

THE SANITARY ASPECTS OF ELECTRIC LIGHTING.

LECTURE TO THE CONGRESS.

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THE chief tendency of modern legislation in our British Parliament is to improve the environments of the human frame, so that we may live, and move, and have our being with greater health to the individual, and greater prosperity to the nation. The cleanliness of dwellings, the drainage of towns, the removal of filth, the suppression of nuisance, have not only been specified but the inspection of the means to effect these objects and of their results are defined and insisted upon by Acts of Parliament. People often speak disrespectfully of our grandmotherly Government, but at least in this region of domestic legislation, the control it has exercised over the food we eat, the water we drink, the air we breathe, is of a true parental order, and deserves our unreserved admiration and respect. The Home Office and the Local Government Board act the part of a wise and economic head of the house to the nation, while each community has its own Local Board or Authority to carry out hygienic provisions, to enforce sanitary principles, to prevent infection, to stamp out disease, to sweeten labour, and to prolong life.

I contemplated at one time submitting an historical summary of these features of sanitary legislation during the present generation, but not only would the task be very onerous, but it would be so lengthy that I should have very little time left to discuss the question set before me—the Sanitary aspect of Electric Lighting.

The propositions that I propose to submit and to demonstrate to you are these:—

1. That electricity and light being analogous forms of

energy, the former is naturally the proper source of artificial illumination.

2. That all other sources of artificial illumination being dependent on the absorption of oxygen, and resulting in the vitiation of air are injurious to health.

3. That the same authority which regulates the sanitation of our dwellings and the supply of our food, should also control the purity of the air we breathe, and of the light we work by.

Light, however it be produced artificially, is simply the equivalent of work that has been done elsewhere. Whether it be by the combustion of tallow or oil, by the burning of coal or of gas, by the glowing of a fine wire, or the formation of the brilliant arc, energy has been expended somewhere, to be transferred and reproduced in some other place in the form of light. The great principle of the conservation of energy teaches us that the amount of energy in the universe is a fixed quantity, that it can be neither created nor destroyed, that it can only be transferred, and that any expenditure of energy—work done—anywhere is the equivalent of energy utilized somewhere else. The rate at which this energy is expended is called *power*, and the amount of power which we foolishly call a *horse-power*, and which we roughly imagine to be equivalent to the power exerted by a horse in drawing a load along a road, is competent to produce an amount of light which is very simply measured. Our standard of light is the light given by a No. 6 sperm candle, burning 120 grains per hour. Now the energy of one horse-power constantly expended will give by the aid of

Tallow	...	...	the light of 6 candles.
Sperm	...	...	" 8·7 "
Oil	...	...	" 9 "
Gas	...	...	" 13 "
Electric current—Glow	...	...	" 248 "
"	Arc	...	" 1492 "

The results to the air of these different modes of producing artificial illumination are well shown by the following Table:—

Products of Combustion in developing 100 candles per hour.

Illuminant.	Quantity Consumed.	Carbonic Acid Produced.	Water Vapour.	Heat.
	lbs.	Cub. ft.	lbs.	Calories.
Tallow	2·2	51·2	2·3	9,700
Sperm	1·7	41·3	2·0	7,960
Oil	1·3	33·6	1·8	7,200
Gas	56 Cub. ft.	40·3	2·5	12,150
Electricity	(Coal) 2·2 lbs.	0	0	257

Thus we see how very much more efficient electricity is than any other agent for the production of light.

The tendency of the teaching of the present day, is to show that the transmission of light waves and of electrical undulations, is of the same character and at the same speed. Clerk Maxwell by theory, and Hertz by experiment, have placed this beyond doubt. A current of electricity passing through a fine filament, first raises its temperature, and then as the current is increased in strength, it glows brighter and brighter until finally it is disintegrated and dissipated with great brilliance, and the light disappears. There has been no chemical consumption of material. The passage of the current has resulted in light, and light seems to have been the natural sequence of the flow of electricity. Energy has however been developed somewhere. There is a boiler for the production of steam, an engine for the application of power, a dynamo for the formation of electric current.

Gas has to be extracted from coal, purified in gas works, distributed through pipes, and chemically combined with the oxygen of the air in jets or burners.

The simple candle, however, is its own gas works. We simply apply a match and the flame itself becomes boiler, engine, and light emitter combined.

In all cases, therefore, we have to consider—

- (a) The source of energy.
- (b) The distribution of energy.
- (c) The utilization of energy as light.

The sources of energy at our disposal are—

- Wind.
- Water.
- Coal (steam).
- Gas.
- Mineral oil.

The inconstancy of the wind in our climate renders it inapplicable for the steady and constant supply of power required for artificial illumination.

Water, on the other hand, is an unfailing source of power in some countries, but the quantity required to produce even small effects is opposed to its use anywhere but in mountainous or hilly districts where it is abundant. It requires a quarter of a ton of water falling one foot *per second* to produce one horse power, or falling ten feet to produce ten horse power. If we wish to maintain ten ordinary electric glow lamps alight for five hours with a fall of ten feet we should require 100 tons of water per hour, or 500 tons altogether.

At Keswick, in Cumberland, a central station has been established, which is worked by a fall of twenty feet of the water of the river Greta, generating fifty horse-power by means of a turbine. At Portrush, in Ireland, a fall of twenty-six feet generates currents that work a tramway to the Giant's Causeway. Many private houses in Scotland are so lighted.

There are innumerable places in the United Kingdom where this power is being allowed to run to waste. The non-utilization is due probably to ignorance, and ignorance as much as indifference is the great obstruction which all new industries have to overcome, even when practicability and economy are almost self-evident.

The power of running streams and of the tides is used in some countries for grinding corn, but the power utilizable is small, and no practical means have yet been introduced to employ them for small installations of electric lighting, though busy minds are actively engaged on this neglected field.

Steam and therefore coal becomes in all comparatively flat countries the principal source of power, while for small installations, gas and mineral oil are extremely convenient cleanly and economical suppliers of energy. Indeed, gas as a source of heat is coming more and more into use, and if a cheaper form of gas, such as water-gas were distributed for fuel purposes—as it probably will be in the future—it would solve the difficulty of the transit of coal, and prevent the possibility of that nuisance, the formation of smoke in the midst of shops and dwellings.

The power that is thus expended is employed in developing electrical energy. Motion is imparted to coils of copper wire in a field of magnetism, and a certain resistance has to be overcome when the lines of force in this field are cut by the wire; the energy of motion is absorbed, it takes the form of electricity, and as an electric current it can be transmitted to a distance, and there utilized. The amount of energy which is found in the form of currents is that delivered by the belt of the engine to the dynamo, less a small amount wasted in friction and in heat in the metal of the dynamo; but this is so small that it is a common thing now to obtain dynamos with an efficiency of 94 per cent. that is, 6 per cent., only of the power applied to it is lost as heat in the dynamo itself.

If a child has a skipping rope made of copper wire and, with its face turned due North or South, it skipped, the rope would cut the lines of magnetic force of the earth in the proper direction, the rope would experience resistance, energy would be absorbed by the rope, and electric currents would be developed from hand to hand of the child. The child thus becomes an animated dynamo. The lines of force of

the earth flowing North and South are cut twice in each revolution of the skipping rope, but alternately in opposite directions. Hence the currents generated are alternately flowing in opposite directions, and the child becomes an alternate current dynamo. It is a very simple thing to straighten these currents and to make them flow continuously in the same direction, and to convert these alternate effects into continuous currents flowing in the same direction.

Now, all electric currents require an electro-motive force, or a difference of electric pressure to drive them through the resistance of metallic conductors, in the same way that water and gas require pressure to drive them through pipes. This electro-motive force in the case of the skipping-rope is very minute, because the intensity of the earth's magnetic field is very small (it is only $\frac{1}{200000}$ th of the field of an ordinary dynamo), the motion of the rope is comparatively slow, and there is only one cutting conductor. If we increase the number of conductors, their speed, and the strength of the field, we can magnify the electric pressure to any amount.

All new ideas require new names to indicate them, and if they are new quantities capable of measurement, they require new units to compare them with numerically. Difference of electric pressure is called voltage, and the unit of comparison is a *volt*. The skipping rope develops only a very small fraction, about $\frac{1}{40000}$ th of a volt. There are now dynamos at Deptford which will generate 10,000 volts, and a flash of lightning is the result of perhaps millions of volts. The human frame is very sensitive to voltage, 50 volts is scarcely perceptible, 100 volts give a distinct though slight shock, 500 volts are painful, and 1,000 volts might probably under certain circumstances kill a man, 10,000 volts if effective through the whole frame would certainly destroy life. We have recently read of a deplorable attempt in the United States to utilize this power for the execution of criminals, an attempt surrounded with sickening horrors, the result of the ignorance that exists at present as to the effects of electricity on the human frame.

The unit of electric current by which measurements are made is called an *ampere*. If an ampere be circulated around a bar or ring of iron, it will magnetize it with a definite amount of magnetism dependent on its dimensions and quality.

If it be transmitted through a bath of nitrate of silver, it will deposit four grammes of silver per hour. If it be driven through a fine filament of carbonized cotton six inches long, such as Edison and Swan use for their glow lamps, by an electromotive force of 100 volts, it will develop a brilliant light of 32-candle power.

The actual energy conveyed by the current is measured by the product of the volts and amperes, and this measures the rate at which energy is being transmitted or expended. The unit of measurement is called *the watt*, which is a much more scientific and accurate unit of power than the absurd horse power that has become so rooted among our engineers. A man in pumping expends about 50 watts; in rowing a race he expends about a 100; in running rapidly up-stairs he expends 500 watts for a few seconds; a horse drawing a load on a level road expends about 500 watts. The so-called horse power is 746 watts. An ordinary arc lamp consumes 500 watts, and an electric tramcar going at seven miles an hour on an average tramway, requires a mean power of about 3000 watts.

Electrical energy is measured and paid for in 1000 watts or in *kilowatts* delivered per hour. A kilowatt-hour is called the Board of Trade unit of electrical energy, and it is defined in all Provisional Orders confirmed by Act of Parliament, thus:

“The expression ‘unit’ shall mean the energy contained in a current of one thousand amperes flowing under an electromotive force of one volt during one hour.”

This Board of Trade unit has not yet received a name. I have proposed to call it a *Bot*, from the initial letters of the Board of Trade, but there is generally a very strong aversion to a new name, however much it may be wanted, and we have during the past few years had a plethora of new names in electrical science.

One Board of Trade unit will keep an ordinary 10-candle power glow lamp alight for 30 hours, or it will keep 30 of such lamps alight for one hour. In Newcastle this energy costs 4½d., in Liverpool 6d., in London 7½d., and in most other places 8d. Taking the cost at 6d., a 10-candle power glow lamp would cost one-fifth of a penny per hour, which is the cost of a 5-foot gas burner at 3s. 4d. per 1000 cubic feet. There is thus very little difference between the price of gas and that of electricity.

The output of a dynamo is measured in watts, and, as the number of watts in ordinary dynamos is necessarily numerous, the *kilowatt*, or 1000 watts, is the unit employed. Thus, a dynamo of 100 kilowatts develops energy equivalent to 134 horse power, and as, for ordinary purposes, the ratio of the power utilized as electric current to the power indicated in the cylinders of the engine may be taken at 80%, it will follow that it will require 160 horse power to drive such a dynamo at full load.

The relations between mechanical and electrical measurements are thus very simple and wonderfully accurate.

100 kilowatts, or 100,000 watts, deliver sufficient energy to illuminate 3,000 10 c.p. lamps, and one of the most difficult problems which the electrical engineer has to solve is to design the best and most economical method of distributing this energy over an extended area. If the distribution be confined to one big building, like the Pavilion in Brighton, or the Post Office in London, the solution is simple. If it be over a widely scattered district, like Croydon, Wimbledon, or the districts of the great vestries of London, the solution is complicated. Every district must be governed by its own conditions, and be controlled by its own environments.

There are several modes of distribution under high pressure or low pressure; by means of alternate currents or of continuous direct currents; by two wires or three wires or five wires. Then again, the supply may be for light or motive power, for street lighting, or for private lighting. If it be by high pressure, say of over 300 volts, then, as such pressures cannot be admitted into our houses, there must be a reduction of this pressure to the safe and ordinary 100 or 50 volts by means of alternating transformers or of secondary batteries.

The ruling guide is of course economy. A certain number of kilowatts are generated in the central station, at a price per hour that is easily obtained from the coal bills, the stores list, and the wages sheet. A certain proportion of this energy is delivered to the consumers, and paid for by them by meter or by contract. A certain proportion is lost:—wasted as heat in the apparatus and conductors. What is the proportion between the energy paid for, and that generated by the central station? What is in fact the efficiency of the system? It is difficult in the present tentative and youthful condition of the industry to obtain a true answer. Most central stations are in their pioneer condition. I have however, examined the figures of certain well known systems, from which I gather that we may estimate the following efficiencies as fairly practical:—

Low pressure—

	Efficiency.
Continuous direct current.....	90 per cent.

High pressure—

Alternate current	60	„
Direct current battery	50	„

In fact, one Company—the St. James and Pall Mall—working on the low pressure system, have on the first half-year of 1890 secured a return of 94·3 per cent. on the energy delivered, while another company, working on the high pressure battery system, secured only 29 per cent.

In January of this year, at the Kensington Court Central Station, working at low pressure, 25,893 bots were registered and paid for, as against 28,291 generated and distributed, representing an efficiency of 92 per cent. At Dacre Street, Westminster, also working at low pressure, in the quarter ending June 24th—the summer and lowest quarter—the efficiency was 84·4 per cent. At the House of Commons the efficiency has been 89·8 per cent.

A simple way of looking at the matter is to find out the coal consumed per bot paid for by the consumer. It comes out—

Low pressure 9 lbs.

High pressure 17 lbs.

It is worth noting that it would require 38 lbs. of coal distilled in the gas works to produce the same light by means of the ordinary fish-tail burner.

The misfortune is, that the low pressure system is applicable only to confined and restricted districts. It involves the use of such heavy conductors, that as the district increases in extent, the weight of copper required varies as the third power of the radius of the area served. While with the high pressure system the weight of copper required diminishes with the pressure used.

It must however be recollected that the use of high pressure involves the use of very highly insulated conductors, and therefore what is saved in copper may be expended in insulation. The question that decides the economic use of high or low pressure is the distance or length of mains and feeders, when the difference between 17 and 9 lbs. of coal (or a penny per bot) is swallowed up in interest on capital and waste of energy in the heavy conductors required by the low pressure system.

The consequence is that while compact areas, covered by a radius of half a mile, are best served on the low pressure system, those supplied beyond a radius of one mile can be served economically only on the high pressure system; while the intermediate range is to be considered simply with reference to its own requirements and its own conditions, such as the supply of water and of coal, the convenience of water and railway carriage, the value of land, the demand of residential districts, and of manufacturing and business quarters. Each district must therefore be dealt with on its own merits.

In London at the present moment several different systems are being used or installed for very similar districts. Thus we have the alternate current transformer system at Brompton, St. Martin's, St. Giles, and the various portions served by the London Electric Supply Association, the high pressure battery system in Chelsea, the low pressure system aided by secondary

batteries to regulate pressure and to maintain the supply of energy during the small hours of the morning, or when breakdown or cases of emergency arise, in Kensington, Westminster, St. James's, Notting Hill, and St. Pancras. The proper system to be used is therefore still in a tentative condition.

The great question that divides the merits of the high and low pressure is that of safety to person. Grossly exaggerated accounts of accidents in America have seriously prejudiced the public mind against the high pressure system. If people only saw for themselves the conditions that surround the distribution of electricity in the United States, they would not be surprised at the accidents that have happened—they would wonder at their being so few. Poles are frequently carried down the principal streets of the towns carrying open telegraph, telephone, fire signal, and electric light wires, all together on the same support, without any particular rules or regulations. A lineman who ascends a pole to attend to a telephone wire is very apt to touch suddenly an electric light conductor. He receives a shock, and is thrown down perhaps on the ground and killed, or perhaps among the other wires, where he may be probably burnt or otherwise injured.

Such things are impossible in England. Mains and conductors must, by legislation, be placed underground in all towns; but where they are for local reasons placed overground, they are subjected to carefully prepared rules and regulations, and to watchful and constant inspection. A high pressure conductor would certainly be dangerous if it were handled, but it should never, under any circumstances, be so placed as to be in a position to be touched by anyone but the skilled technical men who have the charge of its maintenance. There is no case on record of anyone being hurt on a well designed underground system.

The great hygienic advantage of the electric light when illumining our dwellings and our workshops is not that it purifies the air, but that it prevents the air from being vitiated by the introduction into it of the products of combustion, such as carbonic acid, carbonic oxide, sulphurous acid, &c., it prevents the air from being weakened by the abstraction of oxygen, and it prevents it from having its temperature raised by undue radiation, and by throwing into it heated gases.

While legislation and the greatest possible stringent regulations have been drawn up to prevent the adulteration of food and the poisoning of water, scarcely any attention has been devoted to the prevention of the admission of noxious gases and poisonous vapours into the air of our habitations. Carbonic oxide is a poison of the deadliest character, and gas jets are

freely used which deliver copious discharges of this dangerous gas into the atmosphere of our rooms. If we were consistent in our legislation, we ought to forbid the use of any burner which thus poisons the air. A man at rest exhales '00424 cubic feet of carbonic acid gas (CO_2) and '1189 cubic feet of air per pound weight per hour, while a gas jet burning 5 cubic feet of coal gas exhales 4 cubic feet of CO_2 . The maximum proportion of CO_2 to air consistent with health is 6 volumes in 10,000, 10 volumes affect the heart, and 30 volumes produce headaches. Rheumatism, bronchitis, and other ailments proceed from higher proportions. In fact, 5 cubic feet of gas requires 8,000 cubic feet of pure air per hour to maintain it healthy. The electric light requires no such provision.

That the electric light is a powerful element of health is evidenced by the fact that those who use it not only feel all the better for its introduction, but their appetite increases, and their sleep improves, and the visits of the doctor are reduced in frequency. Workpeople work all the better, and absences from illness are far less frequent. In the Savings Bank in Queen Victoria Street, London, where 1,200 persons were employed, the absences from illness were so far reduced, that the extra labour gained paid for the electric light. In Liverpool and many other places the same result has been observed.

The influence of artificial light on the eyes has a very important sanitary bearing. Why is it that there is so much short-sightedness in the present day? Is it due to our mode of producing light? Some assert that the injury to the eyes is due to the heat rays and not the light rays. If that be so the electric light must be much less injurious than any other. On the other hand, no one can have experimented with arc lamps without having had his retina painfully affected, which leads one to think that the ultra-violet rays have some influence. No one has, however, ever complained of the influence of a steady glow lamp upon the eyes, and it is possible to read and to write for many hours by such a light without experiencing the least fatigue.

The electric current is not altogether free from being a cause of fire, and though its use is by no means very general, still it is used sufficiently to make itself felt as an element of danger in this respect. The following table shows the number of fires in London which can be traced to the different methods of lighting:—

	1887.	1888.	1889.	Total.
Lamps	245	205	257	707
Gas	188	197	209	594
Candles	142	113	136	391
Electricity	0	1	2	3

The progress of the electric light in our homes has been much more rapid in England than in any other country, but its employment for street-lighting, for shops and manufactories, has been infinitely more rapid and extensive in the United States than with us. In America the growth has been enormous. There are now 250,000 arc lamps, illuminating the public streets and shops, and 3,000,000 glow lamps in dwellings, stores, and workshops.

The following Table shows the development of the Berlin Central Stations :—

Station.	Effective Horse-Power.						When Completed.
	1884	1885	1886	1887	1888	1889	
Friederickstrasse	300	300	300	300	300	300	300
Markgrafenstrasse .....	...	1000	1000	1000	2400	2400	3100
Mauerstrasse .....	...	...	500	1250	1250	2950	4950
Spaudauerstrasse .....	...	...	...	...	...	2000	4000
Schiffbauerdamm .....	...	...	...	...	...	1000	6000
Total	300	1300	1800	2950	3550	8650	18350
16 c.p. lamps, or equivalent	2500	4600	13229	24660	34750	...	...
Kilometres of cable .....	...	8	10	15	25	75	...

The progress in England has been very much checked by inordinate speculation and by terrible failures in some of the earlier work done. There is something very captivating in the practical applications of electricity, and something romantic in its mystery. The neophyte has rushed into it with remarkable fervour, and the lessons of failure have in consequence been very severe. The users of the light have also been paying heavily for the education and experience of amateur tradesmen and inexperienced contractors, and have neglected to avail themselves of the professional services of the experienced electrical engineer. People who would not build houses without the architect, nor construct bridges without the engineer, nor make their wills without the lawyer, rush wildly into the use of electricity without any professional assistance, where, above all things, experience and knowledge are essential to prevent disaster and disappointment. Large installations have been completed without specifications to guide the contractor, and without inspection to see that the work has been properly done. The user has paid violently for his temerity, and fires and accidents have been the result. The heavy price of wiring

a rented house, and the expensive character of the fittings proposed, have deterred many from adopting the light, even when it is within their reach. Highly insulated wire is unfortunately expensive. All cheap wires are nasty and dangerous. There is nothing that becomes the electric light better than simplicity, and its effect is frequently marred by elaborate brass work. It possesses also most active and widespread opponents, both in oil and gas—opponents who have benefited by its introduction, and who are not slow to profit by its advance. The improvements in gas and oil lamps are as marked as the advancements in electric light, and as means of artificial illumination alone—that is as far as light-giving power is concerned—there is little choice between the three, but oil and gas cannot lose those elements of discomfort and ill-health which differentiate them from the cool and pure glow lamp.

A very important question arises for discussion. Legislation has slipped in to place the virtual control of the supply of electrical energy in the hands of the local authority of the district to be served. Is this supply to be the result of the capital of private enterprise, or is it to be effected by raising money on the security of the rates?

It is argued that the supply of electricity being a purely commercial undertaking, it should therefore be carried out by a limited liability company. The Acts of 1882 and 1888 do not encourage monopoly, but rather court competition, and competition attracts capital. Competition properly regulated and controlled secures economy in supply, and certainly enforces economy in working, while it encourages improvements, and induces perfection of apparatus and novelty in processes. These arguments are plausible, but are easily refuted by those who desire to uphold vested monopolies. Direct competition always means ultimately enhanced cost to the public, for the same public has to pay for double plant, and each competitor only gets half revenue.

The supply of light is in precisely the same category as the supply of water or the supply of gas, and the days have certainly passed when the public will tamely submit to the transference of their right to such vested interests as those of water or gas companies.

It is very easy to argue pro or con on each side. The local authority has to regard the security of traffic, the safety of person, the repression of crime, and the proper supervision of the premises of its ratepayers. It is the custodian of the public interests. It has to control the health, cleanliness, comfort, and beneficial sanitation of its habitable dwellings. It therefore must secure the best light, and if it can do this, and at the

same time relieve the rates which are generally creeping up to dangerous dimensions, then its action would be wise and economical. But it would be entering into commercial rivalry with an active competitor—the Gas Companies; and its commercial control by such a shifting authority as a committee of a Town Council or of a Local Board, subject to the changes of political warfare—to the vagaries of press dictation, and to the fear of November elections—is a very doubtful proceeding. On the other hand, in many instances, such bodies have successfully dealt with the water question, the tramways, and even with the gas. In fact, one-third of the gas capital (21 millions) in this country is in the hands of 173 Local Authorities, and more than half a million of profits go to the reduction of rates.

Bradford has already grappled with the question. It has established a central station for the supply of the electric light. Brighton, St. Pancras, and Bristol are doing the same, and many other places are following suit. They are shying at the probability of handing over their districts to a speculative company, with a virtual though not a legal monopoly, to supply electrical energy for 42 years. Many corporations contemplate a middle course. They have obtained the power for themselves, but they have farmed for shorter terms the right of supply to private enterprise, which can do what they are afraid to do, viz., speculate and experiment. The Board of Trade has sanctioned and facilitated such a transfer of statutory rights.

It is surprising that Gas Administrations in England have not been more enterprising in developing Electric Lighting. In Vienna, Rome, and Stockholm the Gas Companies have established Central Stations, and the progress of the industry in those cities is very great. The proper function of gas is to supply heat, not light, and as a source of power it has a future more brilliant than its past. If it could be supplied as fuel it would remove the troubles of coal transit and storage, of ash and dust removal, of smoke and of stoking. It has even been shown that it is cheaper to convert coal into gas on the spot, and to use the gas as the source of power, than to apply the coal direct for the production of steam in boilers. The waste of energy in the use of coal is enormous. The energy contained in one pound of coal if burnt in one hour is theoretically sufficient to supply 5·6 horse-power for that hour. The best practical result yet obtained by the steam engine is scarcely one horse-power.

The electric light is unquestionably the light of the future. Its use is advancing with leaps and bounds. Not only is it naturally the proper source of light, but economically it must

eventually supplant its rivals. When electrical energy is generally distributed through our towns, and its supply is continuous, and properly controlled, so that it is always within the reach of all; and when means can be devised to wire up houses as cheaply as they are now fitted for gas, everyone will take it, not alone for its beauty, but because it is, above all, a source of health and comfort.
