If a station is using 3.5 watt lamps and had absolutely steady voltage, an average life of 900 hours could be expected. If the voltage however, is two per cent. high, this life is reduced to 700 hours, and the efficiency increased to 3.27 watts. If however, the voltage is four per cent. high the life is reduced to 550 hours, and the efficiency increased to 3.05 watts. Though the candle power is increased, the total watts consumed is not proportional and the station suffers doubly in consequence. Four per cent increase in voltage of a sixteen candle power lamp increases the light emitted about 20 per cent.

This table will probably impress on central station managers how vitally important it is to know the voltage at which their lamps are operating upon different portions of their lines. Unless the regulation throughout the system is unusually uniform, it is most profitable to have the entire system divided into sections or zones, and order lamps of different efficiencies adapted to give the life settled upon as desirable. If the fluctuations are comparatively the same in the different zones, then the same efficiency can be used, only the lamps should vary in voltage, the voltage to be used to be the same in each zone. The manager immediately states that this causes too much confusion, etc., yet it is good business, and is a no more confusing problem than many others in manufacturing. When a method like this is carried out, very black lamps would disappear, average life be greatly increased and customers would be much better pleased. Take a customer upon your lines where the voltage is four to six per cent high, not to speak of twenty per cent. as is often found, and when you replace burned out lamps what is the result; the new lamps may emit from twenty to thirty-two candles and the old lamps eight to ten. Naturally the customer complains that the old lamps are worthless, and to keep peace, you replace these also and he starts with practically all new lamps, the same trouble to be gone through with later on. In the meantime you are apt to write the manufacturer that his lamps are blackening badly and return these specimens as fair samples. Troubles arising from causes similar to this have forced manufacturers oftentimes, who cannot or will not investigate the trouble, to send out their lamps uniformly of a higher voltage than is marked on the labels. This is in one sense self protection which the manufacturer is forced to do if he wishes to retain the trade which is often at such a distance that he cannot afford to investigate personally,

Most lamps imported from the States to-day, are much higher in voltage than indicated on the label. Yet the central, station if it has not due regard for the light emitted, will be pleased with the lamps as they may last almost indefinitely. The most welcome information a manufacturer can receive is to the effect, that a central station does not wish a lamp to last forever so to speak. Consider for a moment how small the expense of the renewal item is under normal conditions. Assuming only six hundred hours average life at the low average meter rate 6/10 cents per lamp hour the income is 3.60. Good lamps can be purchased for 20c. each or less than 6% of the income.

When lights are furnished upon the flat rate basis, and the renewals are paid for by the consumer, highly efficient lamps are not desirable.

When central stations will determine intelligently the proper efficiencies of lamps which they should use, and take means to hold manufacturers to their specifications, then their lamp renewal account will considerably decrease and the legitimate lamp maker prosper proportionally.

Below is given another table of current in amperes taken by lamps at various voltages and candle powers at different efficiencies, which may be found useful for reference.

CURRENT IN AMPERES TAKEN BY LAMPS AT VARIOUS VOLTAGES AND CANDLE POWERS.

3.1 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	110 Volts.	110 Volts.	220 Volts.
8	.50	.45	.31	.26	.25	.24	.23	.21	.11
16	1.0	.90	.62	.52	.50	.47	.45	.41	.23
25	1.6	1.4	.97	.82	.78	.74	.70	.65	.35
32	2.0	1.8	1.3	1.1	.99	.94	.90	.83	.45
50	3.1	2.8	2.0	1.7	1.6	1.5	1.4	1.3	.71

3.5 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	110 Volts.	120 Volts.	220 Volts.
8	.56	.51	.35	.30	.28	.27	.26	.23	.13
16	1.1	1.0	.70	.59	.56	.54	.51	.47	.26
25	1.8	1.6	1.1	.92	.88	.84	.80	.73	.35
32	2.3	2.0	1.4	1.2	1.4	1.1	1.0	.94	.51
50	3.5	3.2	2.2	1.9	1.8	1.7	1.6	1.5	.80

4 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	110 Volts.	120 Volts.	220 Volts.
8	.64	.58	.40	.34	.32	.31	.29	.27	.15
16	1.3	1.2	.80	.68	.64	.61	.58	.54	.29
25	2.0	1.8	1.3	1.1	1.0	.95	.91	.84	.45
32	2.6	2.3	1.6	1.4	1.3	1.3	1.2	1.1	.58
50	4.0	3.7	2.5	2.1	2.0	1.9	1.8	1.7	.91

Before describing the Nernst lamp I will say in reference to 220 volt lamps that great progress has been made in their manufacture during the past year or two, but that little further is necessary in making them more efficient before they will be on a par with 110 volt lamps. In addition to this, plants must be installed calling for a range of 220 to 240 volts before the cost of the lamps can be brought to its proper level by the manufacturer.

During the past year vague rumors have occasionally been wafted across the water of the discovery of a new light, although details of the discovery were entirely lacking until Mr. Swinburne delivered his now famous lecture before the Society of Arts in London, February 8th. I will quote from this lecture a few descriptive remarks and then give some criticisms of the lamp from other sources. Mr. Swineburne in speaking of Nernst's discovery says: "Nernst's like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature. Nernst therefore chose a material that would stand higher temperature than carbon, and his material has the incidental advantage, that its specific resistance is so high, that strong rods can be used for high pressure instead of thin filaments. Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot: Nernst therefore, heats the rod to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. * * * The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires, is then mounted in holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electriolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance is 1.5 watts per candle for large lamps, and 1.6 for small lights of low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a lifetime. When the rod is worn out, a new rod with its little mounts is all that is replaced. The whole lamp is not thrown away at all. The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp."

The above extracts give a very clear idea of the Nernst lamp, as first described to the public by those interested in promoting a large company for its exploitation. There are however serious practical difficulties involved in the practical operation of these lamps at the present time. Assuming however for the sake of argument that the Nernst lamps can be operated successfuly in practice, the relative cost of this operation compared to arc and incandescent lamps is what chiefly interests the central station manager.

The English Electrical Review recently published an article by Mr. John I. Hall upon "The Nernst Lamp vs. The Arc and Incandescence Lamps." I quote for your information a part of this article, giving comparisons in cost between the Nernst and Arc lamps. These are the only figures that have been recently published. After speaking of various methods of lighting, Mr. Hall writes: "But at present the position of the various illuminants may be summed up as follows:—

1. The Welsbach system is an advance over the ordinary method of lighting by gas.

2. The enclosed arc lamp is an advance over the open arc.

3. The Nernst system is an advance in incandescent lighting.

The electric lamps are placed in the order they will occupy in regard to cost of maintenance, for as the Nernst lamp supersedes the enclosed carbon lamp, so does the arc lamp supersede the Nernst lamp.

Mr. J. Swineburne, in the prospectus of the Nernst Electric Light, Limited, states that: "It will, I believe, oust the arc lamp in nearly all cases." On examination it will be found that it will not oust one arc lamp at present in use, as the following particulars will show: