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CANADIAN
ELECTRICAL NEWS
AND ENGINEERING JOURNAL

OLD SERIES, VOL. XV No.
NEW SERIES, VOL. X No. 11

NOVEMBER, 1900

PRICE 10 CENTS
$1 00 PER YEAR.

SPARKS.

Grenville Bros., of Thorold, Ont., have commenced the manufacture of a covering for steam pipes.

The corperation of Brockville, Ont., has finally taken over the electric light and gas plants in that town.

The ratepayers of Bridgewater, N. S., have voted in favor of taking over the existing electric light plant.

Messrs. McDougall, Brandon & Austin, owners of the electric light plant at Fenelon Falls, Ont., are putting in a new 75 kilowatt machine.

The Niagara Falls Power Company is erecting a new transmission line to Buffalo. Aluminum wire is being used, and the voltage will be 22,000.

The council of Beaverton, Ont., have renewed the contract for electric lighting with Mr. Dobson for a period of five years, at the price of $450 per year.

Mr. G. A. Burgess is organizing a company at Carleton Place, Ont., to supply electric light and power. It is proposed to utilize the water power at Arklan.

With a view of preventing overcrowding the platforms of street cars, the Montreal Street Railway Company have decided that not more than four passengers will be allowed on the platform at any one time.

Incorporation has been granted by the Ontario government to the Magnetic Electric Brake Company, Limited, to manufacture a magnetic electric brake. The incorporators include G. H. B. Hooper, electrician, and W. D. Earngey, barrister, of Toronto.

Messrs. Ahearn & Soper have purchased the Little Chaudiere water situated on the Ottawa river above Tetrauville. They already own the adjacent water power property, and it is understood to be their intention to develop both powers at an early date.

A dispatch from Kingston, Jamaica, dated October 18th, stated that a street railway strike was in progress. The street railway system there is controlled by Toronto and Montreal capitalists.

The Capital Power Company, of Ottawa, will soon be in a position to supply 2,500 horse power. The E. B. Eddy will use most of this power, as they are substituting electricity for steam to a considerable extent.

The Lloyd Insurance Company, of London, England, have decided to establish a signal station on Belle Island. Telegraph communication will be on the north shore of the St. Lawrence as far as opposite Belle Isle, where it will connect with acable.

Hon. C. H. McIntosh, of Rossland, B. C., is about to leave for England on business in connection with the Stave Lake power project. This scheme, which includes the supply of electric light and power to the city of Vancouver, is likely to be commenced at an early date.

Plans are in course of preparation for the re-construction of several of the principal lines of the Montreal Street Railway Company. New rails, 60 feet in length and weighing 83 pounds to the yard, will likely be used. It is claimed that the greater length of rail gives a smoother and much more durable track.

The arbitrators as to the value of the plant of the Pembroke Electric Light Company have fixed the amount at $35,772.20. In addition to this figure the town will have to pay about $2,800 for professional fees. The town offered the company $20,000 for the plant. The council have three months in which to decide whether or not they will take over the plant. If they take it, a by-law will have to be submitted to the ratepayers to raise another $10,000 in addition to the $30,000 already voted.

Mr. J. W. Pilcher, who was employed to report on the cost of installing an electric light plant for the city of St. John, N. B., has presented his figures. For 300 arc lamps, using present pole line, the cost for equipment is placed at $88,000, made up of $15,000 for building, $25,750 for engines, boilers, shafting, etc., $1,000 for foundation, and $38,250 for electrical plant, including 26 miles of arc circuits. To provide for an incandescent plant for public building, using same boiler, but separate engine, generator, etc., the equipment for 1000 16 c.p. lamps would cost $7,850, $1,350 being for engine, and $6,500 for generators, transformers and line. The annual cost of operating 300 arc lamps all night during the year, burning 3,800 hours is placed at $26,565, and for 250 lamps $24,027.50. The estimate is based on engine capacity of 500 h. p. and three 125 light dynamos.

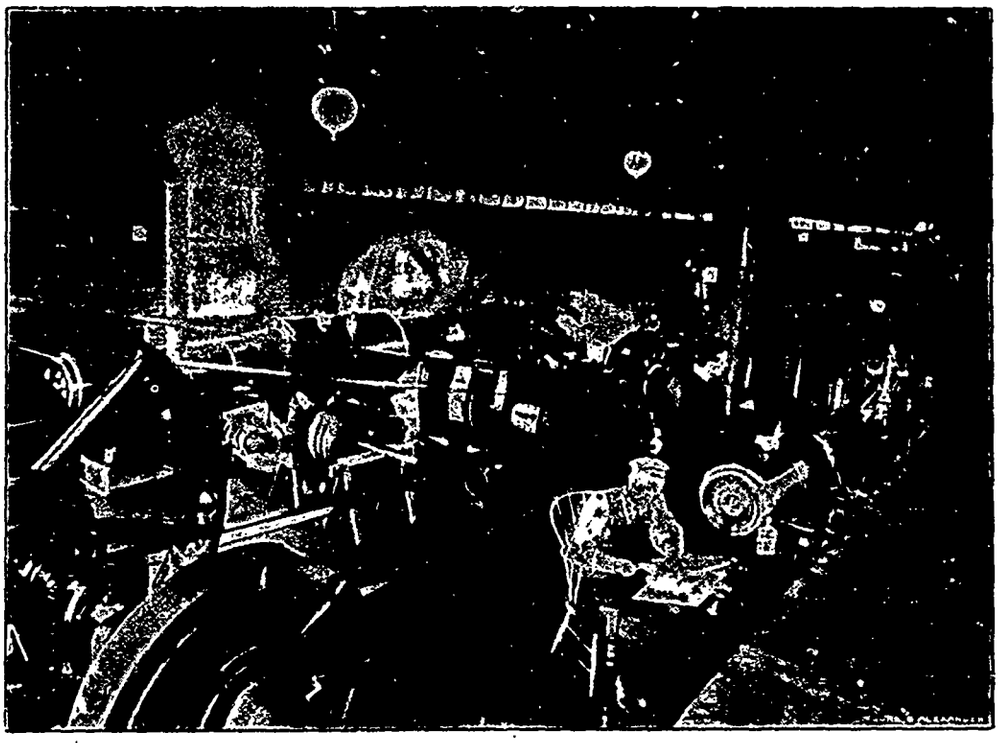
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. NOVEMBER, 1900 No. 11.

THE SARNIA GAS AND ELECTRIC LIGHT COMPANY.

As mentioned in last issue, the plant of the Sarnia Gas & Electric Light Company, at Sarnia, Ont., has been reconstructed, and modern apparatus installed. A view of the plant as rebuilt is shown on this page.

The power house is of red brick, with freestone trimmings and stone foundation. It has a truss roof, and is covered with iron, making the building practically fire-proof.



INTERIOR OF POWER HOUSE, SARNIA GAS AND ELECTRIC LIGHT COMPANY, SARNIA, ONT.

The power equipment of the plant now consists of two large boilers and two engines of the automatic cut-off Wheelock type. The smaller engine is a single cylinder of 100 h.p., and has been in use for some time. The new engine is a tandem compound of 250 h.p. capacity. Both are belted to a new shaft arranged with friction clutches in such a manner that either engine or machine may be used, or both. The main driving belt is 26 inches in width and 90 feet in length. There is a duplex condenser furnished by the Northey Manufacturing Company, of Toronto.

The electrical equipment includes a T.H. alternator of 1,000 lights capacity, and a Wood arc machine capable of supplying seventy-five 1,000 c.p. lamps, both being supplied by the Canadian General Electric Company.

The boilers, engines, shafting, pulleys and clutches were supplied by the Goldie & McCulloch Company, Limited, of Galt, Ont., and were installed by Mr. L. Ingall, erecting engineer for the company. The plans and specifications of the foundations for the machinery were prepared by Mr. R. W. Fawcett, of Sarnia, while the entire work of reconstruction was carried out under the supervision of Mr. Wm. Williams, manager and secretary of the company. The operation of the plant is in charge of Mr. Geo. Shand, chief engineer, and a staff of able assistants.

In addition to their electric lighting business, the Sarnia Gas & Electric Light Company will also supply the power for the new electric street railway now in course of construction in that town. The plant of the company as remodelled is modern and up-to-date in every respect, and should prove a profitable investment for its owners.

The St. George & Penfield Telephone Company have elected M. Eldridge president, H. H. McLean vice-president, and E. W. Cross secretary-treasurer.

In connection with the proposal for municipal control of the electric light plant at Kingston, Ont., the utilization of the water power of some of the falls adjacent to Kingston is spoken of. At Kingston Mills 400 horse power is said to be available, and at Jones Falls about 1,000 horse power.

QUESTIONS AND ANSWERS

"Reader" asks: Are both the motors in a street car always in use when the car is moving, where series parallel controllers are used.

ANS. Yes, both motors are in use for practically all the time that the controller is turned on, the only exception being the few seconds during which the connection is being changed from series to parallel. The current, when the motors are in series, goes first through No. 1 motor, and then through No. 2, thus the same identical current goes through both motors; when the controller is put on to any of the parallel positions, separate currents go through each motor, though if the motors are similar, and neither pair of wheels slip, the currents will be about equal.

"J. B.," Montreal, writes: I have two direct current dynamos running in parallel, driven by separate engines in different rooms; is there any danger of one of them reversing and damaging the work going on through some other machines which are driven by the same countershaft?

ANS. We presume that you mean in case either engine belt come off or anything go wrong with either engine which would cut off the steam from it, to which we would answer no; there is not the slightest danger. If by any accident the power driving either dynamo should come off, it would still continue to run as a motor, and to revolve in the same direction.

"Superintedent" writes: We are having a good deal of trouble in our pattern shop with our incandescent lamps burning out, though lots of lamps are running for over one thousand hours on other lines in the machine shop, offices, etc. I have tested all over, but cannot find anything wrong. What would you suggest?

ANS.—Your trouble is proabably due to static electricity, which generally gives most trouble in rooms where there are many high speed belts running and much dust flying. If static electricity is the cause, you will find a very fine star shape crack towards the bottom of the bulb, which is caused by the hot filament (which is attracted by the static charge in the glass) striking the glass and cracking it. The vacuum is thus destroyed, and the air gets into the bulb and instantly burns the filament. The remedy is the use of lower efficiency, slightly higher voltage and higher candle power lamps.

"C. B.", Halifax, writes: I have two lines of shafting to be driven from one electric motor. Can I run two belts off of it, or will I have to belt from one line of shafting to another?

ANS.—If you have room to put your motor between the two lines, it would be best to belt direct from it to each line, the belts driving each way from a special pulley having two crowns. This method has the advantage over the one in which a pulley is used at each end of the motor, of reducing the strains on the bearings and frame, and also of giving freer access to the motor for inspection and cleaning.

"Engineer" says. We are putting in a new engine in our mill, for which we will have to get a new belt about fifty feet long. As I want to get the very best service possible out of it, please advise me which side I should put next the pulley.

ANS.—If your belt is to be single, you should run the flesh or grain side out, because the outside of the belt when passing around the pulleys is subject to more or less of an extension strain, over and above the strain due only to the load it is driving; whereas the inside of the belt as it goes over the pulley is to a certain extent compressed; obviously, the flesh side being of a more soft and pliable nature than the hair side, is more suited to take the extension strain. If the belt is double, both sides will be grain, the hair sides being glued together, so you will have no choice in the matter.

"Subscriber," London, wishes to know why it is that persons handling a secondary line (sockets) receive severe shocks, apparently primary effects, although it is impossible to find any trace of contact between primary and secondary or secondary and ground by means of 50,000 ohm well.

ANS.—The effect spoken of is due to either: (a) The normal secondary voltage; (b) an abnormal foreign voltage, which latter again may be due to: (c) Static charges, or, (d) a cross with a foreign circuit. (a) It must be remembered that voltages as low as 52 will often give severe shocks to certain nervous systems if their connection with the ground be good, though if all who handle the sockets experience the same effects it would seem to indicate that this is not the cause of the trouble. (b) If there are no belts in the room it is safe to say that this is not the cause. (c) If you are crossed with a line carrying a voltage higher than that of the secondary, it will most probably be a connection with the primary, in the transformer itself, though it must be borne in mind that any test to discover the fault should be made while the transformer is hot, as the cross may disappear as the apparatus cools. It may also be that you have a connection with arc or railway lines from some other generator which is "swinging," i.e., the lines are being blown or knocked together at intervals by wind or some moving object. We would suggest that you put a volt-meter between the socket and ground. If it show a voltage higher than that of the secondary circuit, and steady, you may be certain that your cross is either in the transformer or else in the wiring of that particular building, and should be easily discovered by a visual inspection. If the volt-meter reading is unsteady your cross is swinging, and as the secondary system is not likely to extend far from the building it should not be hard to find. If the foregoing does not serve to get you over the difficulty, if you will write more fully we will be able to go more in detail into the question.

PUBLICATIONS.

The third edition of "Alternating Current Phenomena," by Chas. Proteus Steinmetz, has just been issued by the Electrical World and Engineer, of New York. This work is intended as an exposition of the methods which have been found useful in the theoretical investigation and calculation of the manifold phenomena taking place in alternating current circuits, and of their application to alternating current apparatus. In the third edition several new chapters have been added, such as those on vector representation of double frequency quantities as power and torque, and on symbolic representation of general alternating waves. Many chapters have also been revised. The new edition contains upwards of five hundred pages, is amply illustrated, and sells at four dollars.

On October 17th the Mayor of Brockville, Ont., on behalf of the town, formally took over the electric and gas plants.

A SUCCESSFUL METHOD OF LIGHTNING PROTECTION.

READERS of the ELECTRICAL NEWS will be interested in particulars of the somewhat remarkable experience of the Royal Electric Company of Montreal in connection with means adopted to protect from lightning their long distance transmission lines between Chambly and Montreal. These lines are about 17 miles in length each, of which 14½ miles is aerial, the remaining 2½ miles being composed of three sections of cable: the first section being about a mile and a half from the power house, the second section 15 miles from the power house, and the third section leading into the sub-station in Montreal.

Simultaneously with the construction of the pole lines, the company strung three barb wires to protect the transmission wires from lightning. This barbed wire lightning protection consists of three double strand No. 12 wire, with four barbs about every five inches apart. One of the three wires is placed on a pin, and a glass insulator on the top of the poles, the remaining wires are placed on ordinary glass pony insulators on the ends of the top cross-arm. Each of these wires are connected by means of a soldered joint to the ground wire running down the pole, this ground wire running through a one inch wrought iron pipe 8 ft. in length to the bottom of the pole, and after passing through the pipe, wrapped several times around the butt of the pole. The ground wire and pipe were placed on the pole at the time the poles were erected. The poles are 90 ft. apart and the barbed wires are connected to a ground wire on each pole. The grounding of the barbed wire every 90 ft. is considered one of the most important points in the protection.

It was originally intended to protect these transmission lines by means of banks of lightning arresters, but the lines were put into use before the company were able to procure the requisite number of lightning arresters. It was intended in the event of a severe storm to disconnect the lines until such time as the storm was over, in the meantime operating from the local station in Montreal, it being considered unwise to expose the transmission lines and cables and generators connected thereto to any possible destructive effect from lightning discharges from the transmission lines.

The first storm occurred about midnight, when it was practically impossible to transfer the system, and the company was apprehensive that the cables or step-down transformers or generators connected to the transmission lines might be punctured by destructive discharge. However, the storm passed, without any damage being done to the transmission lines. This seemed to indicate that barbed wire was very good protective device, and when the next storm occurred it was thought advisable to risk possible damage from lightning, inasmuch as the lightning arresters were not then procurable.

Time passed, and the entire summer with the numerous severe storms, had gone before the lightning arresters were available. By that time it had been conclusively proved to the satisfaction of the management that the barbed wire was an effective and efficient lightning protection. Since that time it has been entirely relied upon to protect lines in lightning storms. As an extra precaution, however one bank of lightning arresters was placed at the power house, but they are not regarded as necessary.

One particularly severe storm which occurred caused a great deal of damage to the company's property in Montreal. Noticing that the storm was travelling directly towards Chambly, the general superintendent put himself in communication with the power house by means of his private telephone and kept close track of the storm, which arrived at Chambly, 17 miles distant, about three-quarters of an hour after it had burst over Montreal. The company's lines and transformers in Montreal were considerably damaged, and two local distribution lines at the Chambly end were also damaged, but not a single discharge occurred on the two transmission lines, each 17 miles in length. During one entire season, without any lightning protection whatever with the exception of the barbed wire, there occurred no discharges from the 34 miles of transmission lines, although during the summer season there were numerous very severe thunder storms, which caused considerable damage on local lines that had not been protected by means of barbed wire. The barbed wire has been placed on glass insulators for the purpose of protecting it at the points where it is supported. One of the dangers to be apprehended from the use of barbed wire is its rusting and rubbing to such an extent that it becomes weak and breaks. The Royal Electric Company have not yet had a single barbed wire strand break, but they are giving this phase of the question considerable attention. The means sometimes employed for supporting barbed wire, that of connecting it to the top of the poles or cross-arms by means of staples, is thought to be productive of unsatisfactory results.

An exchange of opinions and experience by central station managers on this important subject would be welcomed by our readers, and is therefore invited.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 11.50	A.M. 5.30	5.40
3....	A.M. 1.00	" 5.30	4.30
4....	" 2.00	" 5.40	3.40
5....	No Light.	No Light.	...
6....	No Light.	No Light.	....
7....	No Light.	No Light.	....
8. ..	No Light.	No Light.	....
9....	P.M. 5.15	P.M. 8.30	3.15
10....	" 5.15	" 9.30	4.15
11....	" 5.15	" 10.30	5.15
12....	" 5.10	" 11.30	6.20
13....	" 5.10	" 0.30	7.20
14....	" 5.10	A.M. 1.30	8.20
15....	" 5.10	" 2.30	9.20
16....	" 5.10	" 3.30	10.20
17 ...	" 5.10	" 4.30	11.20
18....	" 5.10	" 5.30	12.20
19....	" 5.10	" 6.00	12.50
20....	" 5.10	" 6.00	12.50
21....	" 5.00	" 6.00	13.00
22....	" 5.00	" 6.00	13.00
23....	" 5.00	" 6.00	13.00
24....	" 5.00	" 6.00	13.00
25....	" 6.00	" 6.00	12.00
26....	" 7.00	" 6.00	11.00
27....	" 8.30	" 6.00	9.30
28....	" 9.30	" 6.10	8.40
29....	" 10.30	" 6.10	7.40
30....	" 11.40	" 6.10	6.30

Total..... 224.55

The Bertram Engine Works, of Toronto, will install electric light plants on new boats now being built, and have given an order to the Canadian General Electric Company for two 25 k.w. direct connected direct current generators.

By a vote of 190 against 75 the ratepayers of Almonte, Ont., have just decided in favor of raising $30,000 for the establishment of a municipal electric light plant. A similar by-law submitted to the ratepayers one year ago was defeated by a majority of 38.

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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.

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Electrical Development in Montreal.

THE growth of electric lighting and power in the city of Montreal is astonishing. It is learned that, during the last four years the number of lights in use in that city has increased from 54,000 to 100,000. The Royal Electric Company have also in operation over 5,000 horse power in motors. Users of these motors have contracted with the company to run the machines only between the hours of 7 a. m. and 4 p. m. Thus the power load is entirely a day load, and does not in any way interfere with the lighting load. Between the hours mentioned the day load averages between 80 and 90 per cent. of the lighting load, a condition that is believed not to exist elsewhere in the world.

Electricity on the Farm.

THE employment of electrical energy for agricultural purposes has received considerable attention in Europe, and particularly in some parts of Germany. Near Ochsenfurt, in Bavaria, a company has been organized for the establishment of a large water power plant for the generation of electricity to replace animal power on the farms in the vicinity, the current to be distributed from a central station by means of sub-stations. Nearer home, however, we find an application of electricity for agricultural purposes on the Dentonia Park farm of Mr. W. E. H. Massey, situated but a short distance from the city of Toronto. Mr. Massey has installed in a unique power house an electrical plant for lighting and power purposes. There are twenty-six buildings on the farm which are lighted electrically. The plant includes a storage battery system capable of supplying 200 lamps for five hours. It is the purpose to operate the machinery on the farm by electric power. In a future issue we hope to publish an illustrated description of this plant.

Questions and Answers.

REPLIES to several problems pertaining to steam and electrical engineering will be found in the Questions and Answers Department of this issue. It is the hope of the publishers that liberal use will be made of this Department by our readers. If properly taken advantage of it should prove one of the most interesting features of the journal. Every effort will be made to give satisfactory answers to questions propounded. Our views will not, perhaps, in all cases, meet the approval of every reader. Those who may differ from our opinion are offered the free use of the Department to give their solution of any problem. It is in the widest discussion that the many interesting points can best be brought out and the most benefit derived to the student in the various branches of engineering. This Department should be of special benefit to superintendents and operators of steam and water power electric plants, in whose daily employment incidents are certain to arise concerning which they will require enlightenment. We ask the assistance of our readers in maintaining and broadening the influence of this Department.

The Growth of Electrical Engineering.

IT is gratifying to learn that the opportunities in the electrical business appear to be enlarging to such an extent as to attract many of the brightest young men in our leading scientific schools. In McGill University this year there are thirty fourth year students in the Engineering department. Of this number eighteen, or

sixty per cent., are taking the electrical course. The Electrical department is now taxed to its utmost capacty, and, notwithstanding the great improvements which have been made in this department during the last five years, the University authorities are now confronted with the problem of providing still greater accommodation, both as regards extra space and additional appliances. It is learned that a considerable proportion of the young men who have passed through this department have succeeded in securing positions of responsibility and at satisfactory remuneration. Quite a number are yearly absorbed by the electrical manufacturing companies, while others have found positions in the United States where the demand for highly trained men is much greater than in Canada. In this country also the number of important electrical enterprises is rapidly increasing, and with it the demand for young men with a scientific education.

Street Lighting in Toronto.

THE question of street illumination is just now engaging the attention of the city council of Toronto. For this purpose both electricity and gas are now employed. The existing contracts expire on January 1st next. Tenders were recently invited for a renewal of the contract from that date. That the Council might be in a position to judge with some accuracy of the merits of the tenders submitted, two experts were appointed to report on the various forms of street lighting apparatus embodied in the tenders. There were submitted for their investigation by the Toronto Electric Light Company, nine types of lamps, three by the Kitson Hydro-Carbon Heating & Incandescent Lighting Company of Cleveland, four by the Carbon Light & Power Company of Philadelphia, and three by the Consumers' Gas Company, of Toronto, in all nineteen different forms of apparatus for street lighting. The tests were made in the School of Practical Science, and were conducted under conditions similar to those employed by a committee of the National Electric Light Association which reported at its recent meeting in Chicago. Judging by their original report, the experts appear to have made a somewhat comprehensive investigation, and their deductions seem to be in favor of the electric light. Their task was not an easy one, as there is no universally recognized basis of comparison between different lamps. The report shows that the maximum candle power of the open arc lamp under the conditions of the specifications is 1,119, and of the same lamp under paesent conditions 1,674. The maximum candle power of the Kitson lamp, which burns oil, is given as 907, while that of the hydro-carbon vapor lamp and of the ordinary gas lamp is much below these figures. The experts were apparently undecided as to the respective merits of the electric light, the Kitson lamp and the hydro-carbon lamp with special reflector. Following the original report, they submitted to the Council a supplementary document. This, while purporting to assist the Council in their task of deciding upon the most advantageous method of lighting, is to our mind rather contradictory and misleading. In it a statement is submitted of the comparative cost of lighting in the case of each form of apparatus by two methods of comparison, first, the price of one candle power, and secondly, the annual cost per mile of street illuminated in such a way that in each case the light midway between the lamps would be the same. For the purposes of this comparison the experts assumed an illumination equal to that produced by one candle at ten feet on a surface held so as to be best illuminated at that point. In the first column, which is the cost per candle, that for the open arc lamp is given as 10.71 cents, the Kitson lamp 11.08 cents, and the ordinary hydro-carbon lamp 89.9 cents. Looking at the second column we find that the cost per mile of illumination is given as $974 for the open arc lamp, $789 for the Kitson lamp, $1,387 for the ordinary hydro-carbon lamp, and $731 for the hydro-carbon lamp with special reflector. It seems strange that, while on the basis of cost per mile such a favorable showing is made for the hydro-carbon lamp with special reflector, the cost of candle power should have been omitted in respect to this particular type of apparatus only. The casual observer would probably conclude that on the basis of cost per mile the hydro-carbon lamp was cheaper than the electric light. It is unfair, however, to calculate on the basis of per mile of illumination, particularly with the special reflector, which throws most of the light in one direction, as most of the lights on the streets of Toronto are on street corners and diffuse light north, south, east and west. Another peculiarity of the report is that the point of illumination at which the tests were made was the minimum for the electric light and approximately the maximum for the gas light. Under the method of estimating, the electric light at its weakest point was equal to the gas light, but at every other point infinitely superior. This extra and increasing light at every other point than the minimum was not taken into account at all. The question as to which form of lighting should be adopted seems to be at once solved by a comparison of the tenders submitted. On account of lamps being located at intersections of streets, whether the arc lamp or the oil lamp is employed the same number of lamps will be required. The tender for renewing the present contract for electric lighting, with a lamp of the highest efficiency of any submitted to the experts, is $65.70 per lamp per year. Calculating on the basis of 1,000 lights, there would be a saving to the citizens of $25,000 per annum by the adoption of the electric light.

The Automobile Field.

THE automobile is with us, and without doubt to stay, and we are assured upon all hands of the benefits to be derived therefrom, not only on the score of cheaper transportation, but in the matter of cleaner streets, better roads, etc. These things are true and obviously so, but one great change which will inevitably be brought about by the introduction of the automobile has not attracted the attention it deserves. Up till about twelve years ago passenger transportation in the cities was in the hands of the horse-car companies, while intercommunication between cities was entirely by steam. At the present steam transportation is decreasing for interurban short distance work, and its place is being taken by the electric road; the old horse-car systems for urban transportation are entirely superseded by the electric. These are days of rapid changes, and another change will take place within the next few years which will place the electric urban road where the horse-car road is now. For city work the great desiderata are rapid, frequent, flexible and cheap service, and the present electric systems have these advantages over the older horse-car systems, for which

reason the latter have been displaced. The demands for these advantages to a more marked degree are increasing, and that mode of transportation which will fulfill these conditions to the maximum possible will inevitably prevail. In the automobile we have something at hand which will give at least as frequent and rapid service, and will certainly be more flexible in meeting demands than the present electric lines for city service. As regards the cost of transportation, a little consideration of the elements which enter into the question will be necessary to form a judgment. Assuming that automobile bus-lines were initiated and run in competition with the electric cars, what would be their advantages from the point of view of operating costs. The largest item in the cost of electric transportation is generally that of motormen and conductors. This would probably not be decreased, nor would car inspection or repairs, by the use of the automobile. The next largest item is the fixed charges for interest, depreciation, taxes, etc. These depend upon the investment, and very slight consideration will readily convince the most skeptical of the smaller capital cost of the automobile. The electric line has a station costing about $100 per h.p., a permanent way valued at from $10,000 to $50,000 per mile, depending upon the nature of the structure and whether the paving is included, which is often the case; overhead construction costing from $2,000 to $10,000 per mile; cars and equipments from $2,500 to $4,000 each; and in addition probably a percentage of receipts is demanded by the municipality for the franchise. The franchise also has to be obtained at frequently great cost and trouble. Against this, in favor of the automobile, no franchise is required, no permanent way, no overhead construction is needed. The busses will cost no more than the cars at the worst, and no station will be required unless the system be storage battery automobiles, and if required will be much less costly than for the electric cars both in total cost for the same traffic and for operating costs, the reason being that the station will be running at its full capacity at all times, thus requiring a smaller horse power of plant and having that plant operating at its highest efficiency at all times. In the case of steam or gasoline machines, no station whatever would be required. The busses would run upon any street and would never be blocked by interruption to the supply of power, street repairs, etc., and could be concentrated to meet sudden demands in a manner not approachable by the electric cars. Under these conditions the final triumph of the automobile for city transportation appears certain, the electric roads to be restricted to the interurban services where advantages may be had of greater speed over their own right of way than would be permissible in the case of an automobile line traversing the country highways. It may be questioned whether automobiles will be available for winter service in such places as Montreal and Quebec, and the point will be well taken at the present time, but those who predicted the use of electric cars in those places ten years ago were laughed at, and it may safely be predicted that the winter difficulties will be overcome as were those of the electric cars. As to the system of propulsion adopted at the present time, it would appear that steam would be the cheapest, but has the disadvantage over electricity of being more noisy and complicated, and for many reasons apart from cheapness electricity has the most to commend it. A further advantage of the automobile bus line lies in the fact that the public will be guaranteed a fair competition with consequent reduction in fares, as no monopoly can be granted as is done at present. The automobile is in the same position as regards the city business as the electric roads were about ten years ago, and the next ten may see as great a change in this regard as the last.

MONTREAL.

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building.

MONTREAL, November 6th, 1900.

Fifty-two volt lamps, and apparatus generally fo rthat voltage, will, so far as Montreal is concerned, ere long be a "thing of the past." The Lachine Company serve at 110 volts, and all new connections made by the Royal Company are at 104 volts; in fact, this latter company are gradually changing old 52 volt installations over. The Imperial Company are doing the same as the Royal. This in many instances will be beneficial, as there is quite a number of houses wired for too great a percentage of loss.

It is amusing to read in convention discussion that the Quebec Legislature are not "sharks," like the Ontario one, in regard to electrical taxation, etc. Give them time; they are on better "pay streak" at present, but just as soon as they find that a few dollars can be squeezed out of electrical industries, they will "get there" quick enough, and it is easy betting that they will leave their Ontario confreres "miles behind." The Montreal City Council are at the present moment scheming around as to how they can best have a good "crack" at it.

According to the Inspection Department, there are over 40 firms (sic) doing construction work (interior wiring) in Montreal. Who they all are and how they manage to eke out a living (if they do, are questions that would puzzle a Philadelphia lawyer. Variations of 300 per cent. have been noticed among tenders, i.e., by those parties mean enough to take a dozen or so of tenders, and who generally scheme to get a reliable firm to accept the figure offered by the unreliable. The remedy here is an old, though slow one, "The survival of the fittest."

Mr. Robertson, E.E., on the occasion of his marriage lately, received a very handsome present from the staff and fellow employees of the Royal Electric Company, in the shape of a handsome oak case of cutlery. Mr. Robertson was completely taken by surprise. It may do him good to know that he is held in equal esteem by those in the trade generally, as well as by his fellow employees.

On the occasion of the formal opening of the Royal Victoria College for women, by Lord Strathcona and Mount Royal lately, the evening's illumination of the building was striking. The outlines of the college were all picked out in incandescent lamps, and in several places heraldic shields, set with appropriate colored lamps, were hung. The work was placed in the hands of the Royal Company, and executed under the supervision of Mr. J. A. Douglas, superintendent of the interior wiring staff.

How strange it is that if one were to choose to go about Montreal electrical supply houses, he would be able to get four or five prices on regular standard supplies, and yet if one went from the east to the west of the city he would not find a variation of a fraction of a cent. in purchasing say a pound of sugar, loaf of bread, or yard of cotton. This surely is not as it should be, and ought to be easily remedied if the dealers would get together and talk the matter over.

It is to be regretted that the old and tried city surveyor of Montreal, Mr. P. W. St. George, C. E., has had to tender his resignation, being simply driven out of his position, I understand, by unfounded charges made by an incompetent and grossly unjust Road Committee. Such treatment is, however, on a par with usual municipal management here. The question interests certain of the local electrical fraternity, as the permission for location of poles is vested with the city surveyor, and it is ten chances to one that we will have a successor who will try to do his duty in a just and conscientious way, as Mr. St. George has done.

THE BREMER ARC LAMP.

THERE have been many attempts at treating arc-light carbons by impregnation and in other ways, which have had the effect of making the arc burn more quietly and imparting a somewhat better color to the light, but no striking results have heretofore been achieved.

But according to some tests made by Herr W. Wedding, whose experiments are recorded in the Elektrotechnische Zeitschrift, and summarized by the Engineering Magazine, a decided advance has now been made by Herr Bremer, who prepares carbons containing from 20 to 50 per cent. of non-conducting salts of metals, such as calcium, silicon and magnesium.

The first measurements made were of a continuous-current arc lamp taking about 12 amperes. The positive carbon was the only one specially treated, and it contained a calcium compound. In the article just mentioned are given tables and curves of illumination at various angles with the horizontal, from which it appears that when no globe was used, the mean hemispherical intensity of the light was 4,320 candles. The average current through the lamp during the run was 12.3 amperes, the mean electro-motive force 44.4 volts, so that the average power used was 546 watts, or 0.126 watt per candle.

The same lamp with a globe had a hemispherical intensity of 2,772 candles and used 543 watts, or 0.196 watt per candle.

The second lamp tested is similar to one now hung on the Eiffel Tower, in Paris, at an elevation of 95 meters. It has four arcs, takes about 60 amperes of continuous current, and the positive carbons contain a calcium compound, as before. On account of the great intensity of the light the tests had to be conducted at night and in the open air. The lamp was hung 8 meters above the ground, and the illumination was measured on a surface 1 meter from the ground and at different distances from the lamp. From the observed results it was found that the maximum intensity of the light when no globe was used was 83,000 candles, at an angle of 37 degrees below the horizontal, while the mean hemispherical intensity was 49,730 candles. The average current was 55.8 amperes, the electromotive force 89.3 volts, so that the power used was 4,980 watts, or only 0.1 watt per candle. When covered with a globe, the hemispherical intensity of the light was found to be 26,890 candles, and the power used 4,610 watts, or 0.17 watt per candle. From the above figures, it appears that for the arc lights without globes the power used was hardly more than 0.1 watt per candle. Herr Wedding states that the lowest power consumption he had ever found with other kinds of lamps was 0.3 watt per candle, and that the average was between 0.4 and 0.5 watt. The new lamp, therefore, is three times as efficient as the best of the old ones, or, putting it another way, with the same power three times as much light is produced.

An alternating-current arc lamp with one of its carbons treated by the Bremer process was measured without a globe and found to have a mean intensity of 512 candles and to use 0.5 watt per candle. This shows a decided improvement on previous alternating-current arc lamps, and it is believed that with better construction even more favourable results can be obtained.

The regulating mechanism, which works smoothly, is much simpler than in the ordinary kinds of lamps, but the details are not yet ready for disclosure. In the ordinary lamps most of the illumination comes from the glowing carbons, but in the new lamp the arc itself furnishes considerable light, and so makes a more even distribution of illumination. Above the arc and surrounding the upper carbon is a conical tin hood, which helps to retain the heat generated in the arc and also acts as a reflector. Some of the products of combustion settle on the inner surface of this hood in the form of a pure white powder which makes an admirable reflecting surface and helps in the even distribution of light, so that the lamp globe, when on, appears uniformly illuminated and the upper half is not in the shade, nor are sharp shadows of the negative carbon and its holder cast on the lower hemisphere.

Favourable photometric measurements alone do not make a lamp successful. Much depends upon the æsthetic impression which the light makes on the eye, and in this respect the new lamp is not wanting. The large amount of calcium contained in the carbon gives rise to a rich yellow-red radiation, in contrast with the usual bluish-violet rays of the arc, so that the light has a much warmer tone. According to the inventor, the colour of the light can be regulated at will by varying the composition of the carbons.

The richness in red rays of the Bremer lamp led Herr Wedding to try some experiments to determine how well it could penetrate fog and mist. He took a lamp of the ordinary kind and a Bremer lamp and interposed a cloud of steam about 1 meter thick betwen them and a photometer. Repeated observations showed that the penetration of the new light was twice as great as that of the old. This result points to the applicability of the Bremer lamp to lighthouses and signal lights where the penetration of fog is of consequence.

PERSONAL.

Mr. J. W. Marr has been appointed electrician for the Toronto Evening Telegram building.

Mr. Albert Courtney has been engaged as superintendent of the electric light plant at Walkerton, Ont.

Mr. W. R. Miller has been elected a director of the Montreal Telegraph Company to fill the vacancy caused by the death of Mr. Henry Archibald.

Mr. Jos. H. Ward, late electrician for the Grimsby Electric Light Company, is now head engineer in Messrs. J. Cobbledeck & Son's mill at Exeter, Ont.

Mr. C. W. Dill, assistant city engineer of Nelson, B. C., recently tendered his resignation, and has been engaged as superintendent of construction in connection with the municipal power development at Bracebridge, Ont.

Mr. John Hudson, president of the American Telephone & Telegraph Company, successors to the American Bell Telephone Company, died very suddenly at Beverley, Mass., October 31st. For over 20 years deceased had been closely connected with the Bell Telephone interests.

Mr. Ezra Good, who held a responsible position in the works of the Canadian General Electric Company at Peterborough, was tendered a complimentary banquet by the employees of the company a few days prior to his departure from the town. Mr. Good carries with him in his new field the best wishes of many friends.

Mr. C. J. D. Baby, late chief accountant of the Cataract Power Company, of Hamilton, and now assistant manager of the Packard Electric Company, St. Catharines, was presented before leaving Hamilton with a solid silver tea service by the officers and staff of the Cataract Power Company. The presentation was made by Mr. Gordon J. Henderson.

At the recent convention of the American Street Railway Association, which opened in Kansas City on October 17th, the following representatives of Canadian roads were in attendance: C. E. A. Carr, manager, and E. R. Carrington, of the London Street Railway Company; M. Powers and J. M. Smith, of the Toronto Railway Company; C. K. Green, manager, and J. B. Griffith, purchasing agent, of the Hamilton Street Railway Co.

Mr. F. B. Brothers, formerly manager of construction for the Montreal street railway system, but who for the past year has been superintending the construction of an electric railway in Georgetown, British Guiana, returned to Montreal a few weeks ago. His visit, however, was of short duration, as a fortnight ago he left for Cuba in the interests of The Cuba Company, of which Sir William Van Horne is president. Mr. Brothers will assume charge of the construction of several hundred miles of steam road. The work will be on a most extensive scale, and it is expected that 3,000 men will be employed.

Mr. Charles Tollington, representing the Bagley & Wright Manufacturing Company, cotton spinners and manufacturers, Oldham, England, was a recent visitor to the office of the ELECTRICAL NEWS. Mr. Tollington's headquarters are in Montreal, his company having established a Canadian branch at 318 St. James street in that city. The company are introducing to the Canadian trade their covering for electric wires. Having had many years' experience in the manufacture of cotton, they claim to be in a position to furnish just what is required for electrical purposes. It is possible that the company may establish a branch in Toronto.

Geo. S. Munro met death in the Brant hotel, at Brantford, by coming in contact with a live electric wire.

The London & Vancouver Finance & Development Company give notice of their intention to build a tramway from a point on the Chemainus river to the town of Chemainus, and to operate telegraph and telephone lines in connection.

The Incandescent Lamp

By H. D. Burnett.

THE following interesting paper pertaining to the development of the incandescent lamp was read on October 23rd at the second semi-monthly meeting of the Peterborough Engineering Club by Mr. Henry D. Burnett, superintendent of the lamp department of the Canadian General Electric Company.

The present year marks the close of the second decade in the history of the commercially successful incandescent lamp. The closing twenty years of the 19th century have witnessed a development of electrical industries that, in the magnitude of interests involved, capital invested, employment of labour, and display of inventions, presents no parallel in the world's history. The invention of the modern incandescent lamp, about 1880, was probably the principal factor in causing this wonderful development of electrical machinery and general appliances. The incandescent lamp having become an accomplished reality, there sprang up a greatly increased demand for the electric dynamo for supplying current to such lamps, and with increased use a vast amount of scientific skill and ingenuity was applied to its development and to enlarging its field of usefulness.

A great number of subsidiary electrical appliances became necessary; switches, cut-outs, measuring instruments and other station equipments, together with distributing systems, etc. After the establishment of a net-work of wires throughout each large city for the supply of current to the lamps, it was a natural and easy step to devise electric motors that could be run by the current from the same lighting circuits. And the wave of electrical invention spread with increasing rate of speed from year to year, until to-day we witness a display of electrical machinery as applied to nearly all branches of arts and industries that is simply marvellous.

This paper has to deal with an apparently insignificant example of the application of electricity to one of the very useful arts, that of supplying light. The magnitude of the incandescent lamp industry to-day is best understood from the fact that no less than 25,000,000 lamps are manufactured and consumed yearly, and the consumption is rapidly increasing. The importance and commercial value of this little transformer of energy may, perhaps, be appreciated by the fact that it has probably been the subject of more prolonged, obstinate and expensive patent litigation than any other subject or article in the history of inventions.

The invention of the incandescent lamp is, in America at least, almost universally ascribed to Thomas A. Edison, who received his fundamental or basic patent from the United States' patent office, Jan. 27, 1880. This first important patent bearing upon the Edison Carbon Filament Lamp was applied for two months earlier, in November, 1879. This, then, may be taken as the date of birth of the modern incandescent lamp, and to Edison, undoubtedly, is due the credit of being the first one to produce a practical and commercially successful incandescent lamp. But it is a popular error to assign to him the credit of being the first or original inventor of an incandescent lamp. There are many who, no doubt, would be surprised to learn that over thirty years before Edison ever started to experiment in this line, there were incandescent lamps made and patented that consisted of a carbon burner contained in a glass bulb from which the air had been exhausted, which burners were made incandescent by passing the electric current through them. This description to many a casual observer might be considered as describing the present incandescent lamp, so familiar to us all.

Prior to November, 1879, when Edison applied for his celebrated carbon filament lamp patent, there had been produced no fewer than twenty different incandescent electric lamps, by as many different investigators, including English, French, American and Russian, most of which were patented, and all of which differed from each other in more or less important details. The first of these, having a platinum wire for the incandescent part, was patented by Frederick de Moleyns in 1841. It is certain that from that date up to 1879 there was a great deal of attention given to this subject of the incandescent electric lamp. It may then be of interest, now that the smoke of this memorable legal battle has cleared away, to consider for a few minutes the questions: Who was the real inventor of the incandescent lamp? What was the important step in the prolonged series of experiments that brought about a successful lamp? To what extent is Edison entitled to being called the "Father of the incandescent electric lamp?"

The essential and indispensable elements of the incandescent lamp to-day are as follows:

1st.—A bulb or receiver composed entirely of glass.

2nd.—A vacuum of high degree inside the bulb.

3rd.—A filament of carbon having very small cross section and high resistance.

4th.—Platinum wires passing through the wall of the bulb and sealed perfectly by fusion of the glass about them, for conducting current to the filament.

5th.—Suitable joints or connections between the filament that is to become white hot and the metallic leading in wires that are to be kept as cool as possible.

6th.—A base of any suitable substance secured to bulb and bearing two metallic contracts insulated electrically from each other, and connected respectively to the two wires passing through the glass, this base being for the purpose of entering the socket joined to the electrical circuit.

There has never been a commercially successful incandescent lamp that did not embody in its construction all of the six above named elements. Edison's lamp of 1880 contained every one of these elements. Every incandescent lamp made prior to Edison's experiments had one or more of these elements wanting. There have been various attempts made during the last twenty years to construct lamps lacking one or more of these essential elements, or containing important modifications of these elements as stated. Such lamps have usually had a very short history. They have either been found to contain some inherent defects, or have been unable to compete in the open market with the standard lamp embodying the elements mentioned.

Examples:—Westinghouse "Stopper Lamp" with cement filling. Pollard Lamp with silver powder to replace platinum leading wires; Novak Lamp (no vacuum), said to contain iodine. Found by analysis to contain carbon tetra chloride h cl vapour and c.l. gas with trace of nitrogen. (These types of lamps were shown and described by Mr. Burnett.)

We will now consider some of the earlier types of lamps and note what important elements were lacking in them and stood in the way of their success.

It was an American named J. W. Starr, a resident of Cincinnati, who is entitled to the credit of having produced the first incandescent lamp using carbon for the burner. This carbon, obtained from gas retorts, and in the shape of small pencils or thin plates, was enclosed within a glass bulb to which was attached a glass tube about 30 inches long. The bulb and the tube were filled with mercury and then inverted, allowing the mercury to run out from the bulb, leaving in its place a Torricillian vacuum. The carbon pencil was attached at one end to a platinum wire which was sealed into the top of the bulb, and at the other end to a copper wire which dipped into the mercury. This lamp had not the high resistance filament nor the all glass receiver of the modern lamp. It burned remarkably well for the first attempt in this direction, but the life of the carbon must have been very short. A chandelier of 26 of these lamps was on one occasion exhibited in public, symbolical of the 26 States of the Union, which display was admired by the great physicist Faraday. This lamp was patented in England by King in 1845. While Star was the first to produce a carbon, vacuum, incandescent lamp, he was not the first to cause carbon to become incandescent by means of the electric current, while protected by a vacuum from combustion. The principle that light and heat could be produced by passing the electric current through poor conductors was well known in the beginning of this century. Sir Humphrey Davy, who in 1809 discovered the phenomenon of the voltaic art, which is reproduced in the commercial arc lamp of to-day, also experimented in the line of producing light from carbon rendered incandescent by the electic current. His vacuum was underneath the bell-jar of an air pump. So far as known Davy did not attempt to apply these principles to a portable incandescent lamp.

The first incandescent lamp was that of De Moleyn's, already

referred to, which had a platinum wire for the burner. This was patented in 1841. Then came Star's carbon lamp of 1845, already described. The following year Greener and Staite took out a patent for a carbon lamp similar to Star's. In 1849 Petrie patented a lamp in which iridium was used as the burner. Then followed in succession the charcoal rod lamp of Nollet & Sheppard in 1850, the graphite coke lamp of Roberts in 1852, DeChanzy's lamp of 1857, of which he produced, it is said, 12 lights of great steadiness run from 12 Bunson elements; Gardiner & Blossom's platinum wire of 1858, and Adam's platinum wire lamp produced in Boston in 1865 but not patented. All of these lamps were little more than laboratory experiments and attained no commercial importance. In 1873 Lodyguine, a Russian physicist, produced a double carbon burner lamp with which he lighted a public hall in St. Petersburg on the occasion of a number of evening lectures which he delivered on the subject of electric lighting. He used nitrogen in his bulb instead of a vacuum. This was a step backward in the art, and beyond some improvements in details, his lamp was no great advance over its predecessors. For his experiments and researches on carbon as a material for such lamps, in which he showed its decided superiority over platinum, he was awarded a prize by the St. Petersburg Academy of Sciences. This lamp started a new list of experimenters on this subject of the incandescent lamp which had lain practically dormant since Star's lamp demonstrated its own impracticability.

Kosloff went from St. Petersburg to France in 1875 and exploited a lamp which he considered an improvement upon Lodyguine's, in that it had a series of carbon rods thrown successively into action as each one burned out.

Kohn, the same year, patented a similar lamp in England, while Khotinsky in France brought out another multiple carbon lamp. He proposed the arrangement of the lamps in multiple arc and provided a key by which to light or extinguish the lamp at will.

The next year, 1876, Bouliguine constructed a lamp with a single long carbon in holders so that only a small section of the carbon was in circuit at one time. When one section burned out another section was shoved up by the mechanism of the lamp.

This same year, 1876, just one year before Edison began his experimenting along this line, Woodward, in the United States, patented a lamp made from a glass tube, hermetically sealed at each end where the wires entered to conduct current to the small sheet of carbon that constituted the burner. The wires, however, were not sealed into the glass by fusion. The lamps were to be placed in parallel on the electric circuit. The lamps were to be first exhausted, then filled with a rarified gas that did not support combustion. This patent was afterwards bought by the Edison Company.

The period from 1875 to 1879 was one of great activity for inventors in this apparently very alluring field of incandescent lighting. I have referred to the work of Kosloff, Khotinsky and Bouliguine in France. In England there were Kon, Scott, Pulvomachear, Vanchoate, Lane, Fox and Swan, while in the United States the subject was being investigated by Farmer, Woodward, Sawyer and Man, and Edison, and I suppose I should also include the name of the now famous Henry Goebel, who was discovered in 1893, about thirteen years after Edison's patent was issued, by the opponents of Mr. Edison, in his famous series of patent suits against infringers. Mr. Goebel claimed to have made incandescent lamps in considerable numbers during the years extending from 1854 to 1880. He passed through the period when Edison's name was heralded throughout the country as the inventor of a successful lamp, which would bring him untold wealth, and yet he never thought of applying for a patent on his own so-called invention, although he was fully alive to the value of patents, for he had applied for one on another invention.

The activity displayed by lamp inventors during these few years, just prior to Edison's success, is, perhaps, illustrated by the fact that a Frenchman named Fontaine found sufficient matter of interest bearing on the subject to induce him to write a book on the incandescent lamp and electric lighting.

Thus, quite contrary to the popular conception of the subject, Edison, the father of the incandescent lamp, so far from being the first producer of such an article, had access to a book on this subject which was issued in 1877, before he began his regular experiments in this line. This book is very interesting, in that it describes some experiments made by the author on the best types of lamps in use at that time, and we are thus made informed of the state of the art two years before Edison's invention of the successful modern lamp.

Fontaine, referring in his book to Kohn's lamp having several carbons, says: "When the receivers are sealed and the contacts carefully put in line the carbons last for a satisfactory period. The first carbon of a lamp never lasts for less than a quarter of an hour, while its average duration is twenty-one minutes. The succeeding carbons last upon an average for two hours, so long as the luminous intensity does not reach forty burners, (equivalent to 380 c.p.), in which case the average duration is only half an hour. The vacuum never being perfect in the receivers, the first carbon is in greater part consumed. It would appear that, consequent upon the little oxygen contained in the lamp being transformed into carbonic acid and carbonic oxide, the carbons should be preserved indefinitely. But there is then produced a kind of evaporation which continues to slowly destroy the incandescent rods." From these experiments it was concluded that there existed this inseparable obstacle to success with carbon as the material for the burner. Note that these lamps tested by Fontaine gave light of about 300 c.p. each. Fontaine appreciated the desirability of obtaining smaller units. He thought that if one lamp on a certain number of battery cells gave 300 c.p. of light, a number of these, say six, arranged in series on same circuit, ought to give 1-6 of 300, or 50 c.p. each, and when he got with this arrangement practically no light from any of the lamps, he could not understand the reason, and after trying also the multiple arrangement of the lamps, concluded that the sub-division of electric light by means of incandescent lamps was an impossibility.

With these lamps described by Fontaine, as well as the ludicrous results of his experiments in the immediate back ground, and with a perspective view of nearly forty years of spasmodic but persistent attempts to produce a practical incandescent lamp, the brilliant achievement of Thomas A. Edison in this well-beaten road, is worthy of our highest admiration. Undaunted perseverance is the distinctive trait in this man's character, to which we are indebted for the incandescent lamp, as well as numerous other valuable inventions connected with his name.

Probably turned aside at first thought by the numerous failures associated with carbon as the material for a burner, he first gave his attention to platinum, as more likely to afford a staple burner or filament. He produced and patented a lamp having, unlike previous platinum lamps, a filament of comparatively high resistance, which was provided with an automatic cut-out for switching out the filament when its temperature reached that point at which there was danger of its melting. This lamp was little more than an electric vibrator, caused by the continuous action of the cut-out device. Undismayed at this failure in this line, he turned his attention to carbon, and after about a year of experimenting brought out his high resistance carbon lamp, of substantially the same type as that in use to-day.

The important respect in which Edison's lamp differed from all previous lamps was that it possessed the long slender carbon of such high resistance as to permit of the divisibility of the light into small practical units. He displayed a wonderful ingenuity in devising means of manufacturing these threadlike filaments, but when he had gone thus far, had he been contented with the means previously used for securing and retaining the vacuum necessary for the preservation of such a filament, he would have met nothing but failure.

He was the first lamp maker to construct the walls of his vacuum chamber entirely of glass, with the glass melted about the wires that carried the current to the filament. This combination, then, of the high resistance threadlike carbon, with the all glass bulb holding a high vacuum, and the conductors passing through the glass, constituted Edison's great invention.

All carbons used in previous lamps were short and comparatively thick, or of large section, making their resistance low, less than five ohms, as compared with Edison's filament of one hundred ohms or higher resistance. This low resistance necessitated large current, and correspondingly large conductors for the current. Large metallic wires are good conductors of heat. Hence the heat was drawn away from the burner and the unequal expansion of the wires and the material about them caused air leak into the lamps. There was not a lamp made before Edison's time that had a practicable seal for retaining a perfect vacuum. There have been numerous attempts in recent years to make so called improvements upon the Edison all-glass globe, sealed by fusion of the glass, but no such attempt has ever been successful in producing a commercially satisfactory lamp. With the modern lamp, having a carbon filament or burner about 1-200 of an inch in diameter, it is of vital importance that there shall be absolutely no leakage of air into the lamp after the lamp has been exhausted. At the very outset of his experiments with carbon for a

burner, Edison adopted the only method of sealing or closing the vacuum chamber that has ever been found to be perfectly effective in holding the vacuum of high degree necessary in the incandescent lamp. The lamps exhausted by Edison eighteen years ago have just as good vacuum to-day as he produced in them at that time. I have before me a lamp made by the Edison Lamp Company fifteen years ago, and it now has just about as good vacuum as we produce in our lamp to-day. The marvellous ingenuity displayed by Edison in solving the numerous knotty problems connected, first, with the production of a successful lamp, and secondly, with its economical manufacture, has won the admiration of every lamp expert who has studied the early history of this invention. Even to-day, with all the knowledge of the art of lamp manufacture, coming from a practice of twenty years, it is an exceedingly difficult matter for any manufacturer to turn out lamps in commercial quantities, having a uniform grade of excellence, so exceedingly sensitive in this article to the minutest defect in any part of its construction.

That the problem of its first development was no trifling one is shown by the fact that Edison, with his wonderful fertility and unrivalled energy, spent nearly all his time for six continuous years in developing and perfecting his lamp, its manufacture and his system of lighting. During this time he spent on this work about $100,000, and during these six years took out in the United States alone over eighty patents pertaining solely to the incandescent lamp and its manufacture. In his search for the best material for a filament, he tried every substance that he could procure in the animal, vegetable and mineral kingdoms. He sent special envoys to South America, Central America, West Indies, China, Japan, India, and elsewhere, in search for a suitable fibre, and finally adopted for this purpose a certain selected growth of a particular variety of bamboo found in one of the inland districts of Japan. Of this material only a selected portion, that immediately below the outer skin, was found suitable.

Strange to say, after twenty years of experimenting with all kinds of materials, natural and manufactured, there are lamps of certain classes being made to-day out of this same grade of Japanese bamboo that are superior to lamps having filaments made of any other material designed for the same purpose.

To illustrate Edison's remarkable perserverance and capacity for work, there were times when for two weeks he never left his laboratory to go to his house, which was but a short distance away.

On one occasion, in Newark, when a certain printing telegraph machine failed to work to his satisfaction, he locked himself up in his room with five assistants, it is said, and declared he would not leave until he had made it work, and work it did, although it required sixty hours continuous labour.

Let us now consider briefly the improvements that have been made in the incandescent lamp during the twenty years of experimenting and commercial manufacture. The bulb has changed only in shape. The first bulbs used by Edison were blown from glass tube. Then came the free blown bulb obtained from the glass works, which was used for eleven years by the Edison Lamp Company, which has always been by far the largest lamp manufacturer in the world.

For the last eight years the moulded bulb has been used almost exclusively by all lamp factories. The method of sealing the bulb to make it absolutely air tight is practically the same now as it was twenty years ago. The vacuum obtained by Edison in his early lamps was just as good as that produced to-day by those lamp factories that exhaust their lamps by the use of mercury pumps. The Ebison Lamp Works in the States, and the Canadian General Electric Company's Works at Peterborough, are using an improved chemical method of exhausting, which gives not only a superior vacuum to that obtained by the mercury pumps, but also a far more uniform grade of vacuum in all the lamps. Edison required six hours to produce his vacuum. To-day we produce the same in less than one minute. The shortest time required by mercury pumps is about one-half hour.

The filament used by Edison in his first experimental carbon lamp was made from carbonized paper, but this very soon gave place to bamboo, and this material was then used exclusively by the Edison Company for all classes of lamps up to 1894. The Sawyer Man Company, as well as the Thomson Houston Company at Lynn, also used the same material, while other companies were using carbonized silk and cotton thread, and a few amorphous cellulose. This last mentioned material has been used by all the principal companies during the last few years. It is very much cheaper to work than bamboo, is more homogeneous and better adapted to make the long thin filaments necessary for low candle power lamps.

The principal improvements in the quality of the lamp during the last twenty years have been on the filament, and pertain chiefly to improvements in the method of treating or flashing the carbon base, whereby a hard, dense grey coating is deposited upon the surface of the filament. The method employed in making this deposit of dense carbon determines largely the life of the lamp, the maintenance of its candle power and efficiency, and the uniformity of product as to voltage and power consumption. This operation of treating the filament is now performed by automatic apparatus designed to break the electric circuit at the instant when the hot resistance of the filament has reached the desired point. All lamp manufacturers use the process of treating. So that whatever the material used in making the filament, whether bamboo, silk, cotton thread, or cellulose, it is in all cases given a very similar surface coating, all factories using for this purpose some of the various forms of hydro-carbon.

They all keep as secret as possible the various details of their methods of manufacturing this part of the lamp, and the difference in the quality and behaviour of different makes of lamps is traceable chiefly to the different methods of preparing the filament and handling it throughout the several stages of its manufacture.

The process of treating the filament in order to make the surface coating, which I have mentioned, is one of the most beautiful and interesting phenomena in the art of electric lighting. The carbonized thread, already shaped like the filament, is inserted in a bottle from which the air is then exhausted. The bottle, by means of valves and pipes, is then placed in connection with another bottle containing one of the many forms of hydro-carbon liquid, such as gasoline, and the vacuum above the liquid causes it to evaporate rapidly and fill the treating bottle with hydro-carbon gas or vapor. The electric current is now sent through the filament, causing it to become incandescent, as it does when in the finished lamp. This vapor, coming in contact with the white hot filament, is chemically decomposed or broken up into its constituent elements, and a pure carbon, similar in nature to graphite, is deposited on the surface of the filament base, which is also almost pure carbon but of less dense structure and resembling wood charcoal. This operation of artificial growth or enlargement of the filament continues until it has attained the proper electrical resistance, when the current is cut off and the filament is removed from the bottle. The filaments need to be designed of such size and length that when the treated coating has attained the proper thickness, the resistance of the filament will be from 30 to 50 per cent. of the resistance before treating, the per centage varying with different classes of lamps. The time required to make this deposit varies in different cases from a few seconds to half a minute, and longer in some special cases. The resistance of the filament, when in the treating bottle, falls very rapidly since the deposited carbon has about one-sixth to one-tenth the specific resistance of the base carbon.

The most beautiful phenomenon in connection with treating the filament is that of rendering it perfectly uniform in resistance and brilliancy throughout its length, provided the treatment is continued a sufficient length of time. This action will be best understood by reference to a diagram and a little supplementary explanation.

Very strange to say, this process of treating the filament, so essential to the highest quality of lamp, was invented and patented before Edison had produced his first successful carbon filament lamp.

The patentees, Sawyer and Man, although four years ahead of Edison in the production of a carbon burner lamp, would probably never have had any commercial use for their process of treating, and probably would never have appreciated its immense importance and value, had there not been invented a commercially successful high resistance carbon lamp to which the process was more perfectly adapted. Had Edison applied this treating process to his perfected bamboo filament, for which he would have been obliged to pay royalty to Sawyer and Man, he would have produced a lamp twenty years ago that on test by the most severe of modern methods, would have compared very favourably in all respects with the best lamp made to-day.

Edison knew that his competitors could not make a successful lamp without infringing on his own patents, and he did not propose to be indebted to any other individual in the manufacture of a successful commercial incandescent lamp which he considered his own, and his greatest invention. He therefore set at work to discover some other means of accomplishing the same result

He concocted a fluid in which he dipped his bamboo filaments prior to carbonizing, and by this means did effect a great improvement in the material, but the process was by no means equal to the treating process. Edison, with characteristic shrewdness, kept his process of preparing the filament a secret, and to make doubly sure that those engaged in manufacturing the lamps would not become acquainted with the filament process, had this work done under his personal supervision at a small shop several miles away from the lamp works. For about twelve years the Edison Company used this dipping process of preparing their filaments in place of the hydro-carbon treating process. Many of you are no doubt familiar with the old Edison lamp with glossy black filament, which would start at 16 c. p. with an efficiency of 3.1 watts per candle, and in less than 100 hours would be down to 12 c. p. with an efficiency of four or more watts per candle, and the decline in candle power and efficiency continued until, at the end of three or four hundred hours, the candle power was perhaps ten and the power consumption five or more watts per candle. Do you wonder, then, that these lamps after this gave very long life? And yet, you will run across a man now and then, even to-day, who will declare that the lamps made to-day cannot compare with the good old Edison lamps of ten years ago.

When the treating patent expired the Edison Company hastened to abolish the old Edison dipping process, and for the last eight years they have been treating all their filaments with the exception of those used in their 200 to 250 volt lamps, which are not treated, because it is impracticable to make treated filaments of sufficiently high resistance and of sufficient mechanical strength and sufficiently small surface to be used at such high voltage, and give as low as sixteen candle power.

I may add, however, that the treating process is not so necessary with the cellulose squirted filament as it was with the bamboo, since the former is much more homogeneous and uniform in section and surface than was the bamboo.

The lamp with untreated filament will decline in candle power much more rapidly than the treated filament designed for the same candle power, voltage and efficiency. For candle power, maintenance and useful life, the 200 v., 16 c. p. 4 watt lamp with untreated filament stands about midway between the 110 v., 16 c. p., 3 1-2 and 3.1 watt treated filament lamps.

I have now considered the changes that have been made during the last twenty years in the bulb, the vacuum, and the filament. There remain the three important elements, the leading in wires for carrying the current to the filament, the joints between those wires and the filaments, apparently insignificant but very important, and the base of the lamp for attaching it to the circuit.

For leading in wires platinum is used now, the same as it was by Edison, but the quantity used per lamp has been greatly reduced. There have been various attempts to substitute other cheaper metals for the expensive platinum, but none have proved commercially successful.

For joints Edison used a copper wire which was welded to the platinum at one end, and at the other flattened and bent about the carbon filament and finally copper plated. This was very effective and was used for many years, but the use of copper at the joint is somewhat detrimental to the quality of the lamp. At present the principal companies use a carbon paste for attaching the filament directly to the platinum wire. This is not only better, but cheaper than Edison's method.

The base used by Edison is used to-day with but very slight and unimportant modifications. There have been two dozen or more distinct types of base designed by different lamp companies that have started up during the last twenty years, and I have always admired the practical genuis of Edison who, in this, as in many other ways, hit upon just that form, that after twenty years of experimenting on the part of rivals, has survived nearly all other forms of bases and is to-day not only the best but also the simplest and cheapest to manufacture.

Having considered the most important movements that have been made in the incandescent lamp during the last twenty years, I will now treat very briefly of the present method of lamp manufacture. As most of you have probably visited our lamp works, you are already familiar with the main mechanical processes, and I will not need to dwell upon these.

The filament is made from cotton in its original state. This is first thoroughly cleansed and then digested with chemical ragents until it is reduced to a gelatinous state resembling glue. After standing some length of time it is put into a mechanical mixer and thoroughly churned, then strained and exhausted to remove all air bubbles. It is then introduced into a special bottle containing a very small circular aperture or die in its lower neck, and by means of compressed air on top of the mass it is squirted through the die into alcohol, which causes it to coagulate into a white thread, which after being washed is wound onto a drum and allowed to dry, when it very much resembles horse hair. This is gauged and sorted, wound unto suitable forms to give it the filament shape, and then subjected to the baking process. The filaments are placed in graphite crucibles, surrounded by graphite or other material to exclude the air, and then gradually raised in a furnace to a very high temperature, sufficiently high to melt iron but not platinum, and so held for several hours until all the volatile matter is removed from the filament in the shape of gases. When removed from the furnace, the filaments are almost pure carbon and very smooth and glossy. They are now ready for the next process, treating, which has been described.

EFFECT OF SCALE IN BOILERS.

THE commonly accepted idea is that the efficiency of a steam boiler is seriously affected by an accumulation of scale. Perhaps the most often quoted estimate is that the presence of 1-16 in. of scale causes a loss of 13 per cent. of the fuel burned, ¼ in. 38 per cent., and ½ in. 60 per cent. Recently, says the Street Railway Review, we have seen published statements tending to show that the loss of efficiency due to scale has been greatly over-estimated.

Prof. R. C. Carpenter, of Cornell University, writing in the American Electrician, says that so far as he is able to determine by tests a lime scale, even of great thickness, has no appreciable effect on the efficiency of a boiler. A test which he conducted when the boiler was thickly covered with lime scale showed practically as good results as when it was perfectly clean. The explanation is that the heating capacity is affected principally by the rapidity with which the heated gases will surrender heat, as the water and metal have capacities for absorbing heat more than a hundred times faster than the air will surrender heat. Any deposit which curtails slightly the capacity of absorbing heat on the water side has very little effect either on total capacity or efficiency. A thin film of grease, however, being impermeable to water, keeps the latter from the metal and generally produces disastrous results.

Mr. Walter M. McFarland, formerly an engineer officer in the United States Navy, in the course of a lecture at Sibley College, Cornell University, stated his experience had been that a considerable thickness of clean uniform scale made apparently little difference in the efficiency of the boiler. On the U. S. S. Vandalia there were two boilers used for distilling water, and the water evaporated per pound of coal was no more when the boilers were clean than after three months when the scale was nearly ¼ in. thick.

On the other hand, there are recent tests showing that scale does reduce the efficiency. In May and June, 1898, Prof. L. P. Breckenridge, of the University of Illinois, made tests on a locomotive boiler before and after cleaning it of scale and found that the loss due to the scale was 9.55 per cent. The average thickness of this scale was 3-64 in.; analyses of samples taken from different points in the boiler showed from 20 to 67 per cent. calcium carbonate and from 4 to 40 per cent. calcium sulphate.

Also, copies of reports of tests sent us by the Union Boiler Tube Cleaner Co., of Pittsburg, show that there is a marked increase in the efficiency of the boilers after the scale has been removed. In one case the gain was 16.3 per cent. and in another 24.8 per cent.; the thickness of the scale was not stated.

FREE SCHOLARSHIPS.

The trustees of the American School of Correspondence, 156 Tremont street, Boston, Mass., have decided to depart from custom in their policy of promotion. Believing that a personal exposition of the advantages of a school is often better than, or at least, a great help to printers' ink, they have announced their willingness to grant a limited number of free scholarships to men in various large establishments and parts of the country. We are not advised of the exact conditions, but anyone who thinks he would like to have one is invited to correspond with them, giving his occupation, and his application will receive consideration by the trustees. The school calls attention to its coures in mechanical and electrical engineering (including a complete course in mechanical drawing), the former including steam, locomotive and marine engineering. As its work is confined to these branches, they point out the probability of better work being done than would be likely where many other branches are taught.

BY THE WAY.

THE manager of a gas company in one of the leading cities of Canada is having built a new residence in a choice residential district where electricity is almost universally used for house lighting. He complains of having been pestered by electric wiring firms desirous of securing the contract for wiring his new house. The idea had not occurred to these enterprising contractors that it would never do for the manager of a gas company to light his house by electricity. When so informed they gave the gas manager a look expressive of their deepest sympathy with a man who was prevented by circumstances from adopting up-to-date methods.

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In the past great difficulty has been experienced in wiring, for electric light, without damage, residences which are decorated. Wiring men have been obliged to abandon the idea of getting to outlets and switches located on brick walls without channelling. The firm of Strickland & Company recently contracted to wire a large residence in Toronto for some two hundred lights, and in many cases switches and wires had to be located on solid brick wall. They devised a means of overcoming the difficulty and carried out the work successfully. They have baptized the tool used in the work a "persuader," and it is certainly a useful article.

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AT the recent meeting of the British Association some very interesting experiments were performed in firing cartridges by means of electric waves, sent out from an apparatus arranged for wireless telegraphy. In this case it was an apparatus similar to Signor Marconi's that was used, and it was intended to have fired the cartridges from a balloon that was sent up from the Lister Park, where the members of the British Association were being entertained, but the balloon got away so quickly that communication was lost with it before the experiments could be carried out, and to satisfy the scientists the gentlemen in charge of the apparatus fired the charges by imitating the wave that would have arrived from the balloon if the communication had been maintained. The arrangement consisted of the usual coherer which is necessary for inductive wireless experiments, and a wave was sent to it through the wooden wall of the hut in which the apparatus was placed, by means of the spark of an ordinary frictional electrical gas lighter. The action of the wave on the coherer caused an electric relay to operate and to connect a battery of accumulators with the wires leading to the fuse, which exploded immediately the current passed. In the opinion of a writer in the Colliery Guardian there are possibilities in this that may be useful in mining.

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AT the recent convention of municipal electricians, held in Pittsburg, a humorous communication was read from Mr. L. J. Morgan, formerly city electrician of Kansas City, in which he explained that the office of city electrician in that city had been abolished. Referring to some of the conditions under which the city electrician labors, Mr. Morgan said that "his employers consisted chiefly of the mayor and a city council, or probably the city council and a mayor. Characteristic curves of the mayor may be more or less easily plotted, but no one can foretell the vagaries of the city council. The ethics of the profession," he continued, "demand that dignity should be omnipresent, but dignity and aldermen are strangers. In vain you attempt to discuss with an alderman plans which you have for bettering the electrical condition of the city, or money that you have saved by the elimination of electrolytic electrolysis. The alderman dismisses such a proposition with a gesture and brings you down to earth with a jar by telling you that he has a friend whose door-bell doesn't work or that his electric-light meter is working over-time. If he doesn't want a door-bell fixed or his meter shunted, he probably wants a city telephone placed in his hall or a city arc lamp in his parlor, or perhaps he only wants his gasoline stove repaired. When the influential member introduces you to his brother-in-law and confides to you that he is to be your chief or sole assistant, that he is a first-class kalsominer and in a few days will learn to be a good electrician, you must cheerfully accept this as an axiomatic proposition. Never show the slightest annoyance; if you don't like him take him out and connect him up with the alternating-current primaries. This is not crime, but philanthropy. Endorse unreservedly any and every proposition advanced by any member at any time or at any place. It is also wise to express an eagerness to personally assault any person, not a councilman, who has the slightest views opposed to those of the aforesaid member."

ELECTRICAL EQUIPMENT OF THE CHAMBLY PLANT.

The initial installation at the works of the Chambly Manufacturing Company, at Chambly, from which point current is transmitted to the city of Montreal, 17 miles distant, consisted of four two-phase generators of 2,000 k.w. capacity each, wound to generate current at 12,000 volts. The plant was so designed, however, as to provide for the installation of eight machines of the above capacity. The demand for power has been such that the Chambly Company have found it necessary to install the additional equipment originally provided for, and we are informed by the Canadian General Electric Company that they have secured the contract for four generators of 2,000 k.w. each to complete the installation. These will be wound for 2,200 volts, and by means of transformers the current will be stepped up to 12,000 volts for distribution over the circuits.

ELECTRICITY ON GERMAN FARMS.

Under date of August 23, 1900, Consul Hughes, of Cobourg, says: "In this and neighboring parts of Germany, considerable attention is being paid to electrical appliances that can be used on the farm. Near Ochsenfurt, in Bavaria, a company composed of landowners and small farmers has been organized for the establishment of an electrical system for use on their farms and villages. The current is to be generated by steam and water and to be distributed from a central station to the places at which it is wanted. Sub-stations are to be established at given points, with the necessary apparatus for connecting with the farm or other machinery, and also for lighting purposes in the houses, offices, roads and village streets."

The negotiations with Boyd & Company to operate the electric light plant at Huntingdon, Que., by water power have been declared off. The plant will be run by steam until next spring, when steps will be taken by the town to acquire a water power.

ENGINEERING and MECHANICS

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

FOURTEENTH DINNER OF TORONTO NO. 1.

A jolly party assembled in the large dining room of the Walker House, Toronto, on Thanksgiving eve, to partake of the fourteenth annual dinner tendered by Toronto No. 1, C.A.S.E. The attendance numbered about one hundred and fifty. With one large table at the head of the room and ten smaller tables, prettily decorated with plants and flowers, a splendid effect was produced. Seated at and near the head table were ex-Mayor Shaw, Messrs. James Huggett, president Toronto No. 1; G. C. Mooring, executive president; R. C. Pettigrew, Hamilton, past executive president; Chas. Moseley, executive vice-president; A. M. Wickens, executive secretary; G. F. Haworth, of Sadler & Haworth; J. J. Main, Canadian Heine Boiler Company; G. R. Baker, Westman & Baker; W. C. Powers, traveller Vacuum Oil Company; G. W. Grant, Hamilton-Grant Oil Company; J. M. Sinclair, Eureka Mineral Wool Company; E. J. Philip, The Steam Specialty Company; A. E. Edkins, J. W. Marr, W. P. Sutton, O. P. St. John, W. J. Webb, H. E. Terry, George Thompson, James Bannon, W. C. Blackgrove, Wilson Phillips, and others.

The menu was tempting and served in good style. Their appetites appeased, attention turned to the toast list. As presiding officer, Mr. James Huggett welcomed the guests to the fourteenth annual banquet. In his remarks he pointed out that the engineers were banded together to raise the standard of the profession. This was the sole object of the Association. The secretary, Mr. Marr, read a letter of regret from City Engineer C. H. Rust. "The Queen" being honored, the president asked the guests to rise and drink the health of "Canada, Our Home," to which ex-Mayor Shaw responded in a truly patriotic speech. It was not only the material prosperity of Canada that we should be proud of, but fame had come to our country through the gallantry of the Canadian soldiers in South Africa. He concluded with the remark that our destiny must be with the Motherland.

Mr. A. M. Wickens responded to "Toronto, Our City." Toronto, he said, was the center of the educational institutions of Canada. Perhaps it was not generally known that we have the only free technical school in the world. He, as one who had always taken a deep interest in technical education, hoped that it would soon be possible to furnish the scholars with free books as well as free tuition, and that the Toronto school would be the forerunner of many technical schools throughout Ontario.

The names of Messrs. G. R. Baker and J. J. Main were coupled with the toast of "The Manufacturers." Mr. Baker said that when we look back we must admit that the manufacturing industries had improved within the last four years. He was not one who believed that the introduction of new machines and ideas would decrease the demand for labor. When he started in business they had no planing machine, but used the hammer and chisel. He said that as good mechanics could be found in Canada as anywhere in the world. In calling upon Mr. Main, the president referred to him as one always ready and anxious to help the engineers. Upon rising Mr. Main was heartily applauded. He said that it had been his privilege to be present at eleven of the fourteen banquets which had been held by Toronto No. 1. It was also his good fortune never to have had bad times. His trouble had been more work than he could possibly turn out. Recently he had received enquiries for machinery from all parts of the Dominion. Boiler-making, he said, had undergone wonderful changes. A few years ago, when the riveting machine was introduced into the boiler shop, the boiler makers threatened to strike; later pneumatic machinery was introduced, but still there was plenty of work for the men. In his opinion no capable boiler-maker need be out of employment. Mr. Main in closing acceded to a request for a story, the telling of which was roundly applauded.

"Educational Interests" was acknowledged by Mr. E. J. Philip and Mr. A. M. Wickens. The C.A.S.E., Mr. Philip said, had done more to educate its members than any other society. It was the intention of Toronto No. 1 to hold open meetings during the coming winter, at which instructive papers would be read. Mr. Philip referred to the fact that the stationary engineers were in a large measure responsible for the establishment of the technical school. While a course in the technical school was to be commended, another source of education which gave good results was the correspondence schools. A Canadian correspondence school had been started and would be in good running order before the end of the year, and the intention was to cater largely to the needs of engineers. The advantages of this method of education was that students did not require to leave their homes at night, and that older men, who might not be in a position to keep up with the younger students in a class, could regulate the course to suit their ability. Mr. Wickens, in responding, gave a brief history of the objects of the association. There were two associations, the Ontario Association and the Canadian Association. The former is incorporated by the Government to grant certificates to competent engineers, while the latter aims to educate the engineers so that they may obtain these certificates. During the coming year it was proposed to take a further step in educational work. Last year five different lesson papers were issued to active members only, but at the last convention funds were set apart to get out 1,000 copies per month, for twelve months. The object of the papers was to teach engineers how to handle their plant economically. The papers would take up such subjects as water, steam, gases, combustion, temperature, etc., and would be distributed to members and other engineers through the proprietors of steam plants. In this way steam users would get educated regarding the work of the association. Mr. Wickens urged engineers to endeavor to improve themselves, pointing out that there was plenty of room in the engineering trade at the top.

In responding to the toast of "The Executive" Mr. Mooring pointed out that the motto of the Association was safety, reliability, economy, and intelligence. He said that at the last session of parliament they were promised that the legislation asked for would be granted next year. Ald. Pettigrew, of Hamilton, made a brief speech in reply to the same toast. He was pleased to say that the association was growing, and that the Hamilton association, since the last executive meeting, had taken in half a dozen new members. Mr. Chas. Moseley paid a high tribute to Mr. Henry Carscallen, M.P.P., of Hamilton, and Mr. Thos. Crawford, M.P.P., Toronto, for the assistance which they had given the engineers in their efforts to secure legislation.

Mr. O. P. St. John and Mr. A. E. Edkins responded to "Sister Societies," and Mr. James Huggett to "Toronto No. 1." Mr. Huggett stated that open lectures would be given in Engineers' Hall, 61 Victoria street, every third Wednesday in each month, and he extended an invitation to all engineers to attend them. The Association had a good library and was working earnestly to improve the standard of the engineering profession. "Our Host" and "The Press" being toasted, the proceedings of the evening ended.

MR. JAMES HUGGETT,
President Toronto No. 1, C. A. S. E.

An excellent programme of songs was furnished by Messrs. Gillogly, Maguire, Anderson and Trowman.

The dinner committee consisted of Messrs. Jas. Huggett, J. W. Marr, W. L. Outhwaite, W. J. Webb, S. Thompson, Jas. Bannon, A. M. Wickens, H. E. Terry, John Fox, A. A. Storer, and G. C. Mooring.

MR. JAMES HUGGETT.

Mr. James Huggett, president of Toronto No. 1, was born at Chatham, Kent, England, and at the age of fourteen years entered the Royal Navy Dock yard at that place, remaining there until he reached the age of twenty-one, when he left for Canada. He has resided in this country ever since, and has occupied several important positions in steam engineering. For twelve years he was in the employ of A. S. Whitting, of Oshawa, leaving there ten years ago to accept the position of chief engineer and mechanical superintendent for the Freehold Loan & Savings Company, whose office building at the corner of Victoria and Adelaide streets is one of the best equipped in Canada. A short time ago the Freehold Loan & Savings Co. was amalgamated with the Canada Permanent & Western Canada Mortgage Company. Mr. Huggett, however, retained his position, and in addition became mechanical engineer of the various buildings controlled by these amalgamated interests. Mr. Huggett has always taken an active interest in the work of the Canadian Association of Stationary Engineers, and his election as president of Toronto No. 1 is a well deserved honor.

The British American Corporation, who are operating their mines electrically, have placed a contract with the Canadian General Electric Company for a 100 h.p. induction motor. This is in addition to several large motors previously installed. The C.P.R. smelter at Trail have also purchased a 150 k.w. motor.

ELECTRIC RAILWAY DEPARTMENT.

STORAGE BATTERY—ITS USE ON SMALL ROADS.

By B. B. Van Nostrand.

The application of storage batteries to the generating system of large electric roads has been described by many engineers in a variety of ways, so that an impression has been left upon many minds that it is only with these larger systems that the battery scheme is feasible. This idea is incorrect, and I think that the following description of the equipment and operation of the Peekskill Lighting and Railroad Company will bear me out in the statement. In the description of this road we shall see conditions that apply in a general way to most small lines.

This road was placed in operation in June, 1899, since which time it has been running without any interruption except momentary stops caused by the circuit breakers flying out. Beginning at the station of the New York Central Railroad, which is at the western edge of the town, near the Hudson river, the road proceeds in a practically straight line through the center of the town and on to Lake Mohegan—a total distance of 4¾ miles. The road is an exceptionally hilly one, in fact the fairly level portions are the exception, and are never more than 1,600 feet long. Beginning at the New York station terminus, the road, as far as grades are concerned, is about as follows: Starting into town, there is 1,000 feet of 7½ per cent. grade—with a small portion (say 20 feet) where it reaches 9 per cent. For a distance of about 4,000 feet beyond this, there is a gradual grade, varying from 5½ per cent. to 2 per cent., terminated by 300 feet, of 5½ per cent. to 7½ per cent. At the top of this is a short level, leading into a 2,000 feet 2 per cent. incline, followed by 1,600 feet, varying from 4½ per cent. to 8¾ per cent., which is in turn followed by 2,000 feet of 3¾ per cent. of up-grade. There is after this a depression, represented by 1,400 feet of down-grade, varying from 6.8 per cent. to nothing, which, after passing into a short level rises 1,400 feet up-grade with a maximum of 4.6 per cent., to another short level. Then follows another down-grade of about 1,800 feet, varying between 8 per cent. and 2 per cent. This is followed by 1,600 feet of level—terminated by 300 feet of 8 per cent. After this is 1,000 feet of level, passing into a short down-grade of 6 per cent., 1,300 feet of level is after this, passing into 2,000 feet of 7½ per cent. The final portion to the end of the road is about 800 feet level.

On this entire line of single track, with four turnouts, 56-lb. T-rails are used throughout, these being laid in the usual manner.

There is a single-track branch 4,000 feet long extending from the New York Central station north to the State Camp Ferry. This operates but one month of the year, at which time two cars are in service.

The overhead construction of the system is simple—consisting of 00 trolley throughout, with 0000 feeder, extending to within ½ mile of the lake end and 1,000 feet from the station end. The branch has no feeder. The 0000 feeder is tapped at regular distances throughout its length.

The apparatus for operating the road consists of one 60-k.w. Edison bipolar 575-volt, 880 r.p.m. generator, belted to a horizontal 13-in. x 12-in. Armington & Sims simple engine, the horse-power of which is about 100 at 575 r.p.m. Belted to this same engine, in tandem with the dynamo, is a four pole differential booster, which is used to render the charging and discharging of the battery automatic.

There is another unit consisting of a Westinghouse 120 k.w., multipolar 625 r.p.m. generator, belted to a vertical 14-in. and 24 in. x 14-in. Westinghouse compound engine of 200 h.p. capacity. It may be added here that this generator is rarely used, and that only when the road is unusually heavy—such as occur on holidays and warm Sunday afternoons. The same engine which operates this generator is also belted to one of the alternaters for incandescent lighting. It may be well to note that in addition to the above engines there are three other engines which operate the remaining light machines. These, of course, have nothing to do with the railway system. In the boiler room are three 80 h.p. and 100 h.p. horizontal return and tubular boilers, carrying steam at 105 pounds pressure. During the summer months two of the 80 h.p. engines are sufficient to run the entire plant—though three become necessary in winter.

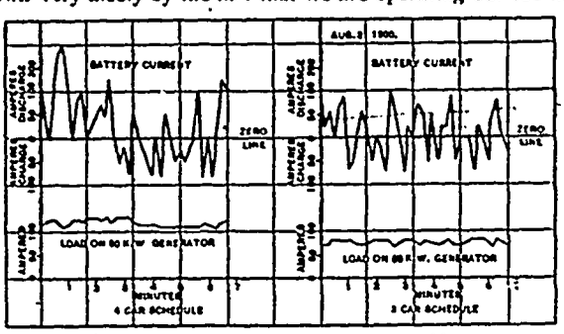
The battery, which is in the simple wooden shed next the boiler room, consists of 26 type F-9 chloride accumulator cells. Each cell is comprised of nine plates, 10½ inches square, suspended in glass jars of sufficient size to enable the capacity to be increased in future by the addition of more plates. Each cell is mounted upon a wooden tray filled with sand, to ensure an even foundation for the jar. These trays rest in turn upon glass insulators, supported by a wooden battery rack. On full charge the battery has a maximum rated capacity of 160 amperes for short periods. As a matter of fact, however, it is often called upon to discharge at a considerably higher rate than this, 250 amperes being called for momentarily.

During the summer season three cars are run from 6 a.m. to 12 p.m. Two of these run through Peekskill as far as the car house at the eastern edge of the town. The other car runs through the town and on to Lake Mohegan. This gives a twelve-minute schedule in town, and forty-eight minutes through to the lake. In the afternoon and evening four cars are run, giving a twelve-minute schedule in town and twenty-four minutes through to the lake. On holidays, etc., five cars are run, all going through—thus maintaining a twelve-minute schedule throughout the run.

Paper read before the New York State Street Railway Association, Buffalo, Sept. 18, 1900.

Having gained a fair idea of the nature of the system, we will pass to the results obtained in the station.

The point of first importance is the remarkable constancy of the load upon the generator, and the correlated fact that the 60 k.w. machine is all that is necessary to operate the road, except when running the five-car schedule. The curve marked No. 1, in the engraving will explain this. This shows the results of ten-second readings, taken upon the battery and generator during a short portion of a four-car run. The total line current is, of course, the summation of these two. It is seen that this total current fluctuates between 25 amps. and 310 amps., and that the generator runs along at practically full and constant load—the battery assuming the fluctuations above and below this. Curve No. 2 shows the same results for a three-car run. Here the average or generator load is lower (about 75 amps.), and the line fluctuates from 0 amps. to 170 amps. The practical good of this is evident. It means that a 60 k.w. machine is running instead of 180 k.w., which would be required were the battery not in service. In other words, although the load fluctuates from almost nothing to 180 k.w., the average is in the neighborhood of 60 k.w., and it is this average only which falls upon the generator and engine. The remarkable evenness of the load upon the generator produced by the operation of a storage battery is shown very nicely by the fact that we are operating our 120-k.w. railway machine and one of the alternators for our electric lights from the same engine. Ordinarily this would produce a very serious flickering in the lights, but in our case it is impossible to detect the slightest change in the brilliancy of the lamps, although the railway may be fluctuating between its widest limits. I have not had an opportunity to test the coal saving produced by this arrangement, but I am confident from my observations that it is sufficient to pay a good return upon the battery investment over and above the interest and depreciation charges.



No 1. No. 2,

The increased economy of a small unit operating at a full and constant load above that of one three times the size, but doing the same work under highly fluctuating conditions, is such as to warrant this assumption.

It would be difficult to increase the simplicity of operation in this plant. After the original adjustment, the apparatus has worked together without the slightest difficulty. We have a generating unit operating under electric lighting conditions, due to the fact that the battery removes from the systems all sudden overloads, and the strain thus removed from the minds of those in charge is in its effect almost as valuable as this latter consideration.

In other ways the battery is valuable. A great many times it has been necessary to shut down the small engine suddenly from some mishap. During the eight or ten minutes necessary to get the other unit into operation the battery has carried the entire load.

Then, too, it is often desirable to run a car for some special occasion very late at night. At such times the generator is shut down and the battery thrown across the line.

In conclusion, I may state that the battery has given us absolutely no trouble since its installation, and the daily labor for its proper care does not average more than one-half hour. In fact, about all the work required is that of taking voltmeter and hydrometer readings upon the individual cells once each week.

THE MONTREAL STREET RAILWAY.

The fortieth annual meeting of the Montreal Street Railway Co was held in Montreal on November 7th. The report of the directors of the past year's business showed a net profit of $647,246.64, as compared with $630,870.61 for the previous year. The operating expenses, it was stated, showed an increase of 1.11 per cent. as compared with last year, this increase being due to more frequent and extended car service, increased expenditure for snow clearing, and increased cost of fuel and general supplies, as well as labor.

The company's rolling stock was increased during the year by the addition of 56 closed motor cars, 45 open motor cars, one stores car, 7 supply cars, and 80 trucks, while 128 motors and 83 controllers were added to the electrical equipment of the cars. There are at present under construction in the company's shops six extra long closed motor cars, mounted on double trucks, making in all 25 cars of this type which will be available for service this winter.

The system of cast-welding rail joints was continued and extended, the experience obtained during the past two years fully justifying the expense incurred.

TRADE NOTES.

We have received from Messrs J. E. Rhoads & Sons, of Philadelphia, a handsomely printed and illustrated catalogue of one hundred pages, descriptive of their leather belting and factory fire-extinguishing appliances, etc.

Mr. L. Sapery, of the Syracuse Smelting Works, Montreal, who has recently returned from Europe, reports that he has secured some good orders for their celebrated babbitt metals and Columbia phosphor tin in England and France, which will be filled for the first time from the Canadian works. This the first instance of babbitt metal or phosphor tin being imported from Canada.

SPARKS.

It is stated that the Electric Development Company, of Philadelphia, will open a Canadian office in Hamilton.

The Chambly Electric Company, of Montreal, have installed a 5 h.p. motor to run a 5 ton capacity elevator in the warehouse of F. X. Benoit & Co., flour merchants, Montreal.

The Aylmer Electric & Manufacturing Company are installing a new 3,000 light incandescent generator purchased from the Canadian General Electric Company, being one of their latest type revolving field machines.

The Chambly Electric Company, of Montreal, have received an order from C. O. Beauchemin & Fils to install a complete warehouse telephone system of ten instruments in their warehouse and seven in their printing office. An aerial cable 5000 feet in length will be used between the two establishments.

It is reported that the American Bell Telephone Company, the Telephone, Telegraph & Cable Company of America, the Western Union Telegraph Company, and the Postal Telegraph-Cable Company will be consolidated into one big company, to be known as the National Telephone & Telegraph Company.

The electrical equipment of the church of Maisonneuve, P. Q., has gone through many changes. Originally a few lamps were put in, but, considering the advantages of electric light, the churchwardens decided to have a complete plant installed for lighting the entire church. Mr. Valois, manager of the Chambly Electric Company, of Montreal, secured the contract for the installation of a 200 light plant, which was completed in September last.

The Toronto Railway Company have for some time been manufacturing controllers after a patent claimed to be owned by the Canadian General Electric Company. The latter brought suit against the railway company to restrain them from manufacturing the controller, and the courts gave judgment in favor of the plaintiffs, and ordered defendants to pay all costs. The controllers now in use on the road will be continued on payment of damages which have been agreed upon.

The corporation of Lachine, Que., has owned and operated its own electric lighting plant for seven years past. Recently, however, it became dissatisfied with this method, and, after having consulted with Mr. R. A. Ross, consulting electrical engineer, decided to dispose of the plant and accept the offer of the Lachine Rapids Hydraulic & Land Company for the necessary supply of current, which will be delivered at the transformer primaries. The distribution system will be entirely remodelled and adapted for the use of alternating current for light and power.

The Electrical Construction Company, of London, Limited, find their business expanding and growing to such an extent that they have deemed it advisable to enlarge their premises and equip their factory with the latest modern improvements for facilitating the economical and convenient handling of their machinery. They have purchased lots No. 32, 34, 36, 38 and 40 Dundas street west, opposite the court house, 200 feet deep, on which they are erecting a three-story factory. This company have recently extended their business to include fixtures, house wiring, and general electric supply trade, together with several specialties of foreign manufacture. They will, in their new factory, be prepared to handle light and power generators of all sizes and of all requirements. Their factory is being built according to the plans of the so-termed modern machine shop, having travelling crane covering the entire shop, and galleries on each side for the lighter work; the main floor being used for the heavy tools and handling of heavy work. They will be in a position to turn out the very best high grade machinery at a minimum of cost.

SPARKS.

Mr. P. Scanlan has been appointed engineer in the new electric light station in East Toronto.

The New Brunswick Telephone Company purpose erecting a new telephone exchange at St. John, N.B.

Nerlich & Company, of Toronto, are installing a 25 k.w. direct connected generator of the Canadian General Electric Company's type.

Wm. Gray & Sons, carriage builders, of Chatham, Ont., are installing a 350 light plant supplied by the Canadian General Electric Company.

It is proposed to build an electric tramway from Nanaimo, B.C., to the Extension Mines, five miles distant. The road is estimated to cost $150,000.

The plant of the Simpson Knitting Company, of Toronto, referred to in last issue, will include a 500 light direct current Canadian General multipolar generator.

Warden Evans, of Lincoln county, recently headed a deputation which asked the Provincial Government for a charter for an electric railway from Niagara to Port Dalhousie and Queenston.

The shareholders of the Hamilton, Grimsby & Beamsville electric railway have decided to apply to the Legislature for authority to extend their road to St. Catharines, Niagara and Niagara-on-the-Lake.

The Wright Taper Roller Bearing Company is a new Montreal concern applying for a Dominion charter, to manufacture a patent roller bearing for railway cars, bicycles, etc. Mr. W. H. Laurie, of Montreal, is interested.

The Dominion Coal Company, of Sydney, C.B., have contracted with the Canadian General Electric Company for three generators, direct connected to Ideal engines manufactured by the Goldie & McCulloch Company, of Galt.

The Von Echa Company are building an electric railway between Ingersoll and Woodstock, Ont., and have purchased their railway equipment from the Canadian General Electric Company, the intention being to use G. E. 1,000 motors.

Geo. Smith, an electrician of Galt, was killed at Lindsay on October 24th while engaged in the installation of a fire alarm system. Deceased had cut a guy wire, which fell across a live wire, and attempted to remove the guy wire with his naked hands. Instant death resulted.

The Westinghouse generators in the power house on the Canadian side of Niagara Falls were set in motion a fortnight ago. Their capacity is 30,000 horse power. The belts for same were supplied by Sadler & Haworth, of Montreal and Toronto, and include several 44 inches and 24 inches wide, and a number of smaller sizes, each about 100 feet long.

The surveys and plans for the proposed electric railway from Niagara Falls to Fort Erie on the Canadian side have been completed, and preparations are being made to proceed with construction this winter. The road will be constructed along the water's edge, will be 20 miles long and built for fast service. Mr. C. H. Mitchell, Niagara Falls, Ont., is engineer.

The Department of Justice at Ottawa are installing a lighting plant in the St. Vincent de Paul penitentiary. The electrical equipment will be supplied by the Canadian General Electric Company and will consist of one 30 k.w. and one 75 k.w. direct current direct connected generators and a three panel switch-board. The power equipment will be one 50 h.p. high speed simple engine, one 120 h.p. high speed tandem compound engine, and two 75 h.p. boilers, supplied by the Waterous Engine Company, of Brantford.

At the last meeting of the Stamford Township Council Mr. Joseph Battle, of Thorold, asked that the Niagara, St. Catearines & Toronto Railway Company be granted the privilege of building a spur line, from a point near the main line and the Stamford-Thorold township line to the Thorold stone quarry. The line will be about two miles in length, and will cost about $9,000. The purpose of the road is to carry stone from the quarries to the main line of the Niagara, St. Catharines & Toronto Railway. It is proposed to be operated by electric locomotives.

An interesting application of electricity for industrial purposes is found in the operation of the plant of the Ottawa Carbide Company at Ottawa. The electrical apparatus was manufactured and installed by the Canadian General Electric Company. A description of the plant would, no doubt, prove interesting to our readers, but this is impossible at present owing to the refusal of the company to allow outsiders to inspect the works. The reason given is that the machinery is said to embody several valuable improvements which have not yet been patented, and new processes in connection with the manufacture of carbide that are known only to the principals of the company. The works are estimated to have cost half a million dollars. Mr. Frank Creelman, C.E., is the consulting engineer.

SPARKS.

James Donaldson, of Goderich, has made a proposition to the council of Thessalon, Ont., to establish an electric plant for street and commercial lighting.

The Parry Sound Electric Light Company has fixed the value of its plant, which the town may purchase, at $20,000. A by-law authorizing the taking over of the plant will likely be submitted to the ratepayers.

The West Kootenay Power & Light Company, of Rossland, B. C., have secured the contract to increase the power for the Trail smelter by putting in three Wagner transformers of a total capacity of 500 h. p.

The steamship Cowrie recently arrived at London from Koetei, Borneo, a distance of 9,250 miles. The trip was made without coal, liquid fuel being used. Twenty-two tons of oil were consumed daily on the voyage.

The Globe Furniture Company, of Walkerton, Ont., are installing a new 20 h. p. Ideal engine, manufactured by the Goldie & McCulloch Company, of Galt, and a new dynamo manufactured by the Detroit Motor Company.

Messrs. John Parker and H. E. McKee have been appointed arbitrators by the town of Sturgeon Falls, Ont., and the Sturgeon Falls Electric Light Company to determine upon the price at which the electric light plant should be taken over by the corporation.

Sam Lung, a Chinaman, was electrocuted at Peterborough. He went down in his cellar to repair some water pipes, and in so doing lowered an incandescent lamp through a hole in the floor. We are told that in some unaccountable manner he received a death shock from the live wire.

By an error in the notorial deed, some doubts arose as to the time when the contract for street lighting in Montreal expires. The matter was referred to the city attorneys, who have decided that the contract between the city and the Royal Electric Company will expire on December 31, 1903.

The city engineer of Hull, Que., has been authorized to put up immediately 50 arc lights for street lighting. The Ottawa Electric Company will supply the current at $53.53 per kilo-watt. The Adams-Bagnall Company will furnish the lamps, Garrioch & Company, of Ottawa, the wire, and R. E. T. Pringle, of Montreal, the insulators.

SPARKS.

The Babcock & Wilcox Company, of Montreal, have just shipped a 500 horse power boiler to the British Columbia Electric Railway Company, of Vancouver, B.C.

A 75 k.w. direct connected generator, of the Canadian General Electric Company's make, is being installed by the City Dairy Co. in their new building on Spadina Crescent, Toronto.

The Saugeen Electric Light Company are about to light the towns of Southampton and Port Elgin electrically, and for that purpose have purchased a 2,000 light standard single phase alternator from the Canadian General Electric Company.

A special transformer of 200 k.w. capacity is now being built by the Canadian General Electric Company for the Hamilton Electric Light & Cataract Power Company. It will be used for coverting the current from 22,000 volts two phase to 2,300 volts three phase.

Messrs. Dunsmuir & Company, of Vancouver, B.C., have placed a large contract for electrical apparatus with the Canadian General Electric Company. The British Columbia Railways Company, of the same city, have purchased a 500 k.w. alternating current generator, with switch-boards, from the Canadian General Electric Company.

The Montreal Water & Power Company are about to replace the steam pumping plant in Westmount with an electric pump, which will pump the water from the catch basin in Westmount to the reservoir at Cote des Neiges. This change has been made partly for the purpose of removing complaints by the residents of Westmount of the smoke and noise occasioned by the operation of the steam plant. It is also the intention of the city to put in an electric pumping plant.

The corporation of Morrisburg, Ont., is developing a water power there. The contract for water wheels and steel work has been awarded to the Wm. Hamilton Manufacturing Company, of Peterboro, and that for electrical apparatus to the Canadian General Electric Company, Toronto. The latter contract includes a 200 k.w. revolving field, three phase generator, with switch-board, wire and all necessary equipment. Mr. R. H. Hill, of Toronto, secured the contract for the hydraulic development.

A system of street lighting different from anything in use in this country, is employed in Flint, Mich. From an illustration sent us by Mr. Davidson, of Messrs. Ness, McLaren & Bate, Montreal, we notice that arches are constructed across the principal business streets. On each arch there are fifty lights of 50 c.p. each. These are regulated so that if required only ten of the lights may be turned on. This is said to be the only city in Michigan that is lighted in this manner. The city of Columbus, Ohio, has a similar method, we understand.

Please mention this paper when corresponding with advertisers.

SPARKS.

It is proposed to make improvements to the street railway system at Sherbrooke, Que.

The Niagara, St. Catharines & Toronto Railway Company have made a survey of the proposed road to Beamsville.

John O'Donohue, of Ottawa, Ont., who was pursuing a course in electrical engineering at the General Electric Company's works at Schnectady, N. Y., was instantly killed in the testing department last month. He was engaged in testing a 400 h. p. generator, and during a period that the power was shut off laid down on a piece of belting and fell asleep. The power was turned on by one of the mechanics at work in the shop and the body was carried to a fly wheel, where it was badly crushed.

The Montreal Street Railway Company have introduced an innovation in street railway building in the reconstruction of their track on St. James street. Steel ties, to which the rails are firmly bolted, are used. The system has been tried in India and various countries in the tropics and is understood to have given satisfaction.

The Paris Electric Light Company are installing a 1,000 light alternator of the Canadian General Electric Company's make.

The Canadian General Electric Company have secured the contract for a 500 light plant for the Sunderland Electric Light Company, of Sunderland, Ont.

The St Hyacinthe Light and Gas Co. have purchased from the Canadian General Electric Co. three 25 light constant current series transformers, and 50 series alternating enclosed arc lamps for the street lighting service in that town.

The Renfrew Electric Light Company, of which Mr. A. A. Wright is president, have placed an order with the Canadian General Electric Co. for a 100 k.w. revolving field, monocylic alternator, to be installed by January 1st next.

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