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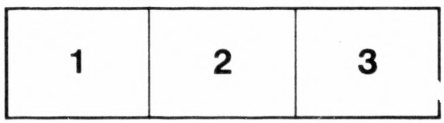

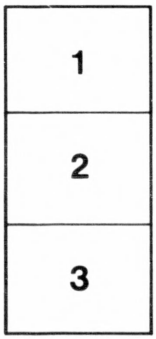

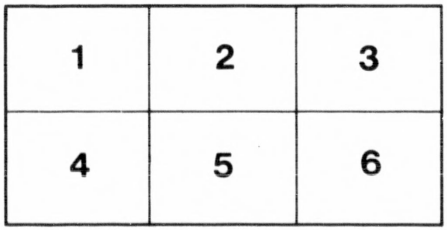

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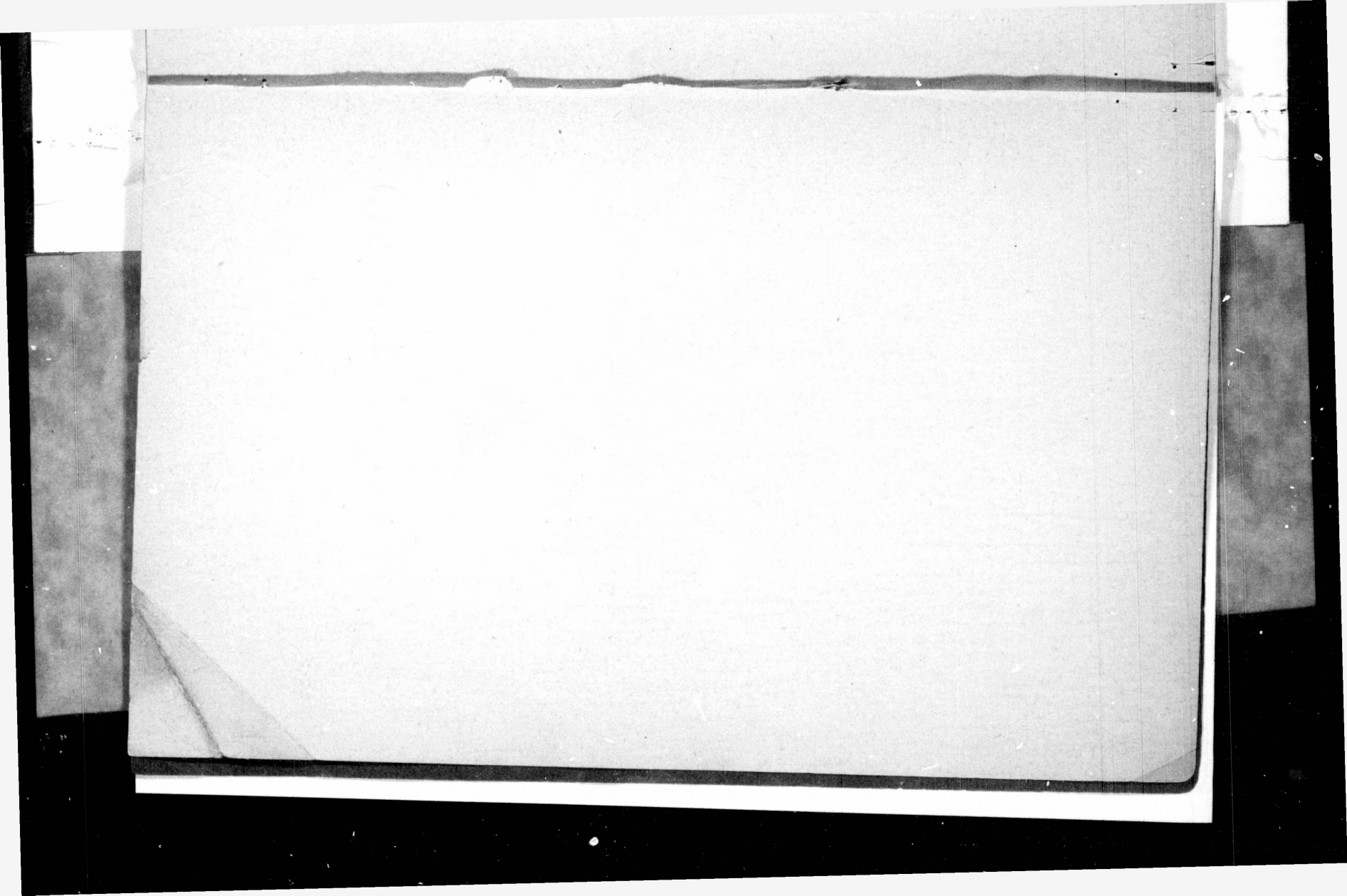
THE CANADIAN ELECTRIC LIGHT COMPANY

AND

The Future of Electric Lighting IN CANADA.

Montreal:
GAZETTE PRINTING COMPANY.
1882.



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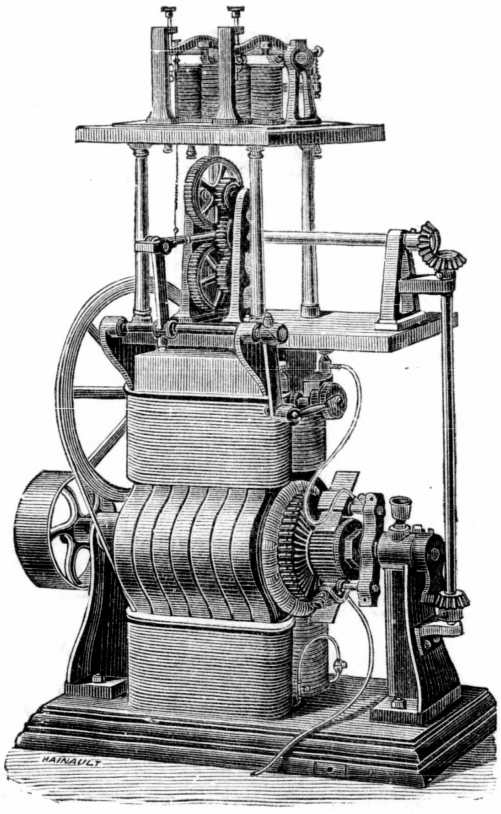
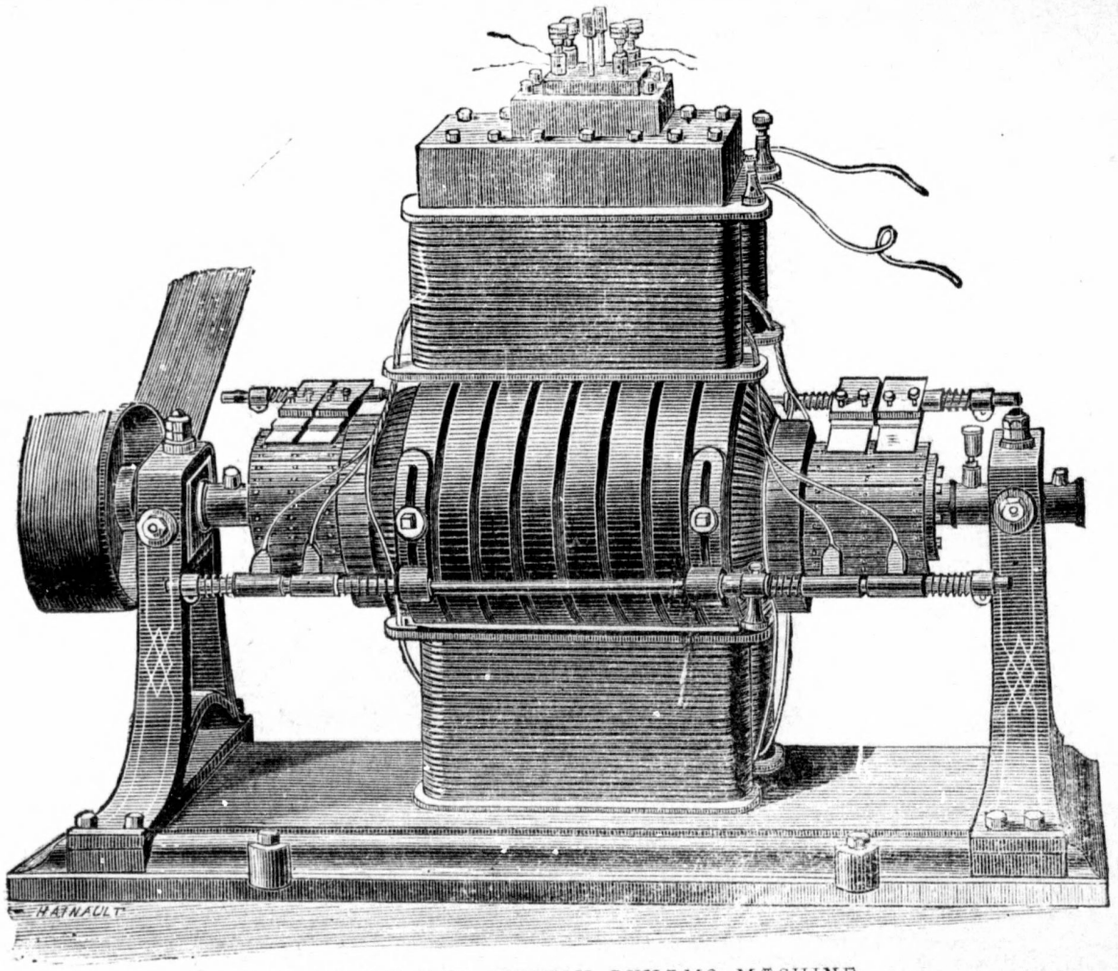
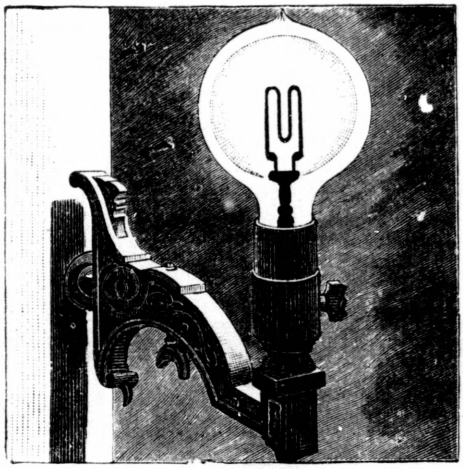


THE MAXIM INCANDESCENT LIGHT REGULATOR.



THE MAXIM AND WESTON DYNAMO MACHINE.



THE MAXIM INCANDESCENT LAMP.

THE
ELECTRIC LIGHT ILLUMINATION

UPON THE SYSTEM KNOWN AS

Gramme, Weston, Maxim, Nichols, Etc.

Under Proprietary Rights for the Dominion of Canada,

OF THE

CANADIAN ELECTRIC LIGHT CO.

No. 17 PLACE D'ARMES, MONTREAL.

GOLD MEDAL awarded to the Maxim System at the Electrical Exhibition held in Paris, September 1881,

AND

GOLD MEDAL awarded to the different Systems exhibited by the Canadian Electric Light Co. at the last Exhibition held in Montreal, September 1881.

The CANADIAN ELECTRIC LIGHT COMPANY has acquired the latest and the most complete patent rights bearing upon the subject of illumination by electricity. These proprietary rights extend even to discoveries that may be made in the future, and which shall come under the control of the great Electric Light Company of the United States, doing business in New-York, and which has a vast amount of capital at its disposal.

The production of electricity has now become simply an industrial problem; it is more easily controlled and regulated than steam. Thanks to the new machines, it is no longer dependent upon the glass friction-wheel, the zinc-and-copper battery, or the Voltaic pile seen in laboratories. A simple iron drum with a copper wire coil, turning cylinder-like between (but without touching) two blocks of iron which are also covered with coils of copper wire—such is the complete mechanism. There is no friction even; it is simply a matter of vibration; and if this drum be made to vibrate during the whole year, it will produce electricity all the year round without the least interruption. No ingre-

dient enters into the production of the mysterious current, which, from this very cause, is inexhaustible and unlimited. To set the machine going, all that is required is a motive power.

The above is a brief explanation in popular language of the generator known as the dynamo-electric machine, which is capable of producing currents of the greatest power; in fact, so intense is the current produced by one of these machines above, when driven by a steam engine of fifty horse power, that it will give a light equal in brilliancy to a hundred thousand candles.

Under conditions such as these, it may be said without fear of contradiction that electricity has now entered into the field of industry, since the production of the current is, henceforth, dependent upon a mere mechanical effect. The instrument, once adjusted, requires no attention; and any mechanic of ordinary intelligence may draw at will light or motive power from this machine with the same facility as he draws light or power from his furnace. Nor is this apparatus liable to work capriciously, because it is simplicity itself. The bearings supporting the shaft of the revolving drum are the only friction points; this gives an absolute assurance of the stability of the current.

It is not intended to give in these notes a full account of the various industrial uses to which this machine may be put; we would call attention, however, to the vast interests in the utilization of our natural water-powers. The transmission of the hydraulic power by means of electricity is a problem which has received a full solution. In causing a drum or bobbin to revolve between two magnets, as explained above, an electric current is produced; but if a current is sent from another place to a machine which is at rest, the drum or bobbin of this machine will immediately begin to revolve with a force proportioned to the intensity of the current. Now, if, to the shaft, or axle of this bobbin a pulley be attached, on which a belt may be adjusted, this pulley will answer all the purposes of a main shaft, or drum, revolving by steam power, by communicating the motion to the machinery of the work-shop. A motive-power may be obtained from one of these machines alone of from one to twenty-five horses, by increasing the number of machines, which cover a surface of about two square feet each, you can have any amount of power; and this power will be as constant, as powerful, and as useful as a steam-power itself.

The importance of this transformation of electricity into motive-power is very apparent as regards great centres. Imagine a water-power of any kind at a few miles distant from a city; it is possible, by means of a simple wire, to transmit from an electrical engine-room, situated at the water-power, to a thousand work-shops in the city all the motive-power which they may require. The loss of power which occurs in such transmission has even been ascertained.

It is found that if a machine receives an impulsion equal to fifty horse-power, at the starting point, only a power of twenty-five horses will be transmitted to the point of delivery; thus, if the water-power be of 40,000 horses, a motive-power of 20,000 horses may be distributed over a few copper wires to all parts of the city, according to the requirements of each consumer. Engines and boilers are dispensed with; and neither coal nor water is required to make steam; no engine-driver nor stoker is wanted; no extra insurance against fire; no costly moving into the premises and fitting up; no waste of valuable space. An apparatus two feet square, and weighing three hundred pounds or less, placed in a corner of the factory, in a cellar, or in a garret, will answer to every requirement of a motive-power; and after deducting the general expense of a dam, and the first outlay, this motive-power of 20,000 horses will cost no more than the millions of gallons of water which run and are lost in the river.

As to the electric light, the problem has been solved quite as advantageously to the consumer. Without going into details, we shall offer an explanation of the two systems already in existence.

THE ELECTRIC LIGHT.

All the different kinds of apparatus by electric energy transformed into light may be arranged into two leading classes, namely;

1st. The Voltaic arc, or great light.

2nd. The incandescent or divided light, for use in the interior of houses.

This general classification nevertheless admits of some systems which may properly be classed between the Voltaic arc and the incandescent light, as they are related to each of these.

THE VOLTAIC LIGHT.

The apparatus to produce the Voltaic arc are of two kinds, namely:

1st. Carbons placed *in prolongation* one over the other ; these are the *lamps* or *regulators*.

2nd. Carbons placed *parallel* to each other ; these are the *candles*.

Candles such as Jablockoff's are not much in fashion.

The name of *regulator* is given to all systems employing more or less complicated mechanism to keep the carbon points apart at their normal distance from each other. A distinction might be drawn between regulators fed by continuous currents and those fed by alternating currents ; this, however, is relatively a secondary feature, and it is better to look to the light itself to establish subdivisions. An important characteristic, which establishes a well marked division, is the number of lights fed by one machine *on the same circuit*.

The following are distinguished, namely :

(a.) Voltaic are *monophotic* regulators, that is to say, those which admit of only one apparatus being placed on the circuit.

(b.) *polyphotic* regulators, or, as they are often called, *dividing regulators*, with which 2, 3, 4 and even 50 lights may be placed on the same circuit. It may be observed in passing that a dividing regulator may be used as a monophotic regulator, by placing one light on a circuit of appropriate power, but that a monophotic regulator cannot be used reciprocally. These work poorly, or not at all, when several are placed on the same circuit.

The light of the Voltaic arc is best adapted for exterior illumination, because the rays of the electric lamp are identical with those of the sun. A solar ray, falling upon a given space, is equivalent to 5,774 candles at the distance of one foot; an electric lamp emits precisely one half of this light ; and it is a singular fact that the electricians of Europe have applied the electric light with the greatest success to promote vegetation during the night. The celebrated Dr. Siemens, a relative to the firm of that name who manufacture all the Transatlantic cables and by whom an electric railway has just been opened near Berlin, has demonstrated the fact that plants and fruit exposed to the action of the electric light continuously during the night arrive at maturity sooner. The electric light has the same effect as the sun in promoting the decomposition of carbonic acid in vegetables and in arresting the injurious effect on the plant of radiation from the earth during the night.

THE INCANDESCENT LIGHT.

The incandescent light, invented quite recently, is of far greater importance than the light of the Voltaic arc, and is destined to play an important part in the interior illumination of houses. From the moment that it is found possible to divide the electric current at will the matter no longer offers any great difficulty. The leading inventors of this system, Maxim and Edison, have kept lights constantly burning at New York for six months past which have not failed one minute during all that time. The light has been tried at Montreal, particularly at the St. Lawrence Hall with the same satisfactory results. This system of illumination is very simple. Electricity, as every body knows, follows a conducting wire; if the currents meets on the way a body less accommodating than the copper wire, a struggle immediately ensues. If this body is not a conductor of electricity at all, the current is beaten and its career is ended; but if this body is merely an imperfect conductor, one through which the current can pass with some difficulty, heat results from the struggle and the obstructing body is set on fire. In the open atmosphere, the struggle would be over in half a second, and the resisting metal or body would be melted or consumed almost immediately; by confining the warring elements within a hermetically sealed glass globe however, about the size of a pear, and from which the air has been extracted, the inconvenience that would result from the destruction of the resisting is avoided. The resisting body which the current has to encounter in the globe is a small piece of card, reduced to carbon and cut and bent in the form of an M with rounded angles. It is, of course, within the globe that the struggle takes place. The piece of card, a bad conductor of electricity, takes fire, and remains in an *incandescent* state as long as the current passes through it; it may be a whole night, a whole week, or during three months if the generator is kept in motion so long, because the combustion of the card cannot take place in a *vacuum*. This incandescence produces a soft, golden light, exactly similar to a gas jet; it is neither stronger nor weaker than gas, but it possesses three advantages over gas. 1st. It is perfectly steady, differing in this respect from gas, which flickers continually. 2nd. As it burns in a *vacuum*, it does not consume, like gas, the oxygen we breathe, nor does it give off the carbonic acid which is injurious to silver-ware, gilding and oil paintings. Nor does it heat the atmosphere. 3rd. Lastly it cannot set fire to the pre-

mises, nor cause suffocation, because, if the globe should break the light would be extinguished instantly on the first fissure appearing in the glass. This system is now working perfectly; ingeniously constructed apparatus provide for everything, and the lights may be distributed throughout the house in the same manner as gas lights and may be lighted and extinguished at pleasure. When a hundred lights are burning, it is possible to extinguish ninety-nine without thereby increasing the current that is being trans-mitted to the only remaining light; and all the lights in the house or only a portion of them, may be lighted at pleasure by simply turning a key in one place.

But, it will be asked. What about the cost? The following data may serve as a basis for more complete estimates: If electricity is supplied by water-power, the cost is almost *nil*, as, in that case, it is in reality the motion of the water in the river that is being changed into light, which may be kept burning night and day without making any one poorer, as no material is consumed. If steam-power is required, the estimate may be based on the fact that one horse of steam-power will supply eight house lights. With a steam-engine having the recent improvements two pounds of coal per hour are consumed for each horse-power, or $\frac{1}{4}$ of a pound of coal to each light. A light kept burning six hours every day during the whole year, will require 547 pounds of coal, or about 80 cents worth. A gas jet consuming six feet per hour will, in the same space of time, require 13,140 feet of gas, to produce which 2943 pounds of coal will be necessary or $4.50, one ton of coal being used in the manufacture of 10,000 feet of gas. Allowing 70 per cent. for the resale of coke, breeze, coal tar and ammonia, there is an amount left of $1.35 against 80 cents as the comparative cost of production. This is about the cost price. But if we consider the figures charged to consumers, $2.00 per 1000 feet, we find that the margin between 80 cents, cost price of the electric light and $26.00 amount of gas bill, is about $25.00 to cover all the incidental and administrative expenses.

The systems of illumination by incandescence are far less numerous than those dependent upon the Voltaic arc; consequently their classification is not so complex. The incandescent systems are divided into two classes, namely:

1st. Incandescent lamps with combustion.

2nd. Lamps purely incandescent.

The class of *incandescent lamps with combustion* is represented by

the apparatus invented by Reynier, Werderman (Napoli patentee,) Joel and Tommasi. All these lamps are constructed with a carbon point resting lightly upon a block of carbon or of metal and thus producing an *imperfect* contact.

The *purely incandescent* lamp is represented by four different systems, that of Edison, Maxim, Swan, and Lane Fox. All these lamps are of incandescent carbon.

The nature of the current is almost a matter of indifference in the case of incandescent lamps; they operate with either a continuous or alternating current. Incandescent lamps with combustion require a large *volume* of the current and are worked with *tension*; while purely incandescent lamps require a small volume and are worked generally with *quantity*.

SCIENTIFIC OPINIONS.

The following opinions upon the systems of Maxim and Weston are taken from the highest authorities in matters of electrical science:

THE MAXIM LIGHT,

AS PRODUCED BY THE UNITED STATES ELECTRIC LIGHTING COMPANY.

(*From the New York Graphic, May 5th*, 1881.)

The rapid advance made in the application of the electric force to the uses of common life is one of the marvels of the age. Ingenious inventors and keen-witted discoverers in all parts of the civilized world have bent their energies to the task of wrestling from Nature the secrets she has held. Repeated experiment, repeated failure, and final success mark the progress of the investigation Rivalries have but stimulated invention; one scientist has trodden close upon another's heels, one company of capitalists has gone a step further than its competitor in developing newly-found resources, and the general public is the gainer by all that has been produced. From the Atlantic Cable of 1858 to the electric light of 1881 is a long stretch, representing incessant labor, high ambitions, manifold applications of scientific skill, wonderful displays of profound learning. What the next quarter of a century will produce may reasonably be inferred from what has already been accomplished.

Readers of current literature are aware, not only of the progress of discovery in reference of the application of the electric light to

practical uses, but are cognizant of the respective claims put forth by rival inventors, some of whom have promised, honestly enough, but mistakenly, to do more than they could perform, being, so to speak, the victims of circumstances beyond their control. Others, achieving partial success, have won reputation and profit. From time to time our newspapers and magazines have described the newest efforts, and the appetite of the public has been whetthed accordingly but has never until now been wholly satisfied, and for a very sufficient reason. For, although great stores and warehouses have been brilliantly lighted up by electric light, streets illuminated and steamships equipped with machines whose rays can pierce dense fogs, two problems have been left unsolved until now. One of these problems was the discovery of the best method of controlling and regulating—the light, the other was the question of cost—a consideration to householders, especially, who suffer under the exactions and impositions of the gas companies. Both of these problems are now satisfactorily solved.

The Maxim light, which is illustrated in this issue of THE GRAPHIC, is found, by a long series of severe tests, to contain several invaluable qualities not possessed by any other electric light in existence. It is produced at a cost much less than gas, and gives more than twice the light that gas furnishes; it creates no appreciable heat; it is adjustable by the ordinary gas stop cock; its carbon burner, instead of wearing out speedily, repairs itself and lasts for many months, and its flame is pure and steady. The United States Electric Light Company, of which Mr. Charles R. Flint is President, holds the Maxim patent, and Mr. Maxim is himself one of the consulting electricians of the Company, among whose advisers are also professor Mortor., Professor Baker, of Philadelphia; Professor Moses G. Farmer, of the United States Torpedo Service, and other distinguished scientists. The company owns altogether about one hundred patents, and business is flowing in upon it in a steady stream, necessitating the erection of a new factory, which is now in process of construction on Avenue B and Seventeenth street.

OUR ILLUSTRATIONS:

show two interiors illuminated by this light. One of the views represents the elegant drug store of Caswell, Hazard & Co., under the Fifth Avenue Hotel, as viewed from outside, showing the convenient arrangement and the extreme brilliancy of the electric

lights, the other is a view of the art gallery of the Union League Club on Fifth avenue, into which these lights were introduced last week, with singularly beautiful effects. A representation of the lamp used for this light is also given.

The peculiar advantages of the United States electric light are: (1) its perfect steadiness; (2) its brilliancy—each lamp giving a light of twenty-four candle power; (3) its cheapness as compared either with gas or other electric lights; (4) its adaptability for household and private use; and (5) the absence of heat. The company has not sought newspaper publicity, preferring to perfect its process and to make the light it furnishes satisfactory to its customers by constant improvement and watchfulness; but now, satisfied that the desired result has been attained, it challenges the attention of the public, and defines its future purposes in the following statement by its President, Mr. Flint. which we copy from the *Evening Post* of Saturday last.

"Six months ago we bought the six story building at Seventeenth street and Avenue B, and immediately ordered an immense quantity of machinery. Owing to the revival of manufactures all machinits have been far behind their orders for the last year, and we are only now getting what we ordered. The boiler and some of the engines are in, besides the shafting and belting throughout the whole building. In six weeks we expect to have our machinery in, and at least one thousand men at work turning out dynamos, lamps and motors.

"At present we have three factories actively at work supplying such material as we need in order to extend our business at a slow rate—say of one machine a day. In twenty-fifth street we have a small shop, in Twenty-seventh street another, and on Sixth avenue one that has been running for a year and a half. The building on Sixth avenue is six stories high and will probably be the station for one of our up-town districts. We are already lighting from it several shops, Caswell & Hazard's drug store, the card rooms of the Union Club, and some of the appartments in the Cumberland building, at Twenty-second street and Broadway. The Union Club members are so well pleased with the light in their card rooms that we expect to put electric lights all over the building, The *Evening Post* spoke of the success of the lights at the Union League Club reception; not an hour's trial was necessary to demonstrate their superiority to gas. In the same way we use a part of the basement of the Equitable building as a

miniature station in order to furnish light to the Equitable building and such offices in the neighborhood as may desire the light. For more than a year we have lighted the Post-office at one-third of the cost of gas, and for the last six months parts of the Equitable building, the banking offices of Fisk & Hatch, Hatch & Foote, and two banks have been lighted up by our lamps. Last week we put the light into the new vault of the Stock Exchange; to-morrow the Maritime Exchange in Beaver street and the offices of W. T. Hatch will be lighted with them; on Saturday the offices of Phleps & Stokes and W. R. Grace will be added to the list. But the real beginning will be made when we get our Seventeenth street building going and organize a down-town station.

"At first we do not intend to charge less for our light than the price of gas. The competition will cause the gas companies to lower their prices, and then *we shall follow them down, and end by making prices lower than they can manufacture gas for.* Within a year gas will be worth no more than $1 per 1,000 feet; our standing offer to every householder will be to give electric light at the same price as he has been paying for gas. As the light is pleasanter, steadier, healthier and safer than gas, and there being *absolutely no danger from fire*, we expect the public to take our light in preference to gas at the same or even a slighly lower price. In three months we expect to be able to make that offer to every person needing light. Each house or office will be supplied with a certain number of extra lamps, so that if one of those in use gives out a new one can be put on with no more trouble than replacing the chimney of an oil lamp. We find that the incandescent lamp will be used entirely in the interior of buildings, the arc being too strong and too unsteady; it gives an immense quantity of light, and is just suited to the street, but quality is what is wanted for houses."

The light of the future seems at last to have been secured after much travail and tribulation. The success which has attended the efforts of the skilful electricians and the enterprising capitalists whose services have for a long time been unremittingly but quietly devoted to the interest of the United States Company, proves beyond question that the desideratum of getting a brilliant electric light at a price less than that of gas, and better adapted for household use than gas, has been attained. A new era begins with the introduction of the light to which THE GRAPHIC to-day invites the attention of its readers. It is to be remembered, more-

over, that this is no untried experiment. On the contrary, the Maxim light is in constant and satisfactory operation at the following named places among others:

Caswell, Hazard & Co.'s drug store, Fifth Avenue Hotel.

Union League Club Art gallery, Fifth Avenue and Thirty-ninth street.

Union Club, Fifth Avenue and Twenty-second street.

Equitable Building, No. 120 Broadway.

Mercantile Trust Company, No. 120 Broadway.

New York Stock Exchange.

New York Post Office.

The *Tribune* Building.

Fisk & Hatch's banking house.

Hatch & Foote's banking house.

The Maritime Exchange.

Cumberland Building, Broadway and Twenty-second Street.

THE MAXIM ELECTRIC LIGHT.

(*From the London Times, May 31st*, 1881.)

Among a few systems of electric lighting which have occasionally been heard of, but which hitherto have not been seen in this country, is that of Mr. Maxim, of the United States, in which country the light is stated to be in considerable use and in good repute. A successul demonstration of this system took place on Friday evening last in the presence of a number of scientific gentlemen who assembled in the Albany Works, 374, Euston-road, London. It is an incandescent system, and comprises a generator, a regulator, and a burner or lamp. The prime generator is a small dynamo-electro machine which is driven at about 200 revolutions per minute. In this machine a current of electricity is generated, which is conducted to a second machine of similar construction, but of larger size. The current from the first machine is caused to circulate in the electro-magnets of the second, thus exciting the magnetic field of the latter. The small machine, or exciter, is provided with an ingenious device for controlling the supply of electricity and regulating the current, in order to meet the requirements of the number of lights burning, which may be constantly varied, without either detriment to the machine or alteration in the other lights. This is called the Maxim

regulator, and consists of an arrangement of electro-magnets. The brushes collecting the current generated by the exciter, together with the brush holders, are made to move around the axis of the machine, and are automatically set to any position between the *maximum* and the neutral points. Two pairs of electro-magnets at the top receive a proportion of the current of the large and small machines respectively, one pair operating the regulating movement and the other a shunt.

The regulator is operated by means of an armature attracted with forces varying according to the number of lights in circuit. When the supply of current becomes insufficient by reason of additional lamps being lighted, the armature being released in one direction and attracted in the other, by means of a spring, a pawl, which is suspended from this armature causes the brush holders to revolve, an intermediary system of gearing being brought into play, thus supplying a greater volume of current. When the current becomes too great in consequence of the removal of some of the lamps from the circuit, the opposite phenomenon occurs. The electro-magnets forming the second pair are so constructed and adjusted that they only act upon their armature when a large increase of the current passing through them takes place, such as would happen if a main wire were broken, or if any other accident occurred. In such an event this armature is strongly attracted, and overcoming the tension of the spring brings it free and in contact with a platinum point, thereby cutting the field magnets of the exciting machine out of the circuit and stopping the generation of the current until the accident is remedied. There is thus a complete safeguard against injury to either the machine or the lamps. The large machine consits of two distinct parts built into one on the same frame and spindle. They are coupled together, and an ingenious and simple contrivance is provided at the top of the machine by means of which the currents supplied by each of the two machines can instantly be disconnected or coupled either in quantity or tension as required. This machine is driven at a speed of about 900 revolutions per minute. It is claimed that this machine will maintain 85 Maxim lights of 25 candle-power each, making an aggregate light of 2,125 candles. The machine is said to be capable of giving a single arc light of 20,000 candle power. A second machine of the same power as the one just described was also used, and was driven at the same speed.

These machines supplied the current which fed 120 lamps placed in various rooms from the basement to the 8th floor of the building, and including the passages and staircases. The lamps are arranged in multiple circuit, each burner being independent of the other. The current is conveyed through a main leading wire with its branches, sub-branches, and lamp wires to the burners. All these wires are arranged similarly to the ordinary gas main and branch pipes. The gas fittings, when available, are used as a return wire; any other pipes, however, such as water pipes, can be used for this purpose. The burner consists of a carbon filament made from cardboard, and having the form of a double loop.

It is contained in a small hermetically-sealed glass globe or bulb, in which, it is stated, there is an atmosphere of gasoline, which prevents the deterioration of the carbon filament. By this means a kind of renovating process is said to be constantly taking place. The two ends of the filaments are connected with the two poles of machines, and the light is, the tap actuating a switch arrangement. The life of the lamp has not yet been ascertained, but it is stated that it will last from 600 to 900 hours. The lamps can be taken out of and replaced in their fittings with ease. They can be fixed to any existing gas fittings, some being so fitted at the Albany Works. The great bulk, however, were fitted in elegant chandeliers of various types, which have been lent by Messrs. Hulett & Co., of High Holborn, for use during the exhibition of the Maxim system, which it is intended shall be continued to the end of June. On the ground-floor of the building some of the suspended lamps were burning in globes containing water, thus illustrating the adaptability of the system for submarine work or exposure to wet. The arrangements generally were such as to illustrate the suitability of the system for use in lighting dwelling-houses, all the various details of the lamps being such as could easily be understood and controlled. Assuming that a central station existed for the production of the current, it was shown that the lighting of a whole house could be intantly effected. In the same way the whole number of lights in a room or any portion of them can be as easily turned on or off. In fact, nothing can exceed the simplicity and ease of the manipulation.

The machines were driven by a semi-fixed steam-engine of 20 horses power nominal, supplied by Messrs. Ransones, Head and Jefferies, of the Orwell Works, Ipswich, and similar to the one which has so successfully driven the electric lighting machinery

on the Thames Embankment for the past two years and a half. The demonstration took place under the auspices of Mr. N. de Kabath, and during the evening the various advantages of the light were fully shown, and the sensibility of the governing machinery was exemplified by Mr. Lockwood. The light produced is softer and more agreeable to the eyes than any we have yet seen, and it is the first demonstration we have attended without experiencing a painful contrast upon either quitting or re-entering the gas-lighted streets. There was really a great surplus of light exhibited, the volume being magnificent, but not intensely bright and dazzling. Altogether the demonstration was a thorough success, and showed that the latest addition to the list of systems for interior illumination would prove a worthy competitor for honours.

THE MAXIM ELECTRIC LIGHT.

(*From the London Draper, June*, 10 1881.)

We received an invitation to be present on Friday week at the Albany Works, 347 Euston-road, London, to witness a series of experiments in electric ligthing by incandescence on Maxim's system, where a number of scientific and literary gentlemen were assembled. The experiments are of considerable importance to drapers, as a clear, inexpensive light of 25 candle power, without heat, will be a boon indeed to our crowded business establishments, and the general adoption of one form or other of the electric light in our large houses has now become but a matter of time. The injury done to delicate fabrics, too, by the smoke and vapours arising from the burning of gas will make any system of electric light which is easy and simple of application doubly welcome. This the Maxim system promises. While the public have been waiting for Mr. Edison to perfect his invention, two incandescent systems have been introduced—the Swan and the Maxim. It is the latter which we now describe, the technical portion of the report taken from the *Times*.

THE WESTON SYSTEM.

[*From the Official Catalogue of the Paris Exposition, p.* 179.]

The Weston system, which has had so great a development in America, is a dynamo-electro machine with continuous currents to which the inventor has made it his aim to give special quali-

ties not possessed by other machines. Thus, to avoid the heating of the ring, Mr. Weston formed a large number of disks of superposed iron, separated by wide intervals, the coils are rolled in longitudinal grooves and bound to a collector with oblique plates. Owing to this arrangement, the ring acts exactly as a centrifugal ventilator and remains always cool in consequence of the rapid circulation of the air. The oblique plates of the collector assure perfect regularity in the current, as the brushes are always in contact with the two plates and thus there is no interruption of the circuit.

The lamp is based on the differential principle which allows of the arrangement of an indefinite number of *foci* on the same circuit. Ten *foci* of 2000 tapers are supplied by a single machine. The Weston lamp is exceedingly simple and its easy working is thus assured. There are really only two moveable pieces—the armature and the upper carbon-holder, without any clock-work. It also gives a remarkably steady light, such as other systems may perhaps attain but which they can certainly not surpass.

The reputation of the Weston Machines is already made in America, there being actually more than a thousand in use for galvanoplastic purposes. They are also beginning to be largely employed in England.

As for the Weston lamps, they are at present used in the electric lighting of a part of the City of London.

ELECTRIC LIGHTING BY INCANDESCENCE—THE MAXIM SYSTEM.

(*From the Official Catalogue of the Exposition*, p. 182.)

Among the numerous systems of electric lighting by incandescence, we have observed that of M. Maxim, which appears to solve completely the problem of domestic lighting. This remarkable system, by which the great hall of honour of the first storey is lighted, comprises a larger number of separate *foci* elegantly grouped side-by-side and forming a beautiful luminous ceiling. The electric light obtained is perfectly steady, as it is produced by the incandescence of a very small carbon conductor contained in a little glass globe. It impresses the eye agreeably, and it is not inconvenienced by intermittent and irregular radiation, which is so annoying and so fatiguing. M. Maxim's system of electric

lighting is carried on by an important American Company, the United States Electric Lighting Co., which has already had a great success in both the United States and England. This company will soon set up their light in several parts of the capital. Even now the visitor to the Exposition of Electricity may see and form a judgment of its results in the large hall on the first storey. The luminous ceiling, as the visitor may ascertain for himself, shines with extraordinary lustre, and the brackets with which the wall is furnished rival in brightness the light that radiates from the upper part of the hall.

The incandescense lamp of the Maxim system presents great advantages. It is lighted and exinguished at pleasure and instantaneously. By the manipulation of a simple *commuter*, its power may be easily graduated from that of a simple night light to the greatest lustre of which it is capable. The light is perfectly steady. Finally, the pure incandescence realizes the almost indefinite division of the electric light.

The Maxim System is already adopted by several English and American establishments. The Union League Club of New York have used it for several months to light their picture gallery and the results obtained leave nothing to be desired. This fine system of lighting is now complete with its special machines, its lamp, its regulator, and nothing stands in the way of its future career.

The Maxim system was first presented to the English public on 28th of May, 1881, by Mr. Kabath, of New York, who organized at the exposition the formation of the United States Electric Company. The Maxim mode of lighting by incandescence forms to-day a system entirely complete, comprising four distinct divisions carefully studied out, and working wherever it had been tried with entire success. These four divisions are: (1) the generating machine which feeds the *foci*; (2) the exciting machine which feeds the inductors of the generating machines; (3) the regulator, and (4) the incandescence lamp. It is the dynamo-electric machines of the Maxim system which produces the current necessary to feed the numerous *foci* which give light at the exposition.

The exciting machine, has, in its upper portion, an extremely ingenious and sensitive mechanism for the regulation automatically of the current furnished by the generating machines, according to the light required, that is, according to the number of

foci lighted. This result is obtained in the following manner: An electro-magnet of fine wire placed on the machine, deviating over the principal current, attracts with a force varying with the power of the current an armature to which is suspended a catch with two opposing teeth, which receives, by a transmission imported from the axis of the machine, a backwards and forwards motion. This catch moves between two toothed wheels which it does not touch when the current has its normal value. But if the current becomes deminished in consequence of new *foci* being lit, the armature, less strongly attached and drawn by an antagonistic force, recedes, raising the catch, of which the upper tooth fastens in the cog of the upper wheel; this motion is then transmitted by means of wheels, to the brush-holders which are arranged so as to turn around the collector, and so that the brushes may approach or recede from the maxima or neutre point; when the brushes approach the maxima points, the intensity of the current of the exciting machine is increased in proportion to the intensity of the current generated; if, on the contrary, the current is too intense, owing to the extinction of a certain number of *foci*, the armature, being more strongly attached, descends with the catch attached to it, and the lower tooth of the latter, fixing itself in the cog of the lower wheel, set in motion, by means of the gear already mentioned, the brush holders and brushes in an opposite direction, being then nearer the neutre and away from the maxima points. The force of the current of the exciter diminishes, and consequently the intensity of the current produced.

The maxim regulator is perfectly sensitive, as is demonstrated when the 60 *foci*, which one machine will supply, are in motion; these foci have been successively extinguished till only one remained, the remaining foci, during this progressive extinction, continuing always at the same intensity.

The maxim lamp is composed of a filament of carbon obtained from calcinced card-board in the form an M with rounded angles; it is contained in a glass globe of about 5 centimetres in diametre, and in which a vacuum is made anew and in succession until a vacuum almost perfect has been obtained with a very slight quantity of gazoline, the presence of which does net exceed the one hundred thousanth of one atmosphere.

A very ingenious commuter, attached to each lamp, can be used to light or extinguish it. The duration of a lamp varies

from 600 to 900 hours. When a lamp is worn out, it can be taken from its support and replaced as easily as one can put a candle in a candlestick or remove it therefrom. Even then it has still a certain value. The new lamp costs at present 7 fr. 50, but, when done with, it can be sold for from 1 fr. 50 to 2 fr., still leaving a certain profit.

All the lamps are so made that each one is perfectly independent of the rest.

The whole arrangement works with regularity in the Palais de l'Industries, and without doubt constitutes one of the most remarkable and most complete of the systems of electric lighting yet invented. Its success at Paris may be regarded a assured.

ELECTRIC LIGHTING BY INCANDESCENCE—THE MAXIM SYSTEM.

(From the Paris *Electricien*, July 1st.)

Pure incandescence (we designate it thus to distinguish it from incandescence with combustion, as represented in France by the system Reynier Werdermann), has its detraction. According to the standpoint from which they are regarded, both systems are right. The pure incandescence lamp is still more simple than the Jablochkoff candle, whose simplicity, its chief, if not only merit, was the cause of its success. The incandescence lamp is lighted and extinguished at pleasure and instantaneously, by means of a simple commuter, and its power may be easily graduated from that of an ordinary night light to its maximum lustre. The light is perfectly steady. Finally, pure incandescence realizes the almost indefinite division of the electric light. Those are the qualities for which its advocates, with good reason, give it the preference.

Its detractors object, with equal reason, that the duration of the lamp is not indefinite, that it must be frequently replaced, that there is no means of knowing when it may suddenly go out, and finally that its yield is far from high, or in other words, that this light demands, for an equal power of illumination, a motive force much greater than the voltaic arc.

When the *pros* and *cons* are fairly weighed, we must come to the conclusion that the Voltaic arc, and pure incandescence conte two methods of electric lighting as distinct in their appli-

cation as in their principles. The first is adapted to illumination of great power where economy is an object; the second, when what is especially required is a beautiful, steady and extremely distributable light.

France, in which country, since the first exhibition of the Jablochkoff candle in 1876, there has been a rapid development of electric lighting by the Voltaic arc, has been much less favored with regard to pure incandescence and hitherto there has only been a few isolated experiments, without practical application. The International Exhibition just about to be opened, will be the point of departure for this new method of lighting, as it is already its rallying point. Unless we are mistaken, half a dozen systems of pure incandescence are about to figure there, those of Edison, Lane Fox, Maxim, Noaillon, Reynier and Swan, and perhaps, as many more.

We now propose to pass these systems in review and to point out their peculiarities. We will begin to-day with the Maxim system, which besides other excellent qualities, has this advantage over its rivals, that it is the first *complete* system that we have seen in practical operation in Europe. The word *complete* implies a point which we had better state does not suffice for a system of lighting to work well, that it comprises a good incandescence lamp. It must also have machines appropriate to that special purpose, and, in fact, a special mode of regulating the current which will assume a constant power and the entire independence of all the *foci*. The character of completeness thus indicated has, up to the present, been applicable only to the systems of Edison and Maxim. These are the only ones that have as yet received the sanction of experience. The apparatus of Swan and Lane Fox, which were tested in England, are not, as far as we are aware, furnished with special arrangements for the regulation of the current.

The Maxim system, which we are about to describe, comprises four principal and distinct parts :

1st.—The generating machine, which feeds the *foci ;*

2nd.—The exciter, which feeds the inductors of the generator ;

3rd.—The regulator, which is placed on the excibing machine and which acts on its power, as we shall explain, according to the number of *foci* supplied by the generator, to maintain the intensity of the current continuous in both cases ;

4th.—The incandescence lamp, of carbon filament.

The generating machine—the electric generator of M. Maxim is a dynamo-electric machine of continuous currents, with vertical inductors presenting the exterior appearance of a small sized Siemen's machine, but of larger dimensions. It is distinguished from it, however, by the form of the ring, which is rolled like that of a Gramme, but with a greater relative length.

The manner of collecting the current is also slightly different from that of the Gramme machine. There are two collectors placed on the road at each extremity of the induct, the coils rolled on the ring are bound successively to the right and left collectors, for instance, if we number them, 1, 2, 3, 4, &c., all the even coils are to the right and the uneven, to the left. The machine, in reality, is managed as if they were two distinct rings, rolled on the same support and moving in the same magnetic area. They can be coupled, as circumstances require, in tensions, in quantity or in two circuits distinct and separate, feeding each a series of incandescence lamps or a mixed light, that is, to employ the half of the ring for the incandescence lamps on a first circuit and the other half for a Voltaic arc regulator on a second circuit. These groupings are very easily made by means of keys and pegs placed at the upper part of the generating machine. The collecting brushes are double; in each pair corresponding to one side of the brushes is a little longer than the others, so that, whatever may be the position of the plates of the collector at a given moment, there is always one of the brushes in full contact with one of them, notwithstanding the isolated parts which separate them.

When the machine works with incandescence lamps, the two halves of the ring are arranged in quantity. The magnetic field in which the ring moves is identical to that of the Siemens machines with continuous current.

The magnetism of the conductors has a variable power which depends on the number of lamps that the machine has to feed—these inductors being placed in the circuit of the exciting machine.

The Exciting Machine—the exciter, save for its smaller dimensions, resembles the generator. There is a single collector, each brush of which is simple; but to realize, notwithstanding, the condition that we pointed out just now of always having a plate of the collector in contact with the brushes, the plates of this collector are not straight and in the direction of the generators of

the cylinder, but are slightly bent in the form of a very obtuse V. The two brushes of the collector are fixed in a moveable arm, and may be displaced for ninety degrees around the axis of the ring, when they touch, according to the position which they occupy, sometimes the two extremities of a horizontal diameter, sometimes the two extremities of a vertical diameter, and all the intermediate positions. The inductors of the exciting machine are placed in the same circuit as those of the generating machine which we have just described. A single exciter suffices to feed and to regulate the current supplied by six generators.

Before examining the regulator, properly so called, let us imagine it suppressed, and let us displace the collecting brushes of the exciter while the whole apparatus of the generators and exciters is in motion.

By referring to the *modus operandi* of the Gramme machine, it will be seen that the current is maximum when the brushes touch the collector according to a vertical diameter, with a slight advance in the direction of rotation, due to secondary phenomena which we need not consider at present.

When the brushes are placed at a horizontal diameter, that is, when they touch the centre points, there will be no current. The displacement of the brushes in an angle of about 90 degrees will, therefore, have the result of making the current produced by the exciter touch all valves from zero to maximum. The magnetic fields of the generator will vary in power in the same proportion as the current produced by the exciter. As the electro-motive force of the generator, for a given and constant velocity, is related to the power of the magnetic field in which it moves, the final result is that every movement of the brushes of the exciter reacts immediately on the generator in augmenting or diminishing its power.

It is quite evident, for instance, that if the generator can feed sixty incandescence *foci*, it must develop a greater electro-motive force when the sixty *foci* are in operation than when only 50, 30, 20, or 10 are in operation. Let us say *en passant*, that, in the Maxim system, all the *foci* are placed *en derivation*, every time that a new one is lighted, the exterior resistance is diminished, and the electro-motive force must be augmented slightly to keep the intensity constant on the circuits already existing, and *vice versa*. We have just seen that it could be done very simply by changing the motion of the brushes of the exciter by the hour.

M. Maxim's regulator is an apparatus which effects this automatically and constantly proportions the power of the magnet field of the generator to the number of *foci* being fed.

The Regulator.—It is easy now to see how the regulator works. the upper part of the exciter has two electro-magnets. We will only consider one of them just now, as the second has a *rôle* quite distinct. This electro-magnet has fine wire rolled round it, of which the extremities are joined to the two ends of the generator from which issue the conductors which reach the lamps. The armature of the electro-magnet is fixed to a horizontal lever whose course is limited by two screws represented on the right; an antagonistic force, the tension of which is regulated by the aid of a screw, balances the action of the electro-magnet on the armature. The extremity of the lever of the armature is joined by a wire, slightly elastic, to a horizontal lever with two small teeth and receiving a backwards and forwards movement by the aid of a small rod and of transmissions by cord which join the centre of the little rod to the centre of the exciter and thus communicate to it a movement of rotation relatively slow.

The horizontal lever moves between two toothed wheels like ratchet wheels.

In the normal position of the armature and of the lever which is joined to it, this lever is moved easily in the space left between the two toothed wheels, drawing neither one nor the other. Suppose, for example, that two or three lamps have been extinguished. The current is then too intense for the remaining lamps. The electro-magnet draws its armature, the toothed lever goes down, and the lower tooth attaches itself to the lower toothed wheel, the back and forward movement communicates to it a rotation in such a direction that, at each turn of the little rod, there is produced a slight movement of rotation which is transmitted to the brushes by a series of transmissions along the gear. In these conditions, the brushes change their motion and approach the centre point, the exciter current becomes weaker, and consequently the current generated by the generator is weakened also. These elementary changes, so to speak, are produced until the current has assumed the new valve which just suits the number of lamps in operation. The electro-magnet then lets go the armature, the toothed lever takes its normal position between the two toothed wheels and at an equal distance from each. If new lamps are lit, the current becomes weaker, the armature

affected by the antagonistic agency recedes again, the toothed lever acts now on the upper toothed wheel, and the same transmission along the gear moves the brushes in an opposite direction, so as to bring them to the maxima points, augmenting the power of the inductors and consequently the electric-motive force of the generator. The regulator has thus the effect of compensating for the changes of intensity resulting from lighting and extinction. Nothing is more interesting than to watch its motion, and it is so sensitive that it is enough to light or extinguish a single lamp to make it at once perform its duty and act in the desired direction.

The antagonistic force constitutes in fine the regulation of the entire system. It suffices to augment its tension slightly to regulate the intensity of all the *foci* fed by the machine. By diminishing it, on the contrary, it is lowered until the lamps seem like mere night tapers or even extinguished altogether. The experiment entertained crowds of visitors in London, in May last, when the system which is soon to be tested at the International Exhibition of electricy was inaugurated.

We have just said that M. Maxim's regulator was very sensitive. This is a quality, however, which is accompanied unfortunately, by a great defect. The regulator is sensitive, but its action is too slow. If suddenly a too great number of lamps are extinguished, the intensity would be excessive in the remaining *foci*. Their power augmenting suddenly, there would result the extinction of several *foci* which could not not long resist a current so intense, before the regulator had performed its functions.

We must say that the remedy, or rather, the palliative, is almost as bad as the evil in M. Maxim's system. This palliative consists of a veritable *safety valve* which the inventor has added to his regulator by placing a second electro-magnet on the upper part of the regulator.

This second electro-magnet is like the first and is placed in the same circuit as the first, which, in order to facilitate the explanation, we have supposed to be placed at the end of the generator. Its armature is mounted on a lever identical with the former and also regulated by force of which the tension is slightly superior to that of the regulator. If the current which passes through the two electors at once is sufficiently intense to attract the armature of the second magnet, it will lower the lever. This lever on des-

cending will unite the two brushes of the exciting machine directly and it will form what they call a short circuit. In these circumstances, the inductors of the exiter and the generator will no longer receive a current; the generator draft will no longer furnish a current, the lamps will gradually grow weaker in intensity, there will be a partial extinction for some seconds, but the light will not go out. M. Maxim must have thought that the regulator would not act efficiently in all possible cases when he added to it a means of protection so radical. Let us at once add that the safety valve is but very rarely called for and that it is useful whenever there is a sudden rupture of a leading conductor or if any analogous accident should happen.

The lamp.—The incandescence lamp of M. Maxim has the exterior aspect of the Edison and the Swan lamps. It is composed of a very thin filament of carbon, which has successively affected very diverse forms: horse shoe, cross of Malta, &c., and which is now presented under the aspect of the figure 2. It is distinguished from analogous lamps by its mode of fabrication. The process is to introduce into the globe a certain quantity of hydrocarbonized gas, then after having formed a vacuum anew, to introduce gas, and so on, until all the air has disappeared.

Experience has shewn that, by the passage of the current, the vapour of the gazoline contained finally in the globe, plays, with regard to the filament, a renovating role by depositing its carbon on the most incandescent parts, that is, the most tennous.

The adherence of the filament of carbon to filings of platina is also worth pointing out, for it affords excellent contact. The conductors of platina also pass through a special enamel, the composition of which contributes to steam-lightness. The coefficient of dilatation of this enamel must have been almost the same as that of platina for avoiding crevices.

At present, thanks to the perfection reached by M. Nichols, copper may be substituted for platina and the lamps may be constructed at an exceedingly low price.

The lamps are arranged on a mounting of ebony, terminated by a tail piece of nickel-plated metal. This can be screwed to gas burners, as well as the ordinary burners.

In case electricity be substituted for gas, a single conductor will suffice, the ordinary piping serves as return wire. The lamps are lit and extinguished by means of a small key, something like the gas tap which closes or opens the circuit.

All these details and others which have not been mentioned combine to make of the Maxim lamp a simple and practical piece of workmanship, of which the duration depends on the intensity of the current that traverses the lamp—say, from 600 to 900 hours. In these conditions, the abatement is insignificant. The loss in all cases is confined to the globe and the filament of carbon.

The Maxim electric lamp will light the hall of honour (hall C) at the exposition of electricity. It has been adapted already by several English and American establishments. The Union League Club, of New York, have used it for several months to light their picture gallery.

It remains for us to say a few words on the question of economy. It is incontestable that pure incandescence requires the expenditure of more energy, for an equal luminous power, than the Voltaic arc. The reason is that the surface to be cooled is much larger in the former case than in the latter.

The temperature is, therefore, less elevated with incandescence, but as the luminous return augments incomparably more rapidly than the temperature, it follows that the increase in the surface of radiation is far from compensating for the loss from the lowering of temperature. There is a gain nevertheless in not having violet rays; the light is whiter, purer, steadier, and can be regulated at pleasure. It, also, in certain circumstances, assumes yellow and orange shades, but these curious effects are obtained at the loss of power. This combination of qualities would, however, be very valuable for spectacular occasions, and for this purpose, indeed, they are sure to be soon turned to account. After what we have said of the Maxim system, it will be seen that pure incandescence, with its advantages and conveniences, is certain before long to receive the patronage in Europe which it has already received in England and America. The question of net cost, which will soon be placed beyond doubt by precise and comparative experiments, has only a secondary importance, as now, more than ever, people consent to pay a high price for a light that is agreeable and better distributed. The objections that were made to incandescence on its first exhibition are every day becoming of less moment. Before long it will meet with on more opposition to the development which avails it.

E. HOSPITALIER.

ELECTRIC LIGHTING OF RAILWAY TRAINS.

(From Capital and Labor, London, October, 1881.)

An interesting experiment, the first of its kind, was made on Friday afternoon on the Brighton Railway, to test the practicability of applying the electric light for the illumination of railway carriages. The trial was made in a Pullman car, forming part of a special train, which left Victoria for Brighton at 3.25 p.m. Mr. J. P. Knight, the general manager of the Brighton Railway; Mr. Houghton, telegraph superintendent; Mr. H. S. Roberts, manager, and Mr. Miller, secretary of the Pullman Car Company; Mr. F. A. Pincoffs, and Mr. Lachlan, of the Faure Accumulator Company, were among those present. The electric lighting of railway carriages has, we understand, long engaged the attention of the Brighton Company, and Mr. Knight, the general manager, and Mr. Stroudley, the locomotive and carriage superintendent, have made many inquiries and several tentative experiments with a view to ascertain whether it was practicable. Till the invention by M. Faure of the secondary battery, by which electric energy can be stored, there was a considerable difficulty in the way of the adoption of electrical illumination in trains. Friday's experience showed that this difficulty has been surmounted. The car carried thirty-two Faure's cells, as they are called technically, each consisting, in fact, of two flat lead plates, coated with red lead. These cells had been previously charged at the offices of the Accumulator Company. All that was necessary when darkness came on was to touch a small switch, and instantly the twelve little incandescent lamps with which the carriage was fitted gave out a fine, mild, equable, white light. The radiance of the lamps was shed down by reflectors, fitted in the roof of the car, and it was sufficiently bright to illuminate every part of the saloon. The Brighton Company are about to put on, for the Victoria and Brighton service, a new special Pullman train, and if Friday's trial may be taken as a fair example of the working of this new system, it is probable that the new cars will be fitted with the incandescent lamps and accumulators for regular use in that train. The car on the down journey during day light was lighted by the application of the switch during the progress of the train through the several tunnels; but on the return journey in the evening the saloon was kept lighted the whole of the distance from Brighton to Victoria.

ELECTRICITY FOR NAVIGATION AND MARINE.

(From the New York Herald, Nov. 21, 1881.)

THE BROOKLYN TO HAVE ELECTRIC LIGHTS.

The departure of the United States steamer Brooklyn, now being fitted for sea at Brooklyn, will be delayed until the 10th or 15th of December, in order to allow the introduction of the electric light on board. The berth deck will be illuminated with incandescent lights, and larger burners be used for the running lights. This improvement will dispense with the oil lamps and make the berth deck, especially in South American waters, more agreeable and healthful. A small donkey engine is to be added to the equipment for running the dynamo machine, and which will also be used for hoisting coal and ashes. *The Brooklyn will be the first vessel of the naval or merchant marine of the United States illuminated with the electric light.* When the subject was proposed, a short time since, officers of the Brooklyn were in doubt about Secretary Hunt approving the plan, especially as it would delay the departure of the vessel. The merits of the plan commended themselves to the Secretary so readily that he ordered the work to be commenced immediately and to delay the departure of the vessel until it was satisfactorily tested. *Additional protection against collision is among the points of recommendation.* The success of the light on the Brooklyn will probably lead to the illumination of all our naval vessels by the electric light.

ELECTRICITY ADVOCATED.

(From the official report for the year ended 30 June, 1881, submitted to the Secretary of the Treasury, Washington.)

The advances made in the appliances for generating electricity, and the great improvements in the efficiency of the burners used in electric lamps, justify the board in recommending the introduction of electricity in some of the first order sea coast lights. An appropriation of $50,000 is asked for this purpose.

In order that the Board may definitely state the cost of a light station at the time they recommended its erection to Congress, an appropriation of $10,000 should be made for the examination and survey of sites for proposed light stations and for preparing plans for the structures.

THE ELECTRIC LIGHT AND PLANT GROWTH.

From Mark Lane's Express, Oct. 17, 1881.

The application of electricity to lighting and other purposes is rapidly increasing in public favour, and every year is marked by some new improvement and some cheaper method in its use. In the streets of London and in provincial towns the electric light no longer excites the curiosity of the crowd, for the familiarity which breeds contempt has led them to regard its dazzling brilliancy with indifference. In the reading-room of the British Museum bright eyes pore every evening over musty volumes which are illuminated by the incandescent carbon points, and in the newest theatre in London it is the electric light again whose revealing rays help to lay bare the flimsy and affected character of modern æstheticism. Only a week or two ago a dispute between the gas company and the local board at the quiet town of Godalming determined the town authorities to light the borough at night by means of electricity, the motor power for which is derived from the hitherto wasted force of the flowing waters of the river Wey. This example is, we believe, likely to be followed elsewhere, and we are undoubtedly approaching within a measureable distance of the time when the immense force expended twice a day in the ebb and flow of the tide upon our rock-bound coasts will likewise be utilised as a source of power.

Among the more delicate attempts to employ the electric light for economic purposes, the researches that have been made as to ts influence on the growth of plants occupy a prominent place, and the subject has in this country received much attention from two such accomplished physicists as Messrs. Spottiswoode and Siemens. In France, the subject has fortunately been taken up by the well-known agricultural chemist, M. Dehérain, who in a recent number of the *Révue Seientifique* gives some account of his work in so far as it has gone.

Mr. Dehérain wished to determine, at the outset, what action, if any, the electric light exerts upon plant life, and further that, if plants after being exposed as usual to the light of day were regularly illuminated by the electric light during the hours of darkness, the advantage thus gained would be sufficient to justify the power in employing the light.

As long ago as 1861, M. Hervé-Mangou found that in plants grown in darkness the electric light alone was capable of determin-

ing the presence in the plants of the green colouring matter called chlorophyll; but it is well known that the feeblest daylight is capable of producing the same result.

Some years ago M. Dehérain grew some plants under red glass; these became perfectly green, and appeared to develop quite normally for some time, but when gathered, the plants were found to possess far less substance than their progenitors, showing that red light, although sufficient to determine the appearance of chlorophyll, has not enough energy to lead to a normal assimilation of carbon.

Dr. Siemens, in England, found that an electric light equal in illuminating power to 1,400 wax candles, and placed at a distance of 6½ feet from growing plants, appeared to possess an action equivalent to that of the light of a winter day. With more energetic sources of light more advantageous results were obtained, and plants which were exposed to the solar rays during day time, and to the electric light during night, presented a marked advance upon those which were kept in darkness all night.

In M. Dehérain's experiments, one of the compartments of the greenhouse had its panes of glass blackened, so that the plants in this compartment were entirely withdrawn from the influence of daylight, and received only the electric light. Five series of experiments were commenced, the conditions differing in each case, and the several results being therefore available for comparison. The series were the following:—1. Plants placed under blackened glass and subjected continuously, through day and night, to the electric light. 2. Plants receiving by day the pale light of the Palais de l'Industrie, and at night the electric light. 3. Plants receiving the same light by day as the second series, but remaining in darkness all night. 4. Plants exposed all day in the flowerbeds of the Champs-Elysées, and placed under the electric light at night. 5. Plants grown normally in the open air.

Undoubtedly, the most important question which these experiments are likely to determine is that regarding the value of continuous illumination. It is known that in countries where the sun, during the summer, remains almost constantly above the horizon, the vegetation developes with surprising rapidity, as, for example, in a country of so high a latitude as Norway. This may, at first, appear strange, but it must be remembered that during the Norwegian summer the sun is visible for 18 to 21 hours out of the 24, during which time the temperature will range

between, say, 55 and 65 degrees. Now if the temperature be multiplied into the number of hours during which the sun is visible, we get for a high latitude like Norway, a product practically equal to that similarly obtained for the much lower latitude of Paris, where the sun is visible for only about 14 hours per day.

Admitting that the electric light has, like the sun, an accelerating effect upon vegetation, M. Dehérain holds that illumination of plants during night should advance growth, and in this case the employer of the electric light might bring his plants to maturity a month or six weeks earlier than otherwise. It is in the market for fruits and vegetables that the advantage would be most manifest, as early scarcity is always accompanied by good prices. For this reason, the fourth series of experimental plants are watched with the greatest interest, as the best natural illumination by day and the electric light at night at once suggests itself as the most appropriate way in which to make use of artificial light.

If the experiments at the Palais de l'Industrie give favourable results, it is probable that the employment of the electric light for the nocturnal illumination of greenhouses will rapidly develope, and the utilisation of streams of water, water-falls, &c., as sources of power will at once come within the region of practical application. Though it may be a very long time before even the most advanced farmers take to working an electric light on their own account, yet it is not unlikely that seed-growers may speedily find it advisable to subject their best plants to nocturnal illumination, for parent plants which are habituated to nature early transmit this precocity through their seeds.

FINANCIAL FUTURE OF ELECTRIC LIGHTING.

(*From William Abbott's Circular for Nov. 10th*, 1881. *London.*)

It is very evident that the popularity of electric lighting is steadily increasing. Its application for illumination purposes has now far advanced beyond the merely experimental stage. The manifold demonstrations of the excellence of "the light of the future" indicate that even now in its very infancy it can favorably compete with gas, with this further advantage, viz :—that it can be applied where gas cannot possibly be utilized. Thus, as distinct from the illumination of houses, streets, embankments, bridges,

open spaces, theatres, railway stations and other large interiors, such as mills, factories, &c., the Electric Light has been found suitable for mines, for railway carriages on long journeys, for light-houses and for ships. Its utility in each of these capacities has been fully and satisfactorily tested.

Apart, however, from the general interest manifested as to the distinctive merits of gas and the electric light they are of considerable importance to the investing public, who, of course, very properly regard the rival claims from the strictly commercial view of relative cost. Upon this special point some valuable information was afforded last week at the meeting of the Electric Light and Powder Generator Company, where, in addition to the statement of Professor Crookes as to the prospect of that company earning "a good profit," the chairman announced that an "official report showed that 42 per cent had been saved in nine months in lighting the South Kensington Museum by electric light, including the cost of engine and men's time." Such a result attending almost the very birth of a new enterprise gives promise of a brilliant future, and when it is considered that the field for operations is practically illimitable, there can be no doubt that the present well established companies will prosper. Indeed, the vigorous and startling developement now going on in this branch of electrical science, affords evidence that it is in such a direction that speculation is likely to be attached, and those who associate themselves with the enterprise in its earliest stages, will of course reap the greatest profit.

In view of the important acquisition of the Maxim patents (which obtained a gold medal at the recent Paris Exhibition) by the Electric Light and Powder Generator Company, I think that company's shares are well worth buying. *The adoption of the Maxim light for the Paris Opera House gives it a stamp of real value, especially when it is certified that "great favor was shown to the apparatus.* The experiment of yesterday and last night was a triumphant test of the superiority of electric over gas lights in theatres." The shares of the Brush Company are also likely to prove a good investment, though they are relatively higher in price, being quoted £4 premium, £4 paid, the Electric Light shares being 2s. 6d. premium for £1 fully paid.

TESTIMONIALS.

Office of the LIDGERWOOD MANUFACTURING CO.,
96 Liberty St., New York.
NEW YORK, August 19th, 1881.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
New York :

Gentlemen—We wish to say that the five-light machine recently put in for us by you at our Brooklyn Shops, Erie Basin, work very satisfactorily.

Your man started it two weeks ago to-day, when it went off splendidly, and has continued to give us the same or rather better light every night since.

Our men that are near or in the vicinity of the lights seem to have about as good light as in the day-time.

Upon the whole we think it the most important improvement that we have yet introduced into our machine shops to facilitate the getting of work out of a busy shop. We shall order our light doubled soon.

Respectfully yours,
LIDGERWOOD MANUFACTURING CO.,
J. W. S., *Supt.*

Office of SMITH & MCNELL,
198 Greenwich St., New York.
NEW YORK, Sept. 16th, 1881.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
120 Broadway, City :

Gentlemen—We have had in use for some months in our restaurant a ten and a five-light Weston Electric Light Machine, the ten-light purchased after the trial of the five-light, and after a trial of other Electric Lights.

We run the five-light during the day-time, and the ten-light all night.

Our gas bills are $85 less weekly than the corresponding week last year, and the cost of Electric Lighting is simply the five-horse power used during the day and about eight-horse at night, with carbons, thus showing a net saving of nearly $85 per week, with the advantage of a steady, pleasing, white light, that notwithstanding rather low ceilings gives the greatest satisfaction to our guests, numbering over 5,000 daily.

The heat from the gas necessitated the constant use of revolving fans, that increase the trouble by blowing the heat down on the tables.

The care of the lights is in the hands of one of our regular help.

Gas bills : 1880. Sept. 10-17, $187.20 ; 1881, Sept. 7-14, 102.05.

Yours truly,
THOS. R. MCNELL.

Office of the IRON STEAMBOAT COMPANY,
NEW YORK, August 3d, 1881.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
120 Broadway, City:

Gentlemen—We had one of the ten-light Weston machines with engine complete put on our steamer "Cetus," at the same time we were using the Brush Light on our pier.

The success attending the lighting of this first steamer was so great that we decided at once to light the remaining boats which we had contemplated lighting, namely, "Taurus," "Pegasus" and the "Cepheus."

The color of your light is remarkable for its purity and absence of any blue shade peculiar to all others. The boats are subject to pretty rough handling in a heavy sea, yet the lights run with perfect steadiness.

Although the lights are necessarily hung quite low, the porcelain globes which your Company have provided produce an effect unequaled by any other means of illumination.

The engine furnishing the lights is frequently run with 15 or 20 lbs. steam pressure, showing the economy in the power consumed in our system.

We think that your light is well adapted to the illumination of every class of river and ocean steamers.

Yours truly,
GEO. S. SCOTT, *President.*

Office of the ROCKAWAY BEACH HOTEL,
ROCKAWAY BEACH, Sept. 3d, 1881.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
120 Broadway, New York:

Gentlemen—The ten-light Weston machine and lamps that you put in for us some weeks ago are running to our complete satisfaction.

Having had experience heretofore in various Electric Lamps, knowing the power consumed and care required in keeping them in order, we feel confident that we have by far the best system in existence for Electric Lighting.

The machine was put up at a very short notice, and is driven from the ordinary engine on the premises, and was turned over to our engineer within a few days from starting, since which time we have had no difficulty whatever in maintaining the lights without interruption.

One of the ten-lights I experimentally had suspended from the ceiling of our main parlor, one of the largest in the country, and the result is past all conception. It has displaced 42 five-feet burners (gas), giving a far steadier, more powerful and brighter light than we have ever had in the same room.

We find the color is not at all objectionable to the ladies, the complexion remaining the same in the light, unlike all other Electric Lights that we know of, that give a blue, ghastly appearance.

Regarding the relative cost as compared with that of gas, a point I have hitherto been unable to ascertain, I can now give correctly, *viz.:* six of the ten lights now save me thirty-five thousand feet of gas per week, which at the price I pay for gas, *viz.*, $3.50 per thousand, equals a saving of $122 per week, less the cost of running the entire ten lights, which is $40 per week, showing a net saving of $82 per week, with four lights to spare.

I am very respectfully yours,

O. G. BURNAP.
Manager of the Rockaway Beach Hotel.

HALL'S SAFE AND LOCK COMPANY,
Mfrs. of Hall's Patent Safes and Bank Locks,

CINCINNATI, Sept. 22d, 1881.

THE WESTON ELECTRIC LIGHT COMPANY,
120 Broadway, New York:

Gentlemen—We have been using four of your ten light machines for nearly one year and find them to work in the most satisfactory manner.

We find the lights not only powerful, but steady, the color perfectly white, which makes it very agreeable to our employees. We find it particularly adapted to our work of all classes, machine rooms, foundries, paint and ornamental room, as also for office use. In fact we would not be without them. Another great point about them to be considered is, the machines can be operated by the same engines in conjunction with other machinery.

We are very truly yours,

HALL SAFE AND LOCK COMPANY.
RICHARD F. PULLEN, *Secretary.*

Office of the PORTER MF'G. CO., (Limited).

SYRACUSE, N. Y., April 20, 1881.

To whom it may concern:

At the request of Mr. Teall we cheerfully make the following statement as to our experience with the Electric Light: Mr. Childs and myself were appointed by the "Board of Directors" to go to New York and examine the different Electric Lights.

We did so, and in our opinion the Weston Light was a whiter light than the Brush. The bluish tinge, which is characteristic of the Brush Light, seemed to be absent from the Weston Light.

The power seemed to be much less per light with the Weston than it did with the Brush, from the indicator cards that were taken from engines running Electric Lights of both manufacturers.

We have been running the Weston Light for about two months, and it has been running very satisfactorily, and has not caused any trouble.

And we think the estimate of three-fifths of a horse power to a light, of a so called 2,000 candle power, would not be out of the way as a fair estimate of the actual power when in common use.

Yours truly,

The PORTER MF'G. CO., (Limited).

G. A. PORTER, *Treasurer.*

ALBANY, N. Y. July 28, 1881.

To whoever it may concern :

This is to certify that we have used the Weston Electric Light Machine in our stores for the past seven months and believe it to be the best machine for lighting purposes yet produced.

This light takes only about one half as much power to each light, as the Brush or any other machine we know of.

We were running the Brush sixteen light machine for Messrs. W. M. Whitney & Co., last fall, and as near as we could ascertain, it took over twenty horse power, while the Weston would not take over ten horse power for the same number of lights.

We also find the Weston lights are much more powerful, and of a much better color, and steadier.

Yours respectfully,

R. STRICKLAND & CO.

Office of the CONGRESS AND EMPIRE SPRING CO.,
SARATOGA SPRINGS, N.

TO THE WESTON ELECTRIC LIGHT COMPANY,
120 Broadway, New York :

Gents—The two ten light machines, with twenty lamps, you furnished us in June last, for our Park and Spring Pavillions, we used regularly without interruption during our business season, from July 1st to September 18th inclusive, and have given us entire satisfaction. The lights have been greatly admired by our visitors and guests, who generally pronounced them superior to all others in the steady, white, diffusive character of the light.

C. SHEEHAN, *Vice Pres.*
C. & E. S. Co.

Office of HADLEY CO., Manufacturers of Spool Cottons, Fine Yarns, Warps, Harness and Seine Twine, &c., &c.,

HOLYOKE, MASS., March 9th, 1881.

J. H. ALLEY, Esq. :

Dear Sir—Replying to your inquiry about the Weston Electric Lights at the Hadley Company's Works, I have the pleasure of saying that, so far, we have been much pleased with them. In fact, I may say that they have given us *entire* satisfaction in every respect.

Yours truly,
WM. GROVER, Agt.

Have now ordered forty additional lights.