and at different pressures. Nothing is known of the “special Lava tip.” U.S. Bureau of Standards 1914, 91.

6. As indicated by the above measurement of flame size, these experiments were probably conducted using the techniques of jet photometry. A jet photometer was not properly a photometer, but rather a carefully-calibrated standard burner whose flame height at a given pressure provided an indirect measure of candlepower. This approach invited several sources of error and fell into disuse by the end of the century. However, Edison appears to have used it as a benchmark for the intensity of light consumers would expect to obtain at this pressure from a clean and adjusted burner, that is, sixteen candlepower. The phrase “15 @ 16” presumably represents a photometer measurement of fifteen candles in practice under conditions where sixteen candles would be expected. U.S. Department of Commerce 1914, 104; see also Doc. 1991.

7. Francis Jehl.

8. The Manhattan Gas Light Co., one of four New York gas suppliers, served the area south of 42nd St. as far as Grand and Canal Sts., a few blocks south of the Bergmann shop. Stotz 1938, 40, 45, 53.

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Notebook Entry: Electric Lighting

At present lamps are made which will give 16 candles for \( \frac{1}{8} \) of a horse power of energy in the shape of current of electricity.

That is 8 lamps may be obtained for each giving 16 candles\(^a\) for one horse power or 33,000 ft. lbs. per minute of available electrical energy.

That is 8 lamps each giving 16 candles if immersed in a calorimeter\(^a\) will show 33,000 ft. lbs per minute given to the water in heat.

The life of these lamps will average 600 hours giving 16 candles, that\(^a\) is if 10,000 lamps are lighted and a record kept of the hours that they gave light the sum total of the burning time of all the lamps would be 60,000 000 hours.

At 8 per horse power of 16 candles the light is estimated as costing the company \( \frac{1}{4} \) ct per hour. [42]\(^{a}\) that is\(^d\) for 600 hours

\[
\begin{align*}
\text{Cost lamp} & \quad \frac{.35}{1.85} \\
$ & \quad \$1.50
\end{align*}
\]

For 10,000 lamps

\[
\begin{align*}
\text{For power} & \quad 15,000 \\
\text{For lamps} & \quad 3,500 \\
& \quad 18,500
\end{align*}
\]

[Menlo Park, c. September 25, 1880]
Received from these at $1.50 per M

\[ \begin{align*}
$45,000 & \\
18,500 & \\
\text{Profit} & $26,500
\end{align*} \]

At 9 per horse power there can be obtained from the same plant ⅛ more lights

\[ \begin{align*}
8 | 10,000 & \\
\_ &= \_ \\
1,250 & \\
11,250 \text{ lights}^2 & \\
.35 \text{ lamps} & \\
56,250 & \\
33,750^a & \\
3,937.50 & [\text{For lamps}] 3,937.50 \\
& \text{[For power] } 15,000.
\end{align*} \]

Receipts

\[ \begin{align*}
45,000 & \\
7,375 & \\
52,355^a & \text{[For power]} 52,355 \\
& \text{[For lamps]} 33,417.5 \\
& \text{[For lamps]} 26,500
\end{align*} \]

Increase Profits $6,917.5

\[ \begin{align*}
128 \div 8 &= 16^e \text{ candles in eight places for a H.P. of current.}^f \\
128 \div 12 &= 10.7^e \\
10 \text{ per H.P. } 12 \text{ candles each}^g & \\
10 \text{ per H.P. } 12 \text{ candles each} & \\
\frac{7}{8} \times 8 &= 2 \text{ cts per hour} \\
2 \text{ cts per hour } 600 \text{ hours} & \\
$12.00 \text{ for 10 lamps horse power} & \\
3.50 \text{ for 10 lamps cost} & \\
$15.50 & \\
$1.55 \text{ per lamp cost to company} & \\
11 \text{ lamps for 1 Horse power} & \\
11 \text{ lamps for } .02 \text{ cts } 600 & \\
\text{[For power]} 12.00 & \\
3.85^i & \\
11 \text{ [For lamps]} 15.85 & \\
$1.44 & \\
\end{align*} \]

*July–September 1880*
1.55
1.44
11 cts gain per lamp
½  5.5 cts to be added to price
½  2.2 cts

Company sells 10 lamps

Tests show that 10 lamps of 12 candles each may be obtained from each Electrical horse power of electricity. That is, if such a lamp were, when giving 12 candles, immersed in a vessel of water, the water would rise in temperature at a rate indicating that 3300 ft. lbs of energy were added to it every minute in heat.

Such a lamp will last on an average 600 hours

That is, if 10,000 lamps were lighted at irregular or regular intervals and a careful record were kept of the time that each lamp was giving 12 candles of light, and after every lamp had ceased to give light these various burning times were summed up, it would be found that they had burned as an aggregate

\[
\frac{10,000 \times 600}{1100} = 6,000,000 \text{ hours}
\]

The lamps are considered as burning an equivalent to 12 candle gas, that is each one giving 12 candles may be thought as taking an equivalent of five cubic feet of gas for each hour that they are burned.

This unit is taken as it is found by experience that the devices by which the light may be made so much more effect practically effectual add so much to the apparent light that everyone is satisfied when told that it is giving a good gas jet. Also that gas cannot be burned in practice so as to give out the maximum of light show by the photometer while the electric light must give the consumer as much as does the tester at the laboratory of 12 candles photometric value will give at least 16 to 18 candles of effective light as Compared with gas


1. The reference at the end of this document to a lower candlepower incandescent lamp providing more effective light in comparison to a gas
lamp of greater candlepower suggests that this was probably written soon after the 23–24 September gas candlepower tests at Bergmann & Co. See Doc. 1990.

2. That is, 10,000 plus one-eighth more.

3. It is unclear where Upton gets this figure for additional receipts from using 9 lamps per horsepower.

4. That is, .35 multiplied by 11.

5. That is, according to the indication of a jet photometer; see Doc. 1990 n. 6.

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[Menlo Park,] Sept. 28, 1880.

Experiment on heating of copper rods revolved through the magnetic lines of force.

Temp. of atmosphere at commencement 76.5° F.
Temp. of Iron Plates of Armature 77.5° F.
Temp. of Fields 81° F.
Time of Commencement 7–27 P.M.
No. revo. per m. 136.
After revolving 10 m. in strong field the temp. still remained 77° F.
Started again at 7–40 P.M.
No. revo. per m. 140
Field strengthened
Temp. of atmosphere remains constant 76.5° F.
After running 30 m. no perceptible heat.
Third test commenced 8–30 P.M.
No. revo. per m. 300.
30 minutes duration of exp.
Copper bar went from 80° to 87.
4th test
commenced 9–7 P.M.
No. revo. per m. 300.
Duration 1 h.
Temp. at end 88° F.
Temp. of air 76° F.

Clarke.


1. Charles Clarke and Edison continued these tests the next day, when they made three more trials. Clarke recorded that “No appreciable rise in temperature was found to have taken place by revolving rods of copper in the magnetic field therefore no injurious local currents and it was