is all the difference between nothing and something—scarcely less than infinity.

In view of certain strongly expressed statements which have obtained currency, the results to be derived from the use of the audiphone in deaf-mutism are likely to prove very disappointing. Repeated tests show that those who are able to hear with the aid of the audiphone hear *their own voices* perfectly without it; while those who are unable to hear their own voices without it can hear no other voice with it.

SOME ELECTRICAL MEASUREMENTS OF ONE OF MR. EDISON'S HORSESHOE LAMPS.

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Much has been written and said within the last few months on the subject of Mr. Edison's new horseshoe lamps, and with all the writing and saying there has been wonderfully little produced in the way of precise and reliable statement concerning the simple primary facts, a knowledge of which would give the means of estimating both the scientific and commercial status of this widely discussed invention.

It was, therefore, with great pleasure that the present writers found themselves, through the kindness of the SCIENTIFIC AMERICAN, placed in possession of one of these horseshoe lamps of recent construction.

To satisfy themselves as to the real facts of the case they soon made a series of careful measurements and determinations, and as the results of these are likely to interest others, they now put them in print for general benefit.

A further examination of other lamps would have been made at the same time had opportunity offered; but as a communication on this subject addressed to Mr. Edison did not evoke a reply, they are obliged to content themselves with the one lamp as a subject of experiment.

They would, however, here remark that the behavior of this lamp, under the tests, and the agreement of its results with information otherwise obtained, convince them that it is at least a fair specimen of the lamps of this form so far produced at Menlo Park.

The first object, on receiving the lamp, was to determine roughly what amount and character of electric current would be needed to operate it efficiently. With this view a number of cells of a small Grove's battery were set up, having each an active zinc surface of twenty square inches and a platinum surface of eighteen square inches.

The lamp being placed in the situation usually occupied by the standard burner in a Sugg's photometer, the battery was, cell by cell, thrown into circuit.

When ten cells had been introduced the horseshoe showed a dull red, with fifteen cells a bright red, with thirty-four cells the light of 1 candle was given, with forty cells the light of $4\frac{1}{2}$ candles, and with forty-five cells the light of $9\frac{1}{2}$ candles, and with forty-eight cells 16 candles.

Having thus determined what amount of electric current would be required for experiments, arrangements were made to measure accurately the resistance of horseshoe while in actual use and emitting different amounts of light. The resistance of this carbon thread at the ordinary temperature had been already determined as 123 ohms in the usual way, but it was presumed, as had been shown by Matthiessen (*Phil. Mag.*, xvi., 1858, pp. 220, 221), that this resistance would diminish with rise of temperature.

To measure the resistance under these circumstances the apparatus was arranged as follows: The current from the battery was divided into two branches, which traversed, in opposite directions, the two equal coils of a differential galvanometer. One branch then traversed the lamp, while the other passed through a set of adjustable resistances composed of German-silver wires stretched in the free air of the laboratory, to avoid heating. (Careful tests of these resistances showed that no sensible heating occurred under these circumstances.)

Matters being thus arranged, the resistances were adjusted until the galvanometer showed no deflection when the candle power of the lamp was taken repeatedly in the photometer, and the amount of resistance was noted.

These measurements were several times repeated, shifting the coils of the galvanometer and reversing the direction of the current.

The results so obtained were as follows:

Resistances.	Condition of Loop.
123 ohms	Cold.
94 "	Orange light.
83·7 "	$\frac{9}{10}$ candle.
79·8 "	5 "
75 "	18 "

The photometric measurement was in all these cases taken with the carbon loop at right angles to the axis of the photometer, which was, of course, much in favor of the electric lamp. On turning the lamp round so as to bring the carbon loop with its plane parallel with the axis of the photometer, *i. e.*, the edge of the loop turned toward the photometer disk, the light was greatly diminished, so that it was reduced to almost one-third of what it was with the loop sideways to the photometer disk.

Having thus determined the resistance of the lamp when in actual use, it was next desirable to measure the quantity of the current flowing under the same conditions.

To do this the current from fifty cells of battery was passed through a tangent galvanometer as a mere check or indicator of variations, and then through a copper voltameter, *i. e.*, a jar containing solution of cupric sulphates with copper electrodes immersed, and then through the lamp, placed in the photometer.

Under these conditions it was found that during an hour the light gradually varied from about 16 candles at the beginning to about 14 candles at the end, making an average of about 15 candles, measured with side loop of toward disk.

The galvanometer during this time only showed a fall of half a degree in the deflection of the needle.

Carefully drying and weighing the copper electrodes, it was found that one had lost 1·0624 grammes.

Now, it is well known that a current of one weber takes up 0·00326 gramme of copper per second, which would make 1·1736 grammes in an hour; therefore the current in the present case must have been on the average $\frac{1·0624}{1.1736} = 0·905$ webers, or a little less than one weber.

Having thus obtained the resistance of the lamp when emitting a light of 15 candles, namely, 76 ohms, and the amount of current passing under the same conditions, namely, 0·905 weber, we have all the experimental data required for the determination of the energy transformed or expended in the lamp, expressed in foot pounds. For this we multiply together the square of the current, the resistance, the constant 0·737335 (which expresses the fraction of a foot pound involved in a current of one weber traversing a resistance of one ohm for one second), and the number of seconds in a minute. Thus, in the present case, we have $0·905^2 = 0·8125$, and $0·8125 \times 76 \times 0·737335 \times 60 = 2753·76$ foot pounds.

Dividing these foot pounds per minute by the number of foot pounds per minute in a horse power, that is, 33,000, we have 0·08, that is, about eight one-hundredths or one-twelfth of a horse power as the energy expended in each lamp.

It would thus appear that with such lamps as this, one horse power of energy in the current would operate 12 lamps of the same resistance with an average candle power of 10 candles each,* or 120 candles in the aggregate.

Assuming that a Siemens or Brush machine were employed to generate the electric current, such a current would be obtained, as has been shown by numerous experiments, with a loss of about 40 per cent of the mechanical energy applied to the driving pulley of the machine. To operate these 12 lamps, therefore, we should have to apply more than one horse power to the pulley of the machine, so that when this loss in transformation had been encountered there should be one horse power of electric energy produced. This would call for $1\frac{2}{3}$ horse power applied to the pulley of the dynamo-electric machine, by the steam engine.

To produce one horse power in a steam engine of the best construction about three pounds of coal per hour must be burned, and therefore for $1\frac{2}{3}$ horse power 5 lb. of coal must be burned.

On the other hand one pound of gas coal will produce 5 cubic feet of gas, and will leave, besides, a large part of its weight in coke, to say nothing of other "residuals," which will represent practically about the difference in value between "steam making" and "gas making coal," so that it will not be unfair to take 5 lb. of gas coal as the equivalent of 5 lb. of steam coal.

These 5 lb. of gas coal will then yield 25 cubic feet of gas, which, if burned in five gas burners of the best construction, will give from 20 to 22 candles each, or 100 to 110 candles in the aggregate.

We have, then, the twelve Edison lamps producing 120 candles and the five gas burners producing 100 to 110 candles, with an equivalent expenditure of fuel.

If each apparatus and system could be worked with equal facility and economy, this would of course show *something* in favor of the electric light; but when in fact everything in this regard is against the electric light, which demands vastly more machinery, and that of a more delicate kind, requires more skillful management, shows more liability to disarrangement and waste, and presents an utter lack of the storage capacity which secures such a vast efficiency, convenience, and economy in gas, then we see that this relatively trifling economy disappears or ceases to have any controlling importance in the practical relations of the subject.

THE AMERICAN FISH CULTURAL ASSOCIATION.

The ninth annual meeting of the American Fish Cultural Association began in this city March 30. A large number of gentlemen interested in fish and fishing were present. The President, Mr. R. B. Roosevelt, read an interesting paper on hybrids. Mr. Seth Green contributed an account of his experience with California mountain trout, brook trout, and black bass at the State hatchery, with remarks on cray-fish and frogs.

Mr. Hugh D. McGovern submitted a short paper on the discovery made by him of a curious habit of eels. At the Brooklyn waterworks, among the wet moss growing on the crown of an arch over a waterway, 12 inches above the surface of the water, he found thousands of small eels, who seemed to live there, clinging to the moss as flies cling to the ceiling. The fact was important, as showing how this fish could move from water to water. To reach the moss these eels must have climbed up the 12 inches of wet wall above the surface of the water.

Mr. Livingston Stone, U. S. Assistant Commissioner of Fisheries, followed with an important paper on the transportation of live fish. Mr. James Annin gave an illustration of trout stripping in artificial propagation, using a number of male and female trout from his ponds on Long Island. Mr. Charles Hallock gave a description of Labrador fishing, and Mr G. Lamphear read a short but valuable paper comparing the statistics of Fulton Fish Market for 1878 and 1879. His figures showed that 34,276,666 pounds of fish were sold in Fulton Market during the year 1879–'80, an increase of 646,700 pounds over the previous year. In addition, 1,509,561 mackerel had been sold and 291,845 shad.

The next day Prof. Brooks, of Johns Hopkins University, described the propagation of the oyster; and Prof. Atwater, of Wesleyan College, read a paper on the nutritive qualities of various kinds of fish. Prof. Brooks believes that the oysters of the Chesapeake do not breed in the same way as European oysters do; that the sexes are separate; and that to propagate oysters artificially the males and females should be chopped up together and thrown into the water, so as to thoroughly mix the eggs and milt.

In this way, he thinks, the oyster might be propagated with profit, using for the purpose small ponds. All this learned trifling will be very amusing to the practical oystermen of Connecticut, who, for a score of years, have successfully propagated oysters by the square mile. Their trouble is not to get an abundance of young oysters. At certain easily recognized times the Sound waters swarm with them, ready to attach themselves to any clean "stools" presented to them. The real trouble is to defend the oyster farmer's acres of partially grown oysters from the swarms of star-fish and other marine vermin which prey upon them; for which defensive work steam dredging seems to be the only economical and certain resource.

PHOTO-ENGRAVING.

In general terms the process of producing engravings or types for printing by photography, consists, first, in making a sharp negative of the picture to be engraved; second, in the photographic printing of a sheet of sensitized gelatine by means of the negative; third, the development of the printed lines upon the surface of the gelatine by water; and fourth, the casting of a copy of the developed gelatine sheet in metal, the metal so produced being used for printing on the press in the ordinary manner. All this is very simple, and in the hands of experienced and skilled persons very beautiful examples of printing plates, having all the fineness and artistic effect of superior hand engraved work, may be produced.

Among the earliest and most extensive efforts to introduce this process commercially were those of Mr. John C. Moss, of this city, to whose persevering labors the public is chiefly indebted for the successful establishment of the new industry in this country.

Mr. Moss has finally concluded to give the public the benefits of all his latest improvements in this line, by the organization of a new corporation known as "The Moss Engraving Company," whose first announcement will be found in our advertising columns. Every description of engraving and printing plates is done in a superior manner by the company promptly on very moderate terms. The Moss process has been used on the SCIENTIFIC AMERICAN, especially on our SUPPLEMENT, for several years past, and we therefore speak from experimental knowledge when we say that it is good and reliable. The motto of Mr. Moss's company is "The best work at low prices, always on time." In all our past experience with Mr. Moss, although we have given him many perplexing jobs, we have never known him to fail in carrying out the above motto. The Moss Engraving Company has a large and splendid establishment at 435 Pearl St., New York, which is fitted up in every department with the latest and best appliances for the execution of good work. It deserves and will doubtless command an extensive patronage.

THE NEW YORK EXHIBITION OF 1883.

A bill to provide for celebrating the one hundredth anniversary of the treaty of peace and the recognition of American independence by holding an International Exhibition of arts, manufactures, etc., in New York, in 1883, passed the Senate March 31. It incorporates the United States International Exhibition, composed of well known New York gentlemen, whose official functions are to continue until the close of the Exhibition. It will be their duty to fix the date of the Exhibition, make the needed preparations for it on a site within the corporate limits of the city of New York, and to superintend the Exhibition during its progress. The bill provides further that the corporation shall cease to exist on or before January 1, 1885. Congress may at any time alter or repeal the act, and the United States are not to be liable for any of the acts or representations of the promoters of the enterprise. Not less than $1,000,000 must be subscribed, and not less than 10 per centum thereof must be paid in before the corporation may do any corporate act other than organize, and no part of the capital stock or assets is to be withdrawn, refunded, or divided among the stockholders until all the debts are fully discharged.

Glucose Manufacture.

There appears to be quite a furor in the West in connection with the manufacture of glucose from corn. A large number of factories are being set up; one at Chicago, it is said, will have a capacity of 20,000 bushels a day. A bushel of corn produces 30 pounds of glucose (grape sugar) or 3 gallons of sirup. The sugar costs 2 cents a pound, the corn selling at 40 cents a bushel.

* The candle power being 15 candles in the best position, and 5 candles at right angles to this, the average or general illuminating power of the lamp is 10 candles.