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This Number of the ELECTRICAL NEWS contains a complete report of the Seventh Convention of the Canadian Electrical Association.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XVI—No. 6.
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JUNE, 1897

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VII. JUNE, 1897 No. 6.

SARNIA GAS AND ELECTRIC LIGHT CO.

WE print herewith an illustration of the power station of the above company, accompanied by a few particulars descriptive of the equipment of the same.

The building is of red brick, with freestone trimmings and stone foundation, with basement under the engine room, having truss roof covered with iron, making the building practically fireproof. The size of the structure is 34 x 72, with an octagon brick smoke stack 75 feet high. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor.

The steam plant consists of a Wheelock engine 13 x 30, boiler 60" x 14', 84 3" flues, with all necessary shafting and pulleys, manufactured by the Goldie & McCulloch Co., of Galt.

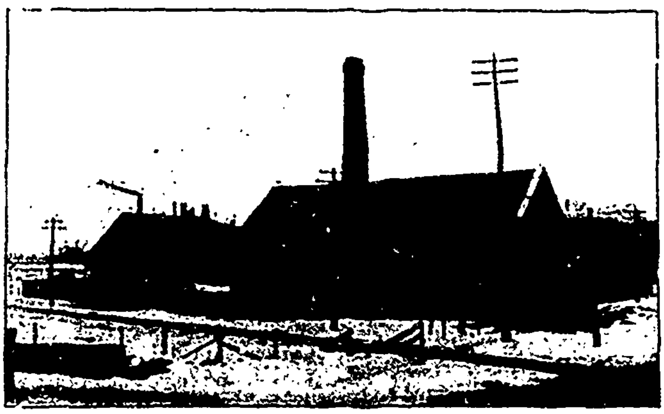
The electric plant was built during the summer of 1894, and consists of one 75 light Wood arc dynamo with spare armature, a 30 kilowatt T.H. alternator with 1½ k.w. exciter, with the usual switchboard apparatus. The electrical plant was installed by the Canadian General Electric Company.

The arc line for public lighting required over 16 miles of No. 6 wire and ten miles of poles, feeding sixty-two 1200 c.p. lamps. Over 600 lamps are wired up for incandescent lighting in the town.

In order to further increase the capacity and efficiency of the plant, during the past summer a 300 h.p. Northey duplex condenser and a duplex boiler feed pump were installed, taking water supply from the river through an 8-in. pipe. These improvements add easily 25% to the economy and efficiency of the plant. It is contemplated to further increase the plant by adding an additional boiler and a larger alternator during the year.

Mr. Wm. Williams is the manager of the business, the success of which is largely due to his enterprise and good judgment. He has an able assistant in the person of Mr. Geo. Shand, the chief engineer and electrician. Accompanying this article are portraits of these two gentlemen.

MR. WM. WILLIAMS.



THE SARNIA GAS AND ELECTRIC WORKS.

MR. GEO. SHAND.

QUESTIONS AND ANSWERS.

SUPERINTENDENT writes : "In a 2,080 volt monocyclic dynamo or in any other machine, does it not have a bad effect upon the armature to have the commutator short-circuited to a more or less extent? I claim that it not only has a bad effect upon the stationary shunt, but also upon the rotating shunt and armature. Am I right or not, please? Would the short-circuiting of the commutator cause the armature to finally burn up altogether? Another question—Supposing I carry on my 'secondaries' a voltage of 118 and then reduce it to 112 volts, what candle-power would I be getting from a 50 c. p. incandescent lamp? How is it computed? and is there any table or book published upon this question? Are not electric wires apt to become "grounded" by passing through branches of trees, especially in constant wet weather? How could you tell if they were grounded if you had no ground detector? Could you tell by 'bell-tests?' How are series incandescent lamps connected up in connection with a direct current arc circuit? If you will be so kind as to answer these questions in your next issue, I will, I am sure, feel obliged."

ANSWER.—(1) In any generator the short-circuiting of the commutator, if a D.C. machine—or the collector rings, if an alternator—will result in a burnt armature. If the "commutator" in the above question means the two-part commutator used in the series field, then short-circuiting it will, in the first place, have the effect of (a) cutting out the compounding coils, leaving the machine as though it were merely separately excited; or (b) depending on the method of connecting in the two parts, might have the effect of sending an alternating current round the series coils; and in the second place would (a) cause heat, which might injure the armature. (2) Supposing your 50 c. p. lamp was intended to give that at 118 volts, then reducing the pressure to 112 would probably reduce the c. p. to about 40 c.p. There is a theoretic method of calculating the reduction of candle power, depending on several specific quantities, such as resistance of filaments, specific incandescence, etc., which is too complicated; it is sometimes stated that variations of 1% in voltage cause variation of 5% in c.p. Ram's book on incandescent lamps is good. (3) Wires are liable to be grounded against branches. (4) A magnet bell will usually disclose the presence of a ground. (5) Just like arc lamps, in series.

A. S. P. writes: "Will you kindly give me some information on the Grant Bramble rotary steam engine, of Sleepy Eye City? I would like to know whether the wheel will rotate when steam is admitted into the chamber, as it is claimed it will."

ANSWER.—The engine will certainly rotate, but the mere fact of it doing this is no evidence of its becoming in any way a superior motive power. As a matter of fact there is not a single point in its favor that will recommend it to a practical engineer. Mr. Bramble has been getting a lot of fine advertising and has produced nothing that is in anyway useful to the engineering world—certainly not an economical rotary engine.

THE STEAM BOILERS ACT.

THE above is a title of a bill now before the Dominion parliament to provide for the examination of stationary engineers and the inspection of steam boilers, the promoters being the members of the Canadian and Ontario Associations of Stationary Engineers. It is improbable that the bill will pass the House at the present session but it is hoped to make such advancement as will ensure its success next year. Below are given the chief provisions of the act:

The Governor in Council may appoint a chief inspector of steam boilers and not fewer than eight inspectors for the purpose of carrying out the provisions of this act, and the said chief inspector and inspectors shall constitute a board to be known as the Board of Steam Boiler Inspection.

No person shall be appointed a member of the board who has not at least five years' experience as a practical engineer, and who does not hold a high class certificate from some incorporated body or government board, showing that he is a person possessed of practical knowledge of the structure and operation of steam boilers.

The inspectors shall meet under the direction of the chairman for the purpose of making regulations subject to the approval of the Governor in Council and not inconsistent with the provisions of this act:—(a) For holding annual or special examinations, to be conducted by the board or any member thereof, of persons from time to time applying under this act; (b) for granting certificates of qualification to persons passing such examination; (c) for regulating the manner of operating steam boilers and the methods to be adopted for securing the safety thereof; (d) for providing for the uniform inspection of steam boilers, the tests to be used on such inspection, and the circumstances under which such inspection shall be made.

Every person not duly registered under this act, who, after the day of one thousand eight hundred and ninety eight, operates any steam boiler, or is in charge of any steam boiler while in operation, whether as owner or as engineer, shall be liable, on summary conviction, to a penalty of not less than dollars and not more than dollars.

Every person who, at the date of the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers have been so operated, or a holder of a certificate from any incorporated body or from any province, shall be entitled, upon making an application to the chairman of the board on or before the first day of January, 189 , and upon payment of dollars to the chairman, to receive a certificate of qualification and to be registered under the provisions of this act.

Any candidate who considers he has been unfairly dealt with by any of the inspectors, or whose certificate has been revoked, may appeal, in writing, to the chairman of the board, setting forth such grievance; and the chairman shall at once investigate such charge, calling in two of the inspectors to assist him; and their decision shall be final.

In case any owner of a steam boiler shows, to the satisfaction of the chairman, that he is unable, by reason of some unforseen occurrence, to immediately secure the services of a duly qualified person to operate such boiler, the chairman or other inspector to whom such application is made may grant a permit to any person producing satisfactory evidence of good conduct and sobriety to operate such boiler for a period of sixty days from the date of application, and in such case no penalty shall be incurred by reason of operating such steam boiler pending the granting of such permit.

Every owner of a boiler shall cause it to be inspected at least once in each year by an inspector appointed under this act. The inspector making such inspection shall forward a copy of his record thereof to the chairman, who shall immediately forward a certificate of inspection to the owner. Such certificate shall be produced upon demand by the chairman or any inspector under this act. For such certificate the owner of the boiler shall pay a fee of dollars.

The provisions of this act respecting the inspection of boilers shall not apply to any boiler insured and inspected by any duly incorporated boiler insurance company doing business in Canada, but the owner of such boiler shall, when required by any inspector under the provisions of this act, produce the certificate of inspection from such company.

PERSONAL.

Mr. W. B. Close has succeeded Mr. R. H. Fraser as manager of the Toronto and Suburban Electric Railway.

Mr. M. J. Sullivan, for many years with the Great Northwestern Telegraph Company at Toronto, has accepted a responsible position in New York.

Mr. A. Smith, of Kingston, has been appointed district superintendent for the Bell Telephone Company for the territory lying between Kingston and Windsor.

Mr. F. C. Wanklyn, who lately became manager of the Toronto street railway, has been appointed superintendent of the Montreal street railway pro tem during the absence of Mr. Granville Cunningham in Birmingham, where the latter will assist Mr. James Ross in the conversion of the road there into an electric railway.

Before leaving for the mining districts of Northwestern Ontario, Mr. R. H. Fraser, manager of the Toronto & Suburban Electric Railway, was tendered a banquet at Occidental Hotel, Toronto Junction. After the banquet the street railway employees waited upon Mr. Fraser and presented him with a gold-headed cane, on which was inscribed, "To R. H. Fraser, Esq., by the employees of Toronto Suburban Street Railway, April 30, 1897."

Judgment has been given at Montreal maintaining the injunction of the Bell Telephone Company against that city. The City Council in November last passed a resolution instructing the city engineer to prevent the petitioner from opening the streets. The court holds that the charter of the Bell Telephone Company gives it the right to make the necessary excavations in the streets to lay its wires underground, and enjoins the city from interfering.

Messrs. Achille Gagnon & Co., of Victoriaville, Que., who began in December last furnishing incandescent light to the towns of Victoriaville and Arthabaskaville, have found it necessary to increase their plant, owing to the rapid increase of their lighting. They have placed their order for a 75 k.w. S. K. C. two-phase alternator with the Royal Electric Company of Montreal, as it is their intention to furnish power as well as light from the same generator and circuit. Their first installation was single phase alternating, but finding that they could also secure some power business during the day, they decided to operate their plant 24 hours per day, and for this purpose secured an S. K. C. two-phase machine, from which they can serve both light and power from the same line.

CONVENTION SPARKS.

(From Souvenir Number ELECTRICAL NEWS, C.E.A. Convention.)

It was a case of "Put me off at Buffalo."

Did we hear you ask "where are we at?" At the end of three days of solid enjoyment.

What a good thing for the farmer hereabouts that the time is not yet, seeing that the lady bicyclist is abroad in the land.

Notwithstanding the plentiful supply of water in this neighborhood, last night's banquet was a "corker," or rather un-"corker."

To-day we shall have the privilege of seeing the biggest thing on earth in the way of electrical enterprise. The next time we come we hope to see a duplicate of it on this side of the river.

As the result of his vigilant observation since last convention, will Mr. Milne tell us what is the latest prank developed by electric light meters? We want, if possible, to be in a position to head them off.

How does this convention illustrate the fact that our holiday seasons differ from those of our cousins across the herring pond? Give it up? Because we hear Carroll-ing in June instead of December. See?

Have you observed a change in appearance of the rainbow at the Falls since this convention assembled? Seems as though Black and Browne are the predominating colors, before whose lustre the other tints are dim.

It is reported that Mr. A. B. Smith has intimated his willingness to prepare a paper for next convention on "How to Keep Sub-Aqueous Cables in Working Condition," based upon recent experience at Sarnia and elsewhere.

Glad to see some Blue-Noses amongst us on this auspicious occasion. They have set us an example of cosmopolitanism which we would do well to imitate. Who knows but we may ere long have a convention down by the sounding sea?

Was it but the whistling wind, or our fancy, or did we actually hear, wafted on the breeze from Queenston, the strains of

"A life on the ocean wave,
And a home on the rolling deep?"

Perhaps friend Kammerer might be prevailed upon to give DeCew to seekers after franchises regarding the means employed to smooth down the opposition humps on the backs of the Hamilton aldermen. Will Mr. Kammerer turn on the X rays.

The man who asked that the ladies be excluded from the banquet on the ground that the embarrassment occasioned by their presence would cause him to forget his speech, is asked to appear for sentence at the Ladies' Headquarters, Hotel Layfayette, City.

This looks like a case of bearding Acetylene Gas in its den. It is to be hoped that notwithstanding the combination of acetylene gas and other kinds of gas and electricity prevailing hereabouts at present, there will be no explosions. We look to Bro. Wickens to keep the safety valve properly adjusted.

So far as the visitors to this convention are concerned, the popularity of Wilfrid Laurier pales into shadowy insignificance beside that of Wilfred Phillips, the good-looking manager of the Niagara Falls Park and River Railway, to whose indefatigable efforts much of the success of the present occasion is due. In the language of the Montreal contingent, Vive le Wilfred!

You may all know by this time that there has been

"A chiel amang ye takin' notes,"

but you may not be aware that the camera fiend, in the person of "Joe" Wright, has been quietly on the look-out for snap-shots since this Convention began. I may possibly have the privilege later on of letting you

"See yersel s as ithers see ye."

Did you ever listen to Mr. J. J. Wright as he discourses upon the beauties of agricultural life in comparison with the job of the man who finds himself in charge of a big lighting and power station? If not, there are flights of enthusiasm and oratory which you may yet enjoy. The experiences of the last few months are said to have perfected Mr. W.'s ability to prove the affirmative of the proposition that the farmer has a picnic without apparently being conscious of his advantages.

As Canadians we feel at liberty to express ourselves in language more emphatic than polite regarding some of the work of the American law makers. We don't always see eye to eye with the Yankee government, but of the individual Yankee we have the highest possible opinion. The manner in which the visitors to this convention have been treated by our friends across the gorge shows them to be out and out "white men." In fact we think so much of them that we hope to annex more and more of them individually in the future.

MECHANICAL ENGINEERS' ASSOCIATION.

THE Mechanical Engineers Association of the province of Quebec was organized as a separate body in the year '94, before which time its members were associated with the Canadian Association of Stationary Engineers. The object of the association is not only to insure for its members benefits in case of sickness or

MR. E. F. VALIQUET.

death, but also to give them the necessary technical instruction. Lectures are given semi-monthly by outside specialists, or by members of the union. By an intelligent administration this society, though having paid large sums of money to sick members, has to-day a good surplus. The election of its officers for the year 1897 took place on the 20th April, with the following result: President, E. F. Valiquet; 1st vice-president, H. Beauchamp; 2nd vice-president, M. Guimond; treasurer, W. Gendron; financial secretary, E. Leroyer; recording secretary, A. Belair; assist-

MR. H. BEAUCHAMP.

ant recording secretary, Jos. Gingras; corresponding secretary, A. Tessier; introductor, A. Habig; door-keeper, O. Fontaine; trustees, M. U. Lessard (president), E. Brisbois, A. Provost, J. Langevin, F. Lavigne, N. Despatie, Jos. Verdon, delegates to Central Council, E. Brisbois, M. Guimond; examiners, R. Drouin, E. F. Valiquet, H. Denis.

The new officers were installed on the 4th of May. Portraits of the president and vice-president appear herewith. The former is chief mechanical engineer at Rutherford & Sons' saw mills, which position he has occupied for the past five years.

CANADIAN
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AND
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SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

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

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:

JOHN YULE, Manager Guelph Light & Power Company, Guelph, Ont.

1ST VICE-PRESIDENT:

CHAS. B. HUNT, Manager London Electric Co., London, Ont

2ND VICE-PRESIDENT:

J. A. KAMMERER, General Agent, Royal Electric Co., Toronto.

SECRETARY-TREASURER:

C. H. MORTIMER, Publisher ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:

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F. C. ARMSTRONG, Canadian General Electric Co., Toronto.

JOHN CARROLL, Sec. Treas. Eugene F. Phillips Electrical Works, Montreal

ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.

A. B SMITH, Superintendent G. N. W. Telegraph Co., Toronto.

A. A. DION, Ottawa Electric Co, Ottawa.

F. A. BOWMAN, New Glasgow, N. S.

WILFRED PHILLIPS, Manager Niagara Falls Park and River Railway, Niagara Falls, Ont.

W. H BROWNE, Manager Royal Electric Company, Montreal.

WILLIAM THOMPSON, Superintendent Waterworks and Electric Light Plant, Montreal West, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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Vice-President, E. J. PHILIP,	11 Cumberland St., Toronto.
Secretary, W F CHAPMAN,	Brockville, Ont.
Treasurer, R. C. PETTIGREW,	Hamilton, Ont.
Conductor, J. MURPHY,	Montreal, Que.
Door Keeper, F. J MERRILL,	Ottawa, Ont.

TORONTO BRANCH NO. 1. Meets 1st and 3rd Wednesday each month in Engineers Hall, 61 Victoria street. John Fox, President; Chas. Moseley Vice-President, T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington, 2nd Vice President, Wm. Smyth, Secretary, B. Archibald York, Treasurer, Peter McNaugton.

ST LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal R. Drouin, President, Alfred Latour, Secretary, 306 Delisle street, St Cunegonde.

BRANDON, MAN, BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President, Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Maccabee's Hall. Wm. Norris, President, E. Teeter, Vice-President, Jos. Ironside, Corresponding Secretary, Markland St.

STRATFORD BRANCH NO 3. John Hoy, President; Samuel H Weir, Secretary

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Cordage Co., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. G. B. Risler, President; D. Campbell, Vice President, Wm. Meaden, Secretary-Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p.m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street, Frank Robert, President, T. G. Johnson Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Utley, President, G. Steinmetz, Vice President, Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, J. W Tandvin; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11. President, G. M. Hazlett; Rec Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO 12 —Meets every Tuesday at 8 o'clock, in Mc Kibbon's block. President, Daniel Bennett, Vice-President, Joseph Lighthall, Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO 14. Meets 2nd and 4th Wednesday in each month W. L. Outhwaite, President; W Forster, Vice-President; A. E. Mc Callum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

Canadian Electrical Association.

OUR readers will no doubt find much to interest them in the proceedings of the recent convention of the above Association, published in this number. It is gratifying to state that the attendance was satisfactory, and more thoroughly representative of the whole Dominion than on the occasion of any previous meeting. A large addition was made to the membership of the Association, principally from the ranks of central station owners and managers. The papers were quite up to the standard of former years, and covered a wide range of subjects. The discussions were far in advance of those at any previous convention both as regards the free expression of opinion and amount of practical information elicited. Central station practice properly received a large measure of consideration, and as a result many central station men were heard to express their appreciation of the benefits to be derived from connection with the Association and attendance at the convention. The reference in the president's address to the necessity of legislation for the protection of the rights of those who have invested their capital in the electric lighting business, and the subsequent action taken thereupon, indicate a determination to make the Association of practical value in conserving the interests of its members and of the electrical industries of the country. In this laudable endeavor it should receive the hearty support of all whose interests are bound up with these industries. The reelection of Mr. Yule was a fitting recognition of the zeal and success with which he has sought to promote the welfare of the organization, and under his guidance good results may be looked for in the year to come. It is to be regretted that Mr. L. B. McFarlane felt compelled, on account of pressure of other duties, to decline to again accept office in the Association. He has been a valued aid to the work of the Association in the past, and it is to be hoped may at a later date reenter the harness. His successor, Mr. C. B. Hunt, is a gentleman of recognized business ability, and will be a source of much strength to the organization, while Mr. Kammerer, second vice-president, lacks neither the ability nor opportunity to enable him to advance its welfare. The executive committee comprises men of ability, and, we are pleased to say, is representative not only of Ontario and Quebec, but of the maritime provinces as well. In view of these and other favorable conditions, friends of the Association may reasonably look forward to a year of great prosperity and usefulness, culminating in a convention at Montreal in 1898 which will eclipse in interest even the successful event at Niagara Falls last week.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE SEVENTH CONVENTION, AT NIAGARA FALLS, ONT.

THE Seventh Annual Convention of the Canadian Electrical Association took place at the Dufferin Cafe', Niagara Falls, Ont., on the 2nd, 3rd and 4th of June, 1897. It was one of the most largely attended and interesting in the history of the Association. There was a noticeable increase in the attendance of central station men from various parts of the Dominion.

A meeting of the Executive Committee was held in the forenoon of the first day, at which twenty-five new members were elected. The first session opened at 2.30 o'clock, the President, Mr. John Yule in the chair.

There were present the following persons:

K. J. Dunstan	Toronto, Ont.
Frederic Nichols	"
J. J. Wright	"
C. H. Mortimer	"
Geo. A. Wilkie	"
E. K. M. Wedd	"
Irving H. Smith	"
A. A. Christie	"
A. B. Smith	"
J. A. Kammerer	"
W. A. Johnson	"
A. M. Wickens	"
W. J. Clarke	"
E. D. McCormick	"
W. H. Bourne	"
Albert Esling	"
T. F. Dryden	"
James Milne	"
F. H. Leonard, jr.	"
J. W. Campbell	"
Jos. Wright	"
E. B. Biggar	"
John C. Gardner	"
Ross McKenzie	"
John Yule	Guelph, Ont.
W. H. Browne	Montreal, Que.
John Carroll	"
Wm. Thompson	"
J. A. Bayliss	"
C. B. Hunt	London, Ont.
C. E. A. Carr	"
Capt. Williams	"
F. Pepler	Barrie, Ont.
Stephen Noxon	Ingersoll, Ont.
G. E. Gayfer	"
Henry Comstock	Brockville, Ont.
Geo. Shand	Sarnia, Ont.
Wm. Williams	"
John Murphy	Ottawa, Ont.
B. F. Reesor	Lindsay, Ont.
H. O. Fisk	Peterboro', Ont.
E. E. Cary	St. Catharines, Ont.
Geo. A. Powell	"
James Lamont	Chatham, Ont.
Geo. Phemister	Niagara Falls, Ont.
Wilfred Phillips	"
G. E. Foster	"
E. T. Freeman	Halifax, N. S.
V. B. Coleman	Port Hope, Ont.
John Farley	St. Thomas, Ont.
F. A. Bowman	New Glasgow, N. S.
J. W. Purcell	Walkerville, Ont.
W. H. Bullard	Seaforth, Ont.
C. H. Philbrook	Buffalo, N. Y.
H. E. Adams	"
W. J. Johnston	New York, N. Y.
Wm. McCullough	"
Geo. Black	Hamilton, Ont.
W. F. McLaren	"
F. W. Martin	"
Gordon J. Henderson	"
B. J. Throop	"
Thos. Wadland	"
O. C. Baker	"
Thos. Duncan	Fort Wayne, Ind.
C. J. Page	Welland, Ont.
J. M. Brown	Carleton Place, Ont.
Chas. E. Taylor	Sault Ste. Marie, Ont.

The President, after welcoming the members to the convention, read the following address:

PRESIDENT'S ADDRESS.

GENTLEMEN:—Once more the Canadian Electrical Association is convened for the transaction of business. Our place of meeting is at this particular time singularly appropriate, the whole district being an object lesson to those engaged in electrical enterprises. The progress of electrical science during the last few years is very fully exemplified in the various undertakings it will be our privilege and pleasure to examine during our meeting. I will, therefore, not take up your time with any remarks on the progress of development in the various branches of applied electricity.

The programme prepared will, I hope, meet with your approbation. The papers to be read are of interest to all, and the valuable information therein contained when carried home and put into practice will realize good financial results, and should be value for every dollar expended in attending this meeting.

Allow me to emphasize that this organization is not for the display of intellectual gymnastics, but to provide an occasion when all can meet on common ground and feel no hesitation in propounding questions or expressing views; every one is a member with equal privileges, entitled to and sure to receive respectful recognition. I therefore urge upon all to take an active part in the discussions. Surely in this gathering there can be culled sufficient information to repay every one of us for the time given to attend.

The different items mentioned in the programme for social enjoyment kindly provided by our friends here and on the other side of the river, will afford a treat not often enjoyed by us, and will, I trust, give members an opportunity of becoming better acquainted with one another. No business jealousies should find a place amongst us, rather ought we to help each other by exchanging opinions and experiences, and particularly should this be the case just now, when so many are face to face with that movement now prevalent in Canada for what is called municipal control. Many lighting companies during the past year have had to fight for the prevention of ruin to their enterprises. I, for one, can speak from personal experience. This question appears to me to be to lighting companies the question of the hour. Repeated repulses does not seem to stay the movement. It is gathering strength and some means will have to be devised to prevent the wiping out of a very large amount of capital legitimately invested in the electric lighting business. We look back and remember the inducements, encouragement and praise that were given to those venturing their savings in the business—in most cases done for the purpose of improving their town and helping their community to keep up with the march of progress—and compare therewith the now vehement attacks of local agitators, and even reputed respectable newspapers who din in the ears of the ratepayers the marvellous success and saving effected in a few large and rapidly growing cities in the old land, entirely oblivious to the conditions existing in the smaller cities, towns and villages of Canada. We hear of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity. They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was, at one time, by the same people, lauded as creditable enterprise on the part of their fellow citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope that our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe in dealing with the telephone question admits this principle in pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on "Monopolies and the People," where the author tersely sets forth the evils of the popular attitude towards competition projects:

"Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval and, under the impression that they are benefitting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known."

In Great Britain the government forbids by legislative enactments local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1318 gas undertakings operated by companies and only 165 managed by municipalities. This, in view of the fact that said municipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 30 years.

Electric lighting in Great Britain has not until within the last two years made very rapid progress. From all the information I can gather plants installed are a long way from being entirely under the control of municipalities. A good deal of adverse criticism followed the passing of the Electric Lighting Act by the parliament of Great Britain as being likely to retard the progress of the introduction of the supply of electricity there. Reading over the Act makes one think parliament, in their wealth of legislative experience, had in view just such a situation as exists in Canada to-day. The Act is very concise and provides fully for the method in which electric undertakings are to be started. Companies can be organized for this purpose, and on proving their good faith and ability to carry on the business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing or not desiring to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation and gives a monopoly of the business under proper control. But what about street lighting? Are the municipalities required to pay any price demanded by the company for that service? Most decidedly not. Street lighting is carefully provided for in the Act. The company is compelled on a requisition from the local authorities to erect and supply street lights; the distances apart and other necessary conditions are prescribed in the general Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. I do not think I can do better than read to you the sections regulating the transfer from companies to local authorities as set forth in the Electric Lighting Act. It is not very long and will give you a fair idea of the method adopted. Sections 27 and 28 read as follows:

ELECTRIC LIGHTING ACT

Sec. 27. Where any undertakers are authorized by a provisional order or special act to supply electricity within any area, any local authority within whose jurisdiction such area or any part thereof is situated may, within six months after the expiration of a period of twenty one years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, from the date of the passing of the act confirming such provisional order, or of such special act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, by notice in writing require such undertakers to sell, and thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials and plant of such undertakers suitable to and used by them for the purposes of their undertaking, within such jurisdiction, such value to be in case of difference determined by arbitration: Provided that the value of such lands, buildings, works, materials and plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials and plant, and to the state of repair thereof, and the suitability of the same to the purposes of the undertaking, and, where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase or of good will or of any profit which may or might have been or be made from the undertaking, or of any similar considerations. The Board of Trade may determine any other questions which may arise in relation to such purchase, and may fix the date from which such purchase is to take effect, and from and after the date so fixed, or such other date as may be agreed upon between the parties, all lands, buildings, works, materials and plant so purchased as aforesaid shall vest in the local authority which has made the purchase, freed from any debts, mortgages, or similar obligations of such undertakers or attaching to the undertaker, and the powers of such undertakers in relation to the supply of electricity under this act or such provisional order or special act as aforesaid within such area or part thereof as aforesaid shall absolutely cease and determine, and shall vest in local authority aforesaid.

28. Where any matter is by this act, or any license, order, or special act directed to be determined by arbitration, such matter shall, except as otherwise expressly provided, be determined by an engineer or other fit person to be nominated as arbitrator by the Board of Trade, on the application of either party, and the expenses of the arbitration shall be borne and paid as the arbitrator directs.

Any license or provisional order granted under this act shall be deemed to be a special act within the meaning of the Board of Trade Arbitrations, Etc., Act, 1874.

We also have an example on this continent of special legislation for controlling lighting companies. In the Commonwealth of Massachusetts there is a Board of Gas and Electric Light Commissioners appointed by the Governor and Council. This Board has been in existence for about thirteen years. The act establishing the Board sets forth that said Board shall have the general supervision of all corporations engaged in the sale of electric light and gas for lighting and fuel. I have been supplied with copies of the last three annual reports. From these reports it appears that nearly everything connected with lighting companies in Massachusetts, all relations between the companies, their customers and the municipal authorities are dealt with by the Commission. Applications for reduction in price, complaints as to the quality, giving power to increase capital, issue bonds, etc., are passed upon by that Board. What strikes me as very remarkable in dealing with the affairs of lighting companies is the unusual amount of common sense advice given to companies, corporations and customers. Their decisions furnish very interesting reading. The fair and equitable way they deal with all kinds of petitions would come to most of us in the nature of a surprise, our experiences are so different. Here is a quotation illustrating their methods. In giving their decision on a petition from the selectmen of Millbury praying for a reduction in the price and improvement in the quality of electric street lights, the commissioners say: "In reaching a decision the Board found it necessary to consider not only the street lights, but the company's income from its entire lighting business and the way in which its affairs are managed. Those who invest their money in order to render a public service of this character are entitled to a reasonable return from their business when properly conducted, but are not entitled for the sake of such return to impose upon a community additional burdens on account of careless or incompetent management." In this case the selectmen had offered $2,000 for the service, the company asked $2,500, and the Board decided that $2,375 was a fair price.

Every lighting company in the state is required annually to make a return to the Board in a form prescribed by said Board of their financial statement for the year, giving full particulars as to capital, income, expenses, dividends paid, etc. It may interest you, gentlemen, to know that of companies doing a purely electric business in Massachusetts the table of dividends paid furnishes the following information. Report for 1895 gives 59 such companies, 35 of these paid no dividends, 2 paid less than 5 per cent., 22 paid 5 and over. In 1896 there were returns from 63 companies, 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. In 1897 Report 62 companies are given; 31 paid no dividends, 9 less than 5 per cent., and 22 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy, thickly populated and prosperous manufacturing state like Massachusetts, I feel certain, could reliable statistics be obtained from the Canadian companies, an even worse showing would be made.

I have endeavored as briefly as possible to lay before you samples of legislation provided for the governing and regulating of capital invested in companies similar to those with which most of us are connected. The question that presents itself to my mind is: Have we not a right to claim the attention of the Legislature of Ontario (I mention Ontario because it is the storm centre of the present agitation), and present to them a request to pass legislation to meet the situation. Municipalities having invited citizens to invest their capital, persons who have taken the risk should be furnished with a reasonable and fair amount of protection. As the law at present stands opposition works can be started by corporations, and enterprising citizens taxed to support a concern competing with them and having the whole taxable resources of the ratepayers behind them. One would think that sound economy and common fairness should dictate a change in the present mode of regulating such investments.

The consolidation of the British and Massachusetts laws, would, I think, meet our conditions. I feel certain that a majority of the companies would be only too well pleased to transfer and take 75 per cent. of the money invested in their plant, should it be decided that municipalities desiring the control must first purchase existing plants.

My reason for thinking the Ontario government ought to look favorably upon our request is, that they have already acted upon and recognized the principle of transferring existing plants to municipalities where they wish to assume and manage semi-monopolistic franchise. In the Gas and Water Company's Act where power is given to cities, towns and villages to take possession of and pay for such plants, at present this power is permissive on the part of local authorities. It occurs to me, however, if corporations were compelled to purchase existing plants before going into business the movement would lose a good deal of the spice and zest it now has for agitators. Gentlemen, this is an important question, and I trust this meeting will be the beginning of an organization including every lighting company in Canada that will persevere until legislation is secured to prevent the making of no value the capital invested in good faith in the lighting business. Let us arouse from our lethargy and not lose sight of the fact that our very existence depends entirely upon the exertion of each and every individual interested.

Before passing from the subject permit me to say it is with pleasure I can testify that the leading manufacturers of apparatus in Canada cannot be charged with what I have noticed complained of in the United States. There it is stated that manufacturers of electric lighting machinery, finding the field for disposing of their products getting limited, are now giving their attention and for the sake of making sales, persuading municipalities to go into the business. We do not expect manufacturers will refuse to sell to municipalities when they wish to purchase; that would be unreasonable. But that they take a stand for the best interest of the business and do not lend themselves to helping in confiscating the property of those who had the courage to invest in electric lighting enterprises, is very much to be commended.

I cannot close my remarks without a feeling reference to the untimely death of our respected late 2nd Vice-President, Mr. E. Carl Breithaupt. I am sure I express the opinion of all who had the pleasure of knowing him that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our Association.

In conclusion I can safely affirm we all agree that those of our members who have taken the trouble and time to prepare papers for our meeting are deservedly entitled to our sincere thanks. In no way can we better show our appreciation of their efforts than by attending punctually at the hour of meeting, that they may have the inspiration of our presence. It is theirs by right of courtesy and I feel sure each member will concur in this and fulfil his individual responsibility and duty by punctual and regular attendance.

I desire to express my thanks for the distinguished honor you conferred upon me in electing me to preside over your deliberations at this meeting. I crave your indulgence for any shortcomings on my part.

At the close of his address the president was greeted with applause.

The President: Does the Association wish to take any action at this stage with regard to the recommendation contained in my address.

Mr. J. J. Wright: I would suggest that, as we expect a much larger attendance to-morrow, the matter of appointing a committee to take up this recommendation be allowed to stand until then, and in the meantime the members will have an opportunity to think it over.

Mr. C. B. Hunt: Mr. President, while I agree with Mr. Wright, do you not think it better to have a committee appointed now, so that a report can be made to this convention.

Mr. J. J. Wright: It is not necessary to make a report to this convention.

Mr. Hunt: I think the committee ought to report back to this convention, as we only meet once a year. With your permission I would like to name a committee to take up this matter, consisting of the following gentlemen: Messrs. Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock and the mover; and that this committee report back to the convention to-morrow.

Mr. J. J. Wright: I second the motion.

The president put the motion, and on a vote being taken, declared it carried.

Mr. C. H. Mortimer, secretary-treasurer, read the minutes of the last annual meeting, which on motion were adopted as read.

The secretary then read his report as secretary-treasurer for the past year, as follows:

SECRETARY-TREASURER'S REPORT.

MR. PRESIDENT AND GENTLEMEN:

It is a sincere pleasure to me, as I am sure it will also be to you, that the report which I am now called on to present is one of a very encouraging character.

As regards our membership, there have been added during the year 42 active members and two associates, a total of 44. During the same period 9 active and 5 associate members tendered their resignation; 6 active members were removed from the roll owing to having changed their addresses and the impossibility of learning their whereabouts; 33 active members and 14 associates, after having received due notice, were struck off the roll for non-payment of dues. The total number of names removed from the membership list during the year for the causes mentioned, was 69. In addition death has removed two of our members, the late Mr. E. Carl Breithaupt, who occupied the position of 2nd Vice-President, and Mr. A. W. Congdon. Their loss we deeply deplore. Our membership at this date comprises 154 active members and 19 associates—a total of 154 active members and 19 associates a total of 173.

As regards the large number of persons struck off the roll for non-payment of fees, I beg to quote as follows from my last report: "There are on the roll a large number of persons who, without having resigned their membership in the Association, have ceased to take an active interest in its affairs, and have likewise failed to pay their membership fees. It should be understood that when a person joins the Association, he thereby becomes a member, not for one year only, but until such time as he formally resigns his membership, and that until his formal resignation is received by the secretary and accepted by the Executive Committee, he continues to be liable for payment of the annual fee. It is perhaps due to lack of a definite understanding on this point that the actual standing of the Association, with regard to its bona fide membership, is at the present time somewhat uncertain. The time has arrived when definite action should be taken to put an end to the present and future uncertainty with regard to this matter.'

The Executive Committee several months ago decided that persons in arrears for fees, who had been carried forward on the roll from year to year, should be notified that their names would be struck off on the 1st of April if their dues were not previously paid. This decision was carried into effect. As a result, though there is an apparent decline in our membership as compared with last year, it has improved in quality, and is on a much more satisfactory footing than ever before.

The finances are in an equally gratifying condition. The receipts for the year show an increase of $448.03 above those of the previous year, while the increase in disbursements was only $165.86, leaving a net gain of $282.17.

Meetings of the Executive Committee were held on July 24th, 1896, Feb. 25th and April 12th, 1897.

At the first of these meetings the accounts in connection with the last convention were passed and ordered to be paid, two associate members were elected and the resignations of six members accepted.

At the meeting in Febuary a resolution of condolence with the family of the late Mr. E. Carl Breithaupt was passed and the Secretary instructed to draft and present the same. The Secretary was instructed to notify members in arrears for fees for a longer period than two years that unless the sum of their indebtedness was paid prior to the 1st of April their names would be erased from the membership roll. The Secretary was further instructed to send accounts for fees to members in arrears for the current year, and give notice that draft would be made if the amounts were not paid within 10 days. Mr. Higman, of Ottawa, was elected a member of the Executive Committee, and Mr. Chas. Hunt was elected 2nd Vice-President to fill the vacancy caused by the death of Mr. Breithaupt. The dates were fixed for the present convention and committees appointed to make the necessary arrangements. Three active members were elected, several accounts passed and ordered to be paid.

At the April meeting five persons were elected to active membership; the sum of $175 was ordered to be placed to the credit of the Banquet Committee.

Following is a detailed statement of the receipts and expenditures:—

RECEIPTS.

Cash in bank June 1st, 1896	$157 21	
Cash on hand June 1st, 1896	1 50	
197 active members' fees at $3.00	591 00	
1 active member's fee at $5.00	5 00	
29 associate members' fees at $2.00.	58 00	
Cash for exchange on cheque	15	
25 copies of report of Sixth Convention sold.	2 50	
Cash from local electrical companies towards entertainment expenses	100 00	
Refund from Statistical Committee	25 00	
		$940 36

DISBURSEMENTS.

Expenses of convention at Toronto		$352 47
By cash C. V. Ward's account, Lorne Park ..	$106 00	
" " C. V. Ward toward floral decorations.	10 00	
" " Str. Greyhound account ..	26 50	
" " J. Ball, music.........	10 00	
" " Board of Trade, rent ..	14 00	
" " Caretaker, Board of Trade.....	3 00	
" " Elevator man, Board of Trade.	2 00	
" " S. Tidy's account	1 50	
" " Alexander & Cable's account..	5 00	
" " Monetary Times account.....	24 00	
" Electrical News" account	79 25	
" " Canadian Photo-Engraving Co.'s account	28 09	
" " Geo. Angus, stenographer	40 00	
" " Ribbon and pins for badges	2 88	
" " Express charges.	25	
	$352 47	
Grant to Secretary		75 00
Stationery......		1 90
"Electrical News" printing..		23 00
Telegrams.		1 30
Telephone messages		60
Postage		62 32
Exchange on drafts and cheques		7 95
Cash in bank May 31st, 1897		410 57
Cash in hand May 31st, 1897		5 25
		$940 36

The report was adopted as read, on motion of Mr. J. Carroll, seconded by Mr. E. E. Cary.

REPORTS OF COMMITTEES.

Mr. J. J. Wright, on behalf of the Committee on Legislation, reported as follows: It has not been found necessary during the past year to convene the committee; there was no legislation that affected the interests of the members generally, and any little matters which came up in the House of a local character were attended to by those personally interested. There is also another committee for which I imagine I am responsible in a way, and that is the committee to interview the government on the question of meters. Nothing has been done in that connection, especially after the discussion we had on that question at the last convention. We found that the officials of the government were disposed to meet us in every reasonable way and treated us very fairly, and there was no urgent necessity under the circumstances to have an interview with the government. But I think both in the question of legislation and also in regard to the question of government inspection of meters, it would be well to exercise considerable care in selecting a committee, for the coming year bids fair to be an important year in both branches.

The President: The late Mr. Breithaupt was chairman of the Committee on Statistics, and I was next on the list to him, but I have not as yet been able to get possession of the papers from Mr. Breithaupt's executors. I have applied for them, but they have not come to hand.

Mr. J. J. Wright: Do you think, Mr. President, those papers will be available; I understand that Mr. Breithaupt devoted considerable time to that committee before his death, and if those papers can be made available, they will be quite a help to any new committee that may be appointed?

The President: The papers are in existence, because I had quite a large number of them during our campaign in Guelph. I sent them back to Mr. Breithaupt, and I think I will be able to get them.

The President: I will name Mr. B. F. Reesor, Mr. C. B. Hunt, and Mr. A. B. Smith as a committee to name the standing committees.

GENERAL BUSINESS.

Mr C. B. Hunt: I do not know whether there are many of the members who know of the new order that has been issued in Council in regard to the inspection of meters; it is one of very great importance to most of us, and I think there ought to be some discussion on it, either to-day or to-morrow. The matter is simply this, that the charge for the inspection of meters now is made per lamp instead of per ampere. To those of us who have a 106-volt service or a 110-volt service the rating for inspection is very much increased. I might give you an example: Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now $1.25; on a 15 ampere meter it is increased from $1.25 to $1.75; on a 25 ampere meter it is increased from $1.75 to $2.25; on a 50 ampere meter it is increased from $2.75 to $3.50; on a 100 ampere meter it is increased from $3.50 to $5.50, and on a 150 ampere meter it is increased from $4.25 to $7.50. If you happen to have three wire meters it will be pretty nearly doubled on that again. I think, therefore, it is necessary to have some discussion on it before we adjourn the convention.

Mr. J. J. Wright: I would move that we make a present to the government of the whole of our plant. (Laughter).

Mr. Hunt: They will have it soon.

The President: You had better bring the matter up to-morrow. As there is nothing else at present under the head of general business, we will call on Mr. John Murphy, of Ottawa, to read his paper entitled "Water Driven Plants."

Mr. Murphy then read his paper, which appears on page 123.

The President: I might say that we have water power some seasons of the year; most seasons we have not. The most satisfactory regulation I find is a quick-acting engine on the same shaft with the water wheel. That has been my experience in regulating when running with water power. The governors that we got did not seem to act quick enough, and the lights were not at all satisfactory, so we put the engine on the same shaft and governed with it.

Mr. H. O. Fisk: Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

Mr. B. F. Reesor: I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine, but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. But the same thing holds good with an engine or water wheel, and much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare. The throwing on of an ordinary load will not affect a water wheel so much by having a governor, but where the wheel is taxed to almost its capacity I can see the difficulty that no governor will help very much to overcome the pull down for electric incandescent lighting.

Mr. Fisk: In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at the Niagara Falls power house now that keeps a constant load on the generator all the time; when the load is not on the road it is on the resistance.

Mr. S. Noxon: I do not know whether I am presumptuous in offering to say a word, seeing I am not interested in a water power plant, but I have had considerable experience in the use of water power. I lived for a time in Walkerton, and we had a large water power there which we employed to drive two or three mills. I took considerable interest in the matter of the regulation of water wheels, and came to the conclusion from the experiments made there that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor; the governor might work quickly but the wheel would not. It wasn't any trouble to get a governor to operate the gate, but the trouble was to get the wheel to respond quickly enough. I have seen governors applied to water wheels under a very high head which regulated very closely, but that is the only condition under which I believe the governor can be applied to a water wheel to give anything like a close regulation. It can be done there because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds. I think that is about the only condition under which a regulator will work upon a water wheel with any degree of satisfaction.

Mr. A. B. Smith moved, seconded by Mr. A. M. Wickens, that a hearty vote of thanks be tendered Mr. Murphy for his interesting paper. Carried.

The President: I will now call on Mr. Wickens to read his paper entitled "The Steam End of an Electric Plant" (see page 123). It may come in very profitably after having just had the water end.

Mr. Wickens then read his paper.

Mr. J. Milne: There appears to be a little mistake in the second paragraph. If you look at the paper it says: "Our steam engine is only a heat engine, and is subject to many losses, in fact, in some of the old engines with large cylinders and slow piston speeds, the water consumption was as high as 60 lbs. per hour per h.p., while to-day, with our higher boiler presures and faster piston speeds with early cut-offs, we reduce that to two and one-half pounds water per h.p. per hour."

Mr. Wickens: That is intended to have been 12½ pounds.

Mr. Milne: It says a little further down: "This very high pressure at that time was only expanded eight-fold, and even under such circumstances gave a h.p. for about two pounds of water per hour." I presume that should be "12" again.

Mr. Wickens: Yes.

Mr. J. J. Wright: There must be some discrepancy here, because you are comparing a modern expansive plant with the experiments of Mr. Perkins, which were manifestly not up to date.

Mr. Wickens: With regard to the engine at Sibley College, there have been a great many reports sent out about it; they were using steam at 500 lbs. pressure; it was an experimental engine built to see what they could do. They undoubtedly have been getting a h.p. with 10 lbs. of water. What the evaporation of the boiler was I don't know exactly; they simply gave the result of the use of the steam in the engine; if the evaporation was 10 lbs. of water per lb. of coal, they were getting a h.p. for one pound of coal per hour. There is no question they have got an exceptionally and remarkably cheap running engine. The point is where to stop putting in cylinders to save money. A short time ago a triple expansion engine was built in such a way that the intermediate cylinder could be discarded; this was a Wheelock engine, and upon experiments they found they had just as much economy without the intermediate cylinder as they had with it—that the friction and loss in connection with that intermediate cylinder, under certain conditions of load, counterbalanced the efficiency of it. There were certain loads under which the engine was run in which the cylinder was all right.

Mr. Milne: There appears to be a little exaggeration about the middle of page 6 of the paper, where Mr. Wickens makes the quotation from the paper read before the British Institute of Civil Engineers, as follows: "Thus an expenditure of 5, 10 and 15% of the furnace heat to super-heat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied." I would take that to mean that by superheating the steam up to that temperature you got 70% more work out of the engine.

Mr. Wickens: No; there is simply an increase of seventy per cent. in the thermal efficiency; it is not so much the work done at the engine.

Mr. Milne: I am inclined to think that superheating is not what it is cracked up to be, because in the tests made by superheating there is very little gain in economy shown. In fact, where an engine is properly designed you can scarcely measure the amount gained by steam jacketing. A steam jacket is a good thing on what we might call a poorly-designed engine, but the amount of gain that can be got out of an engine with the cylinders jacketed does not exceed five per cent. at the very outside. This is a big saving in some places where they have large units, but in smaller units the saving would be a minus quantity. Sometimes we think because an engine is steam jacketed and so on, that we are going to get extremely high results in economy, but I think if the tests are properly conducted and everything measured properly that there will be very little saving. In designing engines there is one thing that has to be taken into consideration, and that is to make the difference of temperature between the initial pressure and the final pressure as small as possible so as to prevent condensation; the greater the difference the greater the condensation, and steam jacketing in a case of that kind may help a little, but where you have triple expansion I do not see that steam jacketing is of any use whatever. Of course, in taking in the gain of steam jacketing you have got to take into consideration the amount of steam spent in steam jacketing.

Mr. Wickens: I think what Mr. Milne says only bears out this very idea in my paper. I think he is right as far as he goes with regard to steam jacketed cylinders. We all understand that the affinity that heat has for iron is very great, and one of the strong reasons we are running a high speed engine to-day is because the ends of the cylinder do not get time to cool, and the incoming steam has not got to heat a lot of iron before it does any work. Take a slow speed engine, and when you open a steam valve at one end of the cylinder the first work that the incoming steam does is to re-heat the metal up to the heat it was when the steam was admitted at the previous stroke, and this is the first expense on the steam. This thing must have been recognized by engineers since the commencement, because the whole trend has been to stop it. Now, with regard to super-heating steam, when you get the steam super-heated and get enough heat in the steam so that when you release it, it has lost so little that the iron has nearly the same heat as the incoming steam, you will get over the very loss that they tried to save by steam jacketing these cylinders, provided you can carry the heat through to the end of the stroke. As I said in the paper, some thirty years ago most important experiments were carried on in the United States Navy on the use of super-heated steam; they discarded it because they could not keep the super-heaters tight and could not lubricate. To-day they have got rid of all that trouble; they can both keep the super-heater tight and lubricate the parts of the engine inside with the heat as high as 650 or 670 degrees. The particular things that stopped them in the early times have been overcome; and it seems to me to be a matter of experimenting before we can expect very much reduction in the use of coal by means of super-heating the steam.

Mr. Milne: There are slow-speed engines running to-day without a super-heater showing better results than many of the fast-running engines, so it appears to me there is a discrepancy some way or other.

Mr. Wright: I don't think you save anything in the loss of heat by the rapidity of the action of the engine. No matter how fast the steam is admitted, expanded and exhausted from the cylinder it will make no difference; if the vibrations are very rapid it doesn't give time for the iron to take up the heat. Of course, there will be a general average. It is just exactly as though you have a steam gauge on a cylinder where the pressure is fluctuating—you cannot possibly get at it. The gauge cannot go fast enough, but if you take and choke that off you get the general average of that heat no matter how fast the engine is running, or whether the engine is running very slowly or very rapidly.

Mr. B. F. Reesor: A little further down in this paper I see Mr. Wickens says, in reference to keeping boilers clean, that some require caustic soda, etc. Nearly all the boiler compound men that come around say in the preparations they have got there is no caustic soda to keep the boiler clean. Then he says, "All organic matter needs alum or fessic." I would like to know how Mr. Wickens administers the "physic." (Laughter.)

Mr Wickens: That is a misprint; it should be "ferric acid." If you put a compound into a boiler you are simply giving it physic.

Mr. Fisk: What is the objection, if any, to using caustic soda.

Mr. Wickens: I would state, as far as my knowledge of using caustic soda for boilers goes, that the trouble is, it makes the steam so sharp that it cuts the valve faces, and more especially it will injure brass valve seats. A certain portion of it goes off in the steam.

Mr. Fisk: Does it go off in dry steam?

Mr. Wickens: Oh, yes.

Mr. J. J. Wright: There is a simple way of getting over the difficulty, that is, to give the boiler a dose of caustic soda and close it up, when it is not running, and then blow that out. That is the way we use caustic soda in our boilers. We let it stand there in the boiler without using the steam at all, and then wash out the boiler and go ahead.

Mr. C. B. Hunt: How much caustic soda per horse power would you put in, Mr. Wright?

Mr. Wright: We never figure it that way at all. The engineer simply says, this boiler is almighty dirty, and he would put in perhaps ten pounds of caustic soda. We find the same difficulty that Mr. Wickens speaks of if we put in a small quantity of caustic soda. It is, I think, the quickest scale remover that there is. We put in caustic soda in the boiler, and we found eventually the brass seats of the valves would show deterioration and a cutting of the faces, and we laid it down at once to the caustic soda and stopped using it, except in the way I have stated.

Mr. B. F. Reesor: Is there any gentleman here who is using petroleum?

Mr. Wickens: Having spent a few years in boiler inspection, it is a matter that I have had some opportunity of knowing something about. There are places where it is perfectly safe to use crude oil, and where crude oil will stop all scale forming in the boiler. There are other places where it will do to use kerosene and where it will work perfectly well; but any of these things are dangerous to be used generally, because they will not work with some of the chemicals or natural properties that are in the water. As soon as the oil deposits, you get the bottom of your boiler into trouble. I have seen many instances where men have used coal oil or crude oil and thought they had found something that was going to keep them out of trouble, but by the time they were using it five or six months they found they had to put new bottoms in their boilers. Pretty soon the bottom of the boiler gets in such a shape that it begins to leak at the joints and a new bottom has to be put in. There are a few places where it is perfectly safe, where it will not form and go to the bottom with the ingredients that are in the water; in that case it is pretty safe to use oil.

Mr. J. J. Wright: I think those remarks apply more particularly to crude oil. The way to get over that is simply to use refined oil instead of using the crude oil; it is a very good scale remover, putting it in by degrees. There is one precaution that must be taken, and it is a very important one—when the engineer has blown off his boiler and undertakes to put a lantern in to see how clean it is, he is liable to climb the stairs pretty quickly. There have been a number of explosions from that very cause.

Mr. Wickens: There are some of the creek waters that it can be used in, but when we come to using Lake Ontario or large tributary waters, we usually have trouble with oil in any shape.

Mr. C. B. Hunt: What is your idea as to the cause of the crystallization of the iron plates where sometimes oil and sometimes caustic soda has been used?

Mr. Wickens: I think the crystallization is usually caused from overheating. It can be traced every time to overheating. As I state in my paper, as soon as you heat your iron up to 600 degrees and over, you are beginning to make it take a crystallized form. I am satisfied in my own mind when you get a crystallized boiler it has been overheated.

Mr. Wright: The crystallization may be due to other causes, for instance, the strain on the boiler. By the raising and lowering of the steam pressure perhaps many thousand times a day, a sheet may be changed in shape, as well as by overheating; and also again in the operation of a large number of boilers together, you often find there is a strong and steady vibration in the boilers themselves. By placing your hand against them you feel a very strong vibration that is set up in the construction of the boiler, and is the cause, no doubt, of crystallization. But I should think the main cause—I have always looked at it in that light—was the increase and decrease in the strain of the boilers, changing so slowly as not to be measurable, perhaps, the shape of the plates in the boiler.

Mr. W. Williams: We have tried various compounds in our boilers, and we find coal oil is the best; it is the only thing that will keep our boilers clean. We use Lake Huron water.

Mr. G. Shand: We use a quart a week and pump it in; our boiler is about 100 h.p. We feed it in gradually just before we shut down.

Mr. Yule: So that it doesn't go off in steam.

Mr. Shand: No. We blow it off.

Mr. Hunt: Do you have any foaming from that?

Mr. Shand: No.

Mr. Reesor. Where is your plant located?

Mr. Shand: Sarnia. We do not get a perfectly clean boiler with the coal oil, but we get it clean enough to suit. You can take a scraper and scrape off the loose scale.

Mr. C. B. Hunt: We had a little experience in our railway power house in London. The water we use is taken out of the river, and just above us are the gas works and also several city sewers, so we get "nice clean water." However, more or less of the scum from the gas works, in the shape of tar, etc., comes flowing down with the water, but there was some trouble with it, as Mr. Wickens stated; it formed a small amount of scale. We had to get a cold chisel and go right along and scrape it off. It wasn't as thick as a sheet of paper, but it was sufficient to cause one of the boilers to bulge down.

Mr. Wickens: I have seen the same thing occur with the use of coal oil in boilers.

Mr. Hunt: It is a sort of drainage from the gas works.

Mr. Wickens: I had the same thing occur in Belleville. They got along splendidly for a few months, but then they found a scale on the bottom.

Mr. B. F. Reesor: What would Mr. Wickens recommend for water that contains carbonic acid gas and oxygen that causes the tubes to pit very rapidly?

Mr. Wickens: Any kind of a pulp; take the Eucalyptus leaf, which makes a jelly, or any good kind of gelatine that is heavy enough to stay down. If you break one of those pits you will find there is a little black, wet, slimy centre to it, and if you test it you will find it is acid. There is no question in my mind but that any of those particular jelly-forming plants will answer the purpose. Irish moss will do if it is properly cooked down, but the most efficient I have heard of is the reducing of the Eucalyptus leaf into a jelly.

Mr. Reesor: Do you think the Balm of Gilead gum would do as well as the Eucalyptus?

Mr. Wickens: I don't know; it might. I never saw it tried.

Mr. Noxon: I am connected with an institution that has three large boilers. We are using water from the river Thames; the water is very strongly impregnated with lime, and we have difficulty with lime scale. We tried all kinds of things, and the only plan we could adopt was to use caustic soda. We would put in a quantity of the soda and heat it up to the boiling point and let the boiler stand two days, and then heat it up again with sufficient pressure to blow it off. In that way we could keep our boilers very clean and without any detriment to the valves or brasswork of the engine.

Mr. Wickens: By using it that way you must use considerable. You have got to make it strong enough to take the scale right down.

Mr. Noxon: You require an extra boiler always.

Mr. Hunt: I have great pleasure in moving a vote of thanks to Mr. Wickens for his interesting paper. It is certainly one which every electric light manager or dealer is interested in. I know I am myself.

Mr. Wright: I second that.

The President put the motion, which was unanimously carried.

The convention then adjourned, to meet at nine o'clock on the following day.

In the evening a visit was made to Buffalo, where an inspection was made of some of the interesting electrical features of that city.

SECOND DAY.

The President called the convention to order at 9.00 o'clock.

A telegram was read from Mr. O. Higman, from Vancouver, regretting his inability to be present, and sending greetings to the Association, and wishing it continued prosperity, stating that he would still take an interest and help forward the work of the Association.

A telegram was also read from Mr. L. B. McFarlane, regretting his inability to be present.

Mr. B. F. Reesor, on behalf of the special committee appointed to name the standing committees, reported as follows:

Committee on Statistics: Messrs. A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection: Messrs. J. J. Wright, Berkeley Powell, and James Milne.

Committee on Legislation: Messrs. John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker, and F. Pepler.

On motion of Mr. B. F. Reesor, seconded by A. B. Smith, the report of the special committee was adopted.

The President: The next thing will be the report of the special committee on the recommendation contained in the president's address.

Mr. W. H. Comstock: As chairman of the committee appointed by this Association, I beg to report that it was considered absolutely necessary that the Committee on Legislation appointed by this Association for the ensuing year be asked to take this matter up, with power to act in raising money for that purpose. I will put in the resolution of the committee of yesterday.

Mr. F. C. Armstrong moved, seconded by Mr. B. F. Reesor, that the report be adopted by the Association. Carried.

Mr. J. A. Kammerer read his paper entitled "Day Loads for Central Stations, and How to Increase them," (see page 124).

Mr. J. J. Wright: It seems to me that this involves a question that was touched upon by Mr. Murphy in his paper yesterday. As I understand it, the idea involved in this paper is the running of arc, incandescent lighting and power from the same dynamo. Mr. Murphy did not seem to recommend that, and he is a gentleman who has had some experience, and I am going to bring this matter up simply to give the friends of alternating current apparatus, and especially to give the writer of the paper, an opportunity to still further substantiate his claim. I remember when I was a little fellow, and that was some time ago, seeing a conjuror who poured out three different kinds of wine out of one bottle; I thought it was a very wonderful thing at that time, but since then I found out it was a fake bottle--it wasn't exactly genuine. I am very far from saying that in this case the dynamo that will produce all these things and do it as successfully as the fellow poured out his three different wines from the one bottle, is anything of that nature. It seems to me that those who have had experience in running incandescent lighting from the same generator as the motive power circuits have experienced a considerable amount of difficulty heretofore. If there is anything in the electrical field that is going to give us an opportunity of doing this just as smoothly and slickly as the gentleman I speak of poured out his wine, we ought to know it, as central station men.

Mr. W. H. Browne: Mr. Wright has put forward a problem that requires some consideration. I thought he was going to talk in a "right" manner; I thought he was going to speak from experience. As I understand it, he has two separate services in Toronto, one serving power, for which he requires a separate set of dynamos and a separate set of stations, and another plant for his lighting; and I thought he knew something about the fact that that was not a fake dynamo out of which you could get four or five different kinds of "wine," but as a matter of fact that you could run an incandescent lamp, an arc lamp and a motor from the same dynamo and the same wire; but, as he seems to be uncertain about it, and seems to have forgotten some of the things that have been told him, I will tell him something. I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 h. p. a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjure of this fake bottle has disappeared.

Mr. J. J. Wright: I hope the gentlemen present, Mr. Browne in particular, did not understand me as saying this thing could not be done. I am perfectly well aware you can produce arc lights, incandescent lights and motive power from the same service. But the question in the case of our friend with the bottle is that, although he did it, was it a practical operation? I know you can do all this; Mr. Browne is doing it in Montreal. It can be done. But can it be done as a practical and satisfactory operation? Mr. Murphy says he does not think so. From what experience I have had myself, I question whether it is altogether feasible, and I simply brought the question up, not because I know it cannot be done, but I want some of these gentlemen here who are doing this thing to give some of their experience as to how successful it is when it is done. For instance, you have a load, with these different services on the one dynamo; supposing you have a number of incandescent lights, and at certain times during the day there are not very many of these lights on;

some of the motors take a sudden draught of current and it interferes with the steadiness of the incandescent lighting. In Toronto we have our services on entirely different wires, and I would dearly love to get them all on the same machines. Being on separate circuits, I have not met with the difficulties that I have heard other gentlemen speak of in this matter, and that is the reason why I would like to hear something from those who have tried this, as to its practicability, that is, the steady running of incandescent lighting at the same time that you are making constant draughts on the same dynamo for motor power.

Mr. Murphy: With your permission, Mr. President, I will read the paragraph from my paper to which Mr. Wright refers: "Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in small units. Incandescent light and power should, I feel certain, never be run from the same water wheel." It is the trouble experienced in the regulation of the speed of the machinery, not of the dynamo itself, to which I refer. I think that is plain from the paragraph.

Mr. Fisk: We are not running power and lighting from the same machine to any great extent, but a few small motors do not seem to make any difference.

Mr. Milne: I do not think there can be any doubt on the subject whatever regarding the supply of light and power from the same circuit; it is unsatisfactory, especially where you have a large amount of power to supply. Take it in Toronto, where we have such a lot of motors and one thing and another requiring heavy powers, and it is impossible, no matter what the machine is like, to have perfect regulation. Take, for instance, the Edison three-wire system, where an electric elevator is turned on taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse, I am certain, when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve h.p. motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three wire system for several years with a day load probably of about 1,500 or 1,600 amperes power load, yet it cannot be said to be extremely satisfactory. There are times when the light is unsteady because of the sudden increase and diminution of the loads, no matter how perfect the regulation is at the station and the engine running so that you could not see a variation in the speed with a tachometer. Yet we all know that by a sudden increase in the load there must be a variation in pressure; so, as far as I am concerned, I do not see that the thing is very feasible, no matter what the system is.

Mr. W. H. Browne: Mr. Milne has made a claim, I think, resulting from the fact that he has not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights. He says, from his experience, that the change of loads of six, eight, ten or twelve h.p. make a blink in the light. I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in Toronto, anyway, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it; if your direct current machine does not regulate for it, your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. J. J. Wright: It appears not to be so much a question of regulation of the machinery itself. I have not the slightest doubt that a good generator could be got that would regulate within a very small percentage, but the difficulty appears to arise from the drop of potential or loss of pressure locally.

Mr. F. C. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point of view that has not been touched upon, and which seems to me is really more material to the smaller central stations who are not at present operating a day load, and the slight difficulties in the operation, and that is the commercial side of it. The main difficulty experienced, I think, in working up a power business in connection with the smaller stations is the difficulty of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor in the smaller sizes which would be used up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years, and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, because I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not aware of any alternating system in which that difficulty is entirely removed.

Mr. F. Pepler: Would those difficulties be applicable to running an electric railway during the day.

Mr. F. C. Armstrong: In connection with lighting?

Mr. Pepler: Yes.

Mr. Armstrong: They certainly would be. We have had some experience in connection with a certain plant in the matter of operating a day lighting circuit and a railway in connection with one another, and we find that while we can maintain a day circuit, it is practically impossible to do so from the same engine, although the engine is of the heavier size, about 200 h. p., from which we are running the lighting machinery. We have tried both.

Mr W H. Browne: Mr. Armstrong has responded to Mr. Pepler about the railroad, and it refreshes my remembrance about a statement he made in the course of his remarks that the difficulty appears to be in the prime mover, by which I infer that the prime mover is insufficient for its work, because if you have a prime mover on which you have a unit of so large a ratio, so large a percentage that the going on and off will affect your prime mover, be it a boiler or water wheel, evidently you have not got your conditions apportioned rightly. Mr. Pepler's question, as I understand it, was, what do you do with a railroad business? As a matter of fact I think we all know that the prime movers—boilers, engines and generators—are adapted for railway service so that the whole load may go off and yet its regulation is effected perfectly, the engine is governed and the dynamo is running at its normal speed. It seems to me it is entirely the question of the adaptation of units to the work they have to do. When we talk about theatre circuits being too large, it is meant that they are the largest proportion of the circuit or dynamo to which they are attached. In regard to small stations, the great difficulty I find with them is that the prime mover the wheel, the boiler, the engine--is not large enough for the work they have to do. They have added on and added on, and put on more lights, and the consequence is they have got too much business for that particular machine, and if they put on a motor or lighting service which will come on and come off, they have more than they can take care of. They have not regulated their machines the same as they do the railway generator. Mr. Armstrong will tell you that he would furnish a generator for railroad purposes that would take the load, no matter what it was, and regulate it. The other matter is simply a question of adaptation, in getting your unit the right size.

Mr. Armstrong: To my mind Mr. Browne has brought out the difficulty even more clearly. It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, and also that under that condition of operation the variation of a steam engine, even with such violent fluctuations of load as having the whole load thrown off instantaneously, will not affect the service. There is this difference in a railway service, that it has a variation of 10, 15 and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, which is due to the change of speed primarily, I presume, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service. Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the cause of this difficulty which will be found in the operation of small plants by the putting on or off of a motor is due to the disproportion between the size, say of a 20 or 30 h. p. motor and a 75 or 100 h. p. generator, still I do not think he would propose as a remedy you should all put in 300 or 400 h. p. I think really that brings us back to the point brought out by Mr. Wright's bottle; it is quite possible to carry three or four or a dozen different kinds of wine in a patent bottle, but it may not be the best to keep water.

Mr. Wickens: It seems to me that the mechanical engineer is the man who has got to get over the trouble after all. It has simmered itself down to this it is actually the prime mover that is making the trouble. One of the difficulties is that we have got a good many points to reach in a convention of this kind. The kind of power that Mr. Wright and Mr. Browne have in view most of the time is not the kind of power that most of the other members are thinking about. You take a small plant, and when you come to make a load you are going to make some regulation with regard to the light. I do not think it makes much difference what system you use. Where the difficulty comes in the most is, for instance, take a small electric railroad where they are running two, three or four cars, and often times the load is all off on that kind of a plant. Now, if they were lighting a few lights here and there, there is no engine under the sun that would regulate close enough to make those lights serviceable at all; that is, if an engine is big enough to make sufficient power to pull four cars up a hill with a load, and loses all of that load excepting, perhaps, 50 ampere on a few lights, there is no engine built that will regulate that satisfactorily. No matter how well your engine regulates you cannot make your machine regulate the engine that is driving it. That is where the discussion has got to now. I think in my own experience, by putting in copper enough, and engine enough, and so forth, the matter can be brought down so that the regulation is very close. Take the stations in the smaller towns that have only a few lights in with their power loads, and those lights will be in cellars and places where it does not make much difference whether they are good or not, and if the lights did vary a little with a station of that kind, there would not be much fault found with it; but in the larger places, in Toronto and Hamilton for instance, where there are a great many lights used in stores and other places all day, that is the place where the main difficulty is. The difficulty is to get a light that is satisfactory if it is running in connection with a power service, and apparently we have got to regulate the engine better to get the light better.

Mr. J. J. Wright: I think the discussion has drifted off from its proper lines altogether. I consider that in a discussion of this kind the engine has got nothing to do with it. In speaking of this day load, and in putting in machines to do everything, whether that can be successfully done is the point; never mind the regulation of the engine.

Mr. B. F. Reesor: I see another trouble looming up. I cannot see why, in a large city like Toronto or Montreal, where the day loads of power and light would be pretty well mixed up, it would not pay them to put in a separate circuit. But what concerns me more, and also a good many others, principally in the smaller places, as a difficulty that would come in the way, is that the day load would be principally power; not very many places, probably very few in proportion, would be light; and in the outlying districts where the transforming units are small, what are you going to do with the drop? The transformers that are used in these smaller places have been in use a number of years, and they feel they cannot afford to throw these away and get nothing for them, and thus incur a great loss; whereas in a large place they can afford to do that. And, as I said, in the larger cities the proportion will be a little more equalized. In the smaller towns the lighting would be very limited, probably for the day only for butcher shops and places like that.

Mr. H. O. Fisk: In speaking of regulation, I would like to ask if any of the members have tried increasing the fly wheel capacity. In putting on a small extra load we found if there was a very heavy fly wheel it would carry that until the engine could recover. I was just wondering if anyone had any experience along that line.

Mr. J. A. Kammerer: Mr. Reesor in his remarks speaks of the transformer losses and their regulation. I distinctly mention in this paper that this is being brought about by the re-construction and re-arrangement of the separate stations, and is the first essential step to the work. If you put transformers in that cost you money to keep alive at night, they certainly are not a good thing to have. That is why I favor reconstruction.

Mr. Farley: I am not very familiar with these questions, but I agree with the proposition that has been laid down here that there must be economy in generating electricity for all these services over the same lines and from the same dynamo. It would seem as if we had not yet arrived at that state where electricians all agree that it can be practically carried out, but for a small company such as I represent it is of very great importance. Where there are railway, power, arc and incandescent services it is like four stations, as it is now; and then there are the municipalities to deal with. There is the question of the increase of lines, which is an objection to municipalities, and which I understand would be done away with if all these could be done over the same lines without additional poles. In St. Thomas we have three or four miles of poles in some instances, and I am not able to gather whether this can be successfully worked out or not. But, as this is my first visit to the convention, I am very pleased with the intelligent discussion on these questions, and I believe that these Association meetings will result in a great deal of good, not so much to the larger cities as to the smaller places who have to struggle to live. I believe that as years roll by and these meetings continue to take place, and as the intelligence of electricians is brought into contact in this way, we will solve some of these questions that have been raised here to-day. I do not agree with the idea that the engine has not something to do with the question. I think it has a great deal to do with the question; and yet it does not settle the question that the dynamo, generator, lines and everything else have not to do with it. I shall be glad to attend the meeting next year and see if this question is solved. I must congratulate you, Mr. President, on your office. I am glad to find that you have been elected president of this Association. I hope that you will continue to be an officer of the Association.

Mr. F. C. Armstrong: Mr. Farley seems to have misunderstood the position which I took, as one of those who has not looked upon Mr. Kammerer's solution as the actual solution of the day-load problem. I think there is no person who will question the perfect feasability and desirability of operating especially a small lighting station and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances. As to the feasibility of doing it, any one of at least half a dozen manufacturers of electrical machinery have upon the market multiphase alternating machinery from which they can guarantee a perfectly satisfactory service for incandescent lighting, for supplying motor power and arc lighting.

Mr. J. J. Wright: I don't think anyone will dispute the desirability of this I think I realize that almost as much or more than anybody here. If the whole of our output could be turned out from one plant it would make a difference in our income. I will give you one instance; it was caused by our trouble with the late fire. I actually had 2,000 h.p. of engines and 2,000 h.p. of dynamos all in position to operate, and I could not run even a measely dough mixer in one end of the city.

Mr. W. H. Browne: I have inflicted myself several times upon the members here, but I think I will offer one suggestion for consideration that may possibly help us out. In answer to the gentleman from St. Thomas, the cost of operating a central station probably rests entirely in the amount of money invested in the plant and the interest to be obtained for that investment as the first item; the next item would be the labor of having that plant in readiness to serve light or power; the third item of expense would be the actual coal, oil and other material used in delivering light and power. We have two items all the time fixed—the interest upon the capital invested and the labor necessary to produce; so it may be ascertained by any one who has plant how much it will cost him to be ready to serve light or power. The additional cost that he will have will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for; that is why power service or day service will pay the station no matter how large or how small it is, because you are getting something in return for capital invested and for the labor that you necessarily employ.

The President: Mr. Browne, at what would you place the day load for 7,000 light capacity in a small town? How much would it be?

Mr. W. H. Browne: Of course, Mr. President, that will depend entirely upon the size of the units that you use.

The President: Take a place of about 10,000 inhabitants.

Mr. W. H. Browne: Taking old transformers and old methods it would mean a great deal, but taking it by what we do to-day—what we know we can do to-day—the transformer leakage for a 7,000 light plant should not be over 10 h.p., but with the old process it would be 150 h.p.

The President: If you have to run 30 or 40 h.p. for the sake of supplying 25 lights you would be very much out of pocket.

Mr. Browne: You should not cultivate the idea that you want to continue to operate a plant that is using up leakage load in that fashion; you cannot afford to do it. No matter how small or how large your plant is, you cannot afford to go on using transformers which are using up that amount of energy. It is being proved every day in small plants that they can afford to throw them all away and get transformers that anybody will make to-day for them. All of us will make them a good transformer that will reduce the leakage so that they can afford to run all day long.

Mr. W. Williams: There is one thing that Mr. Browne neglected to mention; he did not mention the cost of another engineer. You could not expect a night engineer to run all day.

Mr. Browne: I suppose Mr. Williams means that an engineer might cost him $2 a day. I presume that the power that you would get would bring you in considerably more than $2 a day. As I understand the day load, it is not your big power, it is not your railroad power, it is one h.p. here, two there and five somewhere else.

Mr. Farley: Supposing you had only that number, three or four?

Mr. Browne: You could not, perhaps, afford to do it. I have in my mind the case of a comparatively small town where they have a water wheel plant, and when I spoke to the manager of that plant originally about getting in power service, he said: "Well, I don't see any reason why I should; I would have to have another man on in the day time, and I don't believe I would get any, anyway." That was about two years ago. To-day that man has got in small powers, none of them larger than 10 h.p., and he is getting $75 a horse power for it out of a water wheel plant. He can afford very easily to pay for his two dollars a day engineer.

Mr. J. J. Wright: I wonder if that is in Paradise. (Laughter). There is one phase of the subject that has been overlooked, and that is the overlapping of the loads on railway and night work. It may be all right to get a number of motors, but in getting those motors and running them during the day for a certain amount of profit you may paralyze your means of overlapping; that may just knock out the whole of your calculations. You would then have to put in a reserve plant for your power instead of utilizing the same plant that has been put in.

Mr. B. F. Reesor: I would move a hearty vote of thanks to Mr. Kammerer for his able paper.

Mr. F. C. Armstrong: I would second that motion.

The President put the motion, which on a vote being taken was carried.

The President then tendered Mr. Kammerer the thanks of the Association for his valuable paper, which had evoked such an interesting and profitable discussion.

The President: Mr. Wilfred Phillips, who has been so extremely kind to us all, would like the members to go up at noon and take a look at his power house.

NEXT PLACE OF MEETING.

The President: The place at which the Association shall hold their convention in 1898 will now be taken up.

Mr. W. H. Browne: There is no place on the continent to-day, or rather there will not be next year, that will be so interesting from an electrical standpoint as the city of Montreal. There are being installed there two water power plants, that of the Lachine Hydraulic Company and the Chambly Manufacturing Company, and during next year both of these powers will be in active operation delivering current in the city of Montreal. They will both be characteristic in their own line—one will be characteristic for its vertical turbines and three-phase apparatus, made by the Canadian General Electric Company, and the other will be characteristic for its horizontal wheels operated under a high head and on the induction system of machinery; one will be operating at four or five thousand volts, the other at twelve thousand volts; and the power houses, dynamos and transmission lines will be all entirely new and characteristic. I certainly know of no place that can interest electric light people so much as the opportunity of seeing both of these in operation at the same time. From this standpoint and on behalf of the Royal Electric Company, I extend to the members a hearty invitation to come and see our power houses, and I am sure the Lachine and Chambly people will be very glad to have you all come and see theirs.

Mr. Thompson: Mr. Browne overlooked the mechanical engineer. He might have told you also, since he came from Montreal, that the street railway company are starting up a large 4,000 h.p. engine, and that will be in full blast next year. We have also several small stations such as we have been discussing, and there are two suburban railway stations, and I am sure that there is no place in Canada to-day where there is so much interesting information to be obtained, both mechanically and electrically, as there is in the city of Montreal. I have been down there over six years, and during the whole of that time between the universities, the small plants and the large plants, I have gathered up, I hope, a lot of very useful information. I am quite sure that if the gentlemen of this convention decide to come to Montreal, you will not only receive a lot of valuable information, but royal treatment.

Mr. Wickens: There is one thing in connection with going to Montreal: About ninety per cent. of our members live in Western Ontario, and while there is no question it would be very pleasant to go to Montreal, we will not get as large an attendance going that far east as we would if we held the convention in a more central place. People cannot spend the time; of course that is their loss. If we go to Montreal we are going to lose something. I feel satisfied we would not get as large an attendance there. We already know what kind of treatment they would give us; we have been there before. There is no place in the world where an association will be better treated than in Montreal, but I feel sure we would not get as large an attendance by going so far east as if we held the Association meeting in some of the more central places up through Ontario. We have only nine or ten members outside of Ontario altogether; Montreal and Ottawa have a few, but the great bulk are in Ontario.

Mr. J. J. Wright: The best reply to that is the number of members we had at the Montreal convention. I think it was one of the largest conventions we have ever had, and I think some reduction could be got on the railway.

Mr. J. A. Kammerer: Getting on, say, at 2 o'clock you are in Montreal the next evening at six. The fare down by boat and back by rail is only $12, including berth, and meals going down.

Mr. F. C. Armstrong: The selection of the place of meeting is particularly a matter which affects the central stations, and one which I feel some hesitancy in saying anything about. We people who are connected with companies do not pay our own expenses, and it does not make much difference to us where the meeting is. It seems to me that while Mr. Wright is correct in pointing out the large attendance at Montreal, this year's attendance is somewhat different in character from any former meeting of the Association, and in view of the important work that has been undertaken it is desirable to continue this attendance. I refer to the central station men, and I think the next place of meeting should be one which would best meet their convenience. From Mr. Wicken's remarks it seems open to doubt as to whether it is advisable to go away as far as Montreal; it would involve really a considerable expenditure for our members that care to go and especially those who take their wives with them, and it might tend to materially reduce the size of the attendance of central station men.

Mr. W. H. Browne: Perhaps the reason you have so many members in the west is because you have not cultivated the stations in the east; perhaps if you had your next place of meeting at Montreal you might add to your membership considerably by central station men from the eastern end of Canada. I suggest Montreal because I believe that it is the only place where really valuable instruction in what is going to be the future of this electric lighting business can be obtained. It had not occurred to me that it was a question of time; it had not occurred to me it was a question of distance or expense. And the gentleman who has just made a suggestion, I am thankful to him for it, because he said, you have not got very many eastern people here. Probably they found it too expensive to come west, therefore that might be a way of getting those interested in your Association.

Mr. Wickens: That is the way matters lie; we feel that the eastern men will not come up to see us; we hardly ever get any members from the east. The western man puts up his money and goes down east and sees what is to be seen there, and the eastern man stays there; he never comes up to see us.

Mr. John Murphy: The prevailing impression in eastern Ontario is that the Canadian Electrical Association is becoming an Ontario Electrical Association, particularly a western association. If the meeting were held in Montreal it would knock out that idea altogether, and undoubtedly bring in a great many people from the east.

The President: We held a meeting at Montreal, and we found there were not a great many Montreal people followed us up here.

Mr. J. Farley: We must not overlook the fact that we would not learn a great deal if we went to Montreal and saw all those immense power houses such as we saw last night at Buffalo; they are very often like the falls, magnificent to look upon, but for practical information perhaps you would find it more profitable to come to St. Thomas, Lindsay, or some such place. There is no place in the country that we are all more interested in than the great metropolis of Montreal. We all desire to go there, perhaps, more or less; we can go there during a later part of the season; there will be a lot of excursions, but if we want to get the practical side of this question, while we want to give it a national or Canadian character, any of the smaller places might be better than a large place, and it might nduce more to go. I had Montreal in my mind until I began to think the matter over, and I believe Ottawa would be a better place for the practical working of electricity than Montreal.

Mr. W. Thompson: I might point out the fact that four years ago when you held your convention in Montreal, there was practically then only one company in operation, that was the Royal Electric Company. During the past four years there have been wonderful changes taking place. The Royal Company has reconstructed its station. I have had the pleasure of going through part of that station, and it is really worth seeing. Then they are at the present time constructing the Lachine Rapid Hydraulic works; there are two new suburban stations both re-constructed since that time; outside of that there are quite a lot of small plants throughout the city and suburbs. I venture to say there is not one-fiftieth portion of the actual operating engineers outside of station managers of the city of Montreal that are members of the Association. Why, I myself was not a member of the Association; I don't know that I am yet, I just handed my application in today.

Mr. Mortimer: Yes, you are.

Mr. Thompson: If I had known five years ago that these conventions were as interesting and as valuable as they are, I would have been a member long ago. The question of expense certainly is a serious one. I have had to bear my own expenses coming here, and I consider I have got two dollars for every one I have invested, and up to the present moment I have only been here since seven o'clock last night. We want amongst our engineers intelligence, and no single man in this country has got a claim on all the intelligence that is going. It is only by an interchange of ideas and an examination of the practical work that we are to get it. I do not want to urge upon the members to go to Montreal personally, because I would rather come to Ontario, for then I get a holiday, but I really think for the benefit of the Association, and knowing as I do the practical experience you can gain, I cannot impress upon the members of this Association too strongly that they should come and see for themselves.

Mr. J. Milne: I think the best thing we can do is to decide on Montreal. I would make a motion to that effect.

Mr. J. Murphy: I have much pleasure in seconding Mr. Milne's motion.

Mr. Pepler: May I be allowed to put in a good word for the town of Barrie. With reference to the city of Montreal, I quite agree with what has been said But if it is the feeling of the meeting to have the next meeting at some central point in Ontario, I do not think, excepting Toronto, a more central place can be found than the town of Barrie. So far as beauty of scenery and a social time is concerned, I do not think it could be beaten. We have a lovely bay there, on which there are boats running out into the larger lake. The manager of our company owns one of the boats, which I am sure he would be pleased to place at the disposal of the Association, on which the members could go to many points of interest, including Orillia and other places around the lake. Although we would not have anything electrically to offer like Montreal, yet for practical convenience and for a pretty spot and a happy time I do not think you could find a better spot than the town of Barrie.

Mr. S. Noxon: The matter of location for the next place of meeting should not go by default in this way. I make no particular claim, but while I was sitting here it struck me what was the matter with the town of Peterborough for the next annual meeting. Representatives from that city, for some reason, are exceedingly modest in not putting forth the claims of Peterborough. Although I am not opposed to Montreal, at the same time it is my impression that by meeting farther west we would get a far larger representation of those who take an active interest in central station business, that is, the central station managers, yet, at the same time, I would have no objection, providing I feel the same interest in the Association next year that I do now, in going to Montreal, for I think I would be amply repaid. It might also be said that we are all familiar with the generation of electricity in English, and we might go down there and see others do it in French.

Mr. Armstrong: Mr. Noxon has expressed his surprise at the modesty of the people who are connected with Peterborough. As far as Peterborough is concerned, it is a small place, and we have the modesty to believe that most of the electrical interest there would be connected with our own manufactory, and it would look too much like self-interest to urge going to Peterborough. A meeting at Montreal will give the members an opportunity of gaining a great deal of information as to construction, and of seeing a great deal of up-to-date apparatus and methods.

Mr. H. O. Fisk: We have built a new station in Peterborough, and at the present time we have not anything we would care for the Association to see. In another year we may be in a better position. It is a nice point for pleasure, but I take it we should not consider pleasure the first thing. I would be in favor of going to Montreal, because I believe there is so much there for small people like myself to learn. I consider it is like buying a book; if you only get one point out of it that is of value you have not lost anything, and perhaps you have gained a good deal. That is one reason I would be inclined to very strongly favor Montreal.

Mr. W. Williams: What is the matter with Sarnia, and there is London and Guelph?

The President: It has been moved by Mr. Milne, seconded by Mr. Murphy, that the next meeting of this Association be held in Montreal. Carried.

The President then called upon Mr. William Thompson, of Montreal, to read his paper entitled "Determination of the Heating Power and Steam Producing Value of Coals from a Preliminary Examination." (See page 119.)

Mr. Thompson: Probably, Mr. President, with your permission and the permission of the members, it may be desirable, before there is any discussion, for me to make a brief synopsis of the object in writing this paper. I know that it is a somewhat difficult question to tackle, but I think that those of you who have followed up steam engineering as closely as I know members of this Association have, will agree with me that our present methods of determining the efficiency of our boilers and our furnaces is somewhat crude. Now, let us look at it in this way: Supposing we are able to determine (which we are quite able to do with very little practice) the exact heat producing value of the coal which we are using. We will carry that over, speaking commercially, to the debit side. We want to be in a position to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way: We start by knowing the maximum quantity of heat that the coal will give; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion. We have measured our water or weighed it, or ascertained the exact quantity of water fed to the boiler; we have determined the moisture in our steam. We know exactly, then, what amount of heat has passed into that water or what amount of that heat has been efficient, and we can take it as being fairly reasonable that the balance of the heat, if any remains, has been lost by radiation. There we have a complete chain of events, a complete trace of the whole of our process from beginning to end, and we know just exactly where a loss exists. This may possibly give the gentlemen present a clue towards discussion, and I shall be very glad to hear from the engineers or any one interested who wishes information.

Mr. J. Milne: The determination of the heat value in coal is generally done by three methods, first, chemical analysis; second, by combustion in a coal calorimeter; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal heat we are going to get for that day is of the same quality, because you all know, although you are getting coal from the same mine, that you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. The thing is this: We can roughly approximate the heating value of coal, and I don't think that we can be very far out if we assume that as being very nearly correct, without going into any analysis or calorimetric tests. There is an instrument—probably my friend Mr. Thompson is acquainted with it; it is invented by a Mr. Thompson and is used by the North British and some of the leading lines in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water 1° Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning; that would give you the exact heat value in the coal. I think that is the simplest method we have got, and it is just as accurate and near enough for all practical purposes, and from that you can easily determine roughly what the efficiency of your boiler would be.

Mr. Thompson: The use of the calorimeter is not such a simple matter as it appears. I am very well acquainted with this instrument in question, and I consider the information you get from it is entirely astray. We want to get the exact amount of heat, and you must understand we are dealing with a very small quantity of fuel. A certain quantity of that heat only is given to the water; the metal itself absorbs a certain quantity of heat, and there is a certain quantity, no matter how carefully you conduct your examination, lost by radiation. The calorimeter constructed on the principles which are mentioned does not give the exact power of heat in coals, and it takes a very delicate manipulation to first ascertain the amount of heat that is passed into the water and the amount required to raise that metal receiver up to a certain temperature, and then the amount of heat that is passed off by radiation. Moreover, to the engineer this is not the information that he really requires, because there may be a great difference between the actual heating power of a coal and the industrial heating power of a coal. While we can test the industrial heat value of a fuel very nicely when we know exactly the condition under which that coal is being consumed, you cannot do that under a boiler, because the conditions exist and you know nothing about them; you have simply to guess at them. Therefore, if we want to know more about the actual heat value of coal, we want, as engineers, before we can trace discrepancies in our plant, to be able to get at the steam producing value, which varies according to the composition of the fuel, as I have said.

Mr. J. Milne: I am still of the opinion that the coal we buy must be judged by its heating qualities; there is no doubt about that. If we buy one lot of coal at $5 per ton, and get 14,000 thermal units per ton out of it, and for another lot pay $2.50 a ton, and only get the half of that heat out of it, it is just as cheap to buy the dear coal as the cheap. What we want to arrive at as engineers is a simple method of determining the amount of heat, and the simpler the method is the more accurate will be the results. It cannot be gainsaid that that instrument by Lewis Thompson is perhaps used by the largest concerns in the world for determining the heat value of coal; in fact, it is called for in the specification that the coal must be tested by it, so that there must be some good point about the instrument.

Mr. Thompson: I did not mean to say that the instrument was useless, but with the average information engineers have they are not enabled to use a calorimeter. Take our large Montreal plants as an example. I heard it said that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. The making of a proximate analysis of fuel fortunately is a very small matter. My method has always been this: I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see. If he did it would not be fair to himself or his employer; he would make an effort to get as nearly as possible an actual sample, then the making, as I said before, of the proximate analysis becomes an easy matter. In cities where they can get almost anything they want from the wholesale chemist at greatly reduced rates the cost of an apparatus of this kind for the engineer soon becomes very little. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens: When you are going into calorific tests it requires considerable ability and some apparatus. That is all right for a large plant. The larger plants, where they are turning over a good many thousand dollars' worth of coal in a year, can afford to pay for them, or they can send a sample of their coal to the neighboring college. To the ordinary engineer who is not an expert it takes a long while and a great deal of study to become expert, and you cannot run through the tests Mr. Milne or Mr. Thompson speaks of without being considerable of an expert—not only an expert in manipulating and understanding considerable about gases, etc., but you must be something of an expert at figures. Outside of a few corporations this thing is not of very much use to the ordinary engineer. While there is no doubt that the paper in its points is exceptionally well taken, it is not a thing that can be reached by a great many people. A firm that is burning two or three thousand dollars' worth of coal a year scarcely pays enough money to employ an engineer that has got that much ability; they get better situations. The question in his case is, what are you going to do about combustion? He will go at it in a kind of thumb-handed way; he weighs both water and coal, and eventually tells you he is getting so much evaporation for so many pounds of coal. He may not be exactly right, but I think he is very often as near right as the one who is going to figure up a small gramme of coal that represents some thousands of tons and tells us it is so and so. I think the man who goes at it on the other plan will be reasonably near; he will not be near enough to say it is absolutely dead right. I do not think there is an expert in one of our colleges that will tell us that he is absolutely correct; when he goes right down to the bottom of it he finds he has got to allow heat for this and that, and it is partly guess work. I feel that in that particular line, for weighing coal and water and taking the temperature of your slack gases, the whole thing can be done with a pair of scales, a thermometer, a little brains and carefulness, without very much elaboration. After burning a ton of coal you can tell whether a car-load, ten car-loads or a vessel load is going to be worth what is paid for it. I think for the ordinary engineer we have not the class of men that can reach to the height of knowledge that Mr. Thompson and Mr. Milne have attained to. I have found, from travelling around among the engineers throughout the country, that it takes a considerable amount of hard study to attain that particular knowledge, and we have not the means among our ordinary engineers for carrying out such an elaborate scheme. For the purpose of the ordinary engineer, or the engineer running a small plant, his own test is just as satisfactory to his employer as one that will be more elaborate.

Mr. J. J. Wright: It is nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary for Mr. Thompson or some other gentleman to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample. I have great pleasure in proposing a vote of thanks to Mr. Thompson.

Mr. Milne: The sample is really taken from the coal pile, and we have got the stuff there.

Mr. Wickens: I have much pleasure in seconding the vote of thanks to Mr. Thompson.

The President put the motion, which was carried unanimously.

The convention then adjourned, to meet at 2 p.m.

During the noon recess a visit of inspection was made to the well equipped and arranged water power station of the Niagara Falls Park and River Railway above the cataract.

ELECTION OF OFFICERS.

The President called the convention to order at 2 o'clock, and stated that the first thing on the programme for the afternoon was the election of officers, and that nominations for President were in order.

Mr. B. F. Reesor: I would move that Mr. John Yule, our presiding President, be re-elected for the year 1897-98.

Mr. Dunstan: I have pleasure in seconding that motion. In view of the work that is before the Association during the year, I think it is very desirable that the affairs of the Association should be conducted by the same person who has inaugurated the work now in hand.

Mr. John Yule was declared elected President for 1897-98 by acclamation.

Mr. John Yule: I certainly am very much obliged to you for your confidence. I would rather retire and allow some other person to take the office, and I would give them all the assistance I could. I do not believe in one man holding the office for more than one year. There are a number of gentlemen here who ought to be ambitious enough to occupy the position, and who are more able to occupy it than I am. However, since it seems to be the wish of the entire Association, I accept the position and will do the best I can. I must return my thanks to the gentlemen who have attended here. The surroundings, of course, have had something to do with it, but since we have got you here we are able to show you what a benefit it is to attend these meetings, and when you go home and meet your neighbors and friends I hope you will induce them to come along with you to the next convention at Montreal. I might also say that we are very much indebted to the gentlemen who have stood by the Association during all these years. It was a struggle to get it along for a time, and now when it is getting on a sure foundation I think we are especially indebted to you; I do not mean myself, I mean the others who have stayed with the Association. There is now a bright prospect of usefulness before the Association, and I would again ask the gentlemen who have come here and have seen the benefits and privileges of being a member to induce their friends and point out to them the advantages to be derived from this organization. I am now open for nominations for the office of First Vice-President.

Mr. A. B. Smith: I would propose the name of Mr. L. B. McFarlane.

Mr. J. Carroll: When leaving Montreal I was authorized by Mr. McFarlane to state that he would not allow his name to go before the Association as being eligible for election, and furthermore, if elected, he would not serve.

Mr. J. Yule: Perhaps Mr. McFarlane wasn't aware that the convention was going to Montreal next year.

Mr. J. Carroll: He told me positively not to allow his name to go before the convention. He stated that he had also communicated with Mr. Dunstan, and that he absolutely refused to serve, and if elected he would withdraw.

Mr. Dunstan: Mr. McFarlane has his hands very full of business at the present time. Personally, I would like very much to see him, and I am sure the whole Association would like to see him elected First Vice-President. The work of that position is not so great; it is not like the work which falls upon the president, and as the Association meets next year in Montreal it seems to me that we might elect him, and if he finds it is utterly impossible to accept the position (it would only be from pressure of work, not from any lack of interest in the Association—he would like that clearly understood), someone could then be elected to take the office. We could wire him and find out if he would accept the position.

Mr Carroll: I think, judging from his remarks when I left Montreal, it would be a very great mistake to elect him. He cannot attend the meetings, and feels he should retire. I would propose the name of Mr. C. B. Hunt for the office of First Vice-President.

Mr. J. Farley: Although I think we should endeavor to have one of our vice-presidents in Montreal, if possible, for the present year, I have much pleasure in seconding Mr. Carroll's nomination of Mr. C. B. Hunt.

There being no other nominations for the office of First Vice-President, Mr. C. B. Hunt, of London, was declared elected to the office.

Mr. C. B. Hunt: I am very much obliged to you for this token of your confidence, and I hope it will not be misplaced; with our President, I think we will get along very well.

Mr. F. C. Armstrong: I would move that Mr. J. A. Kammerer be Second Vice-president.

Mr. C. B. Hunt: I have pleasure in seconding the motion.

No other nominations for the office of Second Vice-President being received, Mr. J. A. Kammerer was declared elected to the office.

Mr. J. A. Kammerer: Thank you, gentlemen; I will try and assist our president to the best of my ability, and endeavor to make the convention a success.

Mr. C. B. Hunt: I would move that Mr. Mortimer be our Secretary-Treasurer.

There being no other nominations for the office of Secretary-Treasurer, Mr. C. H. Mortimer was declared elected to the office.

Mr. C. H. Mortimer: I have to thank you very kindly again, gentlemen, for the sixth or seventh time, for this expression of your appreciation.

The President: The next item on the programme is the election of five members of the existing Executive Committee to serve for another year. I will appoint Mr. E. E. Cary and Mr. W. Thompson as scrutineers.

Mr. A. B. Smith: While the vote is being taken I would like to move that the usual allowance be given to the secretary for the expenses of his office.

Mr. Dunstan: I second that.

The President: It has [illegible]oved by Mr. Smith, seconded by Mr. Dunstan, that the usual [illegible] of $75 be voted to Mr. C. H. Mortimer for his services during the past year. Carried.

After the ballots were counted the President said: I am sorry, for the sake of the time it takes up, to announce that the scrutineers have reported that there is a tie, and that we will have to have another ballot for one member in connection with the re-election of five members of the Executive. The four elected are: Messrs. J. J. Wright, F. C. Armstrong, John Carroll and A. B. Smith.

On a vote being again taken the President declared Mr. O. Higman, of Ottawa, elected as the fifth member.

The President: I am now open for nominations for the election of five new members to the Executive.

Mr. W. H. Browne: I understand there is a gentleman present who comes from a considerable distance and represents a territory which is comparatively new, and I would move in nomination Mr. F. A. Bowman, of New Glasgow.

Mr. A. B. Smith: I do not know of any man to whom we are more indebted for the arrangements of this convention than Mr. Wilfred Phillips, and I have pleasure in nominating him.

Mr. Wickens: I beg to nominate Mr. Thompson, of Montreal.

Mr. Thompson: I would rather Mr. Browne would take the nomination instead of me.

Mr. W. H. Browne: I believe that I can be of just as much service without going on the committee, and I would rather that you would diversify your committee a good deal more as to locality. Mr. Thompson, I think, would ably and properly represent Montreal. We who are in Montreal will take care of the Montreal interests without being on that committee.

Mr. F. C. Armstrong: I nominate Mr. Reesor, of Lindsay.

Mr. J. Carroll: I nominate Mr. Cary, of St. Catharines.

Mr. J. J. Wright: I nominate Mr. A. A. Dion, of Ottawa.

Mr. C. B. Hunt: I nominate Mr. Wickens, of Toronto.

Mr. W. H. Browne: I nominate Mr. James Milne, of Toronto.

Mr. J. J. Wright: I nominate Mr. Dunstan, of Toronto.

Mr. F. C. Armstrong: I nominate Mr. Williams, of Sarnia.

Mr. Dunstan: I nominate Mr. George Black, of Hamilton.

Mr. W. Thompson: I nominate Mr. Browne, of Montreal.

Mr. A. B. Smith: I nominate Mr. Bayliss, of Montreal.

The President: The following are the names of the gentlemen who have been nominated: Messrs. Bowman, Phillips, Thompson, Reesor, Cary, Bayliss, Dion, Wickens, Milne, Dunstan, Williams, Black, Browne. I would name Mr. H. O. Fisk and Mr. J. A. Kammerer as scrutineers to count the ballots.

On a vote having been taken the president declared Messrs. Bowman, Browne and Thompson elected, there being a tie for the fourth and fifth places between Messrs. Phillips, Reesor, Dion and Milne.

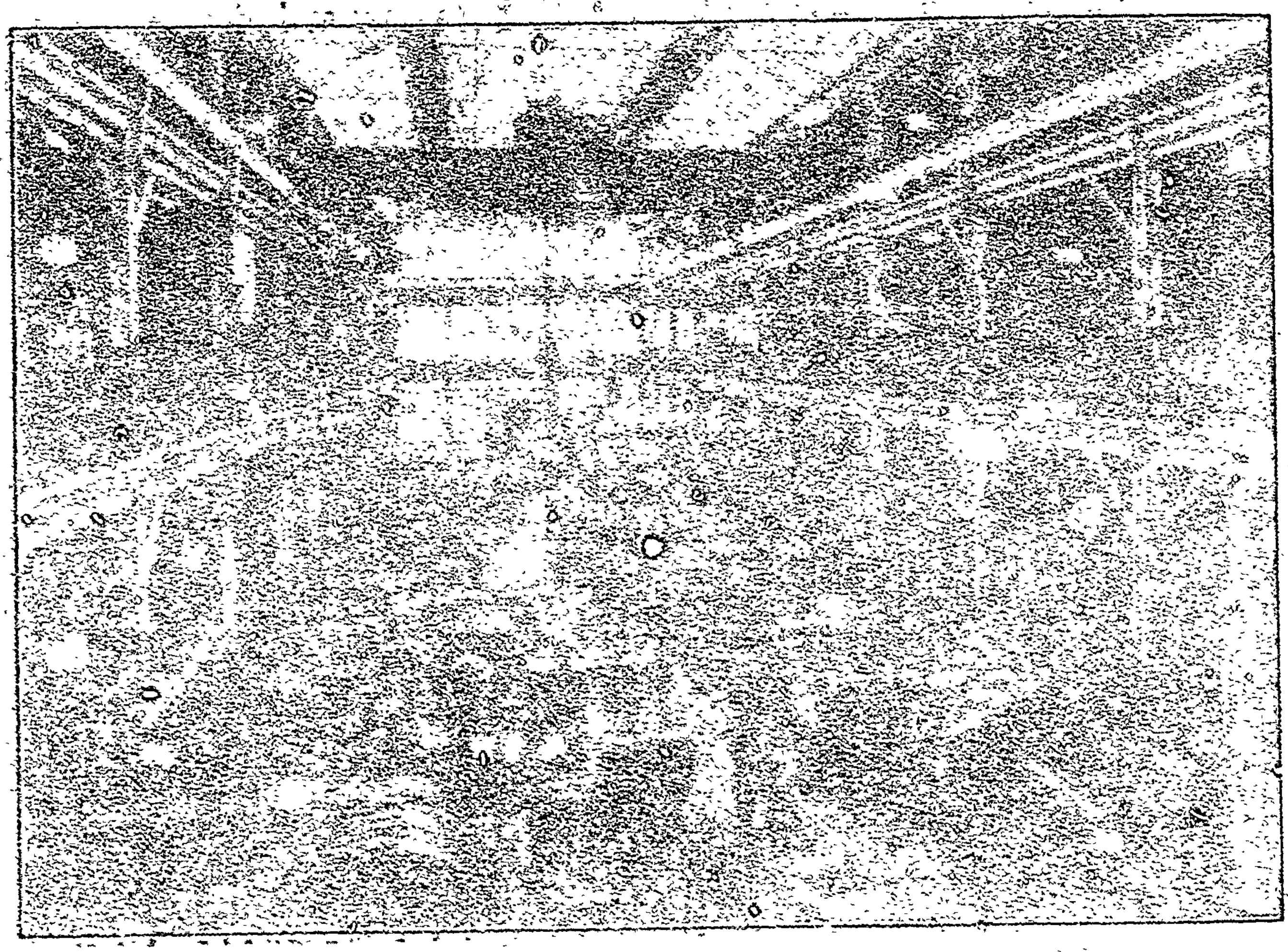
On a second vote being taken the president declared Messrs. Phillips and Dion elected.

The President then called upon Mr. F. C. Armstrong to read his paper entitled "Why Some Lighting Plants Do Not Pay." (See page 117.)

Mr. Armstrong: Before proceeding to read this paper I would like to explain that it is very incomplete. Unfortunately the preparation of it was deferred until too close to the time of commencing the convention. I did not realize the scope of the paper, which really covers the whole lighting industry and operations in detail and in every other way. The first part of it was prepared and sent to press before I found that difficulty to the full extent, and I could not re-cast it, so I had to cut it in two in the middle.

Mr. Armstrong then read his paper.

TWO 600 K. W. "S. K. C." TWO PHASE SYNCHRONOUS MOTORS
to be used by the Montmorency Electric Power Co., Quebec, to drive generators for the Quebec District Railway.
Starting Motor shown in position on the closed machine.



THE ROYAL ELECTRIC CO.'S SHOP, MONTREAL.
The two 600 K. W. "S.K.C." Units for Quebec being assembled in the foreground.

Mr. W. H. Browne: I think that a most enthusiastic vote of thanks is due Mr. Armstrong for this paper. It is very ably thought out, closely and well put together, and nearly every item is worthy of the highest commendation. I think, however, that for the purpose of raising the discussion I will take issue with him on the question of meter rates versus flat rates. As I take it from this paper, he believes that the method of selling current by flat rates for small plants is better than meter rates, and that for large plants meter rates are better. In my experience I really find no difference between small and large plants. I think the same principles govern them all, and the experience that I have found with flat rates is that your maximum output is taxed to its utmost with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. There is no way that I know of to check the consumption of current by your customers on the flat rate system, and the result is that you tax your load capacity, for the income returned, far beyond what it should be. I would recommend every man to serve his customers entirely on the meter basis, and starting from that standpoint to make a bid for the increased use of current on our hours; in other words, to make the rate for the first hour of service -I use that word because that is pretty nearly the average use with regard to residential and small commercial current make the rate for the first hour of service such a one as will make a return on the investment and cost, and make your second, third and fourth hours of service exceedingly cheap. You will find very soon that the people are going to find means for using your current for lighting and power, because the cost beyond the first hour is so small that they can afford it; they become educated, and the result will be that you will get, instead of an hour a day average, probably about three hours a day, in your lighting service.

The President: How do you arrive at it in making out your accounts?

Mr. Browne: The idea is this: your customer has a certain number of lamps on his premises; you of course know how much that is; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. John Farley: That is the same as the gas company; they charge a certain rate up to 5,000 and then reduce the rate for the next 5,000 and the next 5,000 again.

The President: Not exactly.

Mr. F. C. Armstrong: In connection with what Mr. Browne has said, the method he speaks of is, I believe, quite general in England; it is practically giving a discount, as I understand, to the consumer, which is proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view to a considerable extent, but my idea in pointing this out and taking the position which I did was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found myself in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis. I would like to ask some of the central station men what their experience is, both those who have gone on the contract basis with a sliding schedule of rates, and those who have used meters.

Mr. W. H. Browne: I thought some of the gentlemen here operating small stations would answer more readily. I happen to have in my experience two small stations in which the flat rate system was in operation; one of them was a 1,000 light plant; the other was a 3,000 light plant. I changed both of these on to the meter system. I did not change them to the system I have just been outlining—for I confess that is rather a new departure with me—but I did put them on the meter basis, and instead of having a 1,000 light plant I obtained over 4,000 lights served from that same plant, and each individual customer paid a great deal less money, but I got a great deal more money out of my 1000 light machine on the meter basis than I could on the flat rate basis. When I asked a man $3.00 a lamp a year he objected, but he might pay $1.50; and on the meter basis he could pay $1.50, and somebody else would pay $1.50, and so I got out of my 4,000 lights a larger amount of revenue than I did out of 1,000.

Mr. S. Noxon: I am glad to see Mr. Armstrong has cracked a nut and exposed the kernel to view on a question which is of great importance to small central station managers. I was anxious to learn from the discussion here the relative merits of the flat rate and meter systems of selling electricity from those who have had experience, for the reason that we are supplying electricity upon the flat rate basis, and although we have discussed and pondered over this matter to a considerable extent the objections which seemed to present themselves to us were of such an insurmountable nature that we could not see our way to changing our system. And in this I will have to differ from Mr. Browne in his experience. I think it is easier to get a customer to pay a uniform rate per month on a flat rate than it is to get him to pay a large rate per month during the heavy lighting season, and a much smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays. The minimum amount cuts no figure with him; he does not realise that his average is a certain amount; perhaps he would if he figured it up, but the greatest trouble with most of our customers is that if you present a large bill to them they think it is outrageous. Now, I believe, so far as my experience is concerned, that you can do better upon a flat rate, and you can make your arrangements with your customers better than you can with a meter system, for the reason that it is easier to make a yearly contract on a flat rate. On the meter system, on the other hand, your customer agrees to pay so much for whatever he uses; he naturally feels he should be in a position to either take your goods or leave them alone as it suits his fancy, and for that reason your revenue is much more stable under the flat rate than under the meter system. The only question which might arise is the gross revenue which you get. But as regards the feasibility and practicability of working the two systems in connection with a plant where you have keen competition from gas, I believe, and unless some argument is presented which will have greater force than those already presented, I still must be of opinion that in a small plant the flat rate system is better under all circumstances and conditions than a meter rate.

Mr. W. Thompson: I have the misfortune to be one of the small central station managers, and I have listened with a great deal of interest to what the gentlemen have said. I have at the present time both meter rates and flat rates, and I must say that the flat rates are an abomination to me; there are several reasons why. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 to 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the capital outlay and the income from flat rates at 30 cents a month wouldn't pay the interest on the capital alone. Every ampere that we deliver into the residences or into business houses we are entitled to be paid for, at a fair rate; consequently we are entitled to be paid on the meter basis. I think so, and I strongly adhere to the principle, and I think if this gentleman (Mr. Noxon) would try the meter basis he would very soon find out which brought in the most money.

Mr. Armstrong: I cannot agree with Mr. Thompson, in spite of his statement that it is his own experience, which is somewhat modified by the fact that he is close to Montreal, and therefore governed by city conditions which exist, as to the relative desirability of the two systems. Speaking of my own experience, I know that in a majority of cases they do find it better, as Mr. Noxon points out, to make a contract on a yearly basis than to deal with meter charges, which vary so widely. And, going back to the point which I outlined in my paper, that is, what your meter measures, I believe when Mr. Thompson states that you should have pay for everything which passes through your meter, that would be quite satisfactory if you could measure it. But the measuring of ampere hours does not really represent the value of what is going through your meter, and that is just for the reason I have given in my paper. If taken off at 6 p.m., at the time of the maximum load, every unit you are supplying must pay its full proportion of what is invested for plant capacity; if taken off at a later period of operation it is not necessary to charge it with that proportion at all, and therefore it does not cost as much, and should not be sold for as much; it is really a different kind of unit, looking at it from a commercial point of view.

Mr. Pepler: I think this question comes home in reference to a small plant. Referring to our experience, I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no possible way of checking the consumption. At the same time, we realized that it was the most popular plan. There is no question, it is easier to deal with customers on the flat rate than on the meter plan. However, all things considered, we determined to adopt the meter system, and we are now on that system, but it is not altogether satisfactory, more particularly with regard to the question of popularity. When you are in the hands of a municipality you have got to consider that question. We are are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take and partly by way of increasing the number of our small consumers): we are proposing to have a sort of combined plant; to continue the meter plan for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of $75, and a still larger discount to consumers over $100.

Mr. W. H. Browne: I think the difficulty of dealing with customers is very largely magnified. It has been my experience on the meter system to get into the business with a company that was serving entirely on the flat rate basis, and initiating the meter system. My clerks said to me, when the customers complained of the size of the bills, what are we going to do about it, Mr Browne? I said we will adopt this uniform plan; in the first place, we will endeavor to get lamps that will consume a given quantity of current—that we can know are within a certain *reasonable range. We will insist upon our station men operating* the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; that will be our first work; and when we have done that we will say to our customers: If you find any fault with your bill consult your meter; read your meter; you can read it as well as you can *read your clock.* I adopted the uniform plan of *making a* test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded; the man never complained the second time; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light are able to use the meter as a means of checking their consumption by their employees. In one notable case that I had in my experience, the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the *lighting. The great trouble we find in the business* is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. But if you say to a man, take this light and use it just as your needs and your pleasure dictate and pay for what you use, his individual bill is less than it would be by the flat rate; and it simply requires to make the man know that he has to pay for what he burns to get him to use it. You can get $1.50 per lamp out of a man easier than you can get $3. He is apt to look upon the meter system as he looks upon meters in connection with gas. But let us take the position and say: Gentlemen, we have a commodity to sell; we are honest about it, we want you to measure it and check it up and pay for what you use. Charging by the flat rate is not honest, it is not fair to the consumers or to the electric light man; it is not fair to the consumer in the summer time who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay $10 when he has only used $3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is $75 or $100 a month; that is a matter of no consequence; the man that pays you $75 may not be as good a customer as the man who pays you $5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. B. F. Reesor: I am thoroughly in sympathy with this idea of using meters; as fast as we can we are working into the meter system. Of course, you understand, you get all kinds of stories; there is a good deal of talk about the meters with a good many people; they think they would rather pay a flat rate because they say we want to know what we are paying for. The *answer to that is, go to your grocer and ask him what you are* paying for groceries per year; why, the man would laugh at him. In the flat rate system, as you all know, you have got to make a rate and allow for waste in stores, etc. In the business portion of the town where one man has a rate he pays a certain price and we have got to charge him more than we naturally would charge him because we expect him to waste his light. In letting his lights burn it is an advertisement as far as he is concerned. If he had to use coal oil or gas he would not use those lights after hours. When he has a flat rate he lets them go as long as they like. The next man to him has a meter in; he closes up his place of business and shuts off his light. If there is anything unusual going on and he wants to advertise his store front, he turns on his light and is willing to pay for it, as far as the meter rate is concerned. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way: We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in *the morning when they start up they* have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a *larger quantity* he gets a larger discount, and we make the rate low. We do the same thing with other customers. Some of those who have mills talk the same way; they say we do not want to have a meter because we have no confidence in them; we do not think they will register right; we have had experience with gas meters and all that kind of thing and we want to know what it is going to cost. And I say, go to your grocer and buy your groceries that way.

Mr. F. A. Bowman: I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can overwire very much more largely when you have a number of meters in than you can under any other conditions. When we make flat rates we base them on what we consider would be a *fair average consumption through the year; you cannot* give more than a few different kinds of rates, and the result is a great many of the customers through carelessness consume a very much larger amount of light than your rate is figured on. I know you have to keep constant watch or else you will find them leaving the lights on; you will find a customer leaving his lights on every night and letting them run all night, and things like that. *I know of an instance, fortunately not my own, in which* every store in the town is left on till the plant is turned off. My customers use me very much better than that, and as a rule they shut their lights off; still, you have got to watch them to a considerable extent. Take houses on meter rates and on flat rates, and I think you will find a very great deal of difference, you take an ordinary sized house, it has between 20 and 30 lights, if you *put them in* on the meter system there are about two, *three or* four lights in the house that practically make the meter bills for the month, say in the front hall, the sitting room, the kitchen and perhaps the dining room; the rest of the lights are used comparatively little and they cost the man practically nothing in the year. You give that customer a flat rate and go past that house on an evening and you will find three-fourths of the lights in that house turned on from dusk until bed-time. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps, whereas on the meter basis we can figure on 5 c.p. and 10 c.p. Although the lamps are not quite as efficient as the higher class of lamps, on the whole I think we will generally find it to our advantage to get meters introduced into the small plants as fast as possible. You know a great deal better what you are doing and you have the certainty that you are getting paid practically for all that goes out. I might say in this connection that I have rather a unique scheme, I have a small town where I am lighting the streets on the meter system; in other words, we put in an independent circuit, on a three-wire circuit, centered at the town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system, so I think they are tolerably well satisfied.

Mr. H. O. Fisk: In regard to the flat rate system, we ran against a snag that I have not heard mentioned; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c. p. lamps. This thing went on in this way for a year or so, the load got tremendously heavy, and the income didn't come up, so we put an unknown *man on the road to investigate. He went around and looked* at all the lights and the result was that about ninety-eight per cent. of our 10 c. p. lamps were 16 c. p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps; so they made a contract for 16 c.p. With reference to the meter rate, I might say we made a discount about a year ago of 33⅓ per cent. of what we were charging, for all bills *paid before the 10th of the month. The result was that by the* 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33⅓ per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way, and we find that that load is the best paying load we *have got. We get a larger return for the number of amperes* put out than we do in any other way.

Mr. S. Noxon: I understood Mr. Browne to say that by using the meter he would make a reduction in price, and that his revenue came up even in spite of that on account of the extensive use of the light under the meter system. I would like to know how that operated. Of course there are two items in the calculation as between the flat rate and meter rate, and that is the relative price you get for either. It doesn't make any difference how "flat" your rate is providing you get money enough. It is all a matter of revenue for the service which you give. If you mean by a flat rate that you are going to get $2 a lamp for every lamp installed, there is no doubt you would not get much of a revenue, but if you get $4 you will have a pretty good revenue. If you are safe in *having* your installation from 25 to 40 per cent——

Mr. Thompson: In residential work you might safely double the capacity.

Mr. Noxon: That is so much better for the argument of the flat rate. If you are safe in installing double the capacity of your dynamo, as Mr. Thomson said, on the meter basis, will it not apply to the flat rate?

A number of voices: No, No.

Mr. Noxon: If you are safe in installing double the capacity of your dynamo, then, of course, you can make your rate less to correspond with the cheap rate which you would have to give on the meter basis?

Voices: No, No.

Mr. Noxon: Why not? If you can depend upon their only using half of the output, it will amount to the same. If you can depend upon that, why can't you make your flat rate correspondingly less? Where are you in any worse position? Now, what I say about the flat rate is this, and as we have not discussed the price of the flat rate, my argument on the flat rate holds perfectly good until the price is established. After the price is established, then it is a question whether that price will pay or not. If you have a 1,000 light machine and you can install 2,000 lights and can get $2 on a flat rate for these, you get $4,000. Can you get any more on your meter system?

Mr. Browne: Certainly you can, and the objection to your argument is this: You say, establish the question of a flat rate without regard to price, and you can double your installation. The lower you make your price ——

Mr. Noxon: I said, when the price comes to be discussed it might change the conditions. What I say is this, that providing you can get a rate on the flat rate basis which would equal your income from your meters, then where are you at an advantage?

Mr. Browne: Leaving the question of the price out, the lower the price is on the flat rate basis the less chance there is of overwiring. The only way that you can secure the opportunity of overwiring would be to charge a high price on the flat rate. Mr. Bowman told us a little while ago that in England the experience is that on residential lighting 35 per cent. of the lamps installed is the maximum load. That is a high percentage. In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at midwinter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent; in other words, you will have 1000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine. You have not got to put in a thousand light machine to serve a thousand customers. You are not going to get the revenue out of your machine on flat rates that you will on meter rates.

Mr. Noxon: This is a question in which I think not only myself, but a considerable number, are interested. What I wanted to satisfy by this discussion is this, that what Mr. Browne says is correct, that you are safe in wiring up three times the capacity of your machine. We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine?

Mr. Browne: If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 5,000 lights on a thousand light capacity.

Mr. Bowman: It looks to me as if somebody is investing a great deal of money in this thing that is not going to bring great returns. If your machine is employed only to that proportion of its capacity, I cannot see where the revenue comes in unless somebody is paying a great deal more for their light than they should be.

Mr. Browne: In answer to your enquiry as to how much you may wire: In the city of Montreal to-day we have wired up on our circuits 65,000 lights; we are serving those lights with five 300 kilowatt machines, that is 1,500 kilowatt capacity, and we always have one to spare.

Mr. Thompson: I think Mr. Noxon really misunderstood what I said. I meant to say that on the meter system I was quite safe, (and that has been pretty well borne out from facts, and I know from four years' actual observation and experience that I have proof of what I say) that I could safely, on the meter system, put on 2,000 lights on my machine. Now, supposing that I sold those 2,000 lights on the flat rate, and that all our customers were perfectly honest—unfortunately a lot of customers, when you put them on a flat rate, use 16 c. p. lamps instead of 10, and I have known them to use 32 c. p. instead of 16; I have known them to pay for 15 lights and install 25—you may take it for granted with the most honest of customers that at some time during the night you are going to have your full maximum of 2,000 lights on, consequently you must provide 2,000 light apparatus. What does that mean? It means that your 2,000 light apparatus is simply bringing in the income that you could bring in on a 500 or 1,000 light apparatus.

Mr. Armstrong: This discussion seems to have drawn out considerable discussion; those who are in favor of the meter system stick to the point that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, and the purpose of my paper was, that for small plants—I mean plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time was very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of charging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator. I know also of an example in residential lighting where they have about 50 or 60 lights in, and on an average they do not use more than half a dozen or eight lights; there is no object in keeping their lights blazing all through the house. I could give instances of a large number of similar cases in towns of a similar size where by the flat rate system they have realized nearly the same conditions as under the meter system; where, so far as making money is concerned, the flat rate approximates closely to what a meter rate would be. Then you have the expense of meters, which is quite a capital charge on the plant. Then, under the flat rate, you have the advantage of a clean cut business; you know what your revenue is going to be to a dollar, and the only increased cost which the contract basis may allow an opportunity for is the increase in fuel, and that is not, in a small plant, very large. I do not wish to be understood at all as saying that that applies in all cases. In all the larger plants and in some special cases with the smaller plants, a meter basis is not only desirable but necessary. But I am speaking generally for a certain class of small stations, some of which, I think, are represented here, and from the owners of which I would like to have heard an expression of opinion.

Mr. J. M. Brown: It seems to me this question is largely a matter of expediency with regard to small plants. I happen to run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too high. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near feature my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. Now, there is another point: I think that for commercial business in a small town you have got to have a flat rate for the simple reason that a good many stores close, say, so many nights a week; and I even know of one town not very far from me where only last year they closed all their shops at six o'clock in order to cut off the electric light and heat. In that case they were running on the meter basis. If that town were on a flat rate they would have been getting an assured revenue from commercial lighting. I think for commercial lighting you should have an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should be run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a fact that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them. I can take residences that have 50 lamps on the meter system, and they are not using, on an average, through the heavy lighting part of the evening, more than 10 lamps. Other residences with a less number of lights in, on the flat rate, are using frequently 20 lamps right through the heavy lighting part of the evening. They do not always do so, but they frequently do. In any event they use nearly double the amount of lamps that residences do that are on the meter system, and I get very little more out of them. So that I believe the meter rate is the only practical way to get over the difficulty in connection with the residence portion. But, from our own standpoint, I prefer the flat rate for commercial lighting. You could not get hotels on the meter basis at all; they would not use the light no matter how low a rate you gave them, for the simple reason they claim they have no control over their light. We get the commercial rate from hotels, and although they use a considerable number of lamps all night, those lamps are on when the load is light and the power is not of so much consequence to us; it doesn't tax your capacity in any way, and you get a good revenue from them. If you put them on the meter system they would not stay with you at all, for they could not stand it.

Mr. Thompson: I beg to move a vote of thanks to Mr. Armstrong for his excellent paper that has brought out so much discussion. I am sure we have all appreciated it very much.

Mr. Noxon: I beg to second that.

The President: I have great pleasure in tendering to you, Mr. Armstrong, the vote of thanks from this meeting. We would ask those who prepare papers for the next convention to choose subjects that will evoke discussion and difference of opinion, and bring out what the experience of different members is in different localities.

The President: I will now call upon Mr. C. E. A. Carr, of London, to read his paper entititled "The Commercial Aspect of Electric Railways. (See page 122.)

Mr. Carr: Mr. President, gentlemen and members of the Association: The subject of my paper as announced on the printed sheets is rather misleading, as the paper was written before I had the subject sent to me, therefore it appears on the paper "Electric Railways, and How to Make Them a Commercial Success." I do not know that the paper will have as much interest to most of you as the paper read by Mr. Armstrong, because not many of you, I understand, are very closely connected or associated with electric railways.

Mr. F. C. Armstrong moved, seconded by Mr. W. H. Browne, that a vote of thanks be tendered to Mr. Carr for his valuable paper.

Mr. Browne: Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested. This is necessary to the success of electric lighting, railroading or any other business.

The President at this point called upon Mr. W. A. Johnson, of Toronto, to read his paper on "Accumulators Their Application to Central Station Lighting and Power. (See page 125.)

Mr. C. B. Hunt: I have very great pleasure in moving a hearty vote of thanks to Mr. Johnson for his valuable paper.

Mr. J. Farley: I have much pleasure in seconding the motion. While all the papers have been, to my mind, exceedingly interesting, there is none probably that has a more practical bearing on the future than the one just read.

Mr W H Browne Before passing the resolution, I notice that the question of the cost of installation was referred to, but nothing said, I believe, as to the cost of operation or maintenance account. Could you add anything on that line, Mr. Johnson?

Mr. Johnson: I refer to the question of maintenance very briefly here. I simply stated that it had not been found to be excessive. So far, for about three years on the North American continent, during which time the modern type of battery has been in use, the cost of maintenance has been found in central stations to give good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purchasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne: The object of my inquiry was, I had understood that manufacturers of storage batteries were willing to guarantee that the maintenance or repair cost was considerably lower than 10 per cent., in fact, I have heard them declare that they would guarantee 3 per cent.

Mr. Johnson: It is possible it is so now, but instructions have not been issued up this way to that extent.

Mr. Browne: If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in

Mr. John Yule,
President Canadian Electrical Association.

New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. F. C. Armstrong: The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty, Mr. Browne?

Mr. Browne. My way of using it is by operating a direct current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an efficiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson: I might say that there is no doubt there are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the city and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled fully as easily, perhaps, with the same generators as through the usual alternating circuits: that would apply especially to a water power that was not extremely large.

The President: It has been moved by Mr. Hunt, seconded by Mr. Farley, that a hearty vote of thanks be tendered to Mr. Johnson for his paper. Carried.

The President: The paper by Mr. Keeley on "Economy in Circuits" will have to be taken as read. (See page 120.) It will appear in the report of the proceedings of the convention.

A vote of thanks was tendered to Mr. Wilfred Phillips for his untiring and valuable efforts for the success of the convention, and for the complete arrangements made for the entertainment of the delegates.

Votes of thanks were also tendered to the press for the accurate reports of the proceedings of the convention, and to the following for courtesies extended Niagara Falls Park and River Railway Company; Buffalo and Niagara Falls Electric Railway Company; Buffalo Railway Company; Suspension Bridge Company; Niagara Navigation Company; Captain Carter; Niagara Falls and Suspension Bridge Railway Company; Niagara Power Company, and Hydraulic Power and Mfg. Company.

Adjournment was then announced by the President.

SOCIAL FEATURES.

On Wednesday morning an excursion to Buffalo took place, which was well attended. Great interest attached to the inspection of the power station of the Buffalo Railway Co.

The annual banquet was held on Thursday evening at the Dufferin Cafe', and was a marked success. About 125 members and their friends were present. Mr. John Yule presided. Letters of regret were read from Hon. A. S. Hardy, premier of Ontario; Hon. J. M. Gibson, Commissioner of Crown Lands, and several others. After Her Majesty had been duly honored,

Mr. C. B. Hunt,
First Vice-President Canadian Electrical Association.

responses were made to the various toasts as follows: "Our Guests," Mr. Wilson, of the Queen Victoria Niagara Falls Park Commission, Mr. Lincoln, of the Cataract Construction Co., and Mr. Innes, of the Guelph Light and Power Co; "Electrical Industries," Messrs. W. H. Browne and H. P. Dwight; "The Ladies," Mr. F. C. Armstrong; "The Press," Mr. W. Johnston, of the Electrical World; "The Mayor of Niagara Falls, Mr. Cole; "The Presiding Officer," Mr. John Yule.

The closing day was devoted entirely to sight-seeing. Starting at the Hotel Lafayette, the party were conveyed by the Niagara Falls Park and River Railway to "Rapids Views," Brock's monument, and Queenston. Crossing the river to Lewiston, a trip was made on the gorge railway. A visit was also made during the day to the power houses and works of the Cataract

Mr. J. A. Kammerer,
Second Vice-President Canadian Electrical Association.

Power and Construction Company and the Niagara Falls Hydraulic and Power Manufacturing Company, and the expedition wound up by a trip on the Maid of the Mist.

Amongst the visitors to the recent convention of the Canadian Electrical Association at Niagara Falls, was Mr. William McCulloch, formerly with the Canadian General Electric Company, now the representative of Mr. Hugo Reisinger, 38 Beaver street, New York, who is the American agent and importer of "Electra" carbons, manufactured at Nuernberg, Germany. These goods will be on sale in Canada by the Canadian General Electric Company, and Mr. McCulloch hopes to establish quite a business in this country. These carbons do not come in competition with American or Canadian made goods.

WHY SOME LIGHTING PLANTS DO NOT PAY.

By F. C. Armstrong.

Before proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition taking everything into consideration would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present or as far as we can see any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output which means commercially that under most circumstances it is cheaper to get your light from a central station than to install an isolated plant. It may, therefore, fairly I think be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion and in it is really involved as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds. The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service; *the second, and in the early days of the electrical art* vastly the most important is the arbitrary depreciation which is due not to the wearing out of the plant but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types. There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small; the commercial efficiency of generators, distribution lines and transformers when used was very low; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines. The efficiency of the best dynamos of to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes. Regulation in the best machines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine—the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its *perfect adaptation to the purpose for which it is primarily* intended - the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent. higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident cases and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes: the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention exclusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests; the next is the large class of small stations which manage themselves, with occasional interference on part of the owner; *in the fourth place, and I say it with due deference*, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of station is as I have stated. Finally we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement.

Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin *on the right side between gross revenue and operating* expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at $10 each per annum has a revenue of $2,000 per annum and may not pay; the same plant, if increased to 1,000 lights at $5 per annum would probably be paying handsomely.

It is evident also that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favorable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, *and not sold by bulk and by guess, there is at bottom* a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischevious has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners; the recent governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.

By William Thompson, Montreal West.

The choice of a subject for a paper to be placed for discussion before an Association composed of gentlemen so eminently fitted for their profession as are the members of the Canadian Electrical Association, becomes a matter of more than ordinary importance.

In choosing my subject I was first guided by the request of your committee that my paper should be along the line of "Chemistry in the Boiler Room," and the fact that the members of this Association are gentlemen who hold responsible positions and in many cases are central station managers, and as such, more than ordinarily interested in subjects pertaining to economical management.

We cannot all of us have such magnificent water powers as we see here and elsewhere throughout the Dominion of Canada, and consequently have to go to the coal pile as our source of power.

A successful station manager takes pride in choosing his generating and distributing apparatus with the greatest possible care, and purchases only that which he considers suitable for his purpose. We all know that there is efficient and inefficient station apparatus, and we all strive to get as far as possible that which we consider will bring us in the greatest return and most efficient service for capital invested. The same principle of getting best returns and most efficient service should, I claim, underlie our system of purchasing our fuel.

It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose.

Undoubtedly the most scientific and correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use except by the expert chemist in his laboratory.

Repeated efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. Perhaps the most recent and nearest correct formula of this kind that has been given to the public is the formula constructed by Dulong, and more recently by Mahler.

Both these gentlemen based their calculation upon an elementary analysis of the coal under examination, and they both seem to agree upon the fact that the heating powers of coals of a like composition remained constant, and that the heating power of coal changes as the composition changes. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen.

Dulong accepts as the heat-producing elements of coal carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailable for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula:

$$Q = 14,544\ C + 62,100\ (H - O_8)$$

which for convenience might be written:

$$Q = 14,544\ C + 62,100\ H - 7,762.50$$

Where Q equals calorific value of fuel,

14,544 = constant heating power of carbon
62,100 = " " " hydrogen
7,762.5 = " neautralizing power of oxygen

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14.652 B.T.U., and using the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became:

$$Q = 14,652\ C + 62,100\ H - 5,400\ (O + N)$$

Where Q equals calorific value of coal,

14,652 = constant value of carbon
62,100 = " " hydrogen
5,400 = " neutralizing effect of oxygen, less heat formed by formation of nitric acid, ($N_2O_5 + H_2O$) (Note 1.)

On comparing these formulae with a long series of actual calorimetric tests made by Mahler, it is surprising how near either of these laws come to the actual theoretical value of the fuel.

To engineers, however, a new difficulty here presents itself, since both of these formulas are based upon an elementary analysis, which is not only difficult to make, but exceedingly liable to give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula, constructed on the basis of a proximate analysis.

It is for the sake of clearness necessary for me here to explain the difference between an "elementary" and a "proximate" analysis, and also what the term of "fixed carbon" means. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the coals into four sections, and consists of the determination of moisture, volatile combustible matter, fixed carbon, and ash.

The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal appreciated this difficulty referred to, and after reviewing the work of Mahler and others, made a number of calorimetric tests, comparing them with a formula of his own construction, and published in Progressive Age, Jan. 15, 1897, as follows:

$$Q = 14670\ F.C. + A \times \text{volatile matter},$$

when Q = calorific value of coal.

14670 = constant heating power of fixed carbon,
A = 23400 when volatile matter equals from 2% to 15% of total combustible.
A = 18000 when volatile matter equals from 15% to 30% of total combustible,
A = 17100 when volatile matter equals from 30% to 35% of total combustible,
A = 16200 when volatile matter equals from 35% to 40% of total combustible.

The result of this formula seems to come as near the actual theoretical value of coals, as anything it has been my privilege to consider, and may at the present time be taken as a useful formula for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35% of total combustible, as it gives results altogether too high in samples of extra hydrogeneous or lignitic coals.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric value of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals de-

(Note 1) $N_2O_5 + H_2O = 2\ HNO_3$. The calorific value of 1 lb. nitric acid equals 187.79 B.T.U.

creases almost in the same proportion that volatile combustible increases. The extensive tests of European coals made by *Schurer-Kestuer in 1868, and* afterwards collated by Mons Gruner, gives us most interesting and valuable information on this point.

For industrial purposes Gruner divided these coals into five distinct classes, according to the quantity of fixed carbon contained in the combustible of each.

Class 1: When the total combustible of the coal was composed of 50-60% fixed carbon.
Class 2: 60-68% fixed carbon.
Class 3: 68-74% " "
Class 4: 74-82% " "
Class 5: 82-95% " "

Taking the lowest of each of these classes, he gives the elementary analysis and percentage of total combustible in each class as follows:

TABLE OF INDUSTRIAL VALUE OF COALS, as per Gruner's classification.

CLASS.	Fixed Carbon, % Total Combustible.	Volatile Carbon % Total Comb.	Hydrogen, % Total Comb.	Oxygen and Nitrogen, % Total Comb.	Actual Value in B. T. U.	Industrial Value in B. T. U.	Industrial Value, % of Actual
5	82.	8.	4.5	5.5	16 560	10.368	62 6
4	74.	14.	5.5	6.5	16.740	10.596	63 3
3	68.	16.	5.0	11.	15.840	9.•76	61.
2	60.	20.	5 8	14 2	15.300	8 756	57.2
1	50.	22.	8 5	19.5	14.400	7.716	53.6

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of oxygen in the combustible, and the heating value of the hydrogen *in the combustible will decrease in proportion* to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. It will be observed that both the calorimetric and industrial value of Gruner's class 4 is higher than class 5, although the percentage of fixed carbon has decreased 8%. The industrial heating value, however, has not increased in proportion to the increase of hydrogen in the fuel, while actual heating value by calorimeter fully accounts for such an increase. Although the difference is but slight in this particular case, it points to a very significant fact, which is more clearly exemplified in the following three samples of coal; that is, that the actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases.

We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of *smoke varying* in density and volume according to the quantity and composition of the volatile combustible matter in our fuel. An examination of the sooty deposit formed by the condensation of the smoky products proves it to be largely composed of minute particles of carbon which is combustible, proving to us pretty conclusively that the cause of the decrease in industrial heating value is loss of heat from the carbon *of our coal, due to the extremely* volatile nature of the carbon in combination with hydrogen as hydro-carbons.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel. A review and close examination of Gruner's tables of the results of tests on European coals, and verified as being practically correct by similar tests made by Johnston on American coals at a more recent date, shows us we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. In Gruner's anthracitic class 5, industrial heating value of coal only equals 83.3 of the heating value of the fixed carbon, with Berthelet's determination as a standard.

In semi-bituminous class 4, industrial value equals 97.7% of heating value of fixed carbon; in bituminous classes 2 and 3, 97.1% and 99.6% showing us that if we undertake to fix industrial value of coals without *reference to volatile combustible matter,* we are liable to rate value of anthracite varieties too high.

Bearing in mind these facts relative to the heating value of the volatile combustible, it becomes markedly difficult to construct a formula applicable to a proximate analysis.

It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. Mr. Goutal kept this fact prominently before him, as also the fact relating to fixed carbon, and consequently gives in his formula a series of constants for the determination of the heating power of the volatile combustible. While these constants might be improved upon by division into shorter sections, the results are nevertheless near enough the theoretical value for ordinary purposes.

The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial benefit in enabling engineers to arrive at the s m-making capacity of their coals:

$$Q = 14,652 \text{ f.c.} + A \times \text{volatile matter} \times B,$$

Where A equals 23,400 when volatile combustible is equal to from 2% to 15% of total combustible,

A equals 20,000 when volatile combustible equals from 15-30% of total combustible,

A equals 17,100 when volatile combustible equals from 30-35% *of total combustible,*

A equals 16,200 when volatile combustible equals from 35-40% of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90% of total combustible,

B equals .65 when fixed carbon equals 74-82% of total combustible,

B equals .662 when fixed carbon equals 68-74% of total combustible,

B equals .588 when fixed carbon equals 60-68% of total combustible,

B equals .551 when fixed carbon equals 50-60% of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal.

With this formula and the proximate analysis before us, we are readily enabled to determine, which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

ECONOMY IN CIRCUITS.

By D. H. Keeley.

The design of the diagrams presented hereunder is to establish the fact that, without exceeding the weight of copper, or the drop of E. M. F. in current transmission, found in a single parallel system, it is possible to provide for distribution with an equalized pressure at all points.

This diagram (Fig. 1) represents a transformer delivering 52 Volts with a primary resistance of .05 Ohm.

Current is supplied to 17 lamps, each taking normally 1 Ampere, and located in groups equidistantly—two of them at the terminus of the transformer.

The mains are of such size as presents a resistance of ·05 Ohm per 1000 feet.

The total drop, it will be seen, is .85 + .375 + .125 + .125 + .375 = 1.85 Volts. The difference of potential is 2 per cent. less at the terminal group than it is at the transformer; being, as it figures out according to the drop, 52 85 = 51.15 Volts between A and A1; 52 - 1.60 = 50.40 Volts between B and B1., and 52 - 1.85 = 50.15 Volts between C and C1.

This diagram (Fig 2) represents two transformers of half the size and capacity of the one shown in the preceding figure, each delivering 52

Volts with a primary resistance of .1 Ohm. The number of lamps and their locations are the same as before, the mains in this instance, like the transformers, are half the size of those shown in Fig 1 and present a resistance of 1 Ohm per 1000 feet.

PHILOSOPHY OF FIG. 2.

In a circuit supplied with E. M. F. from more than one source, the current developed at objective points is proportionately contributed to from the several sources of the E. M. F.

Following the above, the amperage of the circuit is halved between the transformers V and V1. To simplify matters, the courses of the currents ordinarily obtaining are indicated by arrows; V heavy and V1 light, running from + to − in each case. It will be seen that where they are opposed, the difference between the two represents the amperage obtaining. The allotment of absorption is traced accordingly. On the whole the distribution of the applied E. M. F. is the same as if the circuits of V and V1 separately ended at the terminal group 5 A. The total drop, it will be seen, is .85+.375+.125+.125+.375=1.85 Volts in V for half the amperage; and the same in V1 = in all 1·85 Volts for the 17 amperes – the pressure or potential difference under these changed conditions being the same at all points since the same total drop of 1.85 Volts is found along the mains between the transformers and each of the several groups.

The author's apology, if any is needed, for bringing this matter again to the notice of the members of this Association is that it might perhaps happen that a good thing was being lost sight of because of its not having been presented in a sufficiently clear manner to secure its recognition on a former occasion when it was dealt with under a different title. The circumstance that at the Ottawa Convention a paper was submitted by the author which in subsequent published comments was stated to have explained a demonstraable but somewhat abstruse fact in a new and clear way, will perhaps justify a renewed effort in regard to the present subject.

The importance of providing for an equal distribution is, from the writer's point of view at any rate, secondary to nothing in the electrical field. Perhaps reference may be allowed to an editorial on page 151 of the September, 1895, number of the Canadian ELECTRICAL NEWS in which the question of economical supply is dealt with. The author of that article prefaces the whole with the observation that

"It is of great importance to electric lighting stations that the pressure all over the system should be sensibly the same, and eq al at all loads."

We are all, of course, prepared to grant this proposition as a whole—whence it follows, the conditions requisite to the end had in view should be enquired into. In the first place it will be seen the requirement, though taken "altogether" in the above quotation, is of a two fold

Fig. 1

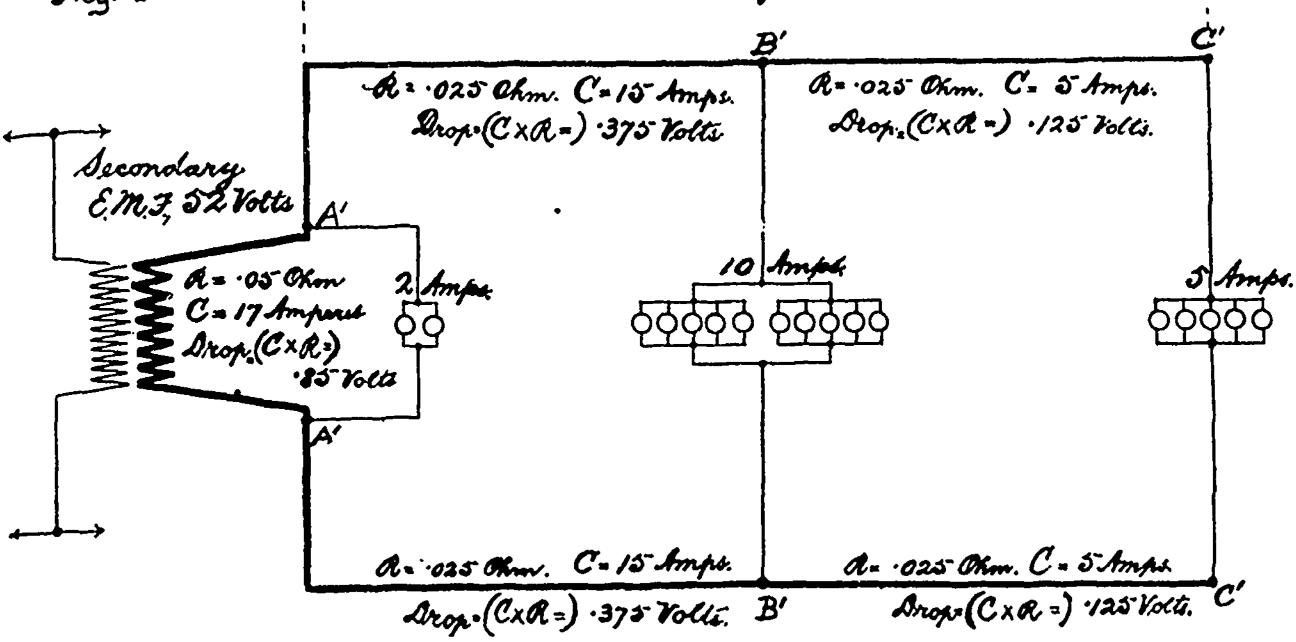
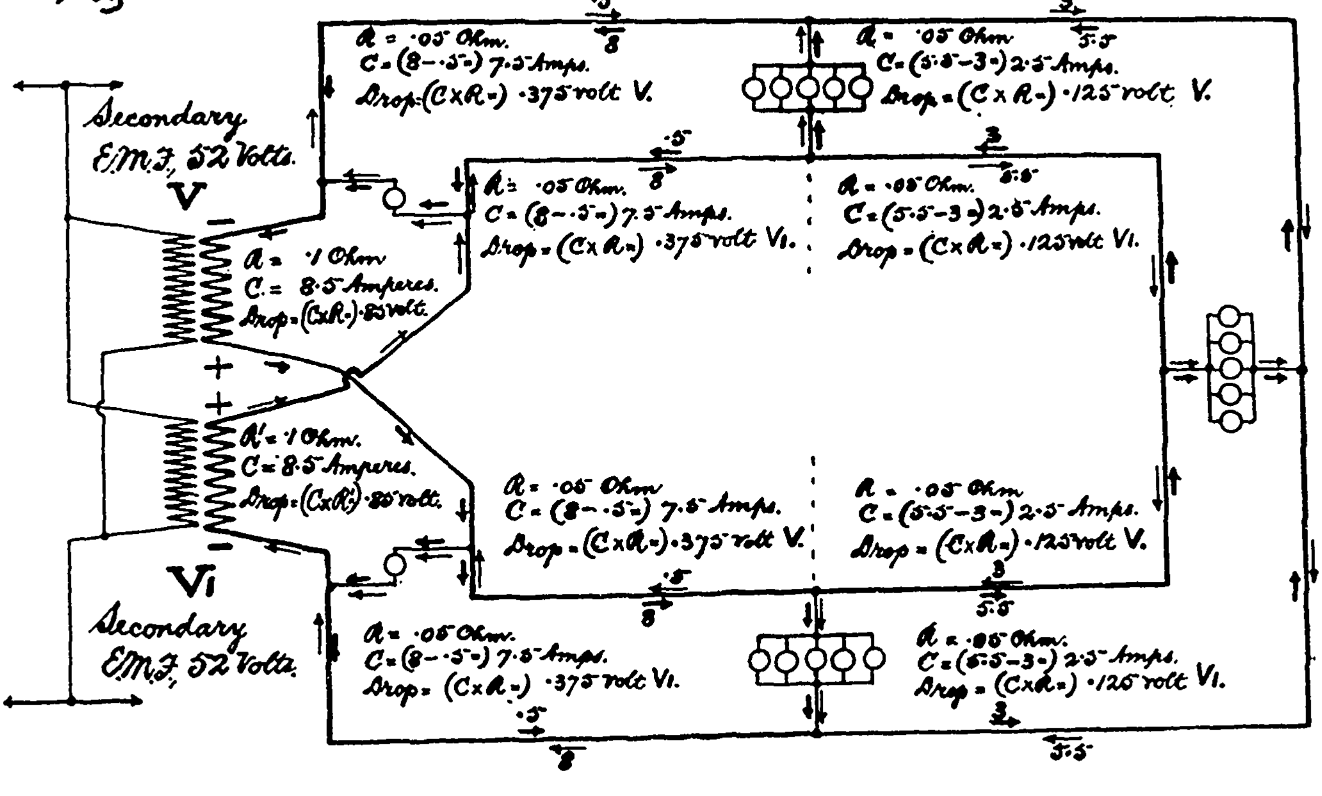


Fig. 2



Distance from sources V V1 to terminal group 1,000 feet:
The other groups occur midway.

character. The need for equalization of pressure throughout a system of supply is one thing, and the need for a uniform pressure under all loads is another thing. The one hinges on the other, however, and so long as one department remains undeveloped the other cannot be brought to make up for the deficiency.

Now it is the first mentioned feature of this proposition the need for equalization of pressure throughout a system that has been dealt with in the present paper. In the other department covering the need for a uniform pressure under all loads we are presented with a problem that so far seems to have been grappled with from behind the dynamo or by the introduction of boosting devices effecting changes of pressure in the mains. As it happens, however, that these changes are made in the circuit as a whole without any particular reference to individual transformer (or lamp group) requirements, it follows that near-by points are given an excessive pressure when the increased demand arises farther off, so that at any time in their operation these methods only operate to maintain a uniform pressure at a given point of the system, and a general uniformity of pressure cannot be obtained by these means alone. The main thing, then, is to secure equal distribution; that being provided, the means already found for regulating the pressure will fall handily into line; and the whole object aimed at will be as nearly attained as may be, pending the evolution of something less clumsy and perhaps automatic, regulating the output of the dynamo.

In conclusion, the point aimed at will bear a little further exposition. In a system of circuits arranged to supply an equal potential difference at all points, it will be found the drop between the source of E. M. F. and the points of consumption is the same in every instance.

As regards the leads then, the absorption of the transmitted E. M. F. amounts to the same total quantity, no matter from what point it is calculated. Hence, when an increased demand arises at any point, the absorption in the mains becomes correspondingly increased in all parts; and when the initial pressure is increased it similarly takes to all parts, thus evenly compensating for the increased absorption and presenting no increase of P. D. at any one point more than another, and in no case higher than may be predetermined or desired.

Moreover, in any such system of circuits a lamp (if the supply is a direct one), or a small transformer operating a lamp (if the supply is in that way conveyed) may be located in the supply station, and it will burn with the same current at the same pressure as any other lamp in the system though this latter extends for miles.

And this it seems can be realized, as demonstrated in the diagrams, without exceeding the weight of copper that is now used in the two-wire or simple parallel system, and at the same time without involving any further drop of the applied voltage than obtains in that two-wire system.

One word more. When we will have arrived at that stage where the pressure in the mains can be kept at something in excess of the demand, while at the points of consumption only so much current is drawn off as there is a demand for, we will have attained perfection. The whole thing will then be automatic. But, in such a system it is obvious an arrangement of circuits operating as described in this paper will be altogether indispensable, so we will have now made much of an advance towards that era.

THE COMMERCIAL ASPECT OF ELECTRIC RAILWAYS.

By C. E. A. Carr.

The subject of my paper "The Commercial Aspect of Electric Railways" is a question that has engaged the thought of the ablest men for years, and in presenting this paper, I do not presume to know more than my fellow creatures, nor to have discovered any special facts that give a satisfactory answer, but merely give you a few chapters from my own experience and observation.

This is not the time nor the place to discuss the best method for the collection of fares, whether to use a rigid or flexible bond, or whether a single or double truck is best, although these details require a great deal of study, and bear a close relation to the answer to my subject.

Electric railways on this Continent are usually built by a company authorized to do so by special Provincial or State legislation, and the opposition so generally met with in obtaining these special powers, is but a pleasant (?) introduction to the later difficulties to be met with in securing from the various City and County Councils the rights to lay down rails and run the cars. Having secured a charter and obtained agreements from these various Councils, the real work of railroading begins, and as to what are the best methods of construction, equipment, and operation to make it a success, will be the leading thought of this paper.

Track construction is a subject that has been thoroughly discussed from time to time, and as so many Engineers differ as to the best methods, I can only express my opinion as to what forms are best suited under certain conditions. For an electric road in a town or city street, or wherever pavements of a permanent character are used, the girder rail seems to be the only one suitable The depth of the rail should be not less than 7 in and should weigh from 70 to 90 pounds to the yard. What the exact weight of the rail should be, would depend upon the frequency of the service required, and the weight of the rolling stock to be used In a macadam or unpaved roadway, a T rail of 65 pounds to the yard is all that is necessary. While it may be better, under certain conditions to have rails laid in concrete with a permanent pavement, my experience has been that cars rattle and jar a great deal more than when running over a road-bed of less rigidity. In all paved streets, rails should be firmly spiked on oak ties 5 in. x 7 in. x 7 feet, spaced 2 feet apart. The grade should first be properly levelled, and the whole surface covered with good coarse gravel 6 in. in depth. Fish plates or angle bars 3 feet long, with not less than 6 bolts at each rail joint, should be properly fitted and bolted. Soft copper bonds of sufficient size to carry the maximum return current from any distant part of the line to the power house, should be properly attached at each joint.

Many improvements have been made in overhead line materials during the last couple of years, so that to day there are several manufacturers of very satisfactory supplies.

The trolley should be carried with a straight line hanger thoroughly insulated and attached to a flexible bracket or span wire. A sufficient number of feeder lines should be used to maintain the voltage under a maximum load, and section switches, emergency breakers and lightning arresters should be placed at frequent intervals, and where a number of lines constitute one system, trolley brakes with each feeder section.

The rolling stock should be the best obtainable, and for city traffic, mounted on single truck with wheel base not more than 7 6. Seats should be fixed crosswise of the car, and the doors and aisle so arranged as to permit of easy and speedy exit. For a high speed suburban road, a car 40' long mounted on double truck, is more desirable, but as so many companies, operating city lines, make long extensions to some suburban town or pleasure park, the city cars are usually called upon to do service. All passenger cars should be well lighted, fitted with signal bells, curtains, and properly heated during the winter season Keep the cars clean inside and out, and upon the first appearance of dowdyism, have them overhauled, repainted and varnished. The appearance of a car is next in importance to the appearance of employees, and very often indicates the prosperity or otherwise of a railway, as the ever exacting public is not slow to give its verdict.

The power house of an electric railway, should, like the cars, be the best obtainable. It should be built near a railroad track, so that coal can be cheaply delivered, and it is very desirable that the site selected should be near a good water supply, so that condensing engines may be used. If these conditions can be had near the centre of distribution a very great saving can be effected in the cost of copper feeders. The building should be a substantial structure of brick or stone, well lighted and fireproof. Direct connected multipolar generators, with slow speed compound condensing engines, will give best results, where a moderately steady load is maintained. Where few cars are run, and the fluctuation in load varies from three to four hundred per cent. a high speed engine would give better service, as it responds more readily to the varied conditions.

In Canada, where soft coal is used for fuel, the high freight and duty rates make it essential to have boilers of the highest efficiency, without much regard to their first cost. For this same reason, the boiler room should be fitted with fuel saving appliances, such as an economizer, heater, stoker, automatic damper, regulators, etc., etc.

For an electric railway to be a commercial success depends not only upon the economy and efficiency of its power house, and of the roadway upon which to operate the cars, but "How to make it a Success" is the query that taxes the brain of General Managers and Superintendents throughout the country. How to increase the receipts, without materially increasing the operating expense, are the questions the Directors ask at every meeting.

A certain degree of revenue is the reward of all street railways that run cars up and down the thickly populated streets of any of our larger cities, but is it the success, commercially, it might be? There is an old story told of a toad, that stood on the bank of a brook, with its mouth wide open, waiting contentedly for flies to come his way. It seems unnecessary to say that the toad died of hunger.

The attitude of many electric railways to-day, is not unlike the unfortunate toad, and while life may be sustained months, perhaps years, death, in the form of the receiver, comes too often.

It is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. This may be accomplished by various means. The railway company, like any other business concern, has goods to sell, in the way of rides, and no doubt there are times in the day when the manager feels that he is overstocked, and is inclined to put on "Bargain Matinees" to get a full car. He should advertise and let the public know there is an electric railway in town; that its business is to carry people from place to place comfortably and quickly, and that they can't afford to walk; that the time saved in riding will more than pay the fare. There are various ways in which to do this, and methods may be adopted so that the cost is very slight.

One very good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. The different firms supplying the company with materials will advertise for the asking, and the cost to the company is practically nil. This style of advertising is particularly valuable to strangers and tourists. The railway company in London issued just such a little booklet as I mention, about a year ago, and it was a daily occurrence to see a group of strangers taking a ride around the Belt Line with book in hand, pointing out the various public buildings, parks and squares, as the car went along.

A specially illuminated car for trolley parties is a profitable source of revenue, and the effect of the colored lights along the line, as the car passes, is very pleasing. It is a good way to advertise, and tends to popularize the service. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, etc. This brings considerable increased revenue, at a time of the day when cars would otherwise be running light. To what extent a railway company should provide attractions for its patrons, must depend largely upon local conditions. Some companies claim to have profited by this departure, while others have an adverse experience. It is more desirable to have the amusements provided by some one who thoroughly understands it, the company making certain concessions in the way of issuing coupon tickets for admission. In this way, the railway runs no risk and profits pro rata on all increased business.

The selection of employees has more to do with the success of an electric railway than anything else. The idea that anyone can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men who, through these qualities, have brought the railway into public disfavor. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public; keep claims for damages at a minimum or make them a burden, and very often their selection does not receive the care that is exercised in the purchase of ordinary supplies. Every employee should be considered an agent of the company, and should not only be sober and intelligent, but have good judgment and a cheerful disposition. Loyalty to the company he serves, should be his first motto.

With the whole army of employees, loyal, faithful and devoted to their duty, gross earnings will steadily increase and operating expenses be at a minimum, and the stockholders would no longer need to ask if the road was a success.

The growing demand of the public for better accomodation and luxury in the matter of travel and speed, must be met by giving them better cars, more comfortably furnished and more expensively fitted than heretofore. By supplying these demands, the company will add largely to its revenue.

WATER-DRIVEN PLANTS.

By John Murphy

The subject matter of this paper is one particularly suited to the occasion of a convention of members of the Canadian Electrical Association held within a stone's throw of America's greatest cataract, because the operation of water-driven lighting and power plants cannot be even thought of without this mighty force of nature looming up and overshadowing everything else in the lines of mechanical and electrical engineering that have been heretofore attempted.

Remembering what had been done at Niagara towards developing her unrivalled power, it was surely no wonder that the task of dealing with such a subject as the operation of water driven lighting and power plants was undertaken with a great deal of temerity.

The writer desires it to be remembered that the various water power plants with which he has been connected have been made up of units never exceeding 500 h. p. in capacity, and further, that the head of water was in every case, within his knowledge, between *fourteen and twenty-two feet.* These facts are mentioned at the outset so that statements made later on will not mislead.

As close regulation is the most important point in the operation of any electrical plant, I will endeavor to show how this can be accomplished best in a water driven plant, and, as so much depends on the manner of installation, I will dwell for a moment on the importance and method of properly equipping the water wheel gate. I take it for granted that the water wheel itself was placed in position by a competent engineer, due provision made to cope with low water, anchor ice and the many other troubles inherent in the use of water power. This having been done the gate and all its connections, from the water wheel to the hand wheel in the dynamo room, should be so constructed as to move quickly, positively and easily. These parts should, as I have just remarked, move quickly, positively and easily, so that the instant the regulator is actuated by a variation in speed the water wheel will receive its greater or lesser supply of water and thus be enabled to maintain a constant speed.

If the water wheel gate works in the manner described, any one of a number of regulators now on the market will keep the speed variations, and consequent potential variations, within very narrow bounds, and the question of keeping a constant load on the water wheel, with the attendant objectionable operating devices of this system will not need to be considered.

An arc plant with its automatic current controllers, driven by a water wheel equipped as indicated above, will run for an indefinite period with little or no attention, but incandescent lighting and power machinery require somewhat more supervision.

Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in very small units. Incandescent light and power should, I feel certain, never be run from the same water wheel. One of the greatest recommendations for the glow-lamp as an illuminant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit.

The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps.

Where large generators are used and many circuits are run the use of individual circuit regulators becomes imperative. But, I find I am digressing from the theme, and am already well into the consideration of the switchboard, a point I did not intend to raise at all.

Before placing my convictions as to the operation of water driven power and lighting plants before you for vivisection, I desire to mention two little pieces of mechanism which will not only tend to improve a service but may hinder the occurrence of a "run away" with its disastrous results. The first device to which I desire to direct your attention is an automatic speed indicator and alarm, which, as its name implies, always points out the speed at which the machinery is running, and also loudly rings a bell or gong at every change of speed, no matter how slight it may be. The other machine referred to closes the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted in a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or spring being released the frictions are pulled together and the gate is immediately closed down before any damage can be done.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that bane of water power users anchor ice. If wheels are favorably situated, that is if they are supplied from a large pond in which there is little or no current and if there is an overflow or by wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut down can be prevented. But, if the wheels have no still pond from which to draw their water supply it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of the approach of anchor ice.

I have striven to deal in a general and concise manner with the operation of water driven lighting and power plants. So much could be said about each of the various parts of such plants from the wheel pit to the cupola that I have, for the sake of brevity, refrained from particularizing except where it seemed absolutely necessary so to do. Should even a single user of water power derive a benefit from any of my remarks, I shall consider myself amply repaid for the labor expended in placing upon paper my very unassuming sentiments.

THE STEAM END OF AN ELECTRIC PLANT.

By A. M. Wickens.

In view of the fact that we are holding this convention at the place where is situated the greatest water power in the world, where recent developments have done so much to advance the usefulness of large water powers, and the transmission of electric currents to long distances, as well as the establishing of large electrically-driven factories situated near the developed power, it seems almost an anomaly to speak of steam power. The position of a great number of the Canadian water powers is so far removed from commercial and manufacturing centres, *that even with the* present and prospective advance in the transmission of electricity, a very great number of our electrical plants must still rely on steam and the steam engine as their motive power. This being the case, it behooves us to enquire more particularly into the working, the efficiency and cost of operating an electrical plant by steam.

Our friends, the manufacturers of dynamos, *tell us with* some considerable pride of the rapid advancement in this class of machinery, and claim to be able to make a generator that has an efficiency of 95%. This statement, I believe, is reasonably borne out, and leaves us in the position that if we expect any further economy we must look to the prime movers or engines and boilers for it, unless our electrical engineers can approach the glow-worm in efficiency, which makes its light with about one three-hundredth part of the force used in our ordinary incandescent lighting plants or should the electrical engineer reach, in the near future, vacuum illumination, without incandescence, we should have a light at 1/6 or less of the present cost for power. But during the time these inventions are being perfected we must do the best we can with our steam engine and boiler as prime movers in hundreds of our electrical plants. Space and time will not permit us to go into a history of the evolution of the steam engine, neither can we go into the actual merits of the different makes of steam engines. There are many engines running to-day that are running with an efficiency of from 70 to 80%; notwithstanding this the waste between the coal pile and the dynamo pulley reaches 7/8 of the total heat in the coal. Our steam engine is only a heat engine, and is subject to many losses in fact, in some of the old engines, with large cylinders and slow piston-speeds, the water consumption was as high as 60 lbs per hour per H. P., while to-day, with our higher boiler pressures and faster piston-speeds, with early cut-offs, we reduce that to 12½ lbs. water per H. P. per hour.

The heavy cylinder losses in the old, slow-running engines caused engineers, as far back as 1825 to 1836, to look for higher pressures, and at the latter date Mr. Perkins in London succeeded in using pressures from 500 to 1500 lbs. per sq. in. This very high pressure at that time was only expanded eight-fold, and even under such adverse circumstances gave a H. P. for about 12 lbs. of water per H. P. per hour. Some of the earlier engines gave 5,000,000 foot lbs. per hundred lbs. of coal. Watt built engines that gave a duty of 100,000,000 to 120,000,000 foot lbs., while some of the modern compounds give from 130,000,000 to 150,000,000 foot lbs., thus showing a reduction in fuel from 12 lbs. per indicated H.P. to 1½ lbs. or even 1¼ lbs. for each H.P. The ratios of expansion have also materially increased from twofold to twenty-fold—and thermo-dynamic considerations say we should still increase the number of expansions. The engineer in striving after too many expansions may find himself over-weighted with engine friction and internal wastes by using too many cylinders to accomplish his object. A recent engine built at Sibley College, with four cylinders, operated under 500 lbs. pressure, at high speed, is claimed to have developed a H.P. with less than 10 lbs. water per H.P. per hour. It is, of course, fitted with *re-heaters* between each of the cylinders, and is carefully covered to prevent loss of heat by radiation.

Our greatest loss is the loss of the latent heat in the steam discharged into the atmosphere or condenser, and as far as known is unavoidable. The combustible in one pound of coal will contain about 14,500 heat units. A well-designed and properly set boiler will deliver to the engine for work in the cylinder 70%, or 10,000 heat units for each pound of coal burned. If this was all utilized we would have a H.P. for 0.26 of a pound of coal per hour. But by the highest engine efficiency yet attained we use 1½ lbs. coal per H.P. hour, or only about 17% of the energy delivered by the boiler is converted into mechanical work. It is safe to say the average engine of the best makers, running in the electrical plants in Canada, requires at least 3½ lbs. coal per H.P.

hour, thus discharging into the atmosphere over 90% of the energy supplied by the boiler. There are cases where the coal consumption is even higher than 9 lbs. per H.P. per hour, but these are either the result of avarice or ignorance—avarice in men who are imbued with the idea that a cheap boiler and engine is an economical machine and that it can be operated by cheap labour; and ignorance on the part of men who claim to be engineers, but who are only dabblers in mechanics, slick salesmen or merely stoppers and starters in the engine room.

The evaporation of water per lb. of coal varies to an alarming extent, and goes from 5 or 6 lbs. to 10 or 11 lbs. water per lb. of coal. Among the various causes for this, is the different calorific values of the coal itself, the difference in the construction of the boilers, the numerous different kinds of setting, and most of all the kind of a fireman you have shovelling the coal into the furnace. The average evaporation with ordinary return tubular boilers does not exceed 6 lbs. water per lb. of coal burned. If the boiler is well set and well fired an evaporation of 8 lbs. water can be obtained. This supplied to an engine giving a H.P. for 3½ lbs. coal per H.P. hour, would represent a water consumption, as per indicated card, of 28 lbs. water per H.P., and is called good practice. If we increase the evaporative capacity of the boiler and evaporate 9 or 10 lbs. water, we are making a great saving. Again, if we increase the efficiency of the engine until we only consume 15 lbs. of water, we have also made a saving that will look well at the end of the year's accounts. Even with our best arrangements our heat losses are great, and engineers are looking for further improvements.

Among the most recent is the superheating of the steam, a plan that was very fully tried and discarded about 30 years ago. The practical difficulties supposed to be prohibitory to the use of super-heated steam, seem to have been overcome, later experience having shown that by purifying feed water the parts of the super-heater do not show signs of scaling, burning or other injury, and with the improved lubricating oils no further difficulty need arise in the pistons or wearing parts of the cylinders. In a recent paper on super heated steam engine trials, read before the British Institution of Civil Engineers, by Professor Wm. Ripper, M. Inst. C. E., the author says: "The heat expended in super-heating reduced the amount of heat employed in evaporation of water; but the heat so diverted for the purpose of super-heating, was shown to be productive of a considerable gain in thermal efficiency. Thus an expenditure of 5, 10 and 15% of the furnace heat to superheat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied. When the load on the engine was fairly constant very little regulation of the super-heat was necessary, and the temperature of the superheated steam in the coils remained remarkably steady. When the steam was superheated it was in a more stable condition than without super-heat, and if the steam contained sufficient excess heat, the steam in the cylinder could be rendered dry at cut-off and release, thus removing all water in the cylinder, which is the great loss in the cylinder, also reducing the amount of heat exchange between the steam and the cylinder walls. One example shown was with steam at 120 lbs. pressure per sq. in. superheated to 674 degrees Fah., which in use reduced the steam consumption from 38.5 lbs. to 17.05 lbs. per indicated H.P. per hour. The rate of decrease of steam consumption being approximately uniform within certain limits, the best results were obtained when the steam was supplied at about 650 deg. Fah. at the engine. It is also important to cover cylinders and pipes with good non-conducting material to maintain the high temperature as long as possible."

This shows that engineers are looking for higher temperatures without increase of pressure as one means of improvement and economy. Thermo-dynamics tell us, and the whole trend of modern steam engineering convinces us, that higher temperatures and pressures, increased ratios of expansion and higher piston speeds are all conducive to a greater economy in the use of steam.

For the larger electrical plants, that is those of one or two thousand horse power we need hardly say very much, because they generally have some one at their head with sufficient engineering ability to make a fairly economical running plant—that is, if the board of directors will allow them to spend enough money for this purpose. These larger plants are usually in our cities, where ground is valuable, and oftentimes water for condensing purposes is not obtainable. To these plants a way is open for cheapening the cost of operation by adopting a water-cooling tower and circulating pump, the cost and operation of which was so carefully gone into last year by Mr. E. J. Philip in his paper on that subject.

The smaller stations—and their number is nine-tenths of all our electric plants—are in a somewhat different position; in fact, many of them are paying a very small return for the money invested. The problem for many of them is: What can I do to make ends meet? In many cases this is not surprising to the engineer. The plant perhaps consists of one, two, or more engines, bought more with a view to saving first cost than anything else. The boilers are also the same—perhaps overrated as to capacity; the setting of each is poor, and their relative positions are bad; chimney drafts not good; boiler tops and domes uncovered; steam pipes bare, feed water pipes bare, and a few small leaks here and there of steam and water—the whole topped off with an engineer (?) at the munificent salary of $1.00 to $1.25 per day of 12 or 13 hours. No part of this plant is clean, and in engineering cleanliness is next to godliness; the man has neither time nor inclination for such work. The boilers are dirty, too, for want of cleaning out and the proper appliances to do it with.

Let us see what some of these things mean in coal. In the first place, a badly set boiler with a few small cracks here and there will not evaporate more than 4 or 5 lbs. of water with 1 lb. of coal, while a well set and well fired boiler of the same kind will most likely reach 7 or 9 lbs. water with 1 lb. coal. This is a loss of from 25 to 35%. The main steam pipe is uncovered. What does that mean in coal? We will suppose the steam pipe is four inches diameter and 40 feet from boiler to stop valve at engine. Each square foot of this pipe will condense ½ lb. of steam per hour, and each foot in length represents one square foot of surface; we have 20 lbs. steam per hour lost. An all-night run will average 11 hours per night, and the steam lost per year is 80,300 lbs., and, with your poor evaporation, 8 to 10 tons of coal per year. If your steam pipe is large and longer than the above, it will cost correspondingly more. If your pump pipes and heater are bare, the loss from this will be from 30 to 40 degrees to your feed water, which means respectively 3 and 4% of fuel. If you are burning 2½ tons coal per day, this means a ton of coal every 10 days. If the domes and boiler top are uncovered, and the boiler is 6' x 14, you will have 90 sq. ft. exposed, and the loss in coal will be double the loss in your steam pipe—say 19 tons coal per year. If the boiler is scaled inside, the conducting power of scale is very low being, according to D. Rogers, as 1 is to 37½. Nystrom tells us that with clean plates ¼-inch thick steam at 75 lbs. pressure can be produced by heating the plates to about 325 degrees, while if ½-inch scale intervenes, it will be necessary to heat the plates up to 700 degrees—very nearly a low red heat—and a heat at which the iron becomes granular and brittle; a scale of 1/16 of an inch thick requires 15% of fuel extra.

The troublesome substances in our feed waters are earth, clay, bicarbonates of lime, sulphate of lime, chloride sulphate of magnesium, carbonate of soda magnesia, dissolved carbonic acid and oxygen, iron and acid. These substances can all be treated in such a way that they will be removable. Some require caustic soda and lime, some need barium, others require chloride; all organic matter needs alum or fessic, and should be filtered.

If boilers are kept clean and well fired, the saving in coal amply pays for the cost, leaving a good margin of profit for the proprietor. A small leak through the exhaust valve of the engine soon makes itself apparent in the coal pile. Badly set engine valves are often prolific sources of loss; I have corrected engine valves and made a saving in coal of 12%.

To the owners of the smaller plants I would say, make the best of what you have got; stop all the small leaks and losses, get more of the heat in the coal into the engine, and keep the engine right. If you are burning 1,000 tons of coal per year you can save at least 25%, or 250 tons, by keeping everything right; 250 tons of coal means in many places $1,000. This in many places can be saved by expending 40 or 50% of it the first year—after that it should all be saved. Get a thoroughly well posted engineer to look over your plant and advise you as to where savings can be made; don't go to a civil engineer or to an electrical engineer, consult a mechanical engineer. If you had a bad fever you would not go to a dentist for treatment. Go to the right kind of an engineer, pay him for his advice and follow it, and make an ordinary electric plant a reasonably good paying investment.

DAY LOADS FOR CENTRAL STATIONS, AND HOW TO INCREASE THEM.

By J. A. Kammerer.

At no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants.

As an evidence of this, there is no more encouraging sign, than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using.

This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric cur[illegible], and the compensation received therefrom.

Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated.

The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work, who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business.

The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "what is its efficiency?" not "what is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured.

It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night-work, they should not look for a day load, any more than a woollen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woollen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woollen mill would either have to close up, or make its plant investment work day and night to make ends meet.

Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand, a central station operating a lighting load only is handicapped, because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant.

The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in, and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum investment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load.

The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect.

With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need lie idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load.

The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone.

The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day.

Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured.

In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to install this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons.

While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours. This must be taken into consideration as making the night-load more remunerative at a very small added cost.

These briefly are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the day-time tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIGHTING AND POWER.

By W. A. Johnson.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste.

Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be less in most cases than the cost of generating plant.

When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h. p. output, owing to the increase in the working staff.

On the contrary, to increase the capacity of a station with accumulators requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30% more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary.

The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage.

No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h.p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals.

The management of the large stations in Boston, Brooklyn and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsation of the practicability of accumulators.

In Germany, France and England they have been largely used for years past.

Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The population of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:—

Company.	H. P. Hour Capacity.
Hartford Electric Co.	3,000
Boston Edison Co., four batteries, a total of	7,400
New York Edison Co.	3,200
Brooklyn Edison Co.	1,600
Germantown Electric Light Co.	300
Electric Railway, Light & Power Co., Anaconda, Montana.	500
Woonsocket Electric Machine & Power Co.	400
Eastern, Pa., Edison Co.	200

These last three plants are used both for railway and lighting work

As good an illustration as I can give of the application of the storage battery to railroad work is to refer to the equipment of the *Union Traction Company of Philadelphia, who use a battery* of 400 h. p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of feeder formerly in use frequently varied as much as 50% ; the battery, however, gave practically a steady pressure at all times. Railroad men need not *be told how much better for their motors and controllers the* maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100%.

In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries.

Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens *from* any cause.

Some of the electric street railroads in Canada serve a district up to 7 miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radical lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified *gravity* (1,200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased.

The claim has been made and experience seems to prove it true that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as, if judgment is used in *proportioning the size of battery to generating plant,* the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it the following gives in figures the actual conditions obtained in a plant now working:—Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90%, 93 h.p..; total steam plant required, if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18¾ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h. p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500-volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity ; in fact, being equivalent to that installed by the Union Traction Company in the before-mentioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple ; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the key note to successful battery operation. While in general the reading of the volt-meter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street commercial and residential lighting which is now operated by steam.

SPARKS.

Mr. L. O'Connor has been appointed electrician of the town of Thorold, Ont.

An electric light plant will shortly be put in running order at Woodville, Ont.

The town of Tilbury, Ont., will vote on a by-law to raise funds for improving the electric light plant.

The Goldie & McCulloch Co., of Galt, Ont., are building a 150 horse power engine for a flour mill in South Africa.

Mr. Henry Surtees, son of the city engineer of Ottawa, has been engaged as chief electrician of the Quebec District Electric Railway.

Mr. Geldart, engineer for Messrs. Dyment & Baker, London, Ont., in renewing subscription to the ELECTRICAL NEWS, states that he finds the paper very interesting and instructive.

By the collision of a freight motor and a passenger trolley car on the Galt, Preston and Hespeler electric railway, several passengers and the conductor and motorman were slightly injured.

Wm. Snider & Co., who have recently entered the electric lighting field at Waterloo, Ont., are putting in a 75 horse power Corliss engine to operate their dynamos, which were purchased from the W. A. Johnston Co., of Toronto.

Only one tender having been received for lighting the town of Owen Sound by electricity, the Fire and Light Committee of the council have recommended the purchase of a civic lighting plant, the cost of which is estimated at $27,000.

We are informed by Col. Stacey, of St. Thomas, Ont., that arrangements are likely to be completed at an early date for the conversion of the street railway in that town to an electric system, *with radial lines extending to the adjacent villages.*

A proposition was recently made by the Chatham City and Suburban Electric Railway Company to construct a radial railway, with the city of Chatham as the centre, and to supply that town with 100 electric lights at $7,500 per year. The arrangement was to take the form of a bond guarantee, given by the city of Chatham, under which the company could float its securities. Voting on the by-law took place on May 29th, but the result was the defeat of the proposition. Col. Geo. C. Rankin was one of the promoters of the enterprise.

The longest electrical transmission plant in the Dominion of Canada was put in operation May 13, 1897, near Three Rivers, Que. This plant was installed by the Royal Electric Company of Montreal for the North Shore Power Company, and transmits 700 h.p. from Grand Chute, on the Batiscan river, a distance of 17 miles, to the city of Three Rivers, Que., where the power is used for arc and incandescent lighting, as well as for power. S. K. C. two-phase apparatus is used throughout. A full description of this, the first long distance plant of such high voltage in Canada, will be published very shortly.

By a regulation of the Inland Revenue Department made on May 7th, 1897, a change has been made in the inspection of electric light meters, by which the charge is now made according *to the number of lights* instead of amperes. It was found that the regulation of the fees by amperes was so perplexing that it was advisable to change the basis, and the rates are now as follows: Meters of 10 lights and under, 75 cents; over 10, and under 20, $1.25; over 20, and under 30, $1.75; over 30, and under 45, $2.25; over 45, and under 60, $2.75; over 60, and under 80, $3; over 80, and under 100, $3.50; and for every 20 additional lights, or fraction thereof, 50 cents. A light means a 16 candle-power incandescent lamp, consuming electrical energy at the rate of 15 watts.

TRADE NOTES.

The London Electric Motor Company, of London, Ont., has recently installed a ten h.p. motor for Norway Cabinet Co., and a two h.p. motor for Mr. Wilcocks, corner Dufferin and Dundas streets, Toronto.

The W. A. Johnson Electric Company, Toronto, are at work on the dynamos for two new steamboats for the Lake of the Woods and Seine River mining district. They also report recent sales of their motors to Montreal, Kingston, Ottawa, Berlin, Preston and Toronto.

On the 1st of April, conducted by Mr. O. E. Granberg, Boiler Inspector, and Mr. Alfred Trevethick, M.E., Montreal, a test was made of the Jones Underfeed Mechanical Stoker, recently installed at the Windsor Hotel in that city. The result is said to have shown an economy over hand firing under former conditions of 46.7 per cent. The T. Eaton Co., Ltd., of Toronto, are replacing three Hawley down draft furnaces with the improved stokers.

The W. A. Johnston Electric Company, Toronto, report the sale of direct current generators and engine and boiler for the ne mining town of Mine Centre, Ont., this plant to be used for commercial lighting and power. They have made a recent shipment to the Lachine Rapids Hydraulic & Land Company of one car load of Wagner transformers, weighing 44,000 lbs., and of a capacity of 18,000 lights, and announce a further sale to the same company of 450 kilowatt transformer capacity and voltage 4,000 x 1,000 volts.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing *actual mathematical problems, wish to* briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined *in this journal*, *commencing at* the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace :

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object : on *the contrary, every problem* will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE II.]

DECIMAL FRACTIONS.

A DECIMAL fraction is one whose fractional units are tenths, hundredths, thousandths, etc.

[NOTE.—The denominator of a decimal fraction is not expressed as in common fractions; instead of expressing the fractions $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, they would be decimally expressed as .1, .01, .001.]

The decimal point is the character (.). It signifies the decimal when placed on the left of the fractional units expressed, and separates the integer from the decimal, as it is on the right of the former and on the left of the latter.

Decimal places consist of the number of figures on the right of the decimal point.

The value of each place is shown in table of decimal notation :

DECIMAL NOTATION.

Hundred Millions	Ten Millions	Millions	Hundred thousand	Ten Thousands	Thousands	Hundreds	Tens	Units	Decimal point	Tenths	Hundredths	Thousandths	Ten thousandths	Hundred thousandths	Millionths
4	0	1	2	3	5	4	0	9	.	4	7	8	3	4	2
9th	8th	7th	6th	5th	4th	3rd	2nd	1st		1st	2nd	3rd	4th	5th	6th
Integers										Decimals					

[NOTE.—It will be observed that the integers are numerated from right to left, and the decimals from left to right. Thus the figures on the left of the decimal point express the number of units or integers, and those on the right of the decimal point the number of tenths or decimal parts of a unit.]

A pure decimal is one in which no integer or common fraction is expressed.

Thus .5, .125, .0625.

A mixed decimal is one which contains an integer and a decimal.

Thus 4.5, 3.125, 84.0625.

The chief principles of decimal notation are :

1st. Annexing ciphers to a decimal does not effect its value. Thus, if a cipher be annexed to the decimal .1, it would then be .10, and changed from tenths to hundredths, but the fractional units are increased tenfold; hence no change in value takes place.

2nd. Prefixing a cipher to a decimal fraction and moving decimal point to the left decreases the value of the decimal tenfold, or is equivalent to dividing by 10.

3rd. Moving the decimal point to the right one point increases the value of the decimal tenfold, moving two points one hundred-fold, etc.

4th. Moving the decimal point to the left one point decreases the value of the decimal tenfold, moving two points hundred-fold, and so on.

5th. The numerator of any decimal is the number of fractional units it contains, and its denominator is 1 followed by as many ciphers as there are places after the decimal point.

[NOTE.—Thus, in the decimal .125 the numerator is 125, and since there are three places after the decimal point, the denominator is 1 followed by three cyphers, and fraction is read $\frac{125}{1000}$.]

It is important to the reader that the principle of decimal notation be thoroughly understood, since our scientists almost without exception adopt the metric system and express their formula and observations by decimal notation, and since micrometer gauges, calipers and rules are now in universal use, it is just as important that the principles of conversion of common fractions to decimal fractions and vice versa be equally well understood.

ADDITION OF DECIMALS.

Addition of decimals is the *process of finding the sum of two or* more decimals, and becomes an easy process once principles of decimal fractions are well understood.

Rule : *To find the sum of two or more decimals, so place the* decimals that the figures of same order shall fall in same column. Then add as in simple addition, placing the decimal point in the result between the integer and decimal.

Find the sum of 1.0625, .45, 87.5, .0007.

Proceed thus,

```
 1.0625
  .45
87.5
  .0007
89.0132 = Total.
```

SUBTRACTION OF DECIMALS.

Subtraction of decimals is the process of *finding the difference* between two decimals.

Rule : To find the difference between two decimals, place the less decimal or subtrahend under the *greater decimal or minuend*, so that the figures of any order or denomination in the subtrahend shall fall under those of the same order or denomination in the minuend. Subtract as in *simple numbers, placing the decimal* point in the result between the integer and decimal.

Example : Find the difference between .6504 and 75.9735.

Process as by rule :

```
75.9735 (minuend)
  .6504 (subtrahend)
75.3231 (difference)
```

Example : Find the difference between .00785 and .625.

Process :

```
.625
.00785
.61715
```

MULTIPLICATION OF DECIMALS.

Multiplication of decimals is the process of finding the product when either the multiplier or multiplicand, or both, are decimals.

Rule : To multiply an integer by a decimal, or vice versa.

Set the factor containing the least number of figures as a multiplier and other factor as the multiplicand, proceed as in simple numbers. Point off as many decimal places in the product as are contained in BOTH FACTORS. If the product does not contain so many places, PREFIX ciphers to supply the deficiency.

Example : Multiply 147. by .75, proceed as per rule.

```
 147.
  .75
 7 35
102 9
110.25
```

Since both factors contain but two places to the right of the decimal point, we require to point off this number in product.

Example (2): Multiply .75 by .625.

```
 .625
  .75
 ----
 3125
4375
-----
.46875
```

Since both factors contain five decimal places we point off this number in product.

Example (3): Multiply .0625 by .075.

```
  .0625
   .075
  -----
   3125
  4375
 -------
.0046875
```

Since both factors contain seven decimal places and product but five, we require to prefix two ciphers, and set decimal point to the left.

DIVISION OF DECIMALS.

Division of decimals is the process of finding the quotient when either the dividend or divisor or both are decimals.

Rule: To find the DECIMAL QUOTIENT when the divisor and dividend are both whole numbers, and the divisor is greater than the dividend, or when the divisor is not contained in the dividend an exact number of times.

Add as many ciphers to the dividend as there are decimal places required in the quotient, divide as in simple numbers, and point off from the RIGHT of the quotient as many decimal places as there have been ciphers added to the dividend, and USED, prefixing ciphers to the quotient if necessary.

Example: Divide 75 by 1506 to 4th decimal place.

Process as per rule:

```
1506)750000(.0498
     6024
     -----
     14760
     13554
     -----
      12060
      12048
      -----
         12
```

Since we wish to extend to fourth decimal place only, we annex to dividend four ciphers and proceed as in division of simple numbers, and get 498. Since, however, we annexed four cyphers to the dividend, and therefore require four decimal places in the quotient, we must prefix one cypher, and quotient will then read .0498, proving that the factor 1506 is contained in the factor 75 .0498 times, or that 75 is .0498% of 1506.

Example (2): Divide 743 by 125.

```
125.)743.000(5.944
     625
     ----
     1180
     1125
     ----
      550
      500
      ---
      500
      500
```

Here we have an example where two whole numbers are to be divided an exact number of times. Since we find the divisor is contained in the dividend 5 and a fractional times, we add to the dividend a cypher and bring this down and annex to the right of the remainder, as in division of simple numbers, repeating this process until there is no remainder. We then proceed to ascertain the number of ciphers annexed to the dividend, and point off a corresponding number of places in the quotient, counting from the right. In example the 125 is contained in 743 exactly 5.944 times.

Example (3): Divide .9735 by 50.

```
50).97350(.01947
     50
     ---
     473
     450
     ---
      235
      200
      ---
      350
      350
```

Here we divide a decimal by a whole number, proceeding exactly as before, and since the decimal contains four places to the right of the decimal point, and we require to add a cipher so as to have no remainder, we necessarily require quotient to contain five decimal places, and have to prefix a cipher to the quotient to bring about this result.

To divide when both divisor and dividend are decimals, and the divisor contains more decimal places than the dividend

Rule: Add ciphers to the dividend until it shall have as many places as the divisor; then proceed as in simple numbers.

Example: Divide .125 by .0515.

```
.0515).12500000(2.4270
       1030
       ----
        2200
        2060
        ----
         1400
         1030
         ----
          3700
          3605
          ----
            950
```

This is an example of the application of principle 1. While we annex to the dividend a cipher we in no way change its value, and since we find .0515 to be contained in .125 two and a fractional times, we proceed by process already illustrated to extend to the fourth decimal place.

To divide when both divisor and dividend are decimals, and the dividend contains more decimal places than the divisor

Rule: Divide as in simple numbers, and point off from the right of the quotient as many decimal places as the decimal places in the dividend are greater in number than those in the divisor.

Example: Divide .5000 by .125

```
.125).5000(4.0
      500
      ---
      000
```

The application of both these rules is demonstrated in previous example. Since, however, we want to make the principle clear, we repeated in another form. The writer wishes especially to impress on the student the great importance of thoroughly mastering the principles of calculation contained in these exercises in common and decimal fractions. A thorough knowledge of the principles involved is of immense benefit in computing much of the formula we shall at a later date meet with; in fact, unless our knowledge of these principles is thorough we cannot hope to properly appreciate all the good things that the scientist has prepared for us.

There remains for illustration yet what concerns many of us, i.e., the principles involved during the conversion of common to decimal fractions and vice versa, which I will briefly illustrate before closing this number.

Since the denominator of a simple fraction is always larger than the numerator, to reduce or convert a common fraction to its equivalent decimal fraction we have to follow one of the rules already laid down for the division of decimals, dividing the numerator by the denominator and adding ciphers as required.

Example: Reduce $\frac{15}{16}$ to a decimal fraction.

```
16)150000(.9375
   144
   ---
     60
     48
     ---
     120
     112
     ---
       80
       80
```

Since we had to add to dividend four ciphers, we place the decimal four places to the left, counting from the right, hence $\frac{15}{16}$ reduced to decimals=.9375.

Example: Reduce .9375 to common fractions.

Since the numerator is 9375 and the denominator 1, with as many ciphers added as there is decimal places in the numerator, then fraction will be set thus $\frac{9375}{10000}$, which we reduce to simplest form:

$$\frac{9375}{10000} = \frac{1875}{2000} = \frac{375}{400} = \frac{75}{80} = \frac{15}{16}$$

HOW TO SELECT AN ELECTRIC PLANT.

By Geo. White-Fraser.

At this present there are in the Dominion six different types of alternating machines manufactured in the country; six different types of arc machines; seven of direct current; four, if not five, different types of transformers. Besides these, that are all of Canadian manufacture, there are several American manufacturing companies who have agencies in the principal cities in the Dominion. It is not, therefore, any exaggeration to say that persons desirous of purchasing a generator can choose from probably at least ten different makes, all of them presumably good. The science of electrical design and construction is not by any means the monopoly of one or two individuals, nor need it by any means follow that the most wealthy manufacturer will get out the best machinery. Because A sells five times as much machinery as B does, it is not a safe assumption that A's machinery is greatly better than B's, unless there be some other evidence in support of it. The safe assumption is that A can afford to advertise more widely than B. There is no good reason why the very best machine should not be sent out of the smallest shop, nor is there any good reason for assuming that any one machine is better than any other machine simply because it bears a well-known name. Of the designers of the ten different machines referred to above, probably every one had the same facilities for acquiring technical knowledge, probably studied the same text-books; they can all buy their copper and iron in the same market for the same price, therefore there is no reason for crediting one particular machine among them with inherent superiority to the others. In fact to do so would probably be to unjustly decry the others. At the same time, it is only reasonable to suppose that ten different designers, working independently, and in competition, will produce results which, although all very good, will differ among themselves and present features which will appeal to different persons with varying weights. And so it is in fact—these ten makes include no less than six different types, and each one of the ten discloses different data. One make has a high full load and a low half load efficiency; a second reverses this. A third compounds the machine with an ironclad armature; a fourth claims superiority for a rotating field, while others say this, that and the other; and as they all ask different prices, it is sometimes no easy matter to come to a fair and correct decision as to their true comparative values to the purchaser. As such purchaser is going into electric lighting as an investment for money, it becomes a serious consideration for him, which really is the best machine as an investment—which one will make most money for him? Even before this, comes the question, "Is an alternating or a direct current system better for such and such a particular case?" This is not a fanciful consideration at all, but one having a direct bearing on dollars and cents. The alternating system was developed to meet peculiar conditions, and unless those conditions exist it has no advantage over the D. C. It is a question of prices principally, and so directly affects the pocket of the purchaser. The cost of an electric lighting plant includes generator, belts, wires, transformers, lamps, etc., and although an alternating 1000 volt generator may cut down the cost of distribution wires very greatly, it must be remembered that transformers will be necessary, and their cost will bring up the price of the alternating system with small wires more nearly to that of the D. C. system with larger ones. Assuming even that the cost of the two systems is the same, the D. C. possesses the advantage, because it has no transformers to introduce copper and iron losses. It will therefore be evident that whether an alternating or a direct current system is better for any particular case depends entirely on local conditions and the prices at which machinery and apparatus can be purchased. For certain conditions the D. C. is distinctly the best; for others it will be immaterial which is adopted, while for still others the alternating should be preferred.

Then "what size of plant will be the best investment?" Local conditions in this case again should decide. To blindly jump to the conclusion that a "1,000 lighter" is best is simply to lend money without inquiring as to the security. The capacity of a plant should be decided on with direct reference to the population, the class of residences, the number of stores, hotels, churches, halls, etc. It is not the total number of lights wired up that should decide the generating capacity, but the estimated maximum amperage at full load, which is very different. If the number of store lights is a very large proportion of the total, a generator of greater amperage will be required than if there be few stores and a number of residences. In an average town of 2,000 population it is a great mistake to place a so-called "1,000 light" machine, or a 60 k.w. It is very improbable that more than 1,200 lights can be sold altogether, including residences, churches and hotels; and most likely the greatest number of lights burning at any one time during the year will not exceed 800, while the minimum will be 100 (this has been the writer's experience). A 50 k.w. machine will give this perfectly well if well constructed, and will not only be less expensive to buy, but will require a smaller engine, less steam, etc., and so save money. Under these circumstances a 50 k.w. is the better investment. When these matters have been settled, and tenders are in from the various manufacturing companies, it may be supposed that it is a simple matter to make a proper selection. It is, however, not so, as will appear from the following illustration taken from an actual case.

Specifications called for a 35-ampere, 2,000-volt alternator, and six tenders were received, the proposed data being as under :—

Tender.	Type of Armature.	Amperes.	Efficiency.	Regulation.	Heat Limit.	Price.	Make.
A	Ironclad	30	90%	Compound	70° F.	$1,900	Canadian
B	Inducter	35	90%	6%	70° F.	2,100	"
C	.. ..	35	90%	6%	70° F	1,750	Imported
D	Toothed	30	90%	Compound	50° F	1,510	"
E	Surface	30	9 %	Compound	....	1,447	Canadian
F	Inductor	30	92%	8%	50° F.	1,750	Imported

The armature of "C" was a peculiar type, ribbon wound, quite excellent, not classed either as Inductor nor Ironclad nor Surface. Armature of "D" was not strictly ironclad, but possessed machine wound coils slipped over polar projections on a rotating armature. Which of these machines was the best investment? Judging on a purely price basis "D" was the best; on a purely ampere-wattage basis "B" and "C" were equally good; in point of efficiency "F" was much the best; in point of regulation the compound wound ones should be taken. The best limit of "D" and "E" was 20° better than the others. Which is the most important consideration? The one with the highest efficiency, "F," is $260 more expensive than the lowest in price, but has 2°/. higher efficiency, and equal heat limit. What is the money value of this higher efficiency? for "F" is undoubtedly entitled to ask a higher price than "D."

The considerations that should decide the selection are:

I. Electrical and mechanical efficiency.

II. Mechanical excellence, and probable freedom from repairs.

III. Heat limit and regulation.

IV. Price.

Taking No. I consideration it seems plain that A and B are out of it; they are the highest in price, highest heat limit and lowest in efficiency. They may therefore be dropped unless any importance is to be attached to home manufacture. In the particular case from which the illustration was taken E was ruled out for reasons having no place here. That left the matter between C D F. These three machines therefore must be compared, and in order to do so it is necessary to reduce them all as far as possible to some standard. It is convenient to reduce them all to the standard of F in point of efficiency, which means that as both C and D will require more coal burnt to generate the same amount of current as F, it is only fair to F to add on to the prices of C and D the capitalized value of the extra coal consumption. It is evident that C will thus have a higher price than F, and as the 20° lower temperature guaranteed for F at 30 amperes may be assumed to compensate for the extra 5 amperes guaranteed for C, we may drop C out of the question, and compare D and F. This difference in efficiency of 2%, will cause an extra consumption of at least $15 worth of coal per annum, or capitalized at 5%, a difference in value of $300. This will bring up the price of D to $1810. The new values for the machines, taking efficiency into account, will be therefore: A, $2200; B, $2400; C, $2050; D, $1810; F, $1750.

Now take No. II, or mechanical excellence and probable freedom from repairs. Any unprejudiced person would at once admit that B, C and F, owing to their construction and design, were probably less liable to injury than any of the others, and more easily repaired if injured, and that D was in this respect better than A. The fact that C and F are imported machines is of practically no importance at all, for nowadays any competent mechanic can repair any armature, and nearness to the factory where it was made is of negligible advantage.

Considerations III and IV have already been taken.

The result of the whole thing is that as an investment F is the best machine.

It is, however, very wrong policy to accept paper guarantees with no intention of proving them by actual test. In the above case F was chosen on the merits of guarantees; if those claims be not fulfilled, then F is not worth as much money relatively as was asked for it. If, therefore, the machinery is bought on the basis of guarantee only, without any subsequent test, then the most reputable makers will always be left out, and the most worthless machinery be taken. It is not a difficult matter to make tests, and it ought always to be done. The purchaser who formulates no scheme of his own, but requests not only tenders, but also suggestions and advice from different makers, is doing an actual injustice to every manufacturer in the market, and also to himself. Every manufacturer is honestly intending to sell good stuff and give good advice, but as they may not all look at the thing the same way, the result will be that a good many will tender on larger machinery than the purchaser will be satisfied with, and will consequently lose business through no fault of their own. A purchaser should give every one a chance, and not give any inside tracks or undue favor. And above all things—an electric lighting or power business should be recognized as an investment for money, and as subject to the same business principles that guide all other business.

A LONDON ELECTRIC LIGHT PLANT.

Messrs. D. S. Perrin & Co., of London, are putting in an entirely new engine and boiler plant for their large factory, together with the first isolated electric light plant in London. The plant and system are being installed under the supervision of Mr. J. H. Dickson, consulting engineer, of London, and consists of a 75 h.p. 13 x 50 Wheelock engine, from the shops of Goldie & McCullough, Galt; two 66 x 16 boilers, carrying 100 lbs. pressure, with new and improved system of forced draft, using a 70 in. steel blower, having 550 revolutions to the minute. The blower only consumes 4½ h.p. running full capacity. They are also putting in a light generator from the works of the London Construction Co., and a 10 h.p. motor, 250 volts, the latter to transmit power across street to one of their factories, thus enabling them to abandon the tunnel under the street which they have hitherto used. Their volt meter is from the well-known German firm, Allgemeine Electricitats Gesellschaft, of Berlin, Germany. A new octagon chimney, 50 ft. high, 46 in. diameter, is also being built. All returns from steam heating kettles are returned to an automatic tank pump. The boiler room is fitted with exhaust heater and duplex pump. When finished this plant will be a credit to London, and speaks well for the enterprise of the firm.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 7.50	A. M. 4.00	8.10
2......	" 7.50	" 4.00	8.10
3......	" 7.50	" 4.00	8.10
4......	" 9.40	" 4.00	6.20
5......	" 10.10	" 4.00	5.50
6......	" 10.40	" 4.00	5.20
7......	" 11.20	" 4.00	4.40
8	" 11.50	" 4.00	4.10
9......	....	.... }	3.40
10......	A.M. 12.20	.... }	
11......	" 12.50	" 4.00	3.10
12......	" 1.20	" 4.00	2.40
13......	" 1.50	" 4.00	2.10
14......	No light.	No light.	....
15......	No light.	No light.	....
16......	No light.	No light.	....
17......	P. M. 8.00	P. M. 10.20	2.20
18......	" 8.00	" 10.50	2.50
19......	" 8.00	" 11.30	3.30
20	" 8.00	A. M. 12.00	4.00
21......	" 8.00	" 12.20	4.20
22......	" 8.00	" 12.50	4.50
23......	" 8.00	" 1.10	5.10
24......	" 8.00	" 1.40	5.40
25	" 8.00	" 2.10	6.10
26......	" 8.00	" 2.40	6.40
27......	" 8.00	" 3.20	7.20
28......	" 8.00	" 4.00	8.00
29......	" 8.00	" 4.00	8.00
30	" 8.10	" 4.00	7.50
....	....	....	......
		Total,	139.10

The Sherbrooke Gas & Water Co., Sherbrooke, Que., have recently made extensive additions and alterations in their plant. Their station has been enlarged, and they have also installed two additional water wheels. They have increased their electrical plant by one 180 k.w. and one 75 k.w. S. K. C. two-phase generators, in addition to the 75 k.w. S. K. C. two-phase generator which they purchased about a year ago from the Royal Electric Company, and which makes their plant one of the most complete incandescent plants in the Dominion. The management of this company have installed a power circuit from their alternating two-phase apparatus, and are now serving power and light successfully from the same generators and lines.

It is said that there are 560 miles of electric roads in Europe, which is an increase of 125 miles in one year. The number of electric cars has increased from 1236 to 1747 in the same time. Germany has 250 miles of electric roads, and 857 motor cars. France has 82 miles, and 225 motor cars. Great Britain has 65 miles, with 168 cars, and Austria-Hungary has 45 miles, with 157 cars. Next comes Switzerland, Italy, Spain and Belgium, in the order given, while Russia has but one electric railroad, with 6 miles of track and 32 motor cars, and Portugal ends the list with 1⅞ miles. Of the 111 European lines 91 are overhead trolleys, of which there were 35 in Germany, 12 in Switzerland, 10 in France, and 7 each in England and Italy, and 6 in Austria, Hungary, etc. Of electric roads with underground current there were but three at the beginning of this year, one each in England, Germany and Hungary. Nine lines are provided with an insulated central track, through which the current is conducted, eight of these railroads being in Great Britain and one in France. The remaining eight lines are provided with accumulators. Of these, four are in France and two in Austria, and one in England and the Netherlands.

SPARKS.

Watford, Ont., has two rival electric light companies, both having recently installed new plants.

It is the intention of the London Street Railway Company to extend their line to the village of Pottersburg.

The Electric Light and Power Company have offered to furnish the town of Dundas, Ont., with 25 street lights of 1,600 candle power for 300 nights a year at $61.25 each.

The steamer Acadia, recently put on the St. Lawrence route by the Hamburg-American Packet Company, is fitted with quadruple engines of 2,500 horse power and lighted by two dynamos.

The McCormick Mfg. Co., of London, have changed their steam cooking system. The work was superintended by Mr. F. Mitchell, and the test now running shows a saving of fully 45% in fuel.

An Austria fluid designed to prevent boiler incrustation is composed of water, calcined soda, oil soot, pulverized zinc, caustic lime and mineral oil, to which blend are added tannin and tartaric acid.

Mr. C. E. Evans, manager of the Quebec District Electric Railway Company, expects to have the road completed before the first of July. Several cars have already been received from the manufacturers.

The city council of Chatham, Ont., by a vote of the ratepayers taken in February last, were authorized to purchase an electric light plant, and steps looking to that end are now being taken. The present contract for street lighting expires on September 1st.

In Gananoque, Ont., there are sixteen arc and eight incandescent lights, costing $1,216 a year, or $70 for each arc and $12 for each incandescent. Under a new five years' contract there will be twenty-one arcs for $1,200, and nine incandescents for $80; total, $1,280.

The Montreal Belt Line Railway Company officially opened their road to Bout de l'Isle last month. The line is twelve miles in length, and is thoroughly equipped. The officers of the company are: W. Dale Harris, president; Charles Desmarteau, vice-president; J. P. Mullarkey, managing director. It is expected to continue the road down the north shore of the St. Lawrence a considerable distance, and eventually to Berthier.

The Bell Telephone Company won the case brought against it by the United States to annul the last Berliner patent. This decision has the effect of continuing the control of the telephone by the Bell Company for seventeen years from the date of the last patent, which was granted in 1891. The government asked to have the patent of 1895 set aside on the ground that the delay of thirteen years in the patent office was fraudulent and the fault of the telephone company, and that the patent issued in 1880 covered the same ground on which the new patent was applied for in 1891. Justice Brewer said that there was no evidence of corruption or undue influence exercised over the patent office by the telephone company, and that there was no evidence that the delay in granting the patent had been brought about by the company. It held that whatever delay there had been was through the fault of the patent office.