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CANADIAN.

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 4.
NEW SERIES, VOL. III.—No. 2.

TORONTO AND MONTREAL, CANADA, FEBRUARY, 1893.

PRICE 10 CENTS
$1 00 PER YEAR

CANADIAN

ELECTRICAL NEWS

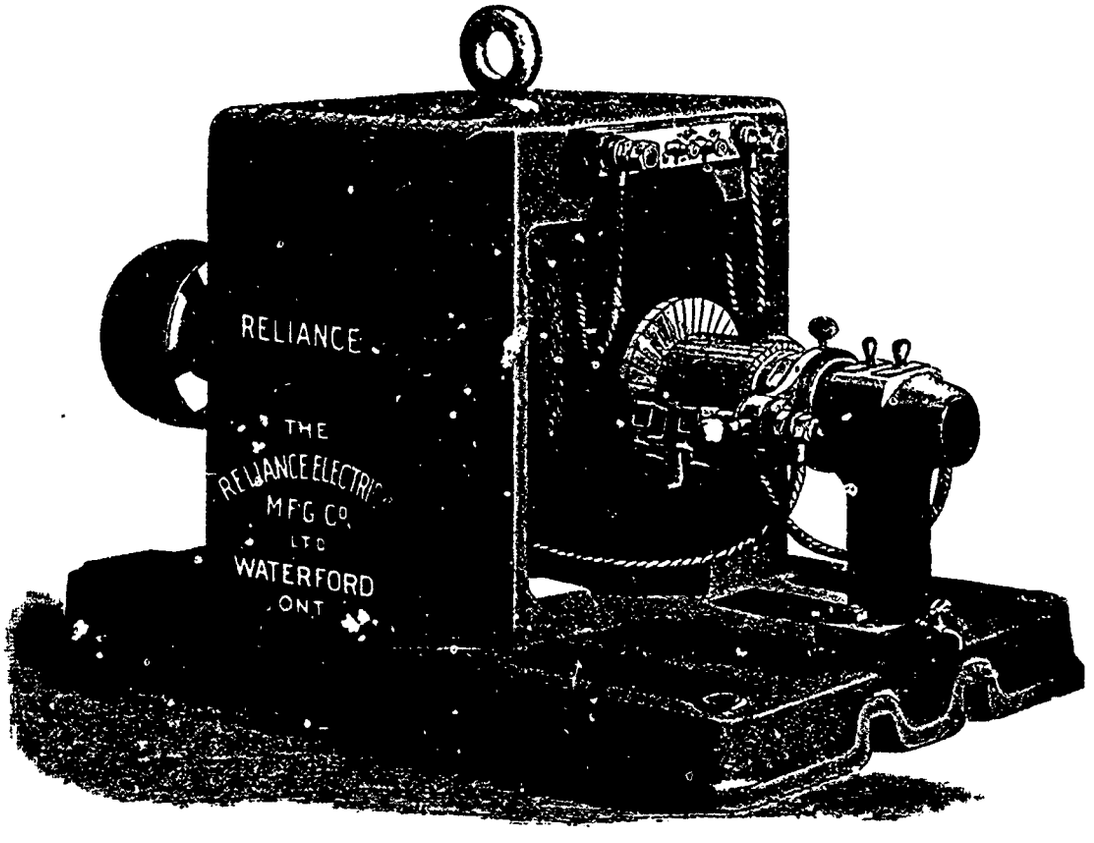
AND

STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, FEBRUARY, 1893. NO. 2.

NEW DYNAMO OR MOTOR.

A new dynamo or motor always attracts the attention of those interested in the electrical business, not only on account of the peculiar features and improvements it may embody, but because there is a very wide difference in the results which are accomplished, and a dynamo or motor that would win favor to-day, must do so on its merits. Cost of construction, economy of power and maintenance, durability, safety of the armature from burning and simplicity of action, are all items of importance to the purchaser. To attain the above results, has been the object aimed at by the Reliance Manufacturing Co., of Waterford Ont., in designing the machine which is herewith illustrated. While it has been successfully introduced, it has not been brought prominently to notice. This machine is of the iron clad type; the entire frame and bearing supports are one casting, having no joints to introduce resistance in the magnetic circuit, and so designed that the field magnets are brought as close to the armature as possible, with the object of making a complete utilization of all the lines of force. Mechanically the design is simple in construction and occupies little space; the bearings are self-oiling and aligning. It operates without sparking at commutator, which is ample in length and diameter, and is supplied with copper or carbon brushes as the purchaser may desire. The manufacturers claim that it gives perfect regulation from full to no load.



These machines are manufactured for generators and motors for 125, 250 and 500 volts current standard windings. Dynamos or motors are upon special order, made for any current voltage.

QUESTIONS AND ANSWERS.

A correspondent writes: An electric light plant (Ball arc, 4 amp.) is driven by a Corliss engine 14"×36", 75 revolutions per min.; there are some incandescent lights run in series on arc circuit, and at times they fluctuate quite peerceptibly at the rate of 72 to 75 per minute. What is the cause? Kindly answer in February NEWS.

ANSWER.—The governor connection to engine's cut-off probably causes the cut-off to take place earlier at one end of the stroke than at the other. An engine in this conditlon and making 75 revolutions per minute, will make 75 attempts to go a little faster each minute. Have an indicator put on your engine and get valve arrangements adjusted to make diagrams from each end as nearly alike as possible.

TRADE NOTES.

Messrs. Robin & Sadler, leather belting manufacturers, of Montreal, are sending out a neat little celluloid memorandum tablet, on the reverse side of which is given a price list, per running foot, of double and single belts.

The Reliance Mfg. Co., of Waterford, Ont., report business very brisk and the outlook bright for the new year. They have recently made the following sales: 165 H.P. generator 500 volts, 25 H.P. motor, 10 H.P motor to W. Cooke & Son, St. Catharines, Ont.; 50 H.P. motor to R. H. Smith & Co., St. Catharines; 10 H.P. motor to A. Meyers, St. Catharines; 7 H.P. motor to The Empire Carpet Works, St. Catharines; 15 H.P. motor, 10 H.P. motor to Hilliard & McKinley, London, Ont.; 10 H.P. motor to J. O. Parker, Toronto; 250 light incandescent plant to Grand Central Hotel, St. Thomas; 60 light incandescent plant to James Robertson, St. Thomas; 50 light arc plant to Brantford Electric and Power Co., Brantford; 220 light incandescent plant to John B. Kelly, Blyth, Ont.; 30 light arc plant to The Verity Plow Works, Brantford; 15 light arc plant to Waterloo Mfg. Co., Waterloo, Ont.; besides a number of small motors.

CANADIAN ELECTRICAL ASSOCIATION.

THE second Convention of the above Association took place in the School of Science, Toronto, on Wednesday and Thursday, Jan. 25th and 26th. The Executive had fitted up temporary headquarters at No. 40 York street, which were placed at the disposal of members during their stay in town.

The Executive Committee held a meeting at 11 a.m. on the 25th, and elected a dozen new members.

The first session of the Convention opened at 2 p.m. in the School of Science, with the president Mr. J. J. Wright, in the chair. The Association was warmly welcomed by Mr. T. R. Rosebrugh on behalf of the Faculty of the School.

The following members were present.

John Carroll, Eugene Phillips Electrical Works, Montreal, 2nd Vice President; C H Mortimer, publisher ELECTRICAL NEWS, Toronto, Secretary-Treasurer; D. A. Starr, Royal Electric Company, Montreal; H O Fisk, Electric Light Company, Peterboro'; A. B. Smith, Canadian Board Fire Underwriters, Toronto; D. Thomson, general manager Hamilton Electric Light and Power Company; W. A. Johnson, Ball Electric Co., Toronto John Yule, manager Guelph Gas and Electric Light Company, Guelph, Thomas H. Wadland, Bell Telephone Company, Hamilton. J B McFarlane, Bell Telephone Company, Montreal; H P Dwight, President G N. W. Telegraph Co., Toronto; A M Wickens, electrician Ontario Parliament Buildings, Toronto, George Black, G. N. W. Telegraph Company, Hamilton; J. A. Bayles and W. A. Tower, Bell Telephone Company, Toronto; R G Black, Hamilton; A. T. Smith, Bell Telephone Company, Kingston, B. J Throop, Bell Telephone Company, Hamilton; George M. Wight, Royal Electric Co., Montreal; J H Greer, Bell Telephone Co., Peterboro', H. Beaumont, Toronto; J. W. Taylor, Porcelain and Porcelain Works, Peterboro'; J. A. Kammerer, Royal Electric Company, Toronto; Geo. W. Sadler, Robin & Sadler, Montreal; F. C. Armstrong, General Electric Co., Toronto; W. Bourne, Toronto Electric Light Co.; H. S. Thornberry, Toronto Electrical Works; W. J. Jones, Bell Telephone Co., Toronto; Hugh Neilson, Bell Telephone Co., Toronto; W. B. Evans, A. Knowles, Bell Telephone Co., Toronto; W. R. McLaughlin, *Electrical World*, New York, W J. Clarke, Bell Telephone Co., Toronto; Capt R F Carter, Electric Light Company, Niagara Falls, Ont; Chas. B Hunt, Electric Light Co., London; Alex. Stark, Bell Telephone Co., Toronto; John Langton, Toronto; E. C. Breithaupt, Berlin; James F. McQuaide, National Conduit Co., New York; A. B. McCallum, Peterboro'; J. M. Campbell, Electric Light and Power Co., Kingston; Isaac Usher, Thorold Ont.; E. E Slaght, President Reliance Electric Mfg. Co., Waterford, Ont; R F Gardiner, Electric Light and Power Co., Hamilton; Prof. Galbraith, Mr. Rosebrugh and E. B. Merrill, School of Practical Science, Toronto; A M Wright, Electric Light Co., Renfrew, Ont; W A Martin, Toronto Electric Light Co, C. E. McManus, G N W Telegraph Co., Toronto; Fred. C. Robertson, C P R Telegraph Co., Toronto; Joseph Wright, Bennett & Wright, Toronto; J. A. Doucett, Bell Telephone Co., Toronto.

PRESIDENT'S ADDRESS.

Gentlemen of the Electrical Association: It is with great pleasure that I meet you again after another half year's experience of our rapidly moving industry. Since last I addressed you several changes of importance have taken place in its aspect, and new departures have been made that will have considerable influence on the future of electrical business in Canada. The adoption of electricity as a motive power on suburban railroads and the conversion of horse tramways has developed in a manner that for rapidity is without a parallel in the history of modern civilization. While a year or two ago it was thought that the limit of production had about been reached and the demand for electrical apparatus filled by the occupation of the field of arc and incandescent lighting, it is a fact that to-day our workshops are as far behind in keeping the market supplied as at any time in the history of the business. This, occurring as it does during a period of general depression, must be looked upon as eminently satisfactory, and as affording a guarantee of much greater expansion in the future. I have to congratulate the members of this Association that their field of usefulness is becoming wider, and that the outlook ahead is so bright and full of promise. While this is the case, and it is undoubtedly a fact that solid and substantial progress has been made by conservative management of electrical enterprise, a word of caution may not be out of place to investors in securities based upon electrical speculation. There is a danger that the fact of this solid progress may be made the means of ultimate injury to the concerns identified with it. It has caused a growth of schemes, having electricity as a basis, to spring up as thick and fast as mushrooms. The inevitable failure of many of these will discredit, to a certain extent, legitimate enterprise and profitable business.

The many schemes for the long-distance transmission of power, though scarcely to be classed with what may be termed the electric fake, are still somewhat far removed from the line of commercial success. Experimentally much has been accomplished in this direction, though the complicated nature of the apparatus and its cost for operation and repair, make financial success rather more than problematical. At the last convention of this Association I took occasion in opposition to views then set forth, to mildly satirize the hundred miles an hour enterprise that was to carry the denizens from the wilds of Missouri to the World's Fair at Chicago. Where is that enterprise to-day? Several miles of road are constructed—all but the track—in a straight line, too, I believe, as considered necessary by the projectors, but no plans are forthcoming, and we do not see the name of any engineer of standing connected with the scheme. The sole energy of the promoters appears to be expended in the production of a very rosy-colored prospectus showing impossible profits, and an elaborate engraving of the happy farmer sawing wood and pumping water by electric light and power for a couple of miles on either side the right of way.

To come nearer home, good hard dollars have been extracted from the pockets of liege subjects of the Queen in the name of electricity, as the magic wand was waved even under the nose of Brock's effigy on Queenston Heights. Where is that scheme now? The Utopian dream of a railroad on every farm that is being promulgated now will not materialize in our generation, except as a sink-hole for the funds of the unwary. A word of warning is needed now, and as President of this Association I give it. It is open to you to dissent from this position, to criticize it if you see fit, and to prove it needless if you can. The safety of legitimate electrical enterprise is endangered by this trading upon the credulity of the people. Nevertheless genuine electric business has made solid progress; its area is gradually widening, and a natural and healthy growth will find increasing occupation for its earnest workers, and afford a fair and reliable return to prudent investors. During the half year just passed there does not appear to have been many new developments in the scientific application of electricity. Effort appears to have been expended in perfecting already known appliances and inventions. Much progress has been made in this field. The best efforts of electricians and mechanics have been devoted to street railroad appliances, and while much yet remains to be done a distinct advance has been made in the perfection and durability of railroad plant. Some new departures have been made in the engineering branch. At our last convention I described what I considered to be the ideal engine for electric light work. That engine has been constructed, and I shall presently have pleasure in asking you to examine its operation. It has more than justified the anticipations of its designer, and has proved a remarkable success. The vertical type of large engine has entered the field of electric work, and is there to stay. Electric generators, taken as units, are gradually growing larger; 250 horse power is not an uncommon size, and the largest yet designed and constructed on this side of the Atlantic has attained to the extraordinary capacity of 2,000 horse power.

I would like to foreshadow action by this Association such as would unite in a closer bond the members whose interests are to a considerable extent identical. It will become an important matter for us to decide, if it is seen fit, either at this or at the annual meeting in September next, whether it would not be advisable to organize subsections of the Association, to more successfully grasp and deal with details that would be somewhat beyond the scope of the Association in its entirety—such, for instance, as the question of fuel supply. In the province of Ontario alone, where all our coal has to be imported from outside sources, the amount consumed for the purpose of generating electricity must reach a considerable sum in the aggregate. United action on the part of owners and operators of central stations which would establish direct communication with the miners of coal, might result in considerable advantage in the matter of its ultimate cost. A sub-section of the Association, comprising central station owners and operators, could handle a question of this kind, while on the other hand it would not be of great interest to a large contingent of members interested in other branches of electrical science. Electrical men generally, who are all more or less consumers of electrical supplies, are interested in the question of railroad freight and charges. It has been suggested to me that the Association take up the matter and endeavor to have a classification of electrical apparatus, graded in such a manner as to materially modify the high rates of freight at present obtaining on some kinds of electrical material, and so on through the various branches of the industry represented by the Association at large. Other amendments to the constitution will have to be considered in preparation for a revision at the forthcoming annual meeting. If I have not before referred to the telephonic branch of electrical work so fully represented in our membership, it has

not been by any means from want of a sense of its importance and magnitude. The amount of work now being prosecuted by its intelligent and industrious contingent of members is equalled only by that performed by the ubiquitous and rapid street railroad man. In fact, just now it is a struggle for the top of the heap, with the odds in favor of our friends of the telephone. The introduction of their enemy, the trolley car, has brought into play all the skill and resource at their command, and so well has the skill been applied that the immense disability caused by the operation of heavy railroad currents has not only been overcome, but the results obtained are, in the large majority of cases, better than ever. To accomplish this herculean task it has become necessary to do a large amount of subterranean work. This branch of construction is one of growing importance, in fact one which concerns the electric light man as well as the telephonist in the larger towns and cities, and I am glad that we are to have some information on the subject from one of the fraternity well qualified to impart it.

Leaving the consideration of practical matters connected with our industries, and glancing at its possibilities, it would seem that there are several new levelopments well within their range. The production of light without heat is a problem that is worthy of the best efforts of the inventor. The experiments of Elihu Thomson and Nikola Tesla with currents of high frequency have been full of significance and promise on this point. Whether a sufficiently high rate of frequency will be attained to identify the vibrations of electricity with those of light, or whether a sufficiently mobile material can be discovered as a medium of transmission, remains for the future to disclose, but the fascinating possibility of a cold and luminous wire as a means of illumination appears to be a consummation worthy of the best efforts and the highest intellects of the human race. The possibility of the production of electricity, and consequently power, from light, would seem to follow this in natural sequence, while those existing in the discovery of a commercially successful application of thermo-electricity would appear to provide plenty of material for the facile inventor. While we deplore the pettifogging tactics of the electric charlatan, we have unbounded faith in the future developments of the science. Owing to the perfection of constructive mechanism, the full fruition of invention and discovery is attained with a rapidity unknown in the days of our fathers when the evolution was a slow and painful groping after perfection. This being the case, we may hope in our own proper persons to behold future achievements as wonderful to our enlightened minds as would be ours of the present day if seen by our predecessors of but a few short years ago.

The President: I will now call upon Prof. Rosebrugh to say a word or two to us.

Prof. Rosebrugh: Mr. President and gentlemen, I am sorry that the Principal of the school is not here to welcome you, but, in the name of the school, I am very happy to be able to throw open the doors of the institution to you; and I hope this will not be the last occasion upon which we shall have the pleasure of having meetings of this kind held in the school. With regard to the laboratories of the school, there are too many present to be personally conducted through them with a view to explaining everything, but we shall be very glad if you will make yourselves perfectly at home, and look around and see what is to be seen downstairs.

SECRETARY'S REPORT.

GENTLEMEN —There is cause for congratulation in the success which marked the first convention of the Association, held in Hamilton in June last. The attendance, as well as the interest attached to the proceedings, were most gratifying, and should encourage the hope that a career of usefulness and prosperity awaits the Association in the future. It is a matter of some regret that a larger addition has not been made to the membership during the last six months. The Association has reached its present standard largely through the exercise of personal effort on its behalf, by those interested in its success. In no better way can its membership and influence be advanced in the future. If this hint be borne in mind, especially by those members who are regularly brought into business contact with persons interested in electricity, there is no reason why the membership should not reach at least one hundred and fifty before the second annual convention in September next.

The Executive Committee has held three meetings since the Hamilton convention, viz.: on the 8th of August and 21st of November, 1892, and immediately prior to the opening of the present convention.

At the first of these meetings, the Treasurer presented a statement of the expenses in connection with the Hamilton convention, amounting in all to about $200, the accounts for which were passed and ordered to be paid. The sum of $25 was voted to the Secretary-Treasurer to reimburse him for incidental expenses. Mr. D. Thomson was appointed Chairman of Committee on Statistics. The Secretary was instructed to have 400 copies of the Constitution and By-laws as revised at the Hamilton convention, printed and distributed to members.

At the meeting on the 21st of November, Messrs. Wright and Dunstan were deputed to complete arrangements with the authorities of the School of Practical Science and to fix the date for the present convention, while the Toronto members were delegated to arrange for the renting of suitable temporary headquarters for the Association, and complete all further arrangements for the convention.

There have also been held at various times, meetings of the official members resident in Toronto, at which arrangements for securing papers to be read at this convention, as well as other matters of detail, were dealt with, thereby avoiding the necessity for more frequent meetings of the Executive.

There have been added to the membership since last convention, 7 active and 4 associate members, bringing the present total membership up to 119.

The statement of receipts and disbursements since date of last report, is as follows:

Receipts.

June 1st, 1892, cash on hand	$ 20 25	
June 1st, 1892, cash in Merchants' Bank	199 99	
36 Active members' fees	180 00	
6 Associate members' fees	12 00	
Balance of Active fee for W. A. Tower	3 00	
Balance of Active fee for J. H. Greer	3 00	
Cheque from Bell Telephone Co.	25 00	
Cheque from G. N. W. Telegraph Co.	25 00	
		$468 24

Disbursements.

Expenses of Convention at Hamilton	$ 94 00	
Telegram	$ 45	
Hotel bill	3 50	
Railway fare	1 95	
Express	50	
Cab hire	34 00	
Caterer	68 60	
Caretaker Board of Trade	5 00	
Reporting proceedings of Convention	20 00	
Grant to Secretary	25 00	
Postage	13 30	
Printing and stationery	79 36	
Certificates and badges	25 40	
Register, stamp and receipt book	2 65	
Exchange on cheques	35	
Cash in Merchants' Bank, Jan. 24th, 1893	191 43	$451 49
Balance in hand	16 75	16 75
		$468 24
Total balance in hand Jan. 24, 1893		$208 18

In conclusion, I would express the hope that the present meeting will be attended by such a measure of success as will awaken the renewed interest of every member in behalf of the future usefulness of the organization, in order that its progress may keep pace with the rapid development of electrical industries in this country.

Moved by Mr. A. B. Smith, seconded by D. A. Starr, that the report be accepted. Carried.

REPORT OF COMMITTEE ON STATISTICS.

Your Committee on Statistics beg to report progress, and also to request that they be authorized to draw on the funds of the Association for the amount necessary to have printed some two or three hundred blank forms containing a set of questions to be asked of every electric light and power company, also telephone and telegraph companies, within reach of ordinary postal facilities, also the necessary stamps and stationery, so that they may be able to compile a list of statistics that will be valuable for future use.

D. THOMSON, Chairman

Moved by Mr. D. A. Starr, seconded by Mr. A. M. Wickens, that the report of the Committee on Statistics be adopted. Carried.

The President: I would like an expression of opinion from some of the members present on a suggestion that was made a short time ago with regard to sub-dividing the Association in sections. The members appear to be taking things very much for granted, but I think we should have an expression of opinion in regard to this.

Mr. A. A. Wright: I do not exactly understand the suggestion; it is entirely new to me. As far as I am concerned, I suppose you refer to the matter of fuel; is that the point?

The President: No, that is not it; the question is whether it would not be advisable in the interest of the Association, to form sub-sections of the Association, comprising the different branches, so that any matter which specially or solely affects anyone of those branches could be dealt with by that branch, while questions affecting and interesting the electrical fraternity generally would be dealt with by the Association at large.

Mr. Armstrong: Would it not be well for some member of the Committee to explain the thing a little more at large.

The President: An amendment would have to be made to the constitution at the convention in September. This being the only meeting of the Association that will take place before then, it seems to me to be a proper time to discuss the matter, and elaborate any scheme which may seem desirable.

Mr. A. A. Wright: I do not really understand this thing yet. Do you wish to have a sort of sub-sections, that is, to have committees appointed to look after certain sub-divisions of the work, or do you want to have other electrical associations for each part of the Province?

The President: Not at all; I thought I made myself plain. I said sub-sections of this Association. Some of those present may be members of the Toronto Board of Trade, and familiar with the manner in which it is sub-divided into sections, such as the coal section, the drygoods section, the grain section, etc. Now, we have an Electrical Association, having among its members gentlemen representing all of the various electrical interests of the Dominion: the telephone, the telegraph, and electric lighting companies, etc. Now, there are matters sometimes arising which are of interest solely and only to some one of those branches. Such a question, the adoption of a uniform standard for electric lighting, was debated at the last convention. That is a question interesting only to those who are engaged in the production of electric light, and it does seem that they are the men who should decide upon any policy referring solely to their interests. It might be that the telephone branch of the Association would find occasion to take action in some of the various matters appertaining peculiarly to them, and which they did not desire to have passed upon by the Association generally as it referred to them solely. That is the way in which the idea

originated, of forming the Associations into sub-sections, to handle matters distinctly belonging to such branches or sections. For instance, there would be a section of central station men. The Association was originally formed for the purpose of bringing together those who were engaged in all branches of electrical business, that they might legislate for their own good, and it is now the question whether you think, in order that the Association may achieve its highest usefulness, that it is advisable to take some such action as I have endeavored to outline.

Mr. A. A. Wright: I have no doubt that is a very good idea, as we are not all interested alike in those objects.

Mr. H. Neilson: I think you will find, if you will consider for a moment, that there will be only one section. On matters of policy affecting the Bell Telephone Company, which is the only telephone company in the country, and the telegraph company, the policy of those companies is dictated from the head office. I do not see how a telephone section would have anything affecting it to discuss, or upon which to frame any rules or regulations. The electric light is entirely different. You have many and divergent interests there; you have a company in nearly every city and town in the country, and there is, no doubt, great difference of opinion such as cannot possibly exist in the case of the telephone company, and to a certain extent in the telegraph company. So that, if you form an electric light section you can can go on and do your business entirely irrespective of the other two.

The President: Of course, speaking as I did, I did not wish it to be understood that I expected that the members of the telephone section of the Association were going to dictate the policy of the company. But there are many matters interesting to the telephone men, apart from the policy of the company, with which such a section could deal.

Mr. Kammerer: I think it would perhaps be well for the present to pass over this matter, and let it be made a special order for to-morrow.

The President: Is that the pleasure of the meeting? If no member is ready to bring the matter forward, perhaps that is the best course. I am only giving voice to suggestions I heard made among some of the members, in fact, I think Mr. Neilson himself was one of those who suggested the idea originally, or, perhaps, it was Mr. Dunstan. And, by the way, I am very sorry that Mr. Dunstan is not here with us; I understand he was prevented by some family bereavement from being here to-day. However, the matter under discussion is entirely in the hands of the Association; I do not press it at all, in any shape or form. I merely bring it before you in my capacity as President of the Association, that is all. I may say, also, that we shall be glad to receive suggestions from any member of the Association as to any amendments to the constitution that he may think will be calculated to advance the interests of the Association, so that we may talk over them and have them formulated and relegated to the hands of the committee which will be appointed to look after the matter, and bring it before the convention in September. Has any member any new business to bring forward?

Mr. G. Black, of Hamilton, then read the following paper:

ELECTRICAL MEASURKMENTS.

In agreeing to write a paper to be read at this meeting, I may say that I do not pretend to offer anything new to the majority of this assembly, but hope that my efforts may be of service to some of the younger or less experienced members. I selected the subject with a view to interest a larger number than a purely telegraphic paper would likely do.

In the early days of the telegraph, very little was known of the science of electricity; the laws of the current and of resistance were imperfectly understood, and escape or leakage was our special bugbear. In the good old days we were satisfied to believe that the current flowed, and we put on battery enough to give a working circuit. With the Grove battery then in use we could do it, but the escape was sufficient to knock out the present generation of "operators." We observed that some wires required more battery power than others of a similar length, and wires were called "good" or "bad" accordingly. Formerly we were satisfied to know that a circuit was established. Now the practical electrician should know how much current is required and how much resistance is offered to it, or he knows nothing. The successful laying of the Atlantic cable led to more scientific methods in the telegraph systems of this continent. The adoption of duplex and quadruplex transmission called for lines in first-class condition. The wonderful achievements of the first telephone experimenters led others to believe that insulation or resistance might be disregarded, but more accurate observation indicated that the telephone came under the same general electrical laws.

The advent of electric lighting introduced comparatively heavy currents of great intensity, and new terms had to be coined to suit the altered circumstances. The names of electric units are perplexing to the uninitiated, failing to convey an idea of their meaning, being adopted from the names of well-known electricians and mechanicians, who have left their footprints on the sands of time." I shall only use a few of these terms, what we may call the practical every day units, namely:—

The Volt, as the unit of electro-motive force.

The Ampere—current.

The Ohm—resistance.

The Watt—power.

We use these units as we use a foot as a unit of length, or a pound as a unit of weight something to compare amounts or quantities with. Using the flow of water through a pipe as a familiar illustration, the *Volt* may be regarded as the pressure or fall given to the water; the *Ampere* to the quantity flowing, the *Ohm* to the resistance or friction of the pipe to the flow of water, the *Watt* to the mechanical power exerted. To deliver an increased quantity of water in a given time you must increase the pressure or enlarge your pipe, so with electricity, you must increase the electro-motive force, or enlarge your conductor.

The *Volt* may be defined as "such an electro-motive force as would cause a *current* of one *ampere* to flow against the *resistance* of one *ohm*."

The *Ampere*, "such a current as would pass with an electro-motive force of one volt through a circuit whose resistance is equal to one ohm."

The *Ohm*, "such a resistance as would limit the flow of electricity under an electro-motive force of one *volt* to a current of one *ampere*."

The *Watt*, "the volt-ampere or unit of electrical work."

Electro-motive force may be defined as the power which a battery or dynamo possesses of causing the transfer of its current from one place to another, or of overcoming resistance. The electro-motive force of a Callaud cell is slightly over one volt, and for rough work may be called one volt. The resistance of a conductor is directly proportional to its length and inversely proportional to its cross section. The conductivity of a wire is the reciprocal of its resistance; thus if a wire has a resistance of 1 ohm, the conductivity is 1. When the resistance is 2 ohms, the conductivity is ½. When it is 4/5 of an ohm, the conductivity is 5/4, and so on.

In 1821 Ohm established his celebrated law: "That the strength of the current was directly proportional to the electro-motive force, in the circuit, and inversely proportional to its resistance." Ohm's law is familiarly represented thus: $C=\frac{E}{R}$, where C represents current in amperes, E the electro-motive force in volts, and R the resistance in ohms.

If $C=\frac{E}{R}$ then $E=C\times R$, and $R=\frac{E}{C}$

By this law, if you know two of the quantities you can easily find the third. For example—(1) What is the strength of the current in a circuit consisting of a wire whose resistance is 5 ohms and a battery whose electro-motive force is 2.3 volts, and internal resistance 4 ohms?

$C=\frac{E}{R}$ or $\frac{E\ 2.3\text{ volts}}{R\ \ 5\times 4\text{ (wire-battery)}}=.225$ amperes.

(2.) What electro-motive force is required to send a current of 2 amperes through a circuit offering 1.6 ohms resistance?

$E=C\times R=2\times 1.6=3.2$ volts.

(3.) A battery whose electro-motive force is 6 volts and internal resistance 2 ohms produces a current of 1.4 amperes. Through what external resistance is it running?

$R=\frac{E}{C}=\frac{6}{1.4}=4.285-2=2.285$ ohms.

From these plain examples it is evident that any one familiar with the application of Ohm's Law can feel the pulse and prescribe for his wires at any time on short notice.

A galvanometer is an apparatus for measuring the strength of an electric current by the deflection of a magnetic needle. It depends for its operation on the fact that a conductor, through which an electric current is flowing, will deflect a magnetic needle placed near it, and free to move. This deflection is due to the magnetic field caused by the current. The action was first discovered by Oersted. A wire over a needle deflects it to the right or left, according to the direction of the current. By doubling the wire under the needle the effect is increased. In extremely sensitive galvanometers very many turns of wire are employed, in some cases amounting to many thousands. These are termed high resistance galvanometers. Low resistance galvanometers often consist of a single turn of wire or a strip of metal and are used for measuring heavy currents.

In England and the Continent the telegraph wires are tested daily for insulation and resistance. They are run over rapidly with a detector or a tangent galvanometer and the deflections tabulated. A battery is first joined up with the galvanometer and a known resistance, say 5,000 ohms, and the deflection noted, say 45 degrees—this is called taking the constant of the galvanometer. The lines are then tested with distant ends open, then distant ends closed, and deflections noted. The resistance is worked out thus: Supposing with the resistance of 5,000 ohms a deflection on the tangent side of 100 divisions were obtained, with line in circuit and grounded at distant end 60, and when distant end open 30 divisions. As the greater the resistance the less the deflection, consequently as 60 is to 100 so is 5,000 to the resistance required, 8,333 ohms conductivity resistance; and as 30 is to 100 so is 5,000 to 16,665. Be careful to remember that these are tangent divisions, not ordinary compass degrees. Date, state of weather and temperature are also recorded for comparative purposes. Any variation from the normal record is gone over again with a Differential galvanometer or a Wheatstone bridge, and the defect rectified at once. By this means troubles are anticipated before they become serious. In testing be careful not to have galvanometer near enough to be affected by other charged wires or masses of iron, such as dynamos, engines, boilers, etc. Where this cannot be avoided place galvanometer in an iron sheathed box.

Electric light companies are supposed to test daily with a magneto, but that does not reveal anything very definite, it will only tell if circuit is dead open, or that there is a leak in the line. The magneto will not reveal a short circuit, nor locate an escape unless line is tested in sections. The telephone companies also call up customers and test lines with magnetos, but unusually heavy resistances may creep in and not be detected by this means, and nothing will be done till the line offers sufficient resistance to attract attention. Electric light companies could test with a small battery and galvanometer, or a milliampere meter in day time for resistance, using magneto for insulation tests. Telephone companies could run over their lines during the silent watches of the night when customers are sleeping. Electric railways should take the resistance of all their circuits at various points, say every quarter of a mile, and at junctions or intersections when first installed, and at regular intervals afterwards. By so doing weak spots, such as broken bonds, defective grounds, etc., may be detected at once and remedied. An occasional run over the lines with volt and ammeters also is recommended. It is well to test with as small a battery as will suffice, as heavy currents sometimes fail to indicate faults, the current welding or expanding the weak spot, or jumping the gap. Lines will sometimes apparently test better in wet weather than in dry, the escape reducing the apparent resistance and rain assisting the conductivity of bad joints. In testing for insulation, as heavy a battery as convenient should be used, especially on short lines, unless you have an extra sensitive galvanometer. Long lines will appear to test worse than short ones. When insulation resistance is secured, it should be reduced to a mileage resistance or it means nothing.

With a good galvanometer and a suitable resistance box it is an easy matter to do plain testing, but difficult problems present themselves which try the metal of the tester. A dead ground or a well defined cross may easily be located. But usually grounds have considerable in them, and crosses do not always make good contact. An example or two from actual practice may be permitted. Wire No. 20, running east from Hamilton, was grounded between Hamilton and St. Catharines. The wire in good condition measured 560 ohms to St. Catharines or 16 ohms per mile. The line measured through the fault with distant end open 4,000 ohms. Another wire, No. 19, of similar resistance was looped at St. Catharines and measured

through the fault on 20 with Hamilton end of 20 open, which went 4,800 ohms. The loop was then measured to prove former test and went 1,120 or twice 560. We now add the two first tests together, 4,000+4,800 = 8,800. We deduct third, leaving 7,680 as remainder. This represented the resistance of the leak, measured *twice*, or 3,840 as resistance of the leak. Now to locate it—the first test stood at 4,000; deduct 3,840, leaves 160, or 10 miles from Hamilton; this proved by the 2nd measurement also. Where distant office uses a galvanometer, a second wire may be dispensed with, but where practicable the tester should prove his own measurements. As a single wire this would measure, 1st from Hamilton, 4,000, then from St. Catharines, 4,240; added together, 8,240, less resistance of wire in good order, 560, or 7,680 for fault twice measured. In this instance the repairer found a broken stay wire touching dry sandy soil, at the distance indicated. Measurements made without a knowledge of the usual conditions of the wire are sometimes misleading, owing to extra resistance not looked for in the measurements.

To measure a cross, it is safer to treat it as a leak to earth. You thus eliminate any resistance which may be in the cross. Ask an office beyond the cross to open one wire and ground the other. First measure the loop through the cross, then each wire through the cross to distant ground. Thus:

Nos. 1 and 2 crossed between you and an office 25 miles distant. No. 1 is opened and No. 2 grounded at that office. Usual resistance of lines, 16 ohms per mile, or 400 to distant ground.

Loop measures 384, No. 1 to ground measures 400, No. 2 to ground 400, indicates no resistance in cross. Half the resistance of loop divided by 16 gives the distance as 12 miles from your end. If wires are of different resistance the case is a little more difficult. Say No. 1 went 20 ohms per mile, and No. 2 went 16, the measurements would be, loop 432; No. 1 to No. 2 ground 448, No. 2 to No. 1 ground at distant end 452; add together make 900, the resistance of both wires. Then 36 (20 and 16) into 432 goes 12 miles. If any resistance in cross it will appear in excess of measurement and should be deducted to get distance. Take an example of two wires crossed by a high resistance, say a mass of wet kite tails. Each wire measures 400 to distant office, each wire measured through the cross to distant grounds 8,400, indicating 8,000 ohms in the cross. Now measure the loop with distant ends open, it goes 8,200. Deduct 8,000 for fault and divide half of 200 by the mileage for distance of fault, or 6¼ miles.

Some time ago we noticed an unusual amount of resistance in wires leading out of Hamilton (they had not been tested for a long time). On testing lines in sections we located the excessive resistance within the city limits. On closer inspection we found some rusty joints which measured immensely, some going as high as 2,100 ohms, or .55 miles of the wire. These were cut out and lines brought within reasonable limits. The safe rule is to keep down resistance to its lowest point. We must have a certain amount of resistance in our circuits, which we may call useful resistance. But useless resistance is a waste of current and consequently a waste of money, an expenditure which pays no dividends, but which, in time, may ruin the company. Remember that every watt costs something to produce. A comparison of the power exerted and the light and power delivered would be interesting. Eliminate therefore all useless resistance and remove all leaks to earth and you get more light and power at less cost.

Referring to Ohm's Law again we found that if we know two of the conditions of a circuit we could find the third. We can then by use of volt and ammeters determine the resistance of our circuits when hot, and with a galvanometer or milli-ampere meter resistances can be accurately measured when cold. Resistances hot and cold differ considerably. The resistance of wires increase with heat, while the resistance of carbon filaments decrease. It is well then to know and tabulate both resistances, or mistakes may be made. As the resistances of wires, lamps, dynamos, etc., can easily be ascertained and tabulated, any deviation from the standard should be sharply looked after. A decrease of resistance means a short circuit, an increase of resistance means a bad joint, or a loose or dirty connection, and as joints become uncovered and corroded, and connections will become loose and dirty, constant vigilance is essential for *safety* and economy.

A word about leakage to earth. Telegraph and telephone companies have to depend upon their insulators entirely, but light and power companies sometimes depend upon the insulation of their wires and are not as careful as they might be about other insulation. The so-called insulation of wires in many cases are rather delusive in wet weather and the only safe rule is to act as if they were naked wires. Almost any kind of insulated wire will be all right in dry weather, but after a heavy rain, if the wires are not kept clear by proper insulators, heavy leaks may be detected. Some of the so-called weatherproof wires are little better than underwriters. Samples of wire should be tested for insulation, for waterproof and for fireproof qualities. For ordinary insulation, test with an induction coil, giving at least an inch spark. Attach one end of the sample to be tested to one of the secondary poles and hold the wire by its insulation. If defective, a shock, more or less severe, will be felt. Fingers should be moist and delicate for this test. To test for waterproof qualities, soak a sample of wire in a metallic tank or tub of water with metal plates for 24 hours. Attach a heavy battery to one end with a delicate galvanometer. Attach other end of battery to metal of tank or plate. Other end of wire tested to be left dry and disconnected. If wire is defective galvanometer will deflect. A good magneto may be used instead of galvanometer and battery.

Fire proof qualities may be tested by passing currents of various strengths through wires for certain length of time. Every coil of wire should be tested for resistance before being used to avoid using wire with flaws. A first-class wire should have the insulating and waterproof qualities of rubber or percha, be fireproof like abestos, not affected by exposure to any and all kinds of weather, be durable and cheap, but I don't know where this wire may be found.

I have endeavored to explain the method of testing telegraph lines, and the application of the same to other electric wires; and urge the regular and systematic testing of all circuits and appliances, believing that by so doing more satisfactory work will be done, greater safety insured, and more money earned by the companies.

Mr. McFarlane. I think we have been all entertained by the paper which Mr. Black has read. We have all, more or less, to plead guilty to his indictment, especially on the question of insulation. I think if the companies looked more closely after that particular they would make better dividends. I know that in the telephone business we started out with the idea that insulation was not necessary. I experimented on lines without insulation, and found it worked all right on lines ten or twenty miles long, but for long distances the result was different. We then gave up that idea, but we have not yet reached the point indicated by Mr. Black, of perfect insulation. In travelling over Canada and visiting its various towns, I think I can say that there is no place where this matter is looked after properly. I think if a little more engineering work were done in the way of testing, and in completing insulation where possible, it would be found more profitable in the long run. Therefore, I think Mr. Black's paper is one which ought to be carefully studied, as it is highly valuable in this connection.

Mr. Neilson: There is one point on which I have to take issue with Mr. Black. He spoke of testing the telephone lines during the "silent watches of the night." I might say that the silent watches of the night with us would run very far into the business of the day before we got through. In this city, with 4000 wires, it would be necessary to put on a very active man to get through with the necessary work. I do not know of any telephone company that does the testing of its wires periodically every day or night, and I doubt very much whether it would be possible, without a very large staff indeed. You will see that it would take quite a few minutes to put the wire on and simply take the constant. The paper brings to mind many incidents connected with my telegraphic experience. I am probably the oldest telegraph operator present, and I remember the time, away back in '54, when men who talked about testing lines were simply considered humbugs. I can remember when I first obtained a galvanometer, and tested some lines of the Dominion Telegraph Company. First, we had a ground on the line from here to Hamilton, and, with fear and trembling I announced that it was somewhere near the Humber. A man drove out there, and found about half a mile of the line floating in the lake, so we were quite satisfied with the test. Another day, we discovered a ground on the line between here and Oakville. The test showed that the ground, measured in the ordinary way, was away up past Hamilton, even away up on the mountain there (laughter), so I then used the loop test, after which I announced that it was a little bit this side of Oakville. We sent out a first-class lineman but he could not find it, and he drove back again, with the same result. The general manager and myself drove out again, and found the difficulty was caused by a cross with the wires of the Montreal Telegraph Company this side of Oakville, and that Company, with their usual kindness in such matters, had immediately grounded their line at their Toronto office, so you can see how the measurement was obtained. I remember another instance where I tested a wire, and announced that the ground was twenty miles east of Toronto. A Frenchman went out, and when he came back he could not express himself fully enough on the wonderful ability of that machine. He said, "I find it just at the mile post." He considered that that beat anything in the way of a test he ever heard of. I have much pleasure in moving a vote of thanks to Mr. Black for his very clear and lucid paper on the subject. It is something we ought to study up more fully than we have done, and I hope that the young members of the Association, at least, will do so.

Mr. Thornberry: Many of us electric light and telephone men have been in the telegraph business, in the old days when insulation was not considered of any practical value at all. I think it was a telegraph company in Toledo, which in those days, when insulators were not used, hung their lines upon the fences, and they swore up and down that those lines worked better than the ones that were insulated. I think the question of insulation for light conductors is a very important one. I think the manufacturers are doing their best to produce cheap and good wires, but owing to the expense, except in isolated cases, we must depend on insulators outside of the question of insulating wire. Construction is very important now, and I think we can learn from such papers as we have just heard a great deal that is valuable. I beg to second Mr. Neilson's motion for a vote of thanks to Mr. Black.

The motion, having been put to the meeting, was carried.

Mr. Black: With regard to what Mr. Neilson has said, I did not intend that every telephone office or telegraph office should test its lines every day or night; I said "periodically testing them," which meant if you run over your 4,000 wires once in a fortnight that would be quite sufficient to keep one man going in a large place like this, testing each line at regular intervals. Of course, if they get them underground, the testing is not so important; where there are so many connections there is sure to be some little leakage somewhere.

Mr. Thomson: I have been waiting for someone to take up the cudgels for the electric light men. Mr. Black says they pay more attention to seeing that the wires are covered with some kind of covering than they do to insulation. I certainly think his information must be far-fetched in this respect, because I think from the time the electric light companies were started, it has always been with them a great object to get good insulation.

Mr. A. B. Smith. I presume that Mr. Thomson is speaking for Hamilton. I am in a position to speak for a good many other places, and I have to say that insulation is looked upon as only a secondary consideration. It is "get there" anyway.

Mr. Thomson: I think if the telegraph and telephone men would pay a little more attention to insulation it would be well for them, too.

Mr. McFarlane: I do not mean it as any reflection upon the electric light men, but I have been in places where I was surprised that the electric light inspector would allow such wiring to be done.

Mr. Smith. Not in Ontario. (Laughter.)

Mr. McFarlane: Yes, in Ontario.

The President: In the days when insulation was not consid-

ered of any account, we used to run bare wires. The Brush Company ran their circuits, 16, 18 and 20 arc lights, on bare wires, but it was very soon discovered that it would be just about as well to have something on them. There is no doubt whatever that a good deal of the insulation that has been put upon electric light wires has been of no account at all; in my opinion the wires would be very much better without it—not that I am advocating bare wires at all, but much of the so-called insulation means simply false security, and is the cause of a great deal of trouble. *For instance, if the wires were bare, and a contact* came on them, it would be at once discovered by various tests made during the day for grounds. But with the so-called insulation, where there may be a hundred crosses one after the other, the tests do not show them, until a rainstorm comes along, and they all develop at once, causing much trouble. Mr. Black spoke of the importance of measuring the resistance of wire as regards quality That is a most important point, and it has been impressed upon me in a very forcible manner in the construction of electrical machines; unless the wire is tested very carefully, one half of the good result is lost. One dynamo may be built, and run perfectly, with a large out put for a reasonable amount of power, and run cool. Another machine may be built from the same patterns, the same wire, the same quality of insulation on it, and you cannot get from it one half of the results, and the concern gets hot enough to burn itself up. That is a point which builders of machines will have to consider more. I have no doubt that in a rough manner the quality of the wire is examined into, but more depends upon good conductivity than anything else in the business. It means the saving of a good many dollars in a year in the question of fuel. There is another point I would like to hear discussed, and that is, the testing of electric light lines for bad connections or faulty circuits. Mr Black suggested the testing of such lines daily for resistance. This I think he would find impracticable for the reason that the measurements would have to be made through the carbons of the lamps. This would introduce an ever varying quantity, as some of the carbons might be short with burnt ends, making perfect contact. When many of the lamps were newly trimmed the resistance from poor contact or dirty points might measure away up in the thousands of ohms, in fact approach an open circuit. That is the difficulty that would have to be contended with in a test for resistance. *It is an important matter to ascertain the condition* of a circuit, and if there is an electric light man here who knows of any means of demonstrating that condition of a test, it would be of great advantage to the fraternity.

Mr. Black: In reply to Mr. Thomson, I knew of the case of an electric light company having their wires one of these "undertaker's wires," as they are called—lying on the cornice of a building weeks at a time, during all kinds of weather. In a country town where I was, I saw one of these underwriter's wire lines running into a church, at an angle of 45 degrees, without any insulator at the window, or anything to prevent the dripping of the rain from the wood, and then turning up inside again. Now, the amount of rain that ran through there might set the casings of that window on fire.

Mr. Thomson: I am afraid an electric light company did not put that in that was a farmer's installation, not an electric light company's.

The President: Mr. W. A. Tower, of Toronto, will read a paper on "Underground Construction."

UNDERGROUND CONSTRUCTION.

It is only within the last six or seven years that underground conduits for electrical purposes have been constructed to any extent, although as early as 1808 Soemering, a Russian scientist, exploded mines electrically through an underground wire a mile long, and in 1837 Cooke and Wheatstone operated the first practical telegraph system in the world by means of underground wires. At that time the art of insulation was in its infancy, and the underground was soon abandoned for the overhead wire. Within the last few years, however, the insulation of wires and cables for underground work seems to have been nearly perfected, and at the present time we have reason to believe that we will never be troubled on that score if proper care is taken in manufacturing and laying the cables.

As my experience has been chiefly confined to underground construction in connection with telephone work, the descriptions in this paper refer to that class of construction, although electric light cables could be put in the same style of conduit.

The first work of burying wires in America was done in Washington, D. C., but I believe the system did not work satisfactorily, and is to be, or has been remodeled. The next work of any importance was done in Chicago, when they adopted the drawing in system, the only practical system for telephone work at the present time.

A drawing in system is one where any number of ducts can be laid and used at any time without having to dig them up, or having to lay the cables at the time the conduit is laid. This system does not necessitate the use of any particular material or make of conduit of which there are a great many the principal ones are 1st iron pipe; 2nd, cement lined iron pipe; and 3rd, the Wyckoff. There are several others, but most of them have been discarded for various reasons, while others I have never seen and cannot give any description of them.

In building an iron pipe conduit, after the trench has been dug, a layer of concrete about three inches thick is laid, wide enough to allow an inch or more between each pipe, and three inches on each side. A row of pipes is then laid. The pipe lengths vary from 14 to 22 feet, and are screwed together by regular threaded couplings. After this is done, concrete is put on, filling up the spaces between the pipes and the three inches on each side. The concrete is then levelled off about one inch above the pipe. Another row of pipe is then put down, and the process repeated until the proper number of ducts has been laid. The top layer of pipe is then covered with three inches or more of concrete, and the trench filled in.

The cement lined pipe comes in lengths of about 8 feet with bevelled male and female ends, and is laid in the same way as the iron pipe. The joints are made by bringing male and female ends together, and covering the junction with neat cement.

The Wyckoff conduit consists of pieces of thoroughly creosoted wood, about 8 feet 4 in. long, 4½ in. in diameter, with a three inch hole through the centre, the ends counter-bored and tenoned. There is first laid an inch and a half board in the bottom of the trench, which is wide enough to hold the proper number of ducts. The ducts are then laid on this, layer by layer, the joints being made by joining the male and female ends about half the length of the tenon, when hot pitch is poured on, and the lengths then driven together. After the ducts are all laid, a 1½" board is placed on top to protect the ducts from the picks of workmen digging across the *line of the conduit. This all appears very simple to those who have had no* experience with this work, but some of the difficulties which have to be overcome are by no means trifling. In the first place, after deciding upon the route to be followed, it is necessary to find out whether there is room enough on the street to lay the conduit, as the gas mains, water mains and other pipes may have been laid before the conduit was thought of. The Engineer or Supt. of construction applies to the city and gas company for the location of their mains, which information, as a rule, is given very graciously, but in three out of five cases the position given is not correct within two or three feet, and about the only use made of the information is to tell on which side of the street the mains are, and, consequently, test holes have to be dug to locate the pipes before the work can be started. As a general rule the bottom of the conduit is put below the level of the gas mains, and when a corner is reached it is often necessary to carry part of the ducts over the mains, and part under them. In some of the larger cities of the States where there are two or three gas companies, the conduit trenches at street intersections often have to be as deep as ten feet, on account of the numerous pipes that cross one another at such points. The manholes are usually located at street intersections, and consist of chambers about 7 feet long, 5 ft. wide, and 7 ft. deep with brick walls laid in cement, and a cast iron head and cover, generally made to bolt down tight to keep out water. After the conduit is laid and manholes built, an entrance must be obtained to the telephone building, which too often has been built without proper consideration for the handling of cables. The largest telephone exchange in the States has this fault; the first cables were pulled into the bottom duct, and it was found that it would be impossible to ever get at them again. The consequence is, that if a cable gives out it will have to be left, and the duct sacrificed. I do not think there are two exchanges which have the same appliances for handling cables, every engineer having a different idea as to how it should be done, and as yet a perfect system has not been adopted anywhere.

In pulling in cables, we first have to get a rope through the duct. This is done with wooden rods, about four feet long, equipped with malleable-iron couplings. A rod is inserted into the duct which is to be used, a second one jointed on to it, and both pushed into the duct, this process is repeated until the rods extend to the next man hole. A rope is attached to the first rod, and the rods and the rope pulled back into the first man-hole, and the rods uncoupled as they are pulled in. The rods are handled quite easily, two men being able to rod 400 ft. of conduit in about fifteen minutes. The rope is then fastened to an iron clevis, about 10" long, made to fit the cable and riveted on to the end of it, the reel of cable being on the holder. The cable is then ready to pull in, which is done with a winch geared to an upright shaft with a sliding drum, and so arranged that the drum can be placed exactly opposite the duct through which the cable is to be drawn, thereby avoiding pulling the cable around or over any corners of the conduit.

After the cables are in, the splicing is to be done. This operation requires the greatest of care, and only thoroughly reliable men should ever be employed to do this work. In making a splice, the cables from each way are bent into their proper place in the man-hole, and then cut to the proper length, which allows the end to lap about a foot. The lead is then stripped off each end the length of the lap, and a piece of lead pipe, large enough to cover the wires when spliced, is then slipped over one of the ends; the wires are separated in pairs and turned back as far as the lead is stripped. Two pairs of the bottom wires, one from each end, are then taken, and the insulation stripped off, care being taken not to nick the wires. A paper sleeve is then put on one end of each wire, the wires twisted together, and the sleeve slipped back over the junction of the wires. After all the pairs are joined in this way, they are boiled out with hot paraffin, to vaporize any moisture that may have been absorbed while making the splice. A piece of paper is bound aroundall the wires to keep the paper sleeves in position; the lead sleeve is now pulled over the splice, and a regular plumber's joint wiped.

If a workman is careless in making a splice he is liable to leave a wire open, or he may not boil it out thoroughly, and so leave enough moisture there to bring the insulation of the cable very low, and it is difficult to locate such a fault exactly without opening splices until it is found.

Before a splice is started, the cable is tested back to the office, or to the point from which it starts, for open and grounded wires; the length to be spliced on is also tested in the same way, and if any such wires are found they are spliced together, so that although there might be a faulty wire in every section of the cable there would still be only one bad wire from end to end. If the testing were not done, a faulty wire in one section might be spliced to a good wire in the next, and so on, in which case, the more sections of cable the more faulty wires there would be in the entire length. After all the splices are made, and the pole or building terminal and office terminal put on, the wires are tested out and put on corresponding binding posts at each end. A capacity and insulation test is made, and if it is up to the standard, the cable is ready for use. At present the insulation must be at least 500 megohms per mile, and the capacity at most .08 microfarad per mile.

The subject of underground construction is too large a one to be treated in any sort of detail in such a paper as this, but if any of you care to follow the subject further you are heartily welcome to inspect the underground work of the Bell Telephone Company in this city.

DISCUSSION.

The President: I would like to ask Mr. Tower if he found in the course of his experience any bad effects from the leakage supposed to come from the grounded lines of the street railway? I have heard that there is a certain amount of trouble caused in that way. The point is one which it seems may presently become important; I suppose it will be a question for the telephone company to say whether they can fix the responsibility on the street railway.

Mr. Tower: There is certainly a difference of potential between some of our cables. There is one case, where we had a separate section of cable, where by touching this section we got a spark as large as you get from an ordinary telephone generator, but as far as ascertaining the point you speak of, it has not been there long enough yet, but there is certainly a difference between our cables underground.

The President: Have you found that the quality of the con-

duit made any difference? Is one what you might call a better insulator than the other? Would that spark be due to induction or a leaky current?

Mr. Tower. It is supposed to be due to the cable being partially grounded at some points. Of course, I have not had very much experience in that. I do not see that any one particular kind of conduit would make any difference. The only way in which we hope to overcome it is by grounding our cables as often as is necessary in the manholes—trying to keep the same tension in the manholes. It is impossible at present to say whether it will be successful.

The President. The reason I ask is this: the question of underground conduits is becoming very interesting, not only to the telephone companies, but to other companies engaged in the distribution of electrical currents. There are two kinds of conduits, as you say, that might come into use—one in which the conductor is insulated, and the conduit is as good as the ground, and the other formed of non-conducting material through which bare wires may be drawn. I do not know whether conduits of that kind give remarkably good results—those made with creosoted paper, through the pipes of which bare wires have been run. Any information from those who have had practical experience would be of great value to those who are in the business, or who may be in future.

Mr. McQuaide. I can give you a little information. I only know of one place in the United States where they have been tried, and it has not been a success. The parties who furnished that material are rivals in business of mine, but nevertheless, I think I am right in saying that in Minneapolis, where it was tried, it has not been found a success. They tried it with feed wires, but they had to keep one man all the time taking it up. It was a disastrous failure. I do not know why it was a failure, but it was all taken up. There are a good many reminiscences in connection with the conduit business, not going quite so far back as those of the telegraph business; but about fourteen years ago, when the electric light first began to be thought of some general use, it was thought that nothing would do but something that was a non-conductor, but opinions seem to have advanced, until now they seem to have reached a point when it seems to be the idea, both of telegraph, telephone and electric light companies, that the only thing you want is a hole in the ground, and let the wire men do the rest.

The President. There is another point on which Mr. Tower might enlighten us, and that is the use of creosoted conduits, the effect they have on the lead covering of the cable.

Mr. Tower: There are many opinions on that subject, which has been pretty well ventilated. Some claim that it does not affect the cable, while others are taking it out, claiming that their cable is being injured by it, so I do not care to express any opinion upon it.

Mr. A. A. Wright: Did I understand the gentleman correctly, that all we had to do was to put the wire in the ground, and it was all right? (Laughter)

Mr. McQuaide: I said that all that was necessary was a hole in the ground. Cables can now be made to do just as well if laid in the ground. Of course they have to be prepared in a special manner. All the conduit is for is to protect the cable, to enable you to draw it in and out for the purpose of repairs.

Mr. Starr: I would like to ask one question. In these conduits, do you find any electrical action between the grounded wires of the street railway and the metallic circuit that is insulated?

Mr. Tower: The trouble is the action on the lead casing of the cable. To my knowledge we never had any trouble on the wires inside the cable, but it is the action that sets up between the different molecules on the lead covering of the cable.

Mr. Starr. If they were insulated, even with creosoted wood, would not that prevent any such action?

Mr. Tower. I have had very little experience of that, and am hardly able to say.

Mr. A. B. Smith. Mr. President, I would like to move a vote of thanks to Mr. Tower for his paper, which, I am sure, has been very much appreciated by those in the business.

The motion was seconded and carried.

The President: The old telegraphers have been indulging in reminiscences of the way in which they used to do it in the year one, and it has occurred to me that it would be interesting if our friend Mr. Smith would give us some idea of what is being done at present, in the most modern developments of the use of the electric current for telegraphy.

Mr. Smith. I did not expect to be called upon in this way, and I do not know whether I can say much that will be of interest to you. We have been indulging to such an extent in reminiscence that it puts one in mind of an old time camp meeting. When a practical electrician, or anybody engaged in the electrical business, begins to talk about the way things were done fifty years ago drop him. (Laughter). Talking of batteries, we have made a new departure in the head office here of the G. N. W. Telegraph Co. We have entirely dispensed with the use of batteries, and have adopted generators, and, although the system is incomplete, being simply in a transitory state, still it is far enough advanced to enable anyone who wishes to see it to do so, and they will be very welcome. After a good deal of hunting around and tracing up all we could find relating to the subject, and inquiring into different systems, we finally adopted what is known as the motor-generator system, or the transformer. In some of the large cities of the United States (there are none here, ours is the first installation in Canada) they have a motor driving a lot of generators at different potentials; others use an engine, and that means a good deal—it means duplicate machinery for everything. In looking the thing over, we came to the conclusion, being very favorably situated here as regards power, having two power companies, that at no time would we be likely to have to shut down for any cause other than a fire in our building, which, of course, is a very remote possibility. I might just say that the machine we have in use was built by our President, and he, probably, could tell you more about it than I can. However, the pattern adopted is the one horse power style, ring armature, having 32 sections 16 are on the motor side and 16 on the generator side. These coils are separated from each other by very thick wooden and mica insulation. They are arranged for 110 volt current to all the motors, and on the generator side for 75, 150 and 300 volts. Well, as I was saying, some of these have been put into practical use and have quite exceeded our expectations so far as efficiency and comfort goes; we get a better current with less trouble. In addition to that, we are running our locals or sounders, short circuit instruments in the office, on which we have a six volt machine and about one hundred amperes of current. Of course it meant a great many changes in the office wiring and the switching apparatus, and if you were interested at all in knowing how the connections were made, I might be able to draw you something on this blackboard. (Diagram shown on blackboard.) In the old days we have heard so much about, it was never customary to work more than four or five lines out of one battery; to work more than that was to use up the battery and you could never get very satisfactory results. In our office we have displaced some three thousand cells, and what I was wanting to get at is this- practically the capacity of these machines is unlimited; you can load them up "out of sight. We are now working about fifty of our long lines out of one of these small machines. The machines are slow speed, running at about 900, taking an ampere and a half of current at 110. I do not see any reason why they should not run forever.

Mr. McFarlane. I would like to ask Mr. Smith to give us some idea of the economy of that apparatus, what it does away with, what it costs, &c.

Mr. Smith: That depends a good deal upon what you pay for power. A plant such as I have described takes between two and three horse power.

Mr. Kammerer: If the dynamo is running, furnishing current to the line, if you find the lamp glow you take out the plug; that takes out the current from your line; how is that line tested?

Mr. Smith. We simply leave it out until the ground is taken off. We know if that lamp glows that the ground is close by, there are a dozen different ways of testing.

Mr. Kammerer: It throws that line out of circuit?

Mr. Smith: Yes, but if you were in the telegraph business you would know that that does not affect it very much. (Laughter.) We have lots of wires to fall back on.

The President. Do you use these dynamo currents for testing purposes. Perhaps that is what Mr. Kammerer meant to ask?

Mr. Smith: Yes, certainly we can.

The President: That closes the programme for the afternoon, but Mr. Rosebrugh will now by means of a stereoptican project upon a screen and an electric arc show you its operation in an arc lamp.

The exhibition proved to be a revelation to most of the members and deeply interesting.

THE DINNER.

At 8 o'clock in the evening the members of the Association to the number of about fifty dined together at McConkey's restaurant. The tables were tastefully arranged and decorated, and the excellence of the menu was the subject of many compliments bestowed upon the worthy restaurateur. Excellent music was discoursed throughout the proceedings by an Italian band.

Upon the removal of the cloth, the President said. It has been understood that this gathering is entirely informal, and there is no toast list; yet I feel it my duty to call upon you to fill up your glasses and drink the health of Our Queen.

The toast having been duly honored, Mr. Martin favored the company with a song, which elicited a vigorous encore, to which he responded with another selection.

Mr. Starr: We have all heard the ruling just now of the President, in which he stated there were to be no toasts to-night, but we have had one, and I think there should be one more. I think every one who has listened to his address to-day, and who is acquainted with his indefatigable exertions in the interest of the Association during the past year, will gladly fill their glasses and join with me in drinking the health of the President of the Canadian Electrical Association.

The toast having been drunk with musical honors, three cheers and a tiger, the President spoke as follows.

Gentlemen of the Canadian Electrical Association. While it is not my intention, not being a speaker, to inflict upon you any speech on this occasion, I must not omit to express to you my very hearty thanks for the manner in which you have just responded to the toast given you by my friend, Mr. Starr. Having broken through the rule of the evening, we may as well go on breaking it, and I certainly have a great

(Continued on page 26.)

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

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THE second Convention of the Canadian Electrical Association has been held. Elsewhere will be found a synopsis of the proceedings with the papers that were presented and discussed. The gathering was a representative one in every respect. The leading electric light, telegraph and telephone men in the Dominion were present and took part in the proceedings. It may be said, that both socially and from a business point of view it was an unqualified success, and will be the forerunner of many more meetings of the greatest importance to the industry. The uniform excellence of the papers presented makes it almost impossible to particularize. We have given them fully in this issue with the exception of those by Mr. Rosebrugh ("Speed Control") and Mr. Breithaupt ("Long Distance Transmission"), which will appear in our next issue. A complete report of the proceedings, including verbatim copies of all the papers, will be printed and distributed to all the members of the Association. The paper by R. G. Black, who is a son of Mr. Geo. Black, manager of the G. N. W. Telegraph Co., Hamilton, and a graduate of the School of Science, Toronto, was a most timely one, and gives strong indications of a future full of promise for the youngest member of the Association. It has been suggested that at future Conventions the papers be printed in advance for the use of the members, so that they may be discussed intelligently and in a profitable manner. As it was, the business of the Convention and the various discussions were taken hold of in a vigorous manner, and both the work and the fun, at the sessions and the banquet, were handled with the vim that electrical men, of all other professions, are noted for. The members are to be congratulated that the "off-meeting," as it was termed, turned out such a complete success. It speaks well for the future of the Association, and without doubt the forthcoming annual gathering which is to be held in Toronto in the month of September, will eclipse in importance anything which has preceded it.

ENGINES FOR ELECTRIC LIGHTING.

I.

There are so many points to be considered in making a comparison between what are called high-speed and low-speed engines that it is not a simple matter to arrange the order in which they should be taken up.

In this article it is proposed to offer some suggestions on the question of the power developed by engines of the high-speed class. Before going further, the point should be determined at what speed does an engine become entitled to be called high-speed? At the Paris Exhibition of 1867, the Whitworth Co., of England, exhibited two Porter-Allen engines. The one was a condensing engine, of two feet length of stroke, which was run at 200 revolutions per minute; the other was a non-condensing engine of one foot length of stroke, and was run at 1,000 revolutions per minute. The engines were most skilfully designed, and the workmanship, like everything Whitworth made, was as near to perfection as could be had. The piston speed of these two engines was very much higher than any then in general use, and the one is probably ahead of anything yet in use. The speed of the piston, however, is not generally considered, although it must be used in the calculation of the power. An engine making two hundred revolutions per minute or over would, by most engineers, be called a high-speed engine, without reference to the length of stroke.

From 250 to 350 revolutions per minute seems to be usual speeds for these high-speed engines, and, as many of them are of about nine inches to one foot length of stroke, 600 feet per minute is a high piston speed for them. Power may be defined as pressure in motion. Inside the steam cylinder there is as much pressure in the cylinder head, as there is on the piston, but it has no motion, and consequently gives off no power. In the steam engine, then, the total pressure on the piston, and the speed at which it moves, are the two elements in the production of the power. At the commencement of the stroke the piston is

close to one end of the cylinder and has no motion. Steam is admitted and pressure produced and motion. The motion at first is very short but increases, until at a point near to the middle of the stroke, the piston speed is as great and for an instant greater than that of the crank pin. The motion then gradually diminishes until the piston comes to a standstill at the other end of the cylinder.

As *horse power* is measured by the standard of 33,000 pounds lifted one foot high in one minute of time, the changes that take place within the *one* minute are apt to be overlooked. In an engine making 300 revolutions per minute, the piston has come to a standstill, in order to reverse its direction of motion, 600 times each minute. The power given off varies even more frequently, as it is the product of the speed and pressure, and both of these are constantly changing. It will probably be more clearly seen if the changes are noted for a particular engine. Take the case of an engine having a cylinder 12" diameter and 12" stroke, and making 300 revolutions per minute, with steam admitted at 100 lbs. pressure, and cut-off at one quarter stroke. The horse power under such conditions would be about 94½ horse power, but if the pressure on the piston at mid-stroke, and the speed at which it is then moving be taken, the horse power would be about 255 horse power. In low speed engines similar differences will be found, but it is questionable if the results of these differences are as great in low-speed as in high-speed.

The great effect of the weight of the reciprocating parts, that is of the piston, piston rod, cross head, and part of the connecting rod, is to reduce the pressure on the crank pin during the first part part of the stroke, while the speed is increasing, and to increase it during the latter part, while the speed is diminishing. This action tends very much to equalize the pressure on the crank pin. The effect of weight, in these parts, on the motion of the engine is far greater in high speed than at low speed; and in designing a high-speed engine the weight of these parts should always be taken into account. At mid-stroke these parts have attained their highest speed, and moving at same velocity as the crank pin, the pressure on the piston is at once conveyed to the pin.

From this way of looking at the matter it is plain that there is no steady power given by the engine. Its power is a series of perpetual changes, the average of which in the engine in question is 94½ horse power. The fly wheel is supposed to be a sort of reservoir into which the surplus energy may be stored, and drawn from it if required. This, however, can only be done by change of speed. These suggestions are offered as probable explanations of some of the complaints made by electricians of unsteadiness in motion or in power. The steam engine is not so perfect in its details as some suppose, and when tested by finely balanced and delicate apparatus, irregularities become apparent which could not be detected by the tests formerly applied to steam machinery. Increased power is obtained by increased speed of piston, whether that speed is obtained by longer strokes or by greater number of revolutions in a given time.

High speed engines require to have weight and strength in proportion to the greatest strains put upon them at any point of each stroke, and not in proportion to the average power. The admission and exhaust of the steam must also be specially provided for. The *admission* must be rapid and the cut-off *certain* and *positive*. In case of an engine making 300 revolutions per minute and cutting off at one quarter stroke, the steam valve opens, admits the steam, and closes again, in one-fortieth part of a second. The exhaust is opened and closed at each end of the cylinder ten times per second. There is often greater difficulty in getting rid of the exhaust steam than in admitting the ve steam. Unless there be ample freedom for the exhaust to escape there is great loss of power from the exhaust steam having to be forced out. Small defects in the valve motion are apt to become of very serious moment when these defects are applied to operations that have to be performed in the fortieth part of a second, and power may be lost through failure to admit the steam properly. A little more admitted at one end of the cylinder than at the other will be sure to be seen in a jerkiness in the motion of the engine.

J. S. Parmenter, of Woodstock, has been granted a patent for a compound engine.

SPARKS.

Messrs. Meikle, Dyment & Son, of Gravenhurst, have recently purchased an electric lighting plant.

J. H. Etherington, of St. Catharines, will in future operate his carpet factory by electric power.

The Mimico Electric Railway Co. propose to make application to the township of Etobicoke, for a bonus of $10,000.

The breaking of a crank pin at the Niagara Falls Electric Light Works recently led to the resurrection of coal oil lamps.

A 300 light electric plant has been purchased by the Yarmouth Duck and Yarn Co., N. S., and will be used for lighting their mills.

Incorporation has been granted to the Ahearn Electric Heating and Manufacturing Company, of Ottawa, with a capital of $25,000.

The library of the Dominion Parliament will in future be lighted by electricity. The effect of the change is said to be most satisfactory.

A 40 horse power engine and steam boiler has been purchased by Mr. Bristol of Madoc, Ont., with which to operate his electric light plant.

The Eel Lake, Ont., mica mines have been purchased by the Thomson-Houston Electric Company, of Lowell, Mass., and will be at once put in operation.

There is said to be a likelihood of an amalgamation of the interests of the Gas and Electric Light Co., and the Incandescent Light Co., of Brockville, Ont.

Two 5,000 light and four 2,000 light dynamos are under construction by the Royal Electric Light Co., of Montreal, for use in their lighting station in that city.

Messrs. Tooke Bros., shirt manufacturers, Montreal, have installed a 400 light incandescent plant, and are also using electricity for heating their polishing and sad irons.

The number of passengers carried on the Montreal Street railway in December was 1,236,482; in the same month a year ago the number was 766,990; the increase was 469,492.

An interim injunction has been applied for to restrain the Davenport Street Railway Co. from crossing the G. T. R. tracks at Davenport Road or for laying tracks for that purpose.

The Standard Electric Light Co., of Ottawa, are about to install 700 lights in the Russell House, and have already installed between 300 and 400 lights in the Grand Union Hotel of this city.

The Detroit syndicate which recently purchased the Walkerville Street Railroad, are said to be considering the advisability of putting in an electric light plant in connection with their railroad enterprise.

The Toronto Street Railway Company has informed the city that the whole of its system will be operated by electricity this year. This will mean the re-paving of thirty odd miles of track at a cost of over $300,000.

A Montreal despatch states that Mr. J. F. O'Brien has entered an action for $15,000 damages, against the Bell Telephone Co., in consequence of alleged damaging statements in connection with his patent telephone index.

The forty-sixth annual report of the Montreal Telegraph Co. shows a surplus of property over the shareholders' stock of $151,824, and a contingent fund of $53,983. A rigid inspection of the company's lines shows them to be in good condition.

The Winnipeg Street Railway Co., pays the city annually $20 for each car used during the year, and in addition to all other sums, pays the city annually after February 1st, 1902, 5 per cent on the Company's gross yearly earnings. The company will considerably extend its lines during the coming season.

At the annual meeting of the London Street Railway Co., H. A. Everett, of Toronto, was elected president. These directors were chosen: J. C. Grace, Toronto; E. W. Moor, Cleveland; S. R. Breake, London, formerly of Toronto; T. H. Smallman, London. Mr. Breake will be manager of the road and secretary-treasurer of the company.

The Halifax Electric Light Company's new building will be 80 feet by 42 feet in size. The capacity of the steam plant is being largely increased. There have been added two incandescent alternating dynamos, each of 2,000 lights capacity. The arc light capacity will also be increased by 100 lights. Three power generators will be installed.

The question as to who should receive the lighting contract in Hamilton, at the expiration of the existing contract with the Hamilton Light and Power Co., which expires a year and a half hence, is already being discussed. It is said that the holders of the present contract have already submitted a proposal to the Council for its renewal. In the event of new tenders being asked for, it is believed that the Hamilton Street Railway Company will make a bid for the franchise.

A correspondent writes us from New Glasgow, N. S., that the Electric Light Company of that place are doing a big business this winter. They are lighting the three towns of New Glasgow, Stellarton and Westville. Their station is in New Glasgow, Stellarton being distant 3 miles and Westville 5 miles therefrom. The Thomson-Houston arc and alternating systems are used. The station is under the management of Mr. F. A. Bowman. Our correspondent states that there exists no such company as the "Westville company" as stated in the last issue of the ELECTRICAL NEWS, and that there is no room for opposition while Mr. Bowman holds the management of the New Glasgow Company.

(Continued from page 23.)

deal of pleasure in proposing to you the health of our worthy host, the Principal of the School of Practical Science, Prof. Galbraith.

The toast was enthusiastically received.

Prof. Galbraith. Mr. President and gentlemen I need hardly say that it affords me much pleasure to be present with you this evening. I think that the advantages which the School of Practical Science will derive from the fact of your holding your convention there will be very great, that while you, for the time being, find with us accommodation, the staff will enjoy an opportunity, not too often afforded us, of coming into contact with those who are actively engaged in the practice of the electrical profession. I need hardly tell you that, shut up as we are, we have not many opportunities of coming into contact with the men who are doing practical work, and we feel that it is a great privilege to have such an opportunity of doing so as is afforded by your holding your convention within our walls. There is no doubt that the advances of electrical science will be great when all those who are interested in it, either as teachers and experimenters, or in the wider field of its practical application to the requirements of daily life, co-operate and help each other in the work. There is no reason at all for those engaged in professional work attempting the same kind of work you are doing outside; we could only succeed in producing a poor imitation. We have each of us our own field—yours the wide field of the world, ours the restricted one of the laboratory and lecture room, and the work that is carried on in each of those fields is in some respects very different. When we look over the advances of the science of practical electricity during the period since it first began to attract attention, I think we shall notice that during the earlier part of that period electrical investigation was carried on principally in the laboratory, and that most of the great laws of electricity were known as much as thirty years ago. But the advances which have been made since that time have not been so much in the line of scientific discovery as in the practical application of known laws, and the surmounting of difficulties which could not have been foreseen in the progress of laboratory work. I shall not attempt to give the names of the great discoverers in this line, for I am very poor at history of that kind, and I might find myself somewhat in the position of a little Sunday School boy, who, when asked to tell what he knew about Esau, replied something as follows: "Esau was also called Ishmael; he built the Suez Canal, and wrote a book of fables called the Arabian Nights, the copyright of which he sold to a publisher for a bottle of potash." (Laughter.) I think you will be able to understand the distinction I wish to draw, that the men in both classes can help each other in doing the work that lies within their special sphere. One great difference between the two fields seems to me to be this. you find your spur to work in money-making; that is to say, the great practical advances are, after all, for the purpose of making money. Now, the work of a professor is not expected to be for that object, and—I am very sorry to have to say so—he seldom disappoints that expectation. (Laughter.) However, we can work together something like some people in a neighbourhood down east, which some of you may know, are said to have done. The inhabitants of the County of Glengarry are, for the most part, Highlanders, and some of them are Presbyterians, and the others Roman Catholics. Notwithstanding this, they are very friendly and helpful to each other, and when the Roman Catholic portion of the community are in want of money for some of their objects, they do not hesitate to apply to their Presbyterian neighbours for a subscription, and in the same way, the Presbyterians would apply to them at other times for assistance in their projects, and they thus lived very happily and peacefully together. The parish priest was named Father Chisholm, and it is said that on one occasion, the Presbyterians having decided to build themselves a new church, and remembering that they had often helped their Catholic neighbours in various objects, a delegation of them called upon Father Chisholm to solicit a subscription from him to help in putting up the new edifice. Being ushered into his presence, the leaders of the delegation were for some time silent as to the object of their call, and at last His Reverence inquired, "Well, gentlemen, what is it that you want?" They explained the object of their mission to him. "What!" said he, "you expect me, a Roman Catholic priest, to assist in building a Presbyterian church! Why! what would the Pope say if he heard that I helped to build a Presbyterian church. No, no, I can't do it." The delegation was about to retire when, with a twinkle in his eye, his Reverence asked, "But what are you going to do with the old church?" "We are going to tear it down," said the spokesman of the party. "Oh!" says His Reverence, "then I'll give you a hundred dollars to help in tearing the old church down." (Laughter.) Now, that was a very amicable agreement, and the same sort of feeling should exist between the professors and the practical men—each should help the other, although one may sometimes help to tear down what the other has built up. By coming in contact with each other, a good many cobwebs, at all events, are torn down, and a much better understanding arrived at.

After toasts had been drunk to the health of the Secretary, the Executive Committee and the supply firms, and humorous addresses, songs, etc., had been given by Messrs. Neilson, A. A. Wright, Starr and others, a right jolly evening came to a close.

SECOND DAY.

The Convention was called to order by the President at 10:30 a.m.

The first order on the programme, the "Discussion on proposed Amendments to the Constitution," was held over until a later hour, in order that there might be a fuller attendance of members present when it took place.

Mr. A. B. Smith, was then called upon by the president to read the following paper, on "Free Wiring," in the absence of the author, Mr. J. M. Campbell, of Kingston.

FREE WIRING.

When arc lighting was first introduced in this country it was customary to put lamps and wires into the premises of the consumer free of charge. This was no doubt the origin of free wiring. As the business increased and incandescent systems of lighting were introduced, this practice was in a great many instances still continued. The simple wires of the arc system multiplied in number and size. The labor of installing these wires increased greatly. A better insulation was called for; incombustible fittings and better workmanship were the order of the day, until at the present time if interior wiring for any incandescent system is put in properly it requires good material and good workmen. Both of these cost money. In the face of all this a great many of the local lighting companies sail serenely on, wire up places of business and houses free of expense to the owners, charge the outlay to "Capital Account" and post it up in their books as an asset. The stockholders at the end of the year very likely obtain a stock dividend, and may consider themselves very fortunate if they are not called on to subscribe for a further issue of stock for extensions and improvements—unfortunately improvements to the property of other parties, and which if an asset at all to the lighting company doing the work, is of a very doubtful character—the kind of an asset which should be written off the books every year as a dead loss. Where do we hear of gas companies piping up customers' premises free of charge? This is seldom if ever done, and yet in small towns the gas making industry does not seem to be any great bonanza, and it is generally conceded that gas light can be manufactured cheaper than incandescent electric light.

No doubt when an electric lighting plant is installed in a town a greater number of customers can be obtained by supplying all interior work free of charge, but when this is done the company is at the mercy of the consumer. On the slightest pretext the company are ordered to take out the lights and wires by the customer, who has not any financial interest in the stuff, and the company's asset of so many lights wired up, becomes a scrap heap of very little value. If the customers put in their own interior work, it saves a large outlay to the company in the first place. They then have an interest in it, and will not be inclined to cut off the current without good reasons. When pay day comes around, the collector will find that he has a different man to deal with than our friend with the free wires. By abolishing free wiring, a better class of customers will be secured. The lighting company's expense will be cut down considerably, as all changes and repairs can be charged for. There will not be so much capital invested, and therefore less dividends to pay, and on that account a cheaper service can be given. Give the people a perfect service at as low a figure as possible, and make them pay for everything inside of and including the main line cut-out.

The company may not secure quite as much business, but it will show a much greater net gain at the end of the year. The business will increase much quicker than the capital account, and by and by when a street circuit must be extended or a new dynamo put in, the money will be on hand to do it with, which would otherwise have been squandered on free wiring.

DISCUSSION.

Mr. Thomson: I must take exception to Mr. Campbell's idea; I do not think he has ever come into competition with a first-class, live gas company, selling gas at about a dollar a thousand feet. He speaks also of small gas companies not being financially successful; I think there are very few of them who are not, for it is a well known fact that the actual cost of producing gas is not greater than five or six cents per thousand feet, and if they get a dollar and a half per thousand feet, net, for it, I think they are getting a pretty good profit. The electric light is quite different. If an electric light company goes to an expense of $6,000 or $7,000 in putting in a large dynamo, I question if it is just right to have that machine sitting there doing virtually nothing, and whether it is not better to expend a few more dollars on free wiring. When I say "free wiring," of course I do not mean to say that you should go into a private house, and wire it from the cellar to the garret free; in that case we should charge for it at cost price. The wires in that case, too, are mostly concealed; but for stores I think in almost every case the cleat wiring should be done free. Of course there may be occasions and situations in which you can charge for that wiring, but cleat wiring can be done properly at a very small price. It is just run along the ceiling, and where there is approved wire does not require to be elaborately covered, or the floors taken up. I think that free wiring is a kind of booming that electric light companies take advantage of to increase their revenue, which there is no doubt it does do in a substantial way some times.

Mr. Yule: I am very much surprised at Mr. Thomson taking the stand he has taken. I do not see why electric light companies should wire free any more than gas companies do free piping. He advocates it because the cost of producing electric light is greater than that of producing gas. Why should not we allow the users of electric light to pay for the wire, and thus be more nearly on even terms of competition with the gas company? Of course I am in favor of free wiring where the electric light is first started, as an advertisement, but after that everyone should pay for his own wire, especially when you supply it by meter. I will give you an instance which has occurred more than once in our town, with cleat wiring. They will start in and paper their stores, and the paper hangers and painters will take down all your wires and cleats, and, about five o'clock in the evening you will get a telephone message to go down at once and fix up those wires. Now, if they paid for those wires, and had an interest in them, they would see that they were kept in proper order, and

would think twice before they destroyed the work. But where it has cost them nothing, they look to you to replace it—they come to the conclusion, naturally enough, that having put it in for nothing, you will keep it up. There is another feature about free wiring—if you do it free, they think that every change that is made should be free also. In many cases it is mere foolishness and absurdity; they will change it to another place, and then, in a very short time, want it back in the first place again. I really am surprised at Mr. Thomson taking the position of being afraid to compete with a gas company. If they can afford to stand on their own bottom, and insist upon their customers putting in the necessary appliances on their own property, I do not see why any electric light man should not do the same.

Mr. Thomson: Allow me to say that our contracts call on the customer to pay for any changes that are made, or alterations. If our customers allow paper hangers to take down the wires, we see that they pay pretty good prices for putting them up again, and our contract also provides that they shall take just as much care of our property as they would of their own. We have frequently had it occur, that paper hangers have come in, and have left cleats down, but if they notify us at five o'clock in the evening that they want the light for that night they don't generally get it, but we let them wait till the next morning, and they learn a lesson they are not soon apt to forget.

The President: Electric light is a little more expensive than gas, and we have to throw this free wiring in as a sort of chromo.

Mr. Yule: I think Mr. Campbell is right, when he says that should be applied to working expenses, and the light made cheaper.

Mr. Thomson: I do not see how you can charge wiring to working expenses, it is a part of your plant, and cleat wiring, if a customer uses it for a year or two, and then decides to take it out, can generally be used again, and all you lose is the labor—the cost of the man's time putting it up and taking it down again. We have several times removed wires from places in Hamilton, and we invariably use that wire over again, unless it is "undertaker's wire."

Mr. Yule: What proportion does the cost of wire bear?

Mr. Thomson: It does not cost us more than seventy-five cents per light, cleat wiring.

Mr. Yule: Where we have put in cleat wiring, we find that the rosettes and other plant are virtually out of the market; you can't put the same stuff in another place, the improvements in appliances are too rapid to admit of it. Where they have been in, say for a couple of years, they are useless for a new installation.

Mr. Thomson: Very true; a couple of years ago they did not require that every light should have a fuse on it, but now it is a well known fact. Now, you can take them down from one place, and put them up in a dozen others. Of course the old wooden rosettes we used a few years ago, when taken down are no good, but that is the only case; there has been a change in underwriter's lines in that respect—an admirable change, no doubt, which should have been made years ago.

Mr. Fisk: I think the work you have in making use of second hand wire is as much as it is worth. According to my experience anything in the shape of sockets or electric light plant of that kind that has been made use of for any length of time, is worth as much to clean up as to buy over again. We did free wiring down at Peterboro' in the stores on a contract for one year. All changes and renewals, and everything of that kind, is charged to the customer.

Mr. Thomson: Of course you cannot do free wiring in houses, that is out of the question, because there your revenue is from only one or two lights out of every ten; the revenue would be so small in proportion to the investment that it is out of the question, though I know it has been done in my city in the first start out. But that is more to boom things than anything else; the old concern wanted to sell out to a New York syndicate, and to get themselves in a position for that, they wanted to wire for two thousand lights, and they went into a house, and wired it from the cellar to the garret, but in many cases we have taken the wires out. Now, speaking of sockets, we find in Hamilton that we can take old sockets and send them to the buffers and have them rebuffed and relacquered at three cents apiece, and other brass work the same way; it does not cost much to renew them. Speaking of fixtures, we always charge for fixtures; our free wiring simply includes plain cleat wiring run across the ceiling. Latterly, since we are pretty well filled up, we charge the labor at cost in putting in wires; it is only free to a certain extent; we charge from 75 cents to $1 per light for putting them in.

Mr. A. A. Wright: I suppose circumstances alter cases; where there is opposition, a man has sometimes to do what he would not do otherwise. But where you have the field to yourself, it seems to me it would be utterly foolish to do free wiring, because if you once start you must keep it up. I believe in the old saying, "Bring up a child in the way he should go," (laughter.) I think that applies to wiring as well as anything else; if you start right, I do not think you will have very much trouble. If we could get along without doing free wiring it would be a long step towards declaring a dividend at the end of the year.

Mr. Wickens: It seems to me that it is not necessary now to do free wiring to boom business. Perhaps when the business was a little younger it was necessary to coax people along, and it is all right to do a little free wiring for advertisement, but since it has become an established fact, and people know of it thoroughly, it seems to me to be an expense that should not be borne by the companies. The practice would naturally have the effect of inducing companies to do the wiring as cheaply as possible, because it may not be long before these men would take a notion to change, and the result of that is that the wiring is not done as well as it ought to be, and for that reason it leaks, and calls for more current than is really necessary to supply the light, whereas, if a customer does his own wiring he will possibly have it done well, and expect it to remain there as a fixture, and in all probability will take better care of it. I think it could be managed if the companies would stand up together, and say, "Now, we won't do this; we are supplying a light that costs considerably more than gas to manufacture, and the gas companies will not go into your house and pipe it for you." I think when you have delivered the current into a man's house, ready for him to hitch on to, that that is as far as the electric light companies ought to go, and after that the customer should be at the required expense; it would be better both for the consumer and the company.

Mr. Thomson: No doubt circumstances alter cases. Take large cities, like Toronto and Montreal, and I think probably they can get paid for their wiring. But even in Montreal, I know for a fact, that the Royal Electric Company there started doing incandescent wiring three or four years ago, and did free wiring. When I left there, a year and a half ago, we had some 5000 lights wired for. Now, we could not have got paid for those lights under any circumstances. Just about the time I was leaving we had decided to charge for the wiring. There is another little company there that has been bothering them considerably, as fleas do dogs (laughter). That company did free wiring, and the Royal Electric turned round and did it too, and the consequence was that in a year and a half they had 20,000 lights, where if they had not done free wiring they would not have had 2,000

Mr. A. A. Wright: What about a dividend?

Mr. Thomson: The Royal Electric is paying eight per cent. right along.

Mr. Wright: They get a good deal of this from their arc circuit.

Mr. Thomson: Very true. Take Hamilton, last year, 4 per cent.; we didn't get that from our arc circuit.

Mr. Starr: The practice in Montreal at present is to pay for all wiring, sockets and everything, and after that the company replaces and furnishes the lamps free.

Mr. Yule: I think, now this thing has been discussed, that there is practically no difference of opinion as to the advisability, or otherwise, of free wiring. The only regret I have is, that it should go out that Mr. Thomson is afraid to compete with a gas company. (Laughter.) I think the electric light is more æsthetic and more healthful and should be able to compete with gas. There is no manner of doubt that gas is not as good a light for a private residence as the incandescent electric is, and, taking these facts into consideration, I think the competition should be on pretty even terms between them, if each stands on its own merits, without any chromos or free wires.

Mr. Thomson: There is no doubt the incandescent light is superior to gas, as far as illuminating properties and health is concerned, but I question whether a man cannot put in eight or ten gas lights cheaper than he can eight or ten incandescent lights; I question whether he cannot run them cheaper—not, understand me, that he is getting the same amount of light with the eight or ten gas lights of so-called 16-candle power that he would with the same number of incandescent lights of 16-candle power. At the end of six months the gas jets begin to choke up, and they are not 16-candle power by any means. Now, many small storekeepers object to paying a dollar a month more than they would for gas. I have known them to take out the incandescent, because it costs a dollar month more, not but what they were getting more light for their money. But the gas jet was good enough for them before, and rather than pay the extra dollar, they will keep on using it, and that is the way the matter stands in my estimation.

Capt. Carter: As has already been remarked, "circumstances alter cases." I have had some little experience in this line in the last few years in regard to free wiring. We started a plant in Niagara Falls three and a half years ago, and after we had established our arc circuit we started out to find what prices we could get for incandescent lights, to see if we could get enough customers to induce us to go into incandescent lighting. We started out with a proposition to charge $2.50 per light for the installation. Now, as you are aware, Niagara Falls is a small place, and the storekeepers are poor, in comparison with those in large cities like Hamilton and Toronto, and we found it a very difficult matter to induce people to put the light in at all. I came to the directors and said, "We will have to do free wiring, for a time at least." They decided to do free wiring, and we did do it, and by means of that free wiring we wired up 700 lights. We have now got to that position that we have sufficient light to make it pay, and we are at present charging a dollar a light for installation, and $2 for concealed wires, so now we will get something for our wires. But I believe if we had charged from the first two or three dollars for installation we would not have had anything like the number of customers we have to-day,

and consequently our plant would not have paid, as it did, 12 per cent. interest. I think it was policy to do the installation to get the thing started in so small a place. That is the experience of a very small town and it has been remarkable, and although I very much favor the electric light company being paid for its wires, there are times, as Mr. Thomson has shown, where, as a matter of business, it is necessary to do free wiring. I think we must be governed by the circumstances in these cases.

Mr. Thomson: Captain Carter is no doubt right there. I think if his Board of Directors had decided to put in another big machine, they would go ahead and put in free wiring, and fill up that machine. If you are not getting revenue enough, and think you can do it by putting in more dynamos, the quicker you can fill them up, the more the machine will be producing a revenue, and I insist you must do free wiring in the small cities.

Mr. Carter: We are in that position at the present moment. We have, by means of free wiring, got our present system taken up, and our dynamos loaded. So now, we are obliged to extend our system, and just this last week, in a number of instances, I have to admit I have had to act like a Jew, and make the best bargain I could, and if I could not get what I wanted, go without. There are a number of special cases, where, even this last week, in order to make contracts so as to get our new plant going, and sufficient lights taken up, we had to do it.

Mr. Thomson: There cannot be a particle of doubt that if you can get paid for it you should do so, but if you can't, you can't.

The President. Don't you think there is considerable objection on the part of new comers to paying for their wiring, when the others did not?

Mr. Carter: Yes; we find that very hard, but we have to get over it the best way we can. We explain to the customer that when first starting business we found it necessary to offer an inducement to persons to put in the light. Now we have our business established, we charge one dollar towards the cost, which averages about $3 per light; supplying the material all through we find that to be the cost, and we only charge one dollar, and we put it in that position to the customer, which is generally satisfactory.

Mr. A. A. Wright: I do not wish to speak too often, but if you put in a thousand lights, there is $2,000 added to your capital account. You may have competition to-morrow you did not think of, and there is that capital account pressing you. The way to make money is to keep down capital account. Now, let me give you one instance. At Arnprior they put in a thousand light machine; they started last fall, and they have more lights ordered now than they can wire for and put in by next spring. So there is no necessity, under such circumstances, to do free wiring. I am fully of the opinion that you can get all the lights you want by exerting yourself, without doing free wiring. Of course, in a place like Hamilton you have to do the best you can.

Mr. Thomson: Arnprior has not a live gas company?

Mr. Wright: That is a question.

Capt. Carter: Only the other day, I had a gentleman from Hamilton who came down to the Falls, who wanted about eight lights put in a store. I told him our terms were eight dollars for the installation. He said, "Why, in Hamilton they wire free." We had quite a little hitch as to whether he should pay a dollar a light, but, after all, he wanted the light and he had to pay it.

Mr. Thomson: We are doing the same thing now. We are not doing absolutely free wiring, but charge from 75 cents to a dollar a light, but we had to do free wiring, especially after we got in a 1500 light machine, and wanted to fill her up, so she would not sit there and eat her head off.

A vote of thanks to Mr. Campbell for his paper was moved, seconded and carried.

The President then called upon Mr. R. G. Black, of Hamilton, who read the following paper:

THE INCANDESCENT LAMP.

Admirable as is the system of arc lighting for use in streets or large halls, it is entirely unfit to take the place of the numerous lights of moderate intensity employed for general domestic illumination. For this purpose it was at a very early period perceived that the incandescent, or heating to luminosity of a continuous conductor by an electric current, was the most promising method. It was also at an early period perceived that the conductor to be used for this purpose must be one which would admit of being raised to a very high temperature without being melted or otherwise destroyed.

The first material which was thought of in this connection was platinum, or one of its allied metals, such as iridium, which have the highest melting point among such bodies, and are besides entirely unacted upon by the air at all temperatures. In 1848 W. E. Staite took out a patent for making electric lamps of iridium, or iridium alloys, shaped into an arch or horse-shoe form.

One of the most serious difficulties, however, even with these materials, was that, to secure from them an efficient light, it was necessary to bring them so near to their fusing points, that a very minute increase in the current would carry the temperature beyond this, and destroy the lamp by fusing the conductor. An escape from the difficulty was offered by the use of hard carbon, such as used in arc lamps, but here the compensating drawback was encountered, that this substance, when highly heated, was attacked by the oxygen of the air, or in other words, would burn. To meet this plans were devised for the replacement of the consumed carbon conductor and for its protection from the air by enclosing it in a non-active gas, or a vacuum.

Thus in 1845 a patent was taken out by Mr. J. W. Star, of Cincinnatti, for an incandescent lamp, the important parts of which are a platinum wire sealed through the top of a small glass chamber constituting the upper end of a barometer tube. This platinum was clamped to a thin rod of carbon supported by a non-conductor and connected by a wire to the mercury below. By passing the current through the platinum wire and thence through the carbon to the mercury the carbon strip, or rod, would be made incandescent and was to a certain extent protected by the surrounding vacuum. Though this lamp produced a brilliant light, it proved in various respects unsatisfactory and was abandoned after many trials.

Other inventors, as for example Konn, of St. Petersburg, continued to work with rods or pencils of hard carbon and achieved a limited success, but the irregularities and brittleness of the material seemed to have been an insuperable objection and drawback, and the problem of commercial electric lighting by incandescent conductors yet remained without a solution.

This was the state of affairs even up to the fall of 1878, when, as it is claimed, Mr William E Sawyer, in combination with Mr. Albion Mann, after many preliminary experiments, produced a successful incandescent lamp with an arch-shaped conductor made of carbonized paper. The lamp brought out by these gentlemen, after filing their application for a patent, on January 8, 1880, described and shown in that application, was a rather large and complicated structure, and had no improvements or simplifications of this lamp been made the present immense development in electric lighting would no doubt have been unattained.

It is to Mr. Thomas A. Edison, without doubt, that we owe many of the simplifications and modifications which, by cheapening the lamp and diminishing its weight, have extended its range of use and its usefulness to a remarkable degree. Like many before him, he first turned his attention to platinum and platinum alloys, and devised a form of lamp admirable for its simplicity, but unfortunately open to many fatal objections. During the year 1878, however, Mr Edison was most diligently at work, and perceiving the imperfections of his first idea sought in every way to overcome them. Having experienced insupreable difficulties present in metallic conductors, he turned his attention to carbon in its various forms, finding fibrous textile material when carbonized to be the most convenient. Though working with the same material and form, Edison produced a structure very different in appearance from that of Sawyer and Mann, but bearing a marked resemblance to the lamps of recent manufacture.

The incandescent lamp of to-day is made in two parts, the outer flask, or the bulb, and the inside part. The first operation on the bulb is to punch a small hole in the center of the closed end of the flask where the exhausting tube is attached. Then the neck is cut off, making the flask the proper length for the carbon. While the bulb is being thus prepared, the inside part, which supports the carbon, is being made. This is done by taking a piece of glass tube about six inches long, and holding it in a glass blower's fire until one end becomes white hot, then two copper wires ingeniously welded to short pieces of platinum wire are run up through the tube until the platinum extends about a quarter of an inch above the hot end of the tube; then the tube is again heated until the platinum and the glass come to a white heat. The end of the tube is then squeezed flat, the platinum being hermetically sealed in the glass. Platinum wire has to be used, as it is the only conductor that has the same coefficient of expansion as glass; these, after being annealed, are ready to have the carbon clamped on. This used to be done by welding a small copper clamp to the end of the platinum, then squeezing the clamp on the carbon, the clamp and the carbon being then copper plated, making an excellent joint. This is done by a simpler process now, however. When the carbon has been securely fastened to the platinum, the inside part is ready to be sealed into the bulb.

Until recently the bulb was sealed over the inside part by hand, but within the last few years a machine has been devised to do this otherwise skilful and difficult manipulation. The bulb and inside tube are turned in the fire until they are securely sealed together. The lamps are then annealed, and after the projecting piece of the inside tube which has served as a handle, has been cut off, the lamps are ready for the vacuum pumps. The next thing to be done with the lamps is to exhaust them. For this purpose they are attached by the small glass tubes before mentioned to the phosphorous cups, and those in turn are attached to the pumps and the mercury turned on. The mercury is allowed to run until a good vaccum has been secured, then the current is turned on and the carbon filaments heated to a dull red, being gradually increased until about half the rated candle power of the lamp is reached. Then each lamp has to be treated individually, in order to work out any gases or impurities in the carbon. This is done by placing a strong magnet at the lower end of the carbon to prevent it from wilting while the current is suddenly increased and the light raised to great brilliancy for a second or two. This is repeated several times, until the mercury tube shows that the gases have been dissipated by the extremely high temperature of the filament. The eliminating of the gases is considered the last of the many stages through which the carbons of our incandescent lamps pass. It is only necessar, to seal off the connecting tube which leaves a small top on the lamp where the hole has been closed up. The lamps are then socketed and tested for the volts required to give a certain predetermined candle power. The voltage is marked on the bottom of the lamp and then it is ready for shipment.

Some of you will ask no doubt, is there is not danger of destroying the filament while driving out the gases? Well, there is, if great care is not exercised. The test is a severe one and only good filaments will stand it. However, it seems a necessary evil. The carbon filament is the all essential part of the incandescent lamp, so important is it that the manufacturers have tried almost every conceivable substance, calling on the productions of the mineral, the animal and the vegetable kingdoms.

Although many good hair filaments are made, vegetable fiber seems to be the most preferable substance for carbonization. This process, although most sacredly guarded by the different manufacturers and varying vastly in detail, is in general as follows. The substance to be carbonized, whether paper, cotton or bamboo, is cut by a machine into delicate strips which are collected in small bundles and bent so as to lie in "U" shaped grooves in graphite plates. These packed with graphite powder, are placed in large black lead crucibles, carefully closed and heated in a Siemens furnace to an intense white heat. After cooling the crucibles are opened and the now carbonized filaments looking like delicate wires, or threads of steel, are removed. They are now the curved shape into which they were bent before carbonization, but are quite elastic and strong. There are various after treatments, such as subjecting the carbons to a plating process, or treating in a vacuum with hydrocarbon, etc. But as said before, the different processes to which these filaments are subjected, are trade secrets. In them lie the important distinction of life and economy given by lamps of different manufacturers.

The distinctive features of the different types of incandescent lamps which are in practical use now, are naturally indefinitely less striking than those in the arc lamp. The latter employs a more or less complicated regulating mechanism, and the constructive detail of this mechanism give rise to an enormous variety of lamps. The incandescent lamp which is fortunately restricted to the use of an incandescent filament, placed in an exhausted globe which does not require any regulating mechanism, allows of a difference only:

1—In the choice of the raw material from which carbon filaments are made.

2—In the treatment of the raw material before and after carbonization.
3—In the length of the filament and its cross section.
4—In the mode of connecting the filament with the current conductor, or platinum wires respectively, which join it to the leads.
5—In the more or less perfect exhaustion of the lamp bulb. In considering these different points, we wish to arrive at a conclusion, not that one particular type of existing lamp is superior to another, but what are the conditions to be filled in order to obtain an efficient incandescent lamp of good durability.

All incandescent lamps with the exception of the Cruto and Bernstein lamps, employ a vegetable fibre of some kind as raw material for preparing the filament. Edison considers the fibrous structure of bamboo advantageous for obtaining a tough filament of high mechanical resistance, while Weston on the other hand subjects the cotton fibre to a process which entirely deprives it of its structural character and transforms it into amorphous cellulose, for which he likewise claims great toughness and mechanical resistance. We know that excellent results have been obtained with both these filaments, from which we may safely draw the conclusion that the nature of the raw material is of little consequence as long as it is of a thoroughly homogeneous character. The carbon is exposed to a series of deleterious influences, which are the more effective the less coherent the filament, not to mention the shocks and concussions to which the lamps are subjected in transportation. We find that, according to the mechanical theory of gases, the last remnants of atmospheric air, which are, even in the most careful exhaustion, left in the lamp bulbs, are set into rapid motion by the intense heat of the carbon; and thus the latter is exposed, so to say, to a continuous bombardment, which soon finds out any weak spots in its texture and brings about a rupture of the filament. There are other influences at work tending to produce the same result, namely: the disintegrating effect of the current and the high temperature to which the filament is raised, and which show themselves in the projection of carbon particles on the interior of the lamp bulb (commonly called the blackening of the lamp bulb).

Under this head, we have also to consider a fact observed by Edison, namely: A continuous current passing through the carbon wastes it more rapidly on one side than on the other. For explanation of this fact, we must assume a sort of electrolytic process in a space which is not absolutely free from air, but only highly attenuated. If this observation is correct, and we have no reason for doubting its accuracy, it constitutes an additional reason for the importance of the uniformity of the filament. We have further to take into consideration the influence of the electric current on the structure of the carbon filament; and that such an influence is exercised has been proved by the molecular changes of a copper wire through which the currents of an alternating machine have been passed for some time. Finally, the higher the temperature to which the carbon is exposed the shorter its durability, and the more marked the deleterious effects on a filament of inferior compactness and uniformity. Hence the condition of radiating surface is one of the main factors in the economy of the glow lamp, and the whole treatment subsequent to carbonation has for its aim to endow that surface with the highest possible radiating capacity.

Until quite recently it has been the object of lamp dealers to procure long-lived lamps, thereby reducing the expense of renewals, hence being better able to compete with other illuminating agents. In order to procure this durable lamp the filament was made much stouter and in consequence lower in resistance. It was found that although these lamps lasted for several thousand hours, they require considerable current, therefore were not very economical. The aim of lamp manufacturers now became to obtain the greatest number of lamps per horse-power, that is to get the greatest amount of light for the least expenditure of energy. To do this the filaments were made longer and finer, and by the after process of carbonization, the resistance was considerably raised. For these and numerous other causes, *the different types of lamps range in efficiency from two and even as* low as one and a half, to six watts per illuminating candle-power, or in other words one lamp will give three times as much light as the other for the same expenditure of current. If this was all the data to be obtained, the problem of determining the best lamps to be used would be a simple one. But it is a well-established fact that an incandescent lamp maintained at a constant voltage will invariably fall off in candle-power. This diminution in brightness is attended by an increase in the amount of energy consumed per candle-power of light, the change being especially marked in the earlier portion of the life of the lamp. This phenomenon appears to take place in all incandescent lamps of the present day, and more particularly in lamps of high economy.

These changes may be ascribed to at least three causes, viz., loss of vacuum, increase of resistance, due to the disintegration of the filament, and finally the deposition of the disintegrated carbon upon the inner surface of the lamp bulb.

Recent elaborate tests go to show that although a lamp may commence with a very high efficiency, say at two watts per candle-power of light, during the first two hundred hours the lamp is likely to decrease uniformly to seven or eight candle-power, thereby only having an efficiency of five or six watts per luminating candle-power. After this point, the falling-off in candle-power and efficiency is not so marked, but continues until the carbon is at last consumed. This falling off in candle power is decidedly unfair to the consumer, who is charged for the full rated candle of the lamp. Nor is it economical to the illuminating company, who are consuming as much, if not more current than when the lamp was burning to its full brilliancy.

Taking all facts into consideration it would seem, according to our judgment, that the best lamp to procure for station work is one of moderately high economy, say of about 3.1 or 3.2 watts per candle-power of light. Having selected our lamp, it now remains for us to decide upon the most successful way of operating and taking care of them.

It is a well-known fact that the efficiency of an incandescent lamp increases very appreciably the more it is forced, that is, the number of watts required per candle-power of light becomes less the greater the voltage to which it is subjected. It is also well known that on the other hand the life diminishes very rapidly the more a lamp is thus forced. As the total cost of the light is increased by going to either of these extremes, of long life and poor efficiency on the one hand, and good efficiency with short life on the other, there must be some intermediate value for the life and the efficiency which would give the most economical results, considering both the cost of the lamp and the power required. Numerous different methods have from time to time been suggested and used to determine this point with more or less success. But they have all apparently led one to believe that a long life is a most desirable feature, so much so, that extremely long lived lamps were considered as great achievements in lamp making. More recently the tendency has been to increase the efficiency slightly and to diminish the life. Put it appears now from the very interesting deductions of Mr. O'Keenan that the most economical point, considering all the factors involved, is very materially different from what was generally supposed, and that it is in fact cheaper to replace old lamps with new ones after a few hundred hours, rather than to continue to burn the old ones. He shows that there is a point in the life of each make of lamps at which it will pay best to break the lamps. To this point he gives the appropriate name of "the smashing point."

Whether you accept these statements or not, lamp renewals is an important item in the expenses of an illuminating station and amounts to considerable, even in small isolated plants. It is therefore a question of momentous importance to be able to decide what kind of lamps are best to use and what is the best way to manage them, so as to secure the most satisfactory results not only in regard to the financial interests of the illuminating company, but also that the public may get the best value for their money.

Having decided upon the best lamp to use, after giving due consideration to the various data supplied by different manufacturers, all of which should be received with the greatest of caution, the next thing to obtain is an absolutely steady current. A precisely even potential is one of the most essential requisites for obtaining any sort of satisfactory results with incandescent lamps. It is astonishing how little attention is paid to this important feature of incandescent lighting. Tests which we have made convince us that there are few stations in Canada which can boast of a potential which does not vary from five to fifteen volts either side of what it is supposed to be operated at. A raise of three volts in a hundred volt lamp will reduce the life one-half. This change is much more marked in lamps of lower voltages. It is a wonder that lamps last half as long as they do, subjected as most of them are to such a range of potential varying in many cases from one hundred to one hundred and twenty volts. We would most emphatically recommend that a man be detailed in every large plant or station to watch the pressure indicators and regulate the current accordingly. Also that the station be provided with a good portable volt meter, so that the potential may be known at different points. If these regulations are strictly and promptly carried out, there would be far fewer complaints about incandescent lamps.

This branch of the electric industry is launching out into new channels, and even now plays an important part in the service of man, not only in domestic spheres but also in the scientific and other useful pursuits of life. Lamps can be had from a fraction up to several hundred candle-power, varying in size, shape, color and efficiency. Now that we have the Ries regulating socket by which the light can be turned up or down without waste of current, the incandescent light is in every way superior and has every advantage offered by any other illuminating agent without their disadvantages, defects, and impurities. May we not therefore conclude with all justice and honesty that the incandescent lamp is destined to be the light of the future?

DISCUSSION.

The President: As a matter of history, I do not know whether it is universally, or even well-known, that Toronto is about one of the the first places where a practical incandescent lamp was constructed. Some years ago, I think at the time the original Gramme machine was made, there was one imported, and some incandescent lamps made here and operated on that machine. There was a patent taken out for these lamps at the time, which ante-dated all the present incandescent lamp patents on this side, even Edison's, but there was one little defect in it. In making out the specification for the patent, the gentleman who got up these lamps got on all right until he got his carbon filament complete and his vacuum. If some one had come along and hit him on the head with a club when he got that far, he would have been the inventor. But, unfortunately, after he got his globe empty he filled it again with something else, with some gas or hydro-carbon, of course making it entirely different from all the patents of the present day. I think that must have been some time in the year 1874.

Mr. Neilson: I happen to remember the date particularly, Mr. President, because I was a stockholder in the company in which Mr. Fuller made his experiments. We afterwards wound up with fifteen cents on the dollar, and that is, therefore, strongly impressed on my mind. (Laughter.)

The President: I think the members will find when they analyze this very clever paper, when it is put in print, that it is a most valuable addition to the literature of the science.

Mr. Neilson moved, seconded by Mr. Thomson, that the thanks of the Association be tendered Mr. Black for his very able and interesting paper. Carried.

AMENDMENTS TO CONSTITUTION AND BY-LAWS.

The President: I will now ask for expressions of opinion on the question I placed before you yesterday, as to the advisability of forming sub-sections of the Association, simply as a guide to any committee that may be appointed with a view to formulating changes of the constitution to be laid before the next *Convention.*

Mr. McFarlane: My own present view of the matter is, that I think the Association is too small yet to branch off in that direction, more especially as we seem, so far, to have got along very well without it. Were it necessary to branch off on any one subject, such, for instance, as the economy of fuel, a committee can be appointed on that, to report to the Association, and those who do not wish to speak on it will be very glad to listen to what is said.

The President: The idea does not seem to obtain an overwhelming number of supporters, so I presume it is just as well to let it slide. A question that must be discussed, however, is the time and place of the next meeting of the Association.

Mr. Taylor. In regard to subdividing, it seems to me that if a question came up at a general meeting which directly applied to central station work, it should be voted upon only by central station men. It struck me that the proposed plan was a good one, and I do not see that it would interfere with the general working of the Association at all.

The President: I hope there is no misconception as to the idea. One or two seem to have the idea that we are proposing *to subdivide the Association; that is not the idea, we have got* along so harmoniously together that that is the last thing I would like to see done. The proposal is simply to appoint com-

mittees, or subdivisions, on each question particularly appertaining to any one branch alone, very much, as I said yesterday, in the manner that is done by the Toronto Board of Trade. It is divided into sections, merely in the shape of committees, to which are referred any particular business that concerns that section alone But perhaps all that would be necessary would be to have it understood that subjects of that character would be simply referred to committees from the branch interested, we might have committees definitely appointed, representing each branch of the Association, or, if it is thought well, the matter can be left just as it is.

Mr. Yule: I agree with Mr. McFarlane, that we have not yet reached the point where we can divide. We are getting along very nicely, and I think, in the meantime, we had better leave things as they are; we want to be a little stronger in numbers first.

Capt. Carter: I think the subject is not given the attention of which it is deserving. I think there are members here, like myself, who are a little afraid to speak; they can talk among themselves, and interest themselves in it, but they don't like to get up here and ventilate their views. I feel that it is a very important question, although I would not for one moment put it in such a way that the interests of the electric light people, the telephone people and the telegraph people should be severed at all; we ought all to remain as one Association, as we are at present, and sit here and listen to each other's views. I like to sit here and listen to the papers upon telegraphing or telephoning—I have great pleasure in listening to them but still, as has been suggested, there may be subjects that are of direct interest to electric light men, telegraph men or telephone men, but would not be of interest enough to other members of the Association engaged differently. I do not think it would at all interfere with the harmonious working of the Association as a whole, if in cases of that kind we had committees which could be called together for an hour during the meeting, to discuss among themselves any particular question solely affecting their own particular interest, and in which other branches are not at all interested. I think it is well to have this subject thoroughly well ventilated, because I know there are those to whom I have spoken privately who do not feel like getting up and speaking on the subject.

Mr. Fisk. I am interested in this. I think the central station men are more competent to deal with a question relating to central station business than the Association as a whole is. I think it would be a good thing to have each member registered in some particular section, and have questions affecting that particular section referred to them. I, for one, would like to see that.

Mr. Armstrong. We have all heard the saying, "First catch your hare, then cook it." It seems to me, in this instance, we have first to catch our central station men, of whom we have not enough; the objects of this Association are undoubtedly more in their interests than in those of the manufacturing and supply companies, and, in order to get the Association spread generally through the country, it would be wiser not to weaken it by separation at present We must use every means, including the assistance of telephone and telegraph men, to spread a knowledge of its objects through the country, and if we start to divide now, it will certainly defeat the objects which the Association has in view. We must hang together for strength like a bundle of sticks.

Mr. Breithaupt: Central station interests are a separate interest, whereas the telephone and telegraph interests are matters representing the whole Association. I agree with Mr. Armstrong, but I think the idea of appointing a committee on central station work, in their interest, would be advisable.

Mr. Neilson. At the first meeting of the Association, I foresaw this difficulty would arise. As long as we are an Association of electricians, meeting to exchange views on electric subjects only, there is not the slightest necessity for any subdivision of any kind. But when you introduce what I might term financial aspects of affairs, then it might be well to have these sections. But then the difficulty comes in, that a section, such as the electric light section, might bring in a recommendation such, for instance, as was moved at the last meeting, of standardizing the current for a lamp, well, now, that should, if the sections are to be formed, be the opinion of that section, and not of the Association as a whole. If that is done, I see no objection whatever to having an Electric Light and Power Section. But the other departments can get along without anything of the kind. I would strongly object to having any resolution of this section brought in as the opinion of the members as a whole on any particular subject.

Mr. G. Black. I think where a question arises on a subject relating purely to the telephone, the telegraph or the electric light section, requiring a decision, that only members of that section should decide upon that question. It was pointed out in the course of discussion at Hamilton, that telephone men would not probably like the electric light men to decide upon their system of wiring. A telephone man, while competent enough to do his own wiring might not understand sufficiently well how to do electric light wiring. Where the subject is purely sectional, it should be voted on only by members of that section of the Association. We have now an Executive, composed of representatives from all branches, and if they cannot decide upon a subject, then let the members of that department only decide, while in general subjects the decision should be that of the whole Association.

Mr. A. A. Wright: As a central station man, I do not fear my friends of the telegraph and telephone fraternity would do anything to interfere with us very seriously It may be advisable, when the time comes, or when the difficulty arises, to have a committee appointed to look after central station work. But, "sufficient for the day is the evil thereof," (laughter), and I think it will be time enough to encounter the difficulty when it arises.

The President: The idea is not at all, as I have already said, to divide the Association. It would be just as Mr. Black says, that those who are particularly interested in a question not affecting the other members of the Association would be the only ones to vote on that question. Let members register in any section they choose, in which they are doing business. Then, when a purely sectional question comes up they vote on it. I do not think anyone proposes that this Association be divided up, and one part to meet at one time, and another at some other time—no one entertains any such idea as that. I think it is simply in order to simplify matters, that in certain questions affecting only a certain branch of the members of the Association that only those who are interested in such questions shall vote upon them. In any matter of business policy, for instance, which concerned some one section alone, it would hardly be fair to the members of that section, if members from other sections should, by their preponderating votes, defeat the objects of those belonging to that branch. As we can bring in no resolution now, this is simply a sort of ventilation of the idea, to get it into shape in case any action should be found necessary at the proper time, and it can easily now be postponed until that time, or until the Executive sees fit to bring in a recommendation, or a committee is appointed on the original constitution.

Mr. Wickens: I think this Association does not at present need anything of that kind If any trouble should arise, it might be well to appoint a committee of the members specially interested to deal with that particular question. Now, if you go on and appoint, say a standing committee in each branch, as it were, it will have an effect which I think is hardly desirable, because that standing committee could not do anything without meeting. That would be well enough in the case of a body like the Toronto Board of Trade, the majority of the members of which reside in Toronto, and which can get a sectional meeting at any time without difficulty. But our members are scattered all over the country, and if we attempt to create standing committees in each section of the work in the way spoken of, they will really not be of any practical use, unless they can come together, and it is hardly to be expected that they will meet together as sectional committees, and then come to the Convention also—it would take too much time—and it will certainly, to my mind, detract from the interest of the Convention if anything of that kind is countenanced. I think if there is any real difficulty in any branch, that wants settling, it will be soon enough when it appears to appoint a committee.

Mr. Fisk: I feel somewhat strong upon this question. Suppose the question came up whether it was better to use one hundred volts or five hundred volts power in transmission, would it not be better to refer that to a committee composed entirely of central station men?

Mr. Campbell: I do not think there is any necessity at the present time at all. Regarding the question our friend has just spoken of it makes a big difference, as far as induction is concerned, whether you jump across a telegraph wire with one hundred or five hundred volts. I think it is better to let the Association stay as it is now.

Mr. McFarlane: You have spoken of the electric light, the telephone and the telegraph men, but you have left out the supply men I suppose when you want to discuss wire it would be better to appoint a committee on wire, and if dynamos, appoint a committee on dynamos, to tell the electric light men what to get. (Laughter.)

Mr. Taylor: Mr. McFarlane was wrong in saying the electric supply men were not heard from, but I did not speak because of anything I expect to get in the way of supplies, it was because of the difficulty which I saw arose at our general meetings. I do not suppose the supply men would have anything to come before them unless it was what Mr. Sadler spoke about last night, the belt slipping. (Laughter.) I think where a question is brought up directly interesting central station men, it should only be voted upon by central station men.

Mr. McFarlane: I was not saying that the supply men had not been heard from, but I was speaking of them as one section of the members of which the Association is composed.

The President: I am very well satisfied from the expressions of opinion that have been elicited, that all are satisfied to "let well enough alone," and after what I have heard I am inclined to favor that view myself.

AFTERNOON SESSION.

At two o'clock the meeting having been called to order by the President, papers were respectively read by Mr. Rosebrugh, of the School of Science, on "Speed Control"; and by Mr. Breithaupt, of Berlin, on "Probabilities as to the Success of Distribution of Power at Considerable Distances by High Tension Currents of Electricity."

Lack of space has made it necessary to defer publication of these papers and the discussions thereon to a subsequent issue.

PLACE OF NEXT MEETING.

The President: The only business now remaining is to decide upon the time and place of the next meeting. Suggestions will now be in order.

The Secretary: I think the Industrial Exhibition Association expressed a wish that the next convention should be held in Toronto simultaneously with the Industrial Exhibition, and it was their desire that the Association should endeavor to hold some kind of an electrical exhibition in connection with the Industrial; I think that is as far as the matter has gone.

Mr. Smith: At the last convention it was discussed, without anything being definitely settled. The wish was expressed by the Industrial Association that we should meet in Toronto, and have an electrical exhibition, and it was then thought we would be able to do it. Since then we have information which would rather discourage the idea. At the same time, without wishing to appear intensely selfish, for reasons pretty well known, I would move that the next convention be held in Toronto, during the month of September, at a date to be fixed by the Executive.

Mr. Thomson: I move, in amendment, that it be held in Montreal.

Mr. Carroll: I second the motion.

Mr. Starr: Mr. President, I would like to second the motion of Mr. Smith, that the next convention be held in Toronto. I think it was generally understood among the members that the next convention was to be held in Toronto, and that the Industrial Exhibition people would co-operate with us in making an exhibition here. As a representative of Montreal, I may say that we should be most happy to see the convention there, and, speaking for myself, I would do everything I possibly could, and I think my company would also do everything to make the visit to Montreal pleasant We have a pretty good reputation now, through the National Electric Association, which visited us a year ago, but we have hardly got over that yet (laughter). We want about three or six months' grace after the next convention to get into a position to entertain the Canadian Association. We do not want to undertake it unless we can do it thoroughly. Perhaps Mr. Carroll can speak better on that subject than I can. We would prefer the next convention to be held in Montreal in the spring, or during the winter, say, a year from now. I therefore think I will support the next convention being held in Toronto, and the one after that in Montreal.

Mr. A. A. Wright: Might I be allowed one word, with reference to the time. Most of the central station men from the smaller towns, like myself, are engaged in some other business as well, and our trade being a rural one, there are certain seasons of the year when we are busy, and others when we are not. September is our busiest time, for the farmers are then through the harvest, and begin to market their grain, and tradesmen whose business is connected with farmers then have to be at home. If you held it in connection with the Exhibition in Toronto or Montreal, I suppose you cannot change the dates, but if it could conveniently be arranged early in the month of September, I think it would certainly be a great accommodation to those central station men who live in rural districts, and not make any difference to those in the city.

The President: The Industrial Exhibition is held very early in September, and I have no doubt it would be a factor in helping to make it a success.

Mr. Smith's motion was carried, that the next convention be held in Toronto, at a date to be appointed by the Executive Committee.

Mr. Starr: In explanation of my having seconded Mr. Smith's motion, I may say that we do not want to have the convention in Montreal until we are in a position to fittingly entertain the Association. As I said, we have not quite got over the last convention we had there.

Mr. Smith: Speaking for the Western members, we are anxious to give Montreal a turn, and when the convention goes there we want to make it one of the best we have ever had.

Mr. A. A. Wright: I would like to thank those who placed this institution at our disposal. I did not know that we had such a one here, or, from patriotic motives, I would not have sent my son to Montreal (laughter and cheers.) If there is an educational centre in Canada it is Toronto; it is the intellectual capital, and I want to uphold it. However, whom are we to thank?

The Secretary: The Faculty of the School of Practical Science.

Mr. Wright: Then I have pleasure in moving that they receive our thanks for the use of this hall, and the courtesy they have shewn in attending our meetings here.

Mr. Starr seconded the motion and it was carried.

Prof. Galbraith: I am sure Mr. Wright's kind remarks are highly appreciated by the Faculty and myself; and we shall have great pleasure in seeing you here at some future time. Of course you know, Mr. President, that this building is under the control of the Ontario Government, and whenever we want to have it in any way diverted from its ordinary use we have to apply to the government for permission. But I have never yet known that permission to be refused. The Minister of Education has always agreed with me in feeling that whatever this institution can do in connection with any of the professions with which our work is allied, will be done, not only in their interests, but in our own. I do not think you have much to thank us for. However, perhaps our friend will send his next boy here.

Capt. Carter. Would it not be proper on our part to tender our thanks to Hon. Mr. Harcourt, the acting Minister of Education, as well as to the Faculty.

The President. I think in expressing our obligation to the Faculty that is implied.

Prof. Galbraith. I would suggest that the two be coupled together; I would prefer if any motion is made that the Minister of Education should be included.

The motion, amended by adding the Minister of Education, was carried.

The thanks of the Association were also tendered the press of Toronto, for the efficient manner in which they had reported *the proceedings.*

The convention then adjourned.

C. A. S. E. NO. 7 ORGANIZED AT OTTAWA.

OTTAWA, Jan. 30th, 1893.

Editor ELECTRICAL NEWS.

SIR,—The ranks of the C. A. S. E. were reinforced on Wednesday, Jan. 18th, by the organization of Ottawa No. 7 with a charter membership of 32. Mr. Edkins, President of the Executive, had for some time previous been in communication with Mr. F. Robert, engineer Russell House, with a view to establishing an association here. To the interest taken in the matter by this gentleman, who interviewed the engineers on the subject, and called a preparatory meeting to discuss the matter, the organization of a large and useful association in Ottawa is due. After an explanation by Bro. Edkins of the objects of the association, the following officers were initiated, elected and installed: President, J.A. Thompson; Vice-president, J. B. Seguin; Treasurer, J. Cowan; Rec. Sec., J. Latour; Financial Sec., F. Robert; Conductor, A. Gaul; Doorkeeper, C. Schofield.

A committee was appointed to secure a suitable place of meeting.

Under the head of "Good of the Order" Bro. Edkins addressed the meeting.

A vote of thanks was tendered to him and also to Bro. F. Robert for the latter's persevering work in bringing the engineers of Ottawa together.

Ottawa No. 7 is composed of good practical men who recognize the need of organization and the good results which must accrue from it. The officers are of the right type and with J. H. Thompson, Chief Engineer Printing Bureau at the throttle, we look forward to a very successful year. The ELECTRICAL NEWS shall hear from us now and then.

OTTAWA NO. 7.

SPARKS.

A $25,000 electric plant has been purchased by the Town of Yarmouth, N. S.

A 200 light incandescent plant is being installed by Messrs. Wm. Kelley & Son, at Blythe, Ont.

A 20 horse power electric motor has been installed by Messrs. Parker & Co., coppersmiths, Toronto.

Elias Vernon and Benjamin Temple, of Hamilton, Ont., were recently granted a patent on a device for starting cars.

A 1,000 light dynamo and plant has recently been installed by the Moncton Gas and Electric Company, Moncton, N. B.

A 700 light dynamo is being installed by the Victoria Electric Company, at Lindsay, Ont., and a 200 light dynamo by the Brantford Electric Light Company.

Messrs. Patterson & Corbin, of St. Catharines, have a contract to supply 30 cars for the Niagara Falls Electric Railway, and 4 cars for the St. Catharines Electric Railway.

William Gives, a dynamo attendant in the Hamilton Electric Light and Power Company's power house, recently received a severe electric shock, which rendered him for a time unconscious.

During the first three months of the operation of the Yarmouth, N. S., Electric Street Railway, there were carried with only two cars running, 58,326 passengers. The cars are heated with electricity.

The Niagara Falls Electric Railway Co. will install six 250 horse power dynamos. The contract has been given to Messrs. Kennedy & Sons, of Owen Sound, for turbine wheels with which to operate these machines.

By authority of the shareholders, the capital stock of the Montreal Street Railway Co. will be increased to $2,000,000, to meet the expenditure required in connection with the equipment of the company and the conversion and extension of their lines.

Incorporation is being sought for by the Peoples' Electric Company at Windsor, Ont., with the object of operating electric railways, and supplying electricity for commercial purposes in Windsor and vicinity. The capital stock is to be $50,000.

The County Court at Windsor, recently awarded $50.00 damages to one Wilson, who brought suit against the Sandwich, Windsor and Amherstburg Railway for personal injury received as the result of an electric car coming into collision with his buggy.

Applications for incorporation has been made by the Compagnie Electrique, St. Jean Baptiste, Montreal, for the purpose of doing a general electrical business, supplying light, heat and motive power, and manufacturing electric appliances in the Province of Quebec; also for the construction of underground conduits for electrical wires in public streets and roads. The capital of the company is to be $100,000. The names of the directors are as follows:— Messrs. Onesime Marin, notary; Hon. Louis Tourville; Arthur Caron, gentleman; Raymond Prefontaine, Montreal, M. P.; Israel Charbonneau, manufacturer, Joseph E Pare, manufacturer; Joseph Lalonde, manufacturer; and Damien Lalonde, manufacturer.

The Beacon Lamp Co., of Boston, are contesting the suit for the infringement of the Edison patent, brought against them by the General Electric Co., with the claim that Henry Gobel, a German-American, invented and used an incandescent lamp prior to Mr. Edison's invention, and that consequently the Edison patent is invalid.

SPARKS.

Mr. John Skinner, of Mitchell, will install an incandescent lighting plant.

The Review Printing and Publishing Co., of Peterboro', have installed electricity as their motive power.

A Victoria company has purchased [illegible] Haslam's interest in the electric light [illegible] Victoria, B. C.

The Carleton Place Electric Light [illegible] purchased an incandescent plant, which will shortly go into operation.

A 300 light incandescent plant is being installed in the Leland House, Winnipeg, by the Kay Electric Works, Hamilton.

Messrs. Corley & Collins of Mount Forest, have purchased a new 60 horse power engine with which to operate their electric light plant.

The loss sustained by the Sandwich, Windsor and Amherstburg Electric Railway Company, by the burning of their power house, is placed at $15,000.

The recently incorporated Smiths Falls Electric Power Company will shortly erect new buildings, and a new flume, and will install a light and power plant.

The Chaudiere Electric Light and Power Company, of Ottawa, are desirous of enlarging their business, and for this purpose have applied for permission to increase their capital stock to $1,000,000.

Mr. Charles W. Harrah, representing a Detroit syndicate, has purchased for $15,000 the Windsor and Walkerville Railway. It is the intention of the present owners to equip the road for operation by electricity in the spring.

Mr. F. E. Handy, formerly with the Ball Electric Light Co., Toronto, and an Active member of the Canadian Electrical Association, has gone to British Columbia to assume the position of manager of the Westminster and Vancouver Tramway Co.

The stipendary magistrate of the city of Halifax, has convicted the Nova Scotia Power Co. of a breach of a provincial statute in running street cars on Sunday. The judge holds that the running of street cars on Sunday is a work of neither necessity nor mercy, and is therefore illegal. A nominal fine of $5.00 has been imposed on the company. The case has been appealed.

The Quebec and Levis Electric Light Company have purchased for $236,000 the Falls of Montmorency and the surrounding property belonging to the Hall estate. The company have under construction a new iron flume, 1200 feet long and 6 feet in diameter, by means of which the water will be conducted from above the cataract to the factories below. It is probable that the company will supply power for the factories in Quebec, light for private residences and city streets, and motive power for the street railway, and for trains on the Montmorency Railway. At the annual meeting of the company the following directors were elected: Andrew Thompson, Hon. E. J. Price, H. T. Machin, C. R. Whitehead, Herbert M. Price, John Sharples and T. H. Dunn.

NOTES.

Toronto *Globe*.—A man in Montreal has been fined for illegally practising dentistry, yet a stationary engineer on whose care and skill a score of lives are daily depending is not required to pass an examination.

The New York Equipment Co. have kindly sent us with their compliments, several vest memorandum tablets made of celluloid—a very useful article.

A new sort of condenser has come into use for steam engines in France. Where steam-power is used on an extensive scale, it often becomes a matter of considerable importance to cool the water condensed from the steam as rapidly as possible. The more quickly the exhaust steam can be condensed into water, the greater will be the difference of pressure between the two sides of the piston, and, consequently, the greater the power developed with a given consumption of coal. For cooling the condensed water, it has been common to run it through clusters of pipes, so as to expose as large a surface as possible to the air, or to allow it to drip through bundles of laths or brushwood into a tank. Under the new system, the condensed water from the exaust is pumped into a sort of gridiron of large p'pes, which are pierced with a great number of small holes, but have no other outlet. The water forced into these pipes under a considerable pressure, spouts in innumerable tiny jets from the holes, and then falls into a tank beneath. Being brought in a state of fine division into direct contract with the air, it loses its heat very rapidly, and, on reaching the tank, is already cool enough to be pumped back for use in condensing the steam from the cylinders. Of course, the jets of hot-water give off clouds of vapor, so that about ten per cent. of water is lost in this way, but the economy and effectiveness of the apparatus more than make good the loss.

SPARKS.

Electric light plants are being installed in the Gerrard Mica Mines, near Ottawa.

The Annapolis Electric Light Company, Annapolis, N. S., are adding to their station plant a new dynamo.

The Toronto courts have decided against the old street railway company, *re* their claim to the possession of a perpetual franchise. The company have decided to carry the case to the highest court of appeal.

Authority is being sought for by the Toronto Street Railway Co. to enable them to extend their lines outside the city limits, to manufacture electricity anywhere in the County of York, and to manufacture for sale all kinds of electrical apparatus.

Several officers of the Toronto Street Railway Company recently made an inspection of the Ottawa Street Railway Company's lines and station. The Ottawa road is justly regarded as being perhaps nearer perfect than any other in Canada.

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