continually He thought they would soon have certificates made compulsory. There was a law in most cities that no gunpowder should be kept within a certain distance from the city limits, yet many of the engines were worse than gunpowder.

Brother Green was happy to say a word for Guelph No 6. He was the originator of the Association. He had got seven engineers to consent to join. He had Edkins to come to Guelph, and on the night of the organization they had sixteen instead of seven. Now the number was twenty six. When the examining board was established he was anxious to try for a certificate, but was afraid, being no scholar. However he tried and came off with flying colors with a second-class certificate. He could not find words in which to thank the Montreal brethren for the way they had been treated.

Brother King replied on behalf of Dresden No. 8. This was the first time he had represented any such organization. Dresden started in May last with sixteen members, now they had eighteen.

Brother Pilgrim, Brantford No. 4, said that No. 4 was progressing favorably. They were united but small in numbers.

Brother Thompson, Ottawa No. 7, remarked that after so many speeches nothing was left for him to say. He was happy to be present, and hoped that the time wou'd pass more quickly this year than last, so that they in Ottawa could return the compliment.

Brother Drouin was called up to reply for Montreal No. 2, but not being adept at English he asked Brother York to reply for No. 2. Bro. York believed that Montreal No. 2 had labored under more difficulties than any other associ ition, but it had got from under the burden. It had shaken off its load and was now as strong as any. There was every day evidence of the work it had done.

Brother Edkins in proposing the health of Montreal No. 1, referred to the splendid exhibit of the Association at the Montreal Exhibition as an evidence of theg reat progress made in engineering, and as a proof of the progress of the two Montreal associations. The toast was heartily drunk and Brother Nuttall was the first to respond. He said: Montreal No. 1 was not so prosperous as Brother Edkins had said it was. Ten per cent. of Montreal No. 1 were doing the thinking for the rest. They had a great many know-alls, a great many guess-alls, a few nonentities and a few rationals. Some get sick when meeting night comes round. At least they think they are sick. We have men of large heads, men of light hearts and big ones, men of great mind. Montreal No. 1 was progressive. They were determined to be in as good a position as any association in the country. He had no idea the west could produce such men as they had sent down amongst them. He was not given to flattery. He knew them or had heard of them all, but he was disappointed. They had proved better men than he thought they were. Montreal No 1 had tried their best to make things pleasant for them and hoped to try again before long.

Brother Ryan also in a few well chosen words thanked those present for the way they had honored the toast of the health of Montreal No. 1. The next toast, "License Law and Inspection," was coupled w th the name of O. E. Granberg, inspector for the Boiler Inspection and Insurance Co., of Canada, who said in reply that he could not say that he did not think he would be called upon to say something and the chairman had kindly furnished him with a subject. He would touch upon but a few points. In Montreal there was a license law and an inspection law. There was also a provision in the Quebec factory act for inspection of boilers. To illustrate the great futility of this inspection, he had been called upon to examine a boiler for insurance. He was shown a certificate of inspection by boiler inspector. Said he, "I found a steam plant with four boilers connected with but one safety valve, and that on the steam pipe with two stop valves between it and the boiler. The steam guage was on the steam pipe between safety valve and the engine. If a valve should be shut, two boilers would be left without either safety valve or guage. I refused the insurance. The proprietor told me that he had run this machinery for 25 years without any accident. Insurance Companies can always protect themselves in cases of this kind by refusing to take the insurance. I reported this case to the factory inspector but no notice was taken of it. All this goes to show that a license law is as necessary as an inspection law. I am in favor of a Dominion license and inspection act. If engineers would bring all their combined powers to bear on the Dominion authorities, instead of dividing themselves up and trying to influence the Provincial or municipal governments, I believe that they would be able to accomplish something. Some engineers are progressive, and many have asked me where they could get a certificate. Others are backward and incompetent. I think that the manufacturers will soon see the practicability of engaging competent and intelligent engineers. Seen in the right light, they will soon learn that for every dollar saved directly by engaging cheap men, they will save ten dollars indirectly in fuel and plant.

"The Brotherhood of Locomotive Engineers," was responded to by Mr. Fred Lytle, President of that order, Mr. Robert Whitehead, the pioneer engineer in Canada, and by Mr. Thomas Clarke, chief engineer of the Bro Loc. Engineers., Montreal division. The latter, speaking at some length said: The object of the C. A. S. E. and the B. L. E. was similar; both were educating themselves to get to the highest position in their trades. Their positions however were different. The stationary engineers had only their employers to please, while locomotive engineers must please a number of persons. It was therefore necessary for them to band together to protect themselves. There would be no trouble if they had only one man to deal with as the stationary engineers had They would not think of forming a labor organization in that case There were a number, however, who got to the head of railway departments for no other reason than that they owned a large amount of the stock. All these people wanted was a return on that stock, and they did not care where it came from. There never has been a cause of conflict between the locomotive engineers and practical men. It was those who by reason of great inherited wealth had been able to procure control, that had caused all the trouble. Where there were practical men to be dealt with they were generally succcessful in their demands for their rights. Those who know nothing of the matter but look for the best possible interest on their stock, make the trouble. The locomotive engineers had pledged themselves to make no trouble during the Fair at Chicago. That promise had been faithfully carried out. There has been cause, many causes, but they did not want to side-track the public going to and from the fair They were going to carry out their agreement in this respect until the Fair closed. The Toledo and Ann Arbor road had withdrawn their action against Chief Arthur. The railway dare not take it before the courts of the country. The report that the company had been paid a sum of money to discontinue the action was false. As to electricity it was yet in its infancy. They had yet much to expect from it, but he quite agreed with previous speakers that steam engineers had nothing to fear from it, and they had steam engines that can take passengers over the road as fast as the road would permit them to go. They need have no fear of being out of work during their life time. They had not a road bed capable of sustaining a speed of 100 miles per hour. He had watched the progress of the Canadian Association of Stationery Engineers. They could be trusted with the lives and property of the general public. Steam engineers controlled one of the vastest powers on earth, a power of which no man can conceive the force. He thought they would soon be called upon to pass an examination. Let them study their profession and not allow any inspector to catch them napping, but be ready to explain anything that they might be called upon for. If they made themselves valuable men there would be no trouble about wages. If they (both associations) put their heads together they could obtain legislation that would mutually benefit both stationary and locomotive engineers.

"The "N. A. S. E." was the next toast, and Brother Wickens, as an honorary member of that association, responded. He was glad at any time to respond for the N. A. S. E. It was organized nine years ago in Detroit. It was an educational order like the Canadian Association. It now numbered over 7000 members and was doing a great work for engineers; and it must not be forgotten that it was doing much for employers as well. They were converting employers very fast. Employers were beginning to see that they were working along right lines. They were taking steps to place the handling of steam in safe hands. The matter of the amount of steam used was appalling. The engines in use in the United States and Canada amounted to 8,000,000 horse power; in Great Britain it was 7,000,000 horse power; in Germany, 4,500,000; in France, 3,500,000. This did not include locomotive engines, which on this continent numbered over 70,000. Every one of these engines was a little powder keg if not properly handled. An ordinary five foot boiler had a stored energy equal to 42 pounds of powder. The reported explosions average about 152 yearly: many do not get into the papers. The number of people injured every year amounts to from four to five hundred. The killed reaches two and three hundred annually. All this could be prevented if the proper parties were there to do it. Four-fifths of the engines now in use had been built within the last twenty-five years. This shows the rapid growth of steam engineering. To manage these, men were required. The demand was so great that incompetent men had to be called in to take charge. As engines improved it required men of greater ability to take the management thereof. Nearly all those competent men are members of our associations. He knew of several instances where the salary of engineers had been increased without demand. Referring to license laws, he said the marine engineers had a law, and he wanted to know why the life of a man walking down the street was not as much worth protecting as that of a man crossing the river in a ferry boat. There were thousands of people on the street as well worthy of protection as the forty running the rapids. He thought that if they pushed for it they could get a law. The Americans had been working along the same lines as themselves. All their cities had local license laws, the result of agitation on the part of the associations. Next year they will have eleven States at work on license legislation, and they will surely be successful in some cases. The Americans are exactly like us—we talk alike, look alike, with only a little imaginary line between us. The Americans are willing to help us along. The speaker thanked those present for the manner in which they drank the toast to the N. A. S. E., and thanked them for coupling his name with the association.

The toast of the C. A. S. E. brought President A. E. Edkins to his feet. He said:—In replying to the toast of the Executive Council of the Canadian Association of Stationary Engineers, which has just been proposed, allow me, as President of the executive, to thank you most sincerely for the kindly manner in which you received the same. The work of the executive is to take the general supervision of all subordinate associations and to establish new associations throughout the country, wherever the number of engineers employed may warrant so doing. As I stated in my address at the opening of the convention, the work done by the executive during the past year has been very successful. It has, possibly, not been so successful as the more enthusiastic of us might wish. I myself, for instance, made up my mind, when the association did me the honor at last convention of placing me in the chair of the executive, to organize at least double the number of associations that we have done this year, but when I made that resolution I did what many have done before me—counted my chickens before they were hatched.

When we take into consideration the small number of men engaged in our profession on which we can draw for our membership, compared with the vast number that other organizations have, it will be evident at once that we can never (or at least for a number of years) expect to have such a large membership as the N. A. S. E., for instance, can boast. Taking all these facts into consideration, I think we can with reason congratulate ourselves on the number of new associations which we have added to our membership during the past term. The Executive has spared no effort in making this year a prosperous one in the history of the Association, and I desire to take this opportunity of returning my sincere thanks to the other Executive officers and the District Deputies, Bros. Ryan, Angell and Mitchell, for the strong support and able assistance which they have given me, and I respectfully solicit a continuance of the same to my successor in office.

The organization of the C. A. S. E. was, in my estimation, a grand thing in the interests of the engineers of this country, and I feel that every practical engineer should come forward and join us, so that we may not only be able to assist him, but also that he may give us the benefit of his experience in our meetings. It is in the hands of the engineers of this country to make their chosen calling rank high in the estimation of the steam users and our fellow citizens, by proving to them that we are men who are endeavoring to raise the standard of our calling to the proper level which it should occupy among the trades of our country. The C. A. S. E. has done more for the engineers in Canada, than most people are aware; it has proved to the public through the reports of its meetings and discussions in the papers, that the stationary engineer of to-day is a much more important person than he was 20 years ago. The sharp competition in all lines of business at the present time requires that manufacturers shall reduce the cost of production of their various lines, to the lowest possible price, and the generation and utilization of steam becomes a most important factor in this direction. They have therefore been compelled to install steam plants and machinery of the most economical and improved type to gain the desired end. Now this is all very good, and is in the proper direction, but as you all know, these modern high class machines, with their delicate and complicated valve gear and motions soon become as wasteful and expensive as the old class of engine unless the engineer in charge is competent and well up in his business.

The object of this Association is to help to educate its members in the profession of steam engineering, in order to fit them for positions as stationary engineers, and there are not wanting instances in our membership to prove that the association is nobly fulfilling its mission. I am fully convinced, Mr. Chairman, that it would be a hard matter to fully estimate the benefits that have in the past accrued, and will in the future also, to the steam users and the stationary engineers of Canada as a result of the C. A. S. E.

Vice-President Hunt also replied to this toast. The President deserved the thanks of all for the way he had worked.

To "Our Guests," Mr. Samuel Fisher and Mr. W. E Gower made suitable replies, wishing long life and prosperity to the Canadian Association of Stationary Engineers.

"The Press" was briefly responded to by Mr. W. H. Sibly and Mr. F. B. Wilson.

After the health of the Souvenir Committee and experience of the different members in getting through the work, all joined hands and sang "Auld Lang Syne," when the most enjoyable event of the most successful convention of the Canadian Association of Engineers was brought to a close with "God Save the Queen," and cheers for Montreal Nos. 1 and 2.

At intervals during the evening the proceedings were enlivened by musical selections by Bros. Mitchell, Blackgrove and D. Robertson.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

TORONTO NO. 1.

Arrangements are being made for holding open meetings once a month during the autumn and winter. At each of these meetings an address will be given by an experienced engineer on a subject related to steam plant management. The first of these open meetings will take place in October, and will be addressed by Mr. Chas. Heal, his subject being "Heat." At the November meeting Mr. A. M. Wickens will speak on "The Expansion of Steam." These meetings, to which every person interested in steam engineering is invited, will no doubt be productive of much interest, and should be the means of adding many new names to the membership roll of the Association.

LONDON NO. 5.

On the 29th of August the members of the above Association tendered a farewell banquet at the Western Hotel, to their president, Mr. Fred. G. Mitchell, on the eve of his departure from the city to assume the duties of a position with the Boiler Inspection and Insurance Company, of Toronto. Congratulatory speeches were made by Brothers Risler and Taylor, and replied to by the retiring president. An evening of much enjoyment was spent, and Mr. Mitchell carries with him the best wishes of every member of the Association for his future success.

THOMSON VS. ROYAL ELECTRIC CO.

It is reported that Mr. Fred. Thomson has entered an action against the Royal Electric Company, for wrongful dismissal. It is said that Mr. Thomson was working under a five years' agreement with the Company at a fixed salary, and that he will endeavor by legal process to enforce payment of his salary for the full term of the agreement.

As a means of cooling bearings in any place where air-compressors are used, or where an air supply is convenient, it would be well to conduct a pipe so as to blow air upon the heated bearings. Air has an additional advantage in the fact that it cools in expanding so as to still further aid in the cooling of boxes where the scheme is applied.

SPARKS.

The Ottawa City Council has resolved that all teleppone wires must go underground.

Mr. A. E. Sulis has sold his electric lighting plant at Bridgetown, Nova Scotia, to Mr. J. W. Beckwith.

Messrs. Leason & Lineham have been granted a franchise for an electric street railway at Calgary, N. W. T.

Geo. Boswell, of East Toronto, was committed for trial by a local magistrate recently, on the charge of shooting at conductor Percy Lynn, of the Toronto and Scarboro' Railway.

It is reported that the Brush Electric Co. may start a manufactory at St. John, N.B. The names of Mr. G. F. Walker of, St. John, and Col. N. S. Rogers, of Cleveland, are connected with the enterprise.

H. Pim has arrived in Vancouver from Toronto to assume the management of the Canadian General Electric Company, Mr. Maxwell, the former manager, having removed to Portland to manage the Portland branch.

After considerable delay in obtaining the necessary plans for the engine and dynamo foundations, arrangements are now completed for the electric light service to be installed by the Waterworks and Electric Light Co. of Lethbridge, N. W. T.

The Canadian General Electric Company have decided to consolidate the various departments of their manufacturing business at Peterboro'. The Council of that town have granted the Company a bonus of $5,000 as an inducement to carry out this step.

TRADE NOTES.

The Kay Electric Works, of Hamilton, recently installed an arc and incandescent plant for lighting the mills and yards of Messrs. John Smith & Son, of Callender, Ont.

One of the heaviest locomotive freight engines in Canada, is at present under construction at the Kingston Locomotive Works. The cylinders will be 18 by 26 inches. The engine will be capable of hauling up an ordinary grade 45 loaded cars.

PUBLICATIONS.

A Directory of street railway exhibits at the World's Fair has been compiled and published by the *Street Railway Gazette*, Chicago.

The Penberthy Injector Company, publishers of the "Penberthy Bulletin," intend in future to publish extracts of interest to engineers taken from the leading mechanical journals, and will send a copy of the publication free to any engineer who may write for it.

PERSONAL.

Mr. Warren Y. Soper, of Ottawa, is at present in Paris.

Mr. John Patterson, of the Hamilton, Ont., Radial Electric Railway, was a recent visitor at the World's Fair.

Ald. Wm. Bell has been appointed successor to the late E. A. Wills, as Chief Engineer of Government Buildings at Toronto.

Mr. J. B. Griffith, manager of the Hamilton Electric Railway Company, accompanied by Mrs. Griffith, is at present on a visit to California.

Mr. F. W. Martin, who has been for some years with the Toronto Electric Light Company, has been appointed manager of the Hamilton Electric Light and Power Company.

Mr. Dan. Thomson, late manager of the Hamilton Electric Light and Power Company, was recently made the recipient of a handsome silver fish and carving set, together with several articles of silver and a sealskin purse for Mrs. Thomson. The presentation was made by Mr. Robert Dickinson, chief engineer, on behalf of the employees of the Company.

Mr. Alex. Taylor, of the Edmonton, N. W. T., Electric Light Co., recently spent a couple of weeks in Eastern Canada with the purpose of purchasing the necessary machinery for greatly increasing the capacity of the Company's plant. Mr. Taylor has been a resident of Edmonton for the last fifteen years, and this is the first time that he has visited the eastern provinces during that period. He came just in time to participate in the C. E. A. convention.

OBITUARY.

It is with much regret that we announce the death of Mr. J.A. Angell, President of the Guelph C. A. S. E. Mr. Angell had just returned from the convention at Montreal when death overtook him. During his stay in Montreal, he was too unwell to take as a part as he would have desired in the proceedings of the convention. His brethren did all they could for his comfort while in Montreal and on the return trip as far as Toronto, where they saw him safely on board the train for his home at Guelph. The deceased had been in poor health for a couple of years, and in making the journey to Montreal, he no doubt overtaxed his strength. With the exception of a couple of years spent on the Grand Trunk Railway, Mr. Angell was employed during the twenty years of his residence in Canada, as Chief Engineer at the Agricultural College at Guelph. He was a good mechanic and engineer, and an enthusiastic worker in the C. A. S. E., of which he was District Deputy and Executive President for Guelph.

The municipality of London West has granted a franchise to Col, Clark, representing a Detroit Syndicate, for the construction of an electric railway.

MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 6.10	P. M. 10.40	4.30
2......	" 6.10	" 11 50	5.40
3......	" 6.10	A. M. 12.50	6.40
4......	" 6.10	" 1.00	6.50
5......	" 6.10	" 2.10	8.00
6......	" 6.10	" 3.20	9.10
7......	" 6.00	" 4.30	10.30
8	" 6.00	" 5.00	11.00
9......	" 6.00	" 5.10	11.10
10......	" 6.00	" 5.10	11.10
11......	" 6.00	" 5.10	11.10
12......	" 6.00	" 5.10	11.10
13......	" 6.20	" 5.10	10.50
14......	" 7.00	" 5.10	10.10
15......	" 7.40	" 5.10	9.30
16......	" 8.40	" 5.10	8.30
17......	" 9.40	" 5.10	7.30
18......	" 10.40	" 5.10	6.30
19......	" 11.00	" 5.10	6.10
20	" 11.50	....	} 5.30
21......	....	" 5.20	
22......	A. M. 12.50	" 5.20	4.30
23......	" 1.50	" 5.20	3.30
24......	" 3.00	" 5.20	2.20
25......	No light.	No light.	....
26......	No light.	No light.	....
27......	P. M. 5.30	P. M. 7.40	2.10
28......	" 5.30	" 8.40	3.10
29......	" 5.30	" 9.40	4.10
30......	" 5.30	" 10.50	5.20
31......	" 5.30	" 11.50	6.20
		Total,	203.10

SPARKS.

The General Electric Company's new power station at London is nearly completed.

The electric light plant at Wiarton, Ont., was destroyed by fire on the 5th of September.

The Brandon Electric Light Company invite tenders until the 10th of October for $20,000 of bonds.

It is said that the construction of the electric railway from St. Catherines to Port Dalhousie, will not be commenced until the spring.

The Toronto Street Railway Company have decided to try the experiment for one month of carrying the city's street refuse to Ashbridge's Bay.

Mr. C. W. Hutchings has been appointed as city inspector of electric wiring for the city of Vancouver. The board of underwriters of that city have adopted the rules of the Pacific Coast Board of Underwriters.

Mr. A. A. Wright who lately put in operation an incandescent plant at Renfrew, Ont., is to have a competitor in a new company which has since been formed, and of which Mr. Mackay is one of the leading promoters.

The council of the village of Grimsby have refused assistance to the Hamilton, Grimsby and Beamsville Electric Railway Company, on the ground that the road would be the means of diverting trade from the village to Hamilton.

A project is on foot for the construction of an electric railway from Brantford, via the Indian reserve, Hagarsville, Nelles Corners and Balmoral, to Selkirk, situated on Lake Erie, a distance of 30 miles, with the object of making Selkirk a summer resort. It is believed that in addition to a passenger traffic, the line would carry considerable freight.

The Bell Telephone Company's system at Brandon, Man., is being thoroughly overhauled and repaired under the superintendance of Mr. Frank Walsh, manager, and Mr. Mitchell, superintendent of construction, of the Winnipeg exchange. The systems at Regina and Wheat City have also been repaired, and at Moose Jaw an entirely new exchange has been put in. In Winnipeg, Mr. Walsh and his assistants are busily engaged in constructing a metallic circuit.

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SPARKS.

The electric street railway service has been put in operation in Kingston.

It is the intention of the Brantford Electric Power Company to erect a new dam on the Grand River.

The employees of the Ottawa mica mines held a very enjoyable picnic near Buckingham, Que., on the 26th of August.

Mayor Dagg and R. B. Cumming, of Selkirk, Man., were in Toronto recently endeavouring to make arrangements for the construction of an electric railway between the City of Winnipeg and Selkirk, a distance of 20 miles. A charter has already been obtained.

The City Council of Ottawa have had under consideration for some time the question of the advisability of the city owning and operating its own lighting plant, and have apparently come to the conclusion that the lighting should be done in this manner. The sole control of the water power of the Ottawa River rests with the Dominion Government. The Government have entered into leases with a number of companies for the use of the water for power purposes, reserving the right for the city to take such water as it may require for waterworks purposes only. A committee of the council has been appointed to interview the Government and endeavor to secure for the city the right to water for power purposes also, and learn the terms upon which it may be obtained; to secure if possible a suitable site for utilizing such power, and report upon the cost, to report as to whether the city has power to purchase or expropriate a site outside the city limits and issue debentures for payment of same; whether a suitable site and power privileges can be purchased within the city, and at what cost; and whether a steam plant as an auxiliary to the water power would be required.

SPARKS.

The firm of Abell, Huot & Co. has been organized to carry on business as electricians at St. Casimir, Que.

The Bell Telephone Company have removed to new and commodious offices in the Dunham Block at Brockville, Ont.

The Gaynor Electric Fire Alarm Company, of Louisville, Ky., are looking for a suitable location for a branch of their business in Canada.

Mr. Dingman, manager of the Toronto & Scarboro' Electric Railway, proposes to inaugurate a trolley freight service on the Kingston road.

Mr. Graham of the Electric Wire and Fixings Company, Westminster, B. C., has devised apparatus by the use of which telephones can be made to deliver messages audibly.

Mr. D. H. Keeley, acting Superintendent of Government Telegraphs, Ottawa, represented that department at the International Electrical Congress held at Chicago recently. The Department of Inland Revenue was also represented by Mr. O. Higman.

The Niagara Falls Park and River Railway Company are offering for sale at par, $300,000 of stock, the intention being to duplicate the line owing to the unexpected passenger business which has been encountered during the first season of the operation of the road.

Canada is said to have a most admirable display at the World's Fair of automatic and traction engines, compound marine engines, high speed engines, fire engines, steam injectors and exhaustors, and general steam fittings, water wheels, etc.

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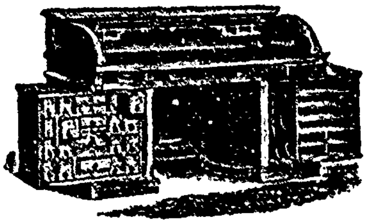

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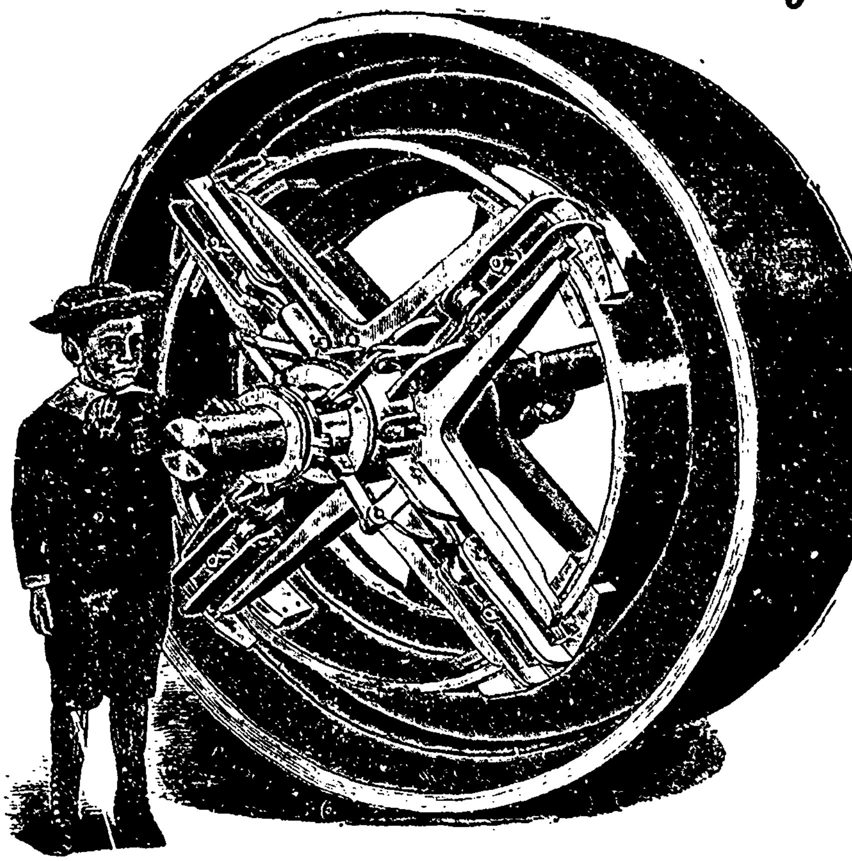

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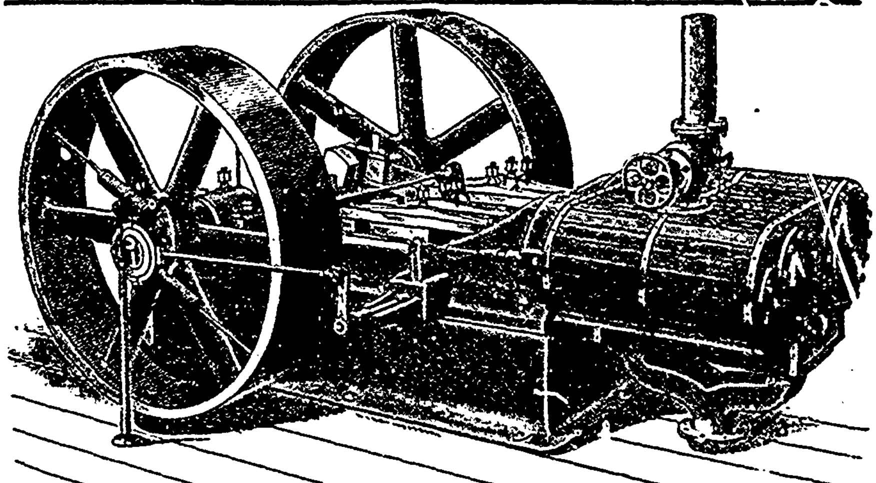

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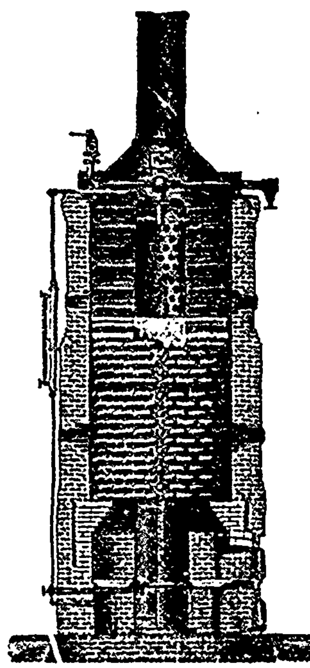

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