The Papers of Thomas A. Edison

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Having just passed the third anniversary of full-time work on an incandescent lighting system, Edison could see his first commercial central station literally taking shape in lower Manhattan. While his business affairs in the United States and abroad continued to demand attention each day, Edison had a new and pressing responsibility. As he told one appointment-seeker, he could “be found most evenings . . . in the neighborhood of Pearl St. superintending the laying of our electric light mains.” Edison’s multiple responsibilities forced him to delegate authority more often than he was accustomed—or liked—to do. When Charles Clarke proposed a particular method of testing underground cables, Edison acceded only on the condition that Clarke “take the responsibility as to any trouble hereafter. . . . I do not at all believe it is the right course to pursue and a little more brain power on the part of someone would devise” a better method. John Lieb was entrusted with supervising construction of the generating station at Pearl Street. John Kruesi ran the Electric Tube Company and had primary responsibility for laying the underground conductors. Charles Dean remained in charge of the Edison Machine Works, which completed another huge C dynamo to Edison’s satisfaction in early October. By late November, the growing Machine Works was capable of turning out two dozen small dynamos per week.

Edison asserted direct personal control in the vital area of lamp manufacture. He received frequent test reports from the factory in Menlo Park, and when he noticed a decline in the durability of the lamps, he called it to the attention of superintendent Francis Upton in October. Perhaps because of an in-
determinate absence to attend to his gravely ill father, Upton did not correct the problem immediately. Edison took things into his own hands in November and virtually lived at the factory for what he called “a grand bounce of the bugs.” This period of intensive experimenting lasted about ten days. Edison claimed to have slept only eighteen hours in an entire week, never once taking off his boots. He left satisfied that he had improved the manufacturing process to the point that the vacuum—and the lamps—would last longer than ever. He also approved new lamp base and socket designs, the basic elements of which have been in use ever since.

Edison periodically returned to Menlo Park to conduct experiments. In late November, for example, he began a series of experiments to develop a higher resistance lamp, especially for the British market. In addition, he had facilities to tackle specific problems at the Machine Works and the lamp factory. At the former, he designed a new regulator that would protect lamps from excessive voltage, a particular concern at isolated lighting installations. The November experiments at the lamp factory led to three of the thirty-five U.S. patent applications that he executed in the last quarter of 1881. Twenty-seven patents eventually issued, including several for electric arc lighting, on which he had also been working. Edison ordinarily had dozens of patent applications pending at any given time, and on 18 October he had the pleasure of cabling Charles Batchelor in Paris that the U.S. Patent Office “issued to me today twenty three patents on system Electric lighting.”

In Paris, Batchelor oversaw assembly of the direct-connected steam dynamo, the largest in the world, before the International Exposition closed in November. At about the same time, he made arrangements for a demonstration lighting installation at the Paris Opera. Joshua Bailey, meanwhile, successfully negotiated amended terms to finance companies for developing the electric light throughout much of Europe. When Bailey fell seriously ill just as the agreements were being formalized, Grosvenor Lowrey cabled Edison from Paris that “Batchelor understands and I advise you rely wholly on him.” In December, Batchelor made arrangements to acquire a factory just outside the Paris city walls to manufacture the lamps and heavy equipment that would be needed in Europe.

Edison looked especially to Great Britain for successful foreign development of the electric light. There he relied almost entirely on the entrepreneurial zeal and managerial acumen of Edward Johnson, who had reached London at the end of
September. Remembering keenly the legal problems associated with Edison’s British telephone patents, Johnson urged a comprehensive review of his lighting patents by eminent authorities and a better method of filing new specifications. Edison assented to both. Edison became deeply involved in explaining his lamp patents and justifying his claims to skeptical legal minds. Johnson was particularly concerned about rival claims to the dynamo armature by the Siemens interests and to the incandescent lamp from several quarters. He moved cautiously in the first case, suspending sales of small dynamos and opening negotiations for a licensing agreement. In the second, he seized on an invitation for Edison to join a lighting exhibition at London’s Crystal Palace. There he hoped to “Bust the Bubbles [Hiram] Maxim [and Joseph] Swan & others blew at Paris or else acknowledge that they are better ‘showmen’ than I.”

Johnson’s primary mission, however, was to set up a demonstration central station to establish the reliability and economy of the system to prospective British investors and consumers. He and Egisto Fabbri (working on behalf of Drexel, Morgan & Company) selected a site on London’s famous Holborn Viaduct in October and immediately began preparations for installing the huge dynamos, the first of which was already waiting on the dock. Edison also wanted Johnson to demonstrate the system’s safety because he feared that carelessness by rivals, such as that responsible for a fire on the steamer City of Rome, would diminish the market for electric lighting.

Edison expected that he would continue to manufacture heavy equipment in the United States for the British lighting market for several years. This additional capacity could only have heightened his financial anxieties; already he had an “urgent” need of funds to cover immediate demands. Some relief came with an advance of $10,000 from George Gouraud, apparently on account of his yet-unresolved British telephone interest. Incorporation of the Oriental Telephone Company, to which he also looked for money, crept forward. One operation in which Edison did not have a direct financial stake was the Edison Company for Isolated Lighting, which began operating independently of the parent Edison Electric Company in November. Its manager, Miller Moore, joined Edison and officials of the parent company at a mid-November conference to discuss lowering manufacturing expenses, mainly by reducing the number of employees and their wages. In a personal venture about which little is known, Edison directed his chemist John Lawson to explore an abandoned copper mine in
Menlo Park. Lawson pumped out the water using an electric motor and was able to discern ore veins, but Edison evidently did not develop the mine commercially.

With Edison away from his Fifth Avenue office frequently and irregularly, Samuel Insull continued to solidify a foundational position in his financial affairs and correspondence. Various Edison shops and companies experienced start-up problems and bickered about prices, but Insull kept Edison’s personal affairs moving remarkably smoothly. Of course, even his talents could not satisfy every constituency, as when Sherburne Eaton grumbled about being uninformed of foreign developments. Edison’s erratic schedule and the volume of his correspondence made it increasingly difficult for Insull to reply swiftly to letters. Most received reasonably prompt replies, but Edison’s longtime acquaintance George Bliss complained that “a man would starve to death while waiting for you to answer his letters. This is not your usual way of doing business.”

Edison and his wife appear to have spent considerable time at Menlo Park from the end of November. Mary Edison planned a party there, apparently a dance, on 20 December. The next day, Samuel Insull gave notice that the family planned to vacate their New York rooms by the end of the year. The Edisons’ eight-year-old daughter Marion, who was enrolled at a boarding “School for Young Ladies” at 63 Fifth Avenue, presumably did not return to Menlo Park with her parents.

2. TAE to Clarke, 20 Oct. 1881, Lbk. 9:211 (TAED LB009211; TAEM 81:74).
3. See Doc. 2187. For a detailed accounting statement of the Edison Machine Works, including the value of the machinery and tools, monthly expenses, income by dynamo model, and profit, see Rocap to TAE, 18 Nov. 1881, DF (TAED D8129ZCQ1; TAEM 81:317).
5. See Doc. 2187.
6. See Docs. 2192, 2197 and 2202.
10. Johnson to Insull, 1 Nov. 1881, DF (TAED D8133ZAL; TAEM 83:674).
11. See TAE to Johnson, 4 Nov. 1881, LM 1:88A (TAED LM001088A; TAEM 83:916).

13. Gouraud to TAE, 10 Nov. 1881, DF (TAED D8104ZET; TAEM 57:279).

14. Eaton to TAE, 9 Nov. 1881, DF (TAED D8126ZAJ; TAEM 58:64).

15. Bliss to TAE, 3 Nov. 1881, DF (TAED D8120ZBK; TAEM 57:653).


17. Graham School for Young Ladies to TAE, 24 Oct. 1881, DF (TAED D8114E1; TAEM 57:539).

To Edward Johnson

October–December 1881

[New York,] Oct. 2. 81

Johnson

Urge necessity engaging all best experts and lawyers. Also experts prepare disclaimer patents where necessary. Will aid this work from here give professors lamps sent abduction. Urge abduction take immediate steps push isolated unpatented countries. Also abatement in England Norway Sweden.

Edison


1. Under British law, invalidation of a single claim for any reason could invalidate the entire patent; the disclaimer process permitted a patentee to narrow the scope of a final specification. Edison’s electric lighting patents to date had been prepared in the U.S. and filed (without revision) by English agents (Davenport 1979, 34–46; see Docs. 1822, 1870, 1880, and 2203). In mid-November, Johnson complained that he did not believe Edison had learned from having had his telephone patents prepared in that way, and urged that

If your future Patents are to be of any value—they should pass through a channel which would scrutinize them with reference to what has gone before. In my judgment every application for an English Patent should be made by some one having the knowledge which he could apply—of the requirements of the Patent Law of England—Just as Wilber does in re—to the U.S. = If you say so—I will at once employ a thoroughly reliable Patent Agent. [Johnson to TAE, 12 Nov. 1881, DF (TAED D8133ZAR; TAEM 58:698)]

2. Cable code for George Gouraud; see App. 4.

3. Cable code for Egisto Fabbri; see App. 4.

4. Edison agreed in March 1881 to sell to Drexel, Morgan & Co. his patents in Norway and Sweden for electric light, power, and heating. Egisto Fabbri (with Grosvenor Lowrey) was a trustee for purposes of
assigning ownership of the patents, a role he also had with respect to Drexel, Morgan & Co.’s control of Edison’s electric light patents in Great Britain. TAE power of attorney to Drexel, Morgan & Co., 1 Mar. 1881; Grosvenor Lowrey to Drexel, Morgan & Co., 25 Mar. 1880; both DF (TAED D8132P, D8026ZBE; TAEM 58:431, 54:221).

To Edward Johnson

[New York,] Oct. 4. 81

English dynamo works to perfection thousand lights on first trial heating scarcely noticeable\(^1\) packing now goes on Greece Thursday\(^2\) also three small machines

L (telegram, copy), NjWOE, LM 1:52A (TAED LMo01052A; TAEM 83:898). Written by John Randolph.

\(^1\) This was a large direct-connected C dynamo for the London central station demonstration. See headnote, Doc. 2238.

\(^2\) Thursday fell on 6 October; the Greece sailed on 5 October. “Shipping News,” New York Herald, 4 Oct. 1881, 10.

STANDARD ELECTRIC CONSUMPTION METER  Doc. 2163

A key element of Edison’s design for central stations involved charging customers based on a measurement of the amount of electricity each one used. Edison’s thinking on this subject was influenced by the way that gas utilities charged for gas distributed from central stations.\(^1\) In late 1878, he conceived the basic design of his electric consumption meter, which used the action of electrolytic decomposition like that in a battery to determine how much electricity had passed through a circuit.\(^2\) Edison experimented with two fundamental designs. His earliest forms used a single metal electrode in an electrolytic solution such as copper sulfate; current passing through the cell deposited metal ions from the solution onto the electrode. Later Edison employed two metallic plates instead. As the customer used electricity, ions from one plate (the anode) passed to the other (the cathode). Because the deposition of a metal occurs at a fixed ratio to the current strength (other conditions remaining constant), the amount of electricity used by a customer could be determined by weighing the plate on which the metal was deposited. Edison used copper electrodes in most of his meter experiments, often in a copper sulfate solution, and
he filed a patent for a basic copper deposition meter in March 1880. As Edison began to commercialize his system in 1881, Francis Jehl, who had carried out many of the experiments at the Menlo Park laboratory, made numerous tests at the Edison Machine Works Testing Room to improve and standardize the copper deposition meter for regular service.

Jehl began an extensive series of trials on 30 August that led Edison to substitute zinc for copper. These involved the effects of different solutions and types of plates under various conditions, and Jehl continued them throughout September and much of October. Edison’s addendum to Doc. 2143 indicates that he had tried “plates of amalgamated zinc in a solution of sulphate of zinc” by 9 September. Jehl followed with several days of experiments on copper plated with silver or gold, and began trying various zinc solutions within the week. The first extant record of tests of meters with zinc plates are Jehl’s from 15 September.

Edison’s shift to zinc was prompted by the fact that polarization, a chemical change at the electrodes which produces a counter electromotive force, rendered the copper meters inaccurate. As Jehl explained in his 1882 pamphlet on the Edison meter, “An endless number of experiments on this point were made by me, under Mr. Edison’s direction, employing every element known.” These experiments showed that “a copper deposition cell, and some other metals, is suitable for large currents . . . but when it is required to register a very small current, such as \( \frac{1}{1000} \) of a weber, and when the deposition cell is always on a closed circuit, it becomes necessary to use something else than copper in order to obtain accurate results.” Edison determined “that by using electrodes of pure zinc, amalgamated with mercury . . . great practical accuracy is ensured when an infinitesimal quantity is desired to be measured.” Jehl’s experiments “terminated in the adoption of zinc plates for his [Edison’s] meters.” On 5 October 1881, Edison executed a patent application for a meter with amalgamated zinc plates. Jehl took the new instrument with him to Europe in February 1882 and the first detailed description and illustrations of it appeared in the 12 May issue of Engineering, about the time that his twenty-four page pamphlet on the instrument was being printed. Extensive meter experiments continued throughout 1882 at the Testing Room, many carried out by George Grower.

The standard meter consisted of an iron box containing two electrolytic cells, German silver short-circuiting shunts, and
an Edison lamp operated by an automatic thermostat to prevent the electrolytic solutions from freezing. Each cell contained two amalgamated zinc plates, separated by ebonite blocks, suspended in a zinc sulfate solution. Current passing through a shunt circuit to each cell caused the transfer of zinc ions from one plate to the other. Plates from one cell were collected and weighed monthly. The other cell, whose shunt circuit had higher resistance and therefore carried less current, were collected quarterly as a check on the monthly measurements. Recorded in a meter book, the weights provided the basis on which to calculate the amount of light used by converting the measure of current (amperes or as they called it at the time webers) into candles.  

10. Edison initially made two versions of the meter, one adapted for 25-lamp circuits and the other for 50 lamps.

1. On gas meters see Docs. 1439, 1548, 1593 n. 1, 1712, and 1900.
2. See Doc. 1622 nn. 1–2. During winter 1881, Francis Jehl experimented with a meter in which a small motor operating proportionally to the current would operate a mechanical register to indicate the amount of current. Edison applied for a patent on it in March 1881. Such meters were not sufficiently accurate in practice because of the effects of initial inertial forces when starting the motor. Jehl Diary, 26–38 passim; Mott to TAE, 21 and 22 Feb. 1881, DF (TAED D8137A, D8137B; TAEM 59:60, 62); Jehl 1937–41, 661–65; U.S. Pat. 242,901; Jenks 1889, 5–7, 36–37.

3. U.S. Pat. 251,545. Edison had included but later removed a copper deposition meter in a February 1879 patent application (Pat. App. 227,227). He also included it in his first British electric light patent (Brit. Pat. 4,226 [1878], Cat. 1321, Batchelor [TAED MBP013A; TAEM 92:107]). See also Doc. 1733 n. 1.


7. U.S. Pat. 281,352.


9. See Docs. 2269 and 2272, n. 1; George Grower to TAE, 14 June and 7 July 1882; all DF (TAED D8235O, D8235Q; TAEM 62:44, 47). In 1936, Charles Clarke had copies made of notebooks containing records of meter trials at the Testing Room in 1882; four are at the Henry Ford Museum (Clarke Meter Notebooks nos. 1–4, EP&RI [TAED X001K5, X001K6, X001K7, X001K8]).

10. Edison wanted customers to be charged on the same basis as gas, the charge for which was based on the amount of gas used by a 5-foot burner to produce about 12 candles. The Edison company could easily calculate the equivalent number of gas burners provided to customers on the basis that a 16-candle A lamp was equivalent to a 7-foot gas burner, which could be calculated as \( \frac{11}{14} \) of an ampere. Jehl 1882a, 14–15.
Standard Electric Consumption Meter

M (historic drawing) (est. 23 × 34 × 10.5 cm), *Engineering* 33 (1882): 468.

1. See headnote above.

2. A meter based on this design and used in the Pearl Street central station district is at the Henry Ford Museum. MiDbEl(H), Acc. 29.1980.275.
3. The short-circuiting shunts, made of German silver wire, are shown underneath the cell jars. The one on the left is connected to the monthly cell and has a resistance of 0.01 ohm while that on the right, connected to the quarterly cell, has one-quarter the resistance or 0.0025 ohm. Underneath the shunts is a bimetallic thermostat switch. At about 42° F, the switch closed a circuit to turn on the heating lamp. Jehl 1882a, 16–17; “The Edison System of Electric Illumination,” Engineering 33 (1882): 467.

4. The two zinc plates are $3 \times 1 \times 0.25$ inches and are attached by ebony screws to two ebonite blocks that keep them .24 inches apart. “The Edison System of Electric Illumination,” Engineering 33 (1882): 467.

--2164--

From Calvin Goddard

New York, October 6 1881

Dear Sir

Strict directions have been given that hereafter no orders shall be executed for account of this Company either for labor or material except upon requisitions bearing the written approval of the Vice President¹ or Secretary².

You will therefore please present all requisitions to the Sec-
retary daily, as far as possible before 12 o’clock noon, accom-
panied by a memorandum thereof, on form supplied for that
purpose,\(^1\) to be filed in the Secretary’s Office\(^2\). Yours Truly
C. Goddard Secy.

ALS, NjWOE, DF (TAED D8126ZAD; TAEM 58:55). Letterhead of
Edison Electric Light Co. “New York” and “188” preprinted.

1. Sherburne Eaton.
2. Goddard referred to 1 October circular letters from the Edison
Electric Light Co. and the Edison Electric Illuminating Co. of New
York. They instructed suppliers to “execute no orders for account of this
Company either for labor or material except upon requisition bearing
the written approval of the Vice President or Secretary. From and after
this date, no bills will be paid except for work done or material furnished
in pursuance of such requisitions.” Both DF (TAED D8126ZAC,
D8122D; TAEM 58:54, 57:726).
3. No examples of this form have been found.
4. Goddard sent a copy of this letter the same day on behalf of the
Edison Electric Illuminating Co. of New York (cf. Doc. 2106). Goddard
to TAE, 6 Oct. 1881, DF (TAED D8122F; TAEM 57:728).

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Dictated

[New York,] 9th Oct [188]1

To Edward Johnson

My Dear Johnson

Look at the article in the Engineer (by Swan) on page 229 of
September 23rd 81!! You will see the cheek of the fellow!

So far I have been able to find nothing about Swans doings
in the proceedings of the New Castle Society except a publi-
cation in 78 or 79 about a Carbon Lamp, with a pencil of car-
bon in it.\(^2\) I think you had better hunt up all the transactions of
this Society (I forget the exact name) and also have some one
go to New Castle on Tyne\(^3\) to find a member who has attended
all of the meetings of the Society during the last few years and
ascertain just what he did have.\(^3\)

You will see that the fellow states that he plated the carbon
to the platinum in 1879. He is now trying to get the credit of
this. The question will naturally arise why does not he do it
now as it is the only practicable way to fix the carbon to the
clamps. Why does he adopt his present cumbersome plan if he
had the \textit{platting} business two years ago. It is very evident
that seeing how we do it he now wishes to claim it, having been
so successful in getting his claim, to the lamp generally, recog-
nized.\(^4\)

It is essential that some communication should be made
calling attention to the following:—

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1st  He did not apply for any patents until after my lamp had been announced all over the world

2nd  That the records of the Society shows that he had only an old King Lamp with a pencil of carbon

3rd  That he now knows that we plate the carbon to the clamps and although not having even tried to patent it he announces that he had it. That he showed it to Sir William Armstrong but did not mention it at the Society. Sir William Armstrong could have been easily mistaken not being an expert and also being an interested party, as I understand, makes the whole thing look very suspicious.

Of course these various reflections on reputable people are all sub rosa but I think after you have satisfied yourself as to the facts you should call attention to the matter.

Your orders for machines lamps and engines are all being attended to. We will take care not to mix up orders.

I cannot understand why Gouraud does not give his orders. He must understand that in as much as we have to supply a great many people he cannot expect to be promptly attended to unless he orders quickly

Yours very truly,

Thos A Edison

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1. Swan 1881.

2. Joseph Swan exhibited a carbon lamp to an informal meeting of the Newcastle Chemical Society on 19 December 1878. Bowers 1982 (113) quotes a report of the event from the 19 December 1878 Transactions of the Newcastle Chemical Society. The Chemical News noted that Swan “described an experiment he had recently performed on the production of light by passing a current of electricity through a slender rod of carbon in an enclosed globe.” According to a published extract from the notes of an assistant, “Swan was endeavouring to use carbon rods, [and] for this purpose he obtained arc carbon rods from Carée of Paris. The smallest were about 2 mm in diameter and were cut into lengths of about 1 in. The central part was reduced to about 1 mm diam. for a length of about 1 in.” Swan again exhibited this lamp (or one like it) before about 700 people at the Literary and Philosophical Society of Newcastle on 3 February 1879. “Proceedings of Societies,” Chemical News 39 (1879): 168; Swan 1946, 12, 23–24; Chirnside 1979, 98; Swan and Swan 1929, 64; Bowers 1982, 113–16 surveys Swan’s early public demonstrations.

3. A few weeks earlier, Edison cabled Charles Batchelor to “engage man work up every detail Swans whole case for three years back to ascertain exactly what he did do.” Batchelor answered that “Bailey got pretty well to bottom of Swan matter and Lowery and [Frederic Henry] Betts are now working it up still further.” TAE to Batchelor, 23 Sept. 1881, LM 1:44B (TAED LM001044B; TAEM 83:894); Batchelor to TAE, 25 Sept. 1881, DF (TAED D8135ZCA; TAEM 58:1080).
4. Edison was probably referring to Swan’s use of spring clamps or “forceps” to attach platinum wires to the carbonized thread in a more recent form of lamp. This was illustrated and described by the *English Mechanic* in September 1880. That article elaborated on Swan’s earlier claim, made in a letter to the editor published in the 1 January 1880 issue of *Nature*, to priority on an incandescent lamp with a horseshoe-shaped filament of charred cardboard or paper (“Swan’s Electric Lamp,” *English Mechanic*, 10 Sept. 1880, Cat. 1015:102, Scraps. [TAED SM015102a; TAEM 24:54]; “Edison’s New Lamp,” *Nature* 21 (1880): 202; see also Doc. 2022 n. 6.). Swan stated in his *Engineer* article that an assistant, Charles Stearn, “undertook to mount some of my [carbonized] papers in a good vacuum, and after many failures from carbons breaking he at last succeeded in making some bulbs very highly exhausted, containing my paper carbons, attached by electrically-deposited copper to platinum strips, which carried the current in and out of the lamp.” He later stated that “soon after” his February display of the carbon rod lamp in Newcastle, “and I am quite sure without knowing what I was doing Mr. Edison produced a lamp identical with mine in all essential particulars. It, too, consisted of a simple bulb from which the air had been exhausted by the Sprengel pump, and which, like mine, had no screw-closed openings nor complications of any kind, but contained simply the in-going and out-going wires sealed into the glass, with the carbon attached to them” (Swan 1881, 229).

5. E. A. King obtained a British patent (10,919) in 1845 as agent for J. W. Starr of Cincinnati for a lamp with a thin rod or plate of carbon (or platinum) heated by passage of an electric current; the conductor was enclosed in a glass globe evacuated by a mercury barometer. This was reportedly the first patent on a lamp with incandescent carbons. Dredge 1882–85, 1:xix–xx.; Swan 1881, 229; Heap 1884, 160.

6. William Armstrong (1810–1900), a distinguished inventor, particularly in firearms, was the son of a former mayor of Newcastle and a major benefactor of that city. Armstrong was president of the British Association’s Section G (Mechanical Science) when Swan reportedly showed him the lamp in February 1879. Armstrong’s house was the second (after the inventor’s own) to be lighted by the Swan light. *Oxford DNB*, s.v. “Armstrong, Sir William George”; Swan 1881, 229; Swan 1946, 31.

7. In long letter reviewing the state of Edison’s light in England, Johnson wrote on 22 October that “everywhere we are cautioned against openly assailing Swan—on two grounds—1st That he certainly did something with carbon in vacuo—before the date of our Patents= 2nd That he is a man of so much influence in scientific circles that to assail him will react on us severely.” Johnson to Sherburne Eaton and TAE, 22 Oct. 1881 (pp. 21–22), DF (TAED D8133ZA; TAEM 58:642).

8. Johnson cabled a firm order on 4 October for ten dynamos to operate half lamps, ten machines for full lamps, one thousand half lamps, and one thousand full lamps. The next day he ordered “two Engines for driving two dynamos each.” He later confirmed these requisitions and reminded Edison not to confuse them with George Gouraud’s orders. Johnson originally intended the dynamos for isolated installations but diverted them to the Crystal Palace. Johnson to TAE, 4, 5, and 6 Oct. 1881, LM 1:52C, 54A, 54C (TAED LM001052C, LM001054A,
From Joshua Bailey and Theodore Puskas

Edison New York

[Paris,] Oct 12. 81

Following are conditions under four heads: first, factory five hundred thousand francs day contract signed million additional put at disposition and company formed when foyer opera lighted three and a half million more when first station two thousand lamps lighted Paris at price gas capital increased after first five millions according to requirements of business our company to have founders shares carrying half profits after five per cent interest on money shares our company name majority board directors three years Batchelor full control half profits go to our shares and this proposition continues in all increases of capital your plan of shares abandoned because impossible under French law syndicate to have quarter of our founders shares second head exploitation syndicate furnish five hundred thousand francs for all Europe when foyer opera lighted million and half additional when first station lighted as above the two million repaid from first profits before any division made minimum capital any city or country two million francs every hundred thousand inhabitants this basis is twenty percent increase on former bacles our company to have forty five per cent of capital of all companies formed no contract to be made for sub companies or syndicates without consent of our company consent or refusal to be given within fifteen days after any contract proposed our company has three months in which to make another contract in place of that refused our company has our third committee of syndicate and direct representatives on boards of all companies formed third head plants all towns not having more ten thousands inhabitants and all plants outside of towns having more than this number belong to our company and syndicate half profits each fourth head in case Paris company give license to syndicate to manufacture and make installations immediately in Paris as they desire to do our company to give six weeks delay in closing Paris contract the syndicate intends during this time to absorb Paris contract bringing Paris under terms of present contract if you cable tomorrow acceptance three conditions with authority to sign contract am authorized

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to say contract will be signed within twenty four hours and first money paid in

Puskabailey

1. The six-year-old Opera building was fitted with electric lights in conjunction with the Paris Electrical Exposition on 15 October, and the official opening occurred three nights later. The arc and incandescent lighting interests represented at the Exposition jockeyed for favorable position in lighting portions of the building. Otto Moses successfully negotiated for Edison the opportunity to light the Grand Foyer, a large and lavishly decorated room with a vaulted ceiling nearly 100 feet high. Because of the size of the room, the Edison interests installed ten chandeliers of forty-eight lamps each. However, the chandeliers were only 15 to 25 feet above the floor and could not adequately illuminate the paintings on the upper walls and ceiling, necessitating the use of Lampe Soleil arc lights. Moses regarded the installation at the Opera “as the biggest piece of advertising possible” for Edison’s lighting system. At the end of November, a committee consisting of artists, the Opera’s director and architect, and the French Minister of Fine Arts conducted a trial to determine which lighting system would be chosen to illuminate the interior of the whole building. The committee chose the Edison incandescent and Lampe Soleil arc lamps; a circuit diagram of the installation is in Undated Notes and Drawings (c.1879–1881), Lab. (TAED NSUN07:70; TAEM 45:191). Edison asked the Edison Electric Light Co. of Europe in September 1882 to defray his expenses for lighting the Opera and the Electrical Exposition, about $6,000 and $34,000 respectively. Moses to TAE, 22 Sept. 1881; William Meadowcroft to Bailey, 15 Sept. 1882; Bailey to TAE, 7 Oct. 1881; all DF (TAED D8135ZBY, D8228ZAJ, D8132ZAV; TAEM 58:1075, 61:679, 58:501); Edison Electric Light Co. of Europe report, 7 Mar. 1884, CR (TAED CE001003; TAEM 97:209); Fox 1996, 174–77; “L’Éclairage Électrique,” La Lumière Électrique 6 (1882): 184.

2. Presumably, “basis.”

3. Edison replied the same day that he accepted the first and third provisions unconditionally and the second “with one amendment, instead of giving syndicate twelve and half hundredths we will give them one quarter of proceeds coming to us Exploitation funds must cover also all expenses of litigating patents but our company will pay for taking out future patents.” He also consented to the fourth provision “if Paris company gives license to syndicate we will give six weeks delay in closing Paris contract Contract now to be made with syndicate subject to existing contract with Leon” (William Meadowcroft summarized terms of the preliminary contracts with Leon in an 18 July 1881 letter to Charles Batchelor [Cat. 1244, Batchelor (TAED MBSB7B; TAEM 95:268)]). Edison authorized Bailey to sign if these terms were also approved by Charles Batchelor and Grosvenor Lowrey. TAE to Bailey, 12 Oct. 1881, LM 1:59B (TAED LMO01059B; TAEM 83:901).

Bailey revised the second provision the next day. The syndicate would “offer make manufacturing company million and half francs and

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put two million for exploitation on signing contract and to increase capital for factory as needed without limiting figure also abandon all conditions about establishment first station and about comparisons price of gas and go in squarely without hesitations or experiments.” Edison consented immediately, and these were substantially the terms that Samuel Insull summarized for James Hood Wright a week later. The Compagnie Continentale Edison and two related companies were formally organized on 2 February 1882. Bailey to TAE, 13 Oct. 1881; TAE to Bailey, 13 Oct. 1881; LM 1:61A, 62A (TAED LM001061A, LM001062A; TAEM 83:902–3); Insull to Wright, 21 Oct. 1881, Lbk. 9:215 (TAED LB009215; TAEM 81:78); incorporation papers, 2 Feb. 1882, DF (TAED D8238R; TAEM 62:252).

4. Cable code for Theodore Puskas and Joshua Bailey; see App. 4.
Feeders—Energy On.¹

Oct. 3rd and experiment was tried with one of the copper underground electric tubes at Edison Machine Works. The current from 800 A lamps of 112 ohms resis. with 102 volts was passed through one of these tubes, each conductor having 262,951 cir. mils. cross section. The tube was not sensibly warmed.

Resis. of lamp circuit 112/800 = .14 ohms.
Current = 102 × 800/112 = 729 vebers
The resis. of one foot of tube would be (two feet of copper conductor) $R = \frac{10.33 \times 2}{262,951}$.

Therefore the energy lost in one foot of tube is $C^2R \times 44.3$

\[
\frac{729^{26} \times 20.66}{262,951 \times 44.3} = 1850 \text{ ft. lbs. per foot of tube.}^3
\]

In one lamp at 10 to the H.P. there are 3300 ft. lbs.
Therefore \(36/100\) of a lamp was lost on one foot of conductor. The lamps in first district are to be 140 ohms, 10 per h.p. and it is intended to lose 15% on the feeders. 16,000 lamps to be supplied.

To lose 15% the total equivalent lamps will be \(100/85\) of 16,000 = 18,824. Lost in feeders 2824 lamps. There are 20 feeders—∴ 141 lamps on each feeder, and none should have more than \(1/2\) lamp per foot of feeder.

With all the lamps on each feeder carries the current to supply 800 lamps.⁴

Clarke


1. No records have been found of the 3 October experiments, probably made with the London Jumbo dynamo. On 11 October Clarke reported that this machine, with 800 lamps in circuit, “gave 102 Volts external at 320 revo. The joint resis. of 800 lamps was .14 ohms and with .0049 ohms in armature supposing no other resis. in circuit, the total E.M.F. was . . 105.6 volts. At 350 revo. this would be 115.5 Volts.” He then analyzed the effects of putting more layers in the magnet windings. Also on that date he determined physical and electrical specifications of a central station dynamo with fewer armature sections but longer field magnets than the London machine. N-81-07-11:41–55, Lab. (TAED N220:17–24; TAEM 41:19–26).

2. The term 10.33 in the following equation is the resistivity of copper expressed as the ohm-mil-foot, or ohms times cross sectional area per length.
3. The term 44.3 in this equation is a constant for converting watts to foot-pounds.
4. On 17 October Clarke calculated the number of volts needed at the generator to operate 16,000 lamps at 102 volts through feeders of 0.03126 ohm resistance. He then determined the amount of energy lost in “regulating resistance” in the system. Ten days later, in his last entry in this book, Clarke listed a decreasing series of “the resistances required to be successively in circuit with lamps so that they shall never be more than 105 volts or less than 102 volts.” N–81–03–24:9–15, Lab. (TAED N227:5–8; TAEM 41:251–54).

—2168—

To Addison Burk

Dear Sir,

I am very much obliged to you for your favour of the 10th calling attention to the lighting of the Baldwin Loco Works.2

I understand that the plant was sold to the Baldwin Loco Works in precisely the same way as we would sell to anyone else. If they like to put an Arc Light in competition with us we can hardly prevent them. More over it is a competition I am not at all afraid of as I know I can get more effective light for $1.00 by means of my Incandescent Light than it is possible to get with an Arc Light

Our own people were over at the B. L. Wks & saw the light start up & they seem perfectly satisfied with the result and report that the Partners of the Firm are very much pleased with it.

If you have not already seen the Light running there I would suggest that you call at the Baldwin Loco Wks some evening & I am sure you will notice the progress made since you were last at Menlo Park.3

Again thanking you for your kindness in writing me I am Very Truly Yours

Thos A Edison

L (letterpress copy), NjWOE, Lbk. 9:201 (TAED LB009201; TAEM 81:69). Written by Samuel Insull.


2. The Baldwin Locomotive Works, in Philadelphia, was the largest
locomotive fabricator and among the largest capital equipment builders in the U.S. The firm employed about 2,900 at this time (Brown 1995, 24–27, App. A). Burk wrote that the works planned to use Edison’s incandescent light “in competition with the Brush and Thompson-Houston voltaic arc lights and thinking that you might not know the conditions of the test I write to give you a friendly warning. Eighty of your lamps are hung in chandeliers in a dingy workshop in size about 250 × 100 feet. They cannot possibly light the place; eighty gas jets, thus disposed, would not do it” (Burk to TAE, 10 Oct. 1881, DF [TAED D8126ZBA; TAEM 57:641]).

3. Burk wrote again on 18 October, giving details of the installation and enclosing a clipping from the Ledger. While accepting Edison’s claim for the economic superiority of incandescent lighting, he noted that “the trouble is to make the public understand what you are aiming at. I shall do what I can to have the Edison light given fair play in that as in other respects.” He stated that the lamps were run at a very high intensity and about eleven had burned out quickly. By February 1882, they reportedly lasted an average of 600 hours. Burk to TAE, 18 Oct. 1881, DF (TAED D8120ZBF; TAEM 57:646); Edison Electric Light Co. Bulletin 3, 24 Feb. 1882, CR (TAED CB003; TAEM 96:674).

My Dear Sir:

I am in distress about the engine sent to London. My arrangement with Mr Johnson in Major Easton’s presence, and to which he also agreed, was expressly that I was to be notified when it was ready to be tried, and should see personally to its being all right. How could you send it off so?¹

Nothing will now do but for another engine to be tested by me and sent in place of it. They are duplicates, the clutches are interchangeable, (or we will meet that matter any way), and this is absolutely necessary.² I have also several things to change, especially the lubricators. Your own interest and mine are identical in this matter. I have no confidence in the governor action. Must send an engine that I myself find perfect.

The one we were trying on Friday & Saturday will not do as it has an exceptionally long shaft. Others all alike. There is plenty of time. When can I see you?³ Very Truly Yours

Chas. T. Porter


¹ The 125 horsepower Porter-Allen engine and dynamo for the demonstration electric light plant were shipped on 5 or 6 October. TAE to Edward Johnson, 4 Oct. 1881, LM 1:52A (TAED LM001052A; TAEM 83:868); see also headnote, Doc. 2238.
2. The “clutches” provided a flexible coupling between the engine and dynamo, not a means of disengaging them. In their 1882 paper for the American Society of Mechanical Engineers, Edison and Porter noted the value of avoiding “a rigid connection between the engine and the armature shafts, which would require the entire series of bearings to be maintained absolutely in line.” This presumably referred to their unhappy experience with the Menlo Park experimental direct dynamo (see Doc. 2074 n. 1). The first London machine instead had a self-adjusting coupling... which will permit of considerable errors of alignment without any abnormal friction being produced in the bearings.

The point of difficulty was the backlash, the engine having no fly-wheel except the heavy armature itself, which was to be driven through the coupling. Provision was made for taking this up by steel keys of a somewhat peculiar form, between which the tongues of the couplings move freely, while they themselves are immovable. These keys are held between set screws threaded in wrought iron rings covering the flanges on the ends of the shaft. All the faces liable to move upon each other are oiled from a central reservoir. This coupling is a very compact affair, without a projection anywhere above its surface, and gives every promise of completely answering its purpose. [Edison and Porter 1882, 6]

3. Porter wrote Edison that he would meet one of his own employees at the Edison Machine Works on Monday, 24 October, and was “exceedingly anxious to meet you there at that time.” This was changed to 25 October but nothing more is known of this meeting. Porter to TAE, 20 and 22 Oct. 1881, both DF (TAED D8129ZCA, D8104ZDY; TAEM 58:299, 57:240).

[New York,] 18th Oct [188]1

To Drexel, Morgan & Co.

Dear Sirs

I have your favour of 17th and in reply beg to state

1st I think that ultimately we shall have to establish a Factory in England but for the first three or four stations the machinery can be supplied from here at lower cost and much better made than were we to start a Factory in England to do the work right away.

2nd We will supply the lamps for the Isolated Business (“Z” Dynamos) at fifty cents each. When a station is started I will supply them at forty cents each for the purpose of lighting up a District I am certain it would not pay for a long time to come to start a Lamp Factory in England as freights being low and there being no duties it would be impossible to compete with our Lamp Factory here as we have established such a perfect system of manufacture and trained men who are now very skillful and experienced
3rd I will contract to deliver twelve “Z” Dynamos per week for use in England without interfering with my supply to the Electric Light Company in this Country.

4th I will duplicate the Big London Dynamo within sixty days of the order being given. We will deliver Station Dynamos at the same cost as to the Light Companies here. The exact cost cannot be ascertained until we have made more of them.

5th As to the Exhibition at the Crystal Palace it has not yet been definitely decided to remove the Paris Exhibit to London. Mr Fabbri first communicated with me on the subject. I then wrote to Mr Johnson requesting him to consult Mr Fabbri on the subject. I stated to Mr Johnson that in as much as the exhibit would of my other inventions would add considerable prestige to the exhibition of the Light I thought that if the exhibition was made Mr Fabbri should provide the funds for the purpose. I have no interest personally in making such an exhibit as is asked for [in?] as my inventions, with the exception of the Light, are all disposed of for England. My expenses in connection with preparing the instruments for the exhibit at Paris were very heavy indeed and I had to bear the whole of it myself. I shall be glad to see the exhibition made at the Crystal Palace as I believe it will greatly assist Mr Fabbri in his negotiations in London.

Very truly Yours

Thos A Edison

LS (letterpress copy), NjWOE, Lbk. 9:204 (TAED LBo09204; TAEM 81:71); an incomplete copy is in DF (TAED D8133ZAH; TAEM 58:639). Written by Samuel Insull. Interlined above.Canceled.

1. Drexel, Morgan & Co. inquired about five items corresponding to the numbered paragraphs below. Samuel Insull made extensive shorthand notes on it which presumably formed the basis for this reply. Drexel, Morgan & Co. to TAE, 17 Oct. 1881, DF (TAED D8133ZAG; TAEM 58:636).

2. At this time there were no specific plans for Edison isolated lighting plants in Great Britain. By the end of October Edison was eager to start the business, but Edward Johnson thought that unwise without sufficient capital in hand. By mid-November Drexel, Morgan & Co. had agreed to commit $25,000. TAE to Johnson, 31 Oct. 1881, LM 1:82A (TAED LM01082A; TAEM 83:913); Johnson to Samuel Insull, 1 Nov. 1881; Johnson to TAE, 19 Nov. 1881; both DF (TAED D8133ZAL, D8133ZAU; TAEM 58:674, 712).


4. This vast glass conservatory building was originally built for the
Great Exhibition of 1851 in Hyde Park. After that event it was relocated and enlarged across the Thames at Sydenham, where it became the central feature of an amusement park and was used for concerts, theater, and exhibitions. *London Ency.*, s.v. “Crystal Palace.”

5. Egisto Fabbri wrote Edison in September that the manager of the Crystal Palace “had decided to open an Exhibition the same as is now going on at the Palais de l’Industrie immediately after this closes and to last from December to March— . . . Major [Samuel Flood] Page assured me that he would do everything to satisfy you as regards quantity of space and locality & hoped you would give him a favorable reply.” George Gouraud forwarded a similar invitation a few weeks later, along with advice that Edison have his exhibits removed promptly from Paris after the Exposition so as not to violate French patent laws. Edison wrote Edward Johnson on 9 October that “the exhibit at Paris seems to have acted as a first class advertisement for the Light . . . I am quite willing that the Paris exhibit should be sent to the Crystal Palace for exhibition but in as much as it would act as a very big advertisement I think Fabbri should bear the expense. . . . I do not think he should object to this. Of course under any circumstances he would have to pay for the Electric Light part of the exhibit. See Fabbri & cable me what he will do.” Edison reminded Johnson by cable on 18 October to inquire about the expenses, to which Johnson replied “Fabbri will instruct Drexels to pay.” The Société Électrique Edison sent six cases of exhibit items to Johnson in early December. Fabbri to TAE, 21 Sept. 1881; Gouraud to TAE, 6 Oct. 1881; Société Électrique Edison inventory, 3 Dec. 1881; all DF (*TAED* D8133ZAB, D8133ZAD, D8135ZCT1; *TAEM* 58:629, 633, 1124); TAE to Johnson, 9 Oct. 1881, Lbk. 9:174 (*TAED* LB009174; *TAEM* 81:58); TAE to Johnson, 18 Oct. 1881; Johnson to TAE, 19 Oct. 1881; LM 1:65B, 68B (*TAED* LM001065B, LM001068B; *TAEM* 83:904, 906).

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[New York,] 20th Oct [1881]

**Major Eaton**

Cabling. European Co*

“I dont think the way this cabling business is managed is right”

For instance. Cable comes at 11.30. Mr Edison Mr Puskas² & myself discuss it. Best form of reply decided on. I go to W[estern]U[union]. office send same by which time it is 1.30 or 2 oclock³ Dont you think it would be better to have a clerk & messenger boy here till the small hours of the morning waiting to reply to cables. You would then be sure of having both cables & replies thereto. And in as much as Mr Banker³ has developed so wonderful an interest in the business I will undertake to share my bed with him so that he will be here to decide the form of reply.

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Such an arrangement would be agreeable to myself & Mr Edison also I imagine as it would give us several hours extra sleep every evening.

I just mention this as a suggestion to overcome a very great difficulty.

As a matter of fact you always do see cables & this is the first time there has been any chance to complain.

The cables were answered but the copies of the replies were in such a form that I was obliged to copy them out before shewing them. I ventured to attend to some very particular letters which had to go by yesterday's European mail & afterwards to an appointment which could not be delayed & I should have missed both if I had attended to the cables. The contents of which being disastrously muddled were not of such great importance until explanations for which we cabled could arrive from Paris.¹

Mr Edison too was in the building knew what the cables contained was cognizant of the answers thereto & could have helped you out of your difficulty.

I told Mr Hannington² I would be back at 4 o'clock or perhaps not till 5 o'clock & Mr Banker waiting therefore³ is not chargeable to my a/c.

If you think there was any negligence on my part I would prefer you to submit it to Mr Edison

Saml Insull

ALS (letterpress copy), NjWOE, Lbk. 9:212 (TAED LBo09212; TAEM 81:75). “X” written at top of page. ¹Followed by dividing mark. ²“by which time...2 o clock” interlined above. ³“copies of the” interlined above. ⁴“Mr Banker waiting therefore” interlined above.

1. Insull quoted from Eaton’s 19 October complaint that cables received the preceding night had not come to his attention: “Things relating to the Europe Co. I ought to see — Mr Banker has been sitting in my room now nearly an hour, waiting for you to come in — I had to simply admit that I knew nothing abt the cables. You see it makes me appear negligent.” Eaton to Insull, 19 Oct. 1881, DF (TAED D8127W; TAEM 58:155).

2. Theodore Puskas had been in the United States since at least early September. Joshua Bailey to Puskas, 4 Sept. 1881; Bailey to TAE, 5 Sept. 1881; both DF (TAED D8132ZAI, D8132ZAH; TAEM 58:464, 459).

3. New York City investor James H. Banker (1827–1885) was among the original trustees of the Edison Electric Light Co. and one of the organizers of the Edison Electric Light Co. of Europe; he was also involved in other Edison interests. See Docs. 1668 n. 2, 1731, and 1736; TAE, Theodore Puskas, Joshua Bailey, and Banker agreement with Edison Electric Light Co. of Europe, 1 Apr. 1881, DF (TAED D8127A1; TAEM 58:88).
4. Insull and his assistants did not normally note the time of receipt or transmission of trans-Atlantic telegraphic messages. The cables referred to in this exchange, however, probably included one from Grosvenor Lowrey about the relationship of the prospective European company with existing contracts for lighting Paris. Edison’s reply on this subject, addressed to Joshua Bailey, stated that the incoming message was “muddled.” Lowrey to TAE, 18 Oct. 1881; TAE to Bailey, 18 Oct. 1881; LM 1:66B, 67A (*TAED* LM001066B, LM001067A; *TAEM* 83:905).

5. Charles Hanington assisted Insull in the office. He remained in Edison’s employ for several years and, in 1888, conducted a search for fibrous plants in Latin America. Jehl 1937–41, 948; see also Hanington’s correspondence in Electric Light—General (D-88-28), DF (*TAED* D8828; *TAEM* 122:753).

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To George Gouraud

My Dear Sir,

After several cables to Johnson & yourself I at last got yours as follows¹

Ship immediately three sixty light complete outfits without power. Cable price and steamer Drexel’s advised.
to which I today replied²

Three plants will cost twenty two hundred forty five dollars. Will cable shipment. Am filling your order for twenty. Drexels only instructed pay for three Answer

Almost a month intervened between your order for twenty machines & the receipt of your above quoted cable. On the receipt of your first cablegram I ordered the stock for your machines & set my shop at work on them.³ Your long silence caused me considerable inconvenience as your not being punctual in answering my enquiry as to how I was to get payment made no difference to my creditors who sent in their bills with that same charming regularity as is their wont.

I have very heavy accounts to meet every week which of course is natural with a very large & consequently expensive shop, my resources of manufacture are taxed to their utmost & therefore if you want machines you must back up your orders by promptly saying where I am to get my a Were I a millionaire I should not be quite so sharp after such things but as I am not & have to stand personally a weekly expenses of from $20,000 to $25,000 I have to take very great care to keep myself out of what would be a very big hole.

Further more you must remember that the countries you control have got to be operated in very vigourously or else it
Paris, October 23 = 1881

My dear Edison

I send you by this mail the official list of awards.² You will know all about it before this letter reaches you, but you will never know the satisfaction which your friends here have felt in the last two days, nor be able to realise the contrast between

From Grosvenor Lowrey¹

---2173---

My dear Edison

I send you by this mail the official list of awards.² You will know all about it before this letter reaches you, but you will never know the satisfaction which your friends here have felt in the last two days, nor be able to realise the contrast between
our feelings now and four weeks ago. I keep the recountal of particulars until I see you. I am now trying hard to get away on the 29th by the Alaska but Bailey’s contract is awfully in the way. Fabbri does not seem to care to have me remain in England now, and I do not see that during the next month (during which I could not stay in that clime) there is anything to be done in which I could assist very much.

Two telegrams went to you yesterday one of which was as follows

“You have received the highest award in the power of the jury to give and I congratulate you— (signed) Joseph Wilson Swan.

the other:—

“accept my congratulations you have distanced all competitors and obtained a Diploma of Honor the highest award of the Exhibition. No person in any class in which you were an exhibitor received a like award. George F. Barker—" I also sent you a despatch explaining how the five gold medals voted you by the Subjuries were committed to into a diploma of Honor, which, though but a bit of paper is considered vastly more valuable.

The first despatch was written in my presence at the breakfast table yesterday where I was by invitation of Mr. Swan, with James C Stephenson, Member of Parliament for Newcastle-on-Tyne and president of Swan’s Coy and Mr. Watson, solicitor, of Newcastle, a director. Mr Swan said “I think I ought to have had something better than Maxim and Lane-Fox, but I admit that Edison is entitled to more than I! He added he has seen farther into this subject, vastly than I, and foreseen and provided for details that I did not comprehend until I saw his system.” Swan is a man of a style as different from Maxim as you can conceive. He is a chemist and keeps a drug store I believe, but is a man of literary cultivation very modest manners, and I should think a most excellent fellow. At any rate while he said nothing that was fulsome and only in the casual way of conversation I have never heard more satisfactory expressions concerning you than I have heard from Mr Swan. I doubt if there is any man who appreciates your work better than he, and he, partly appreciates it so well, because—as another friend informs me,—Sir Wm Thomson who is a friend of Mr. Swan’s, constantly has warned Mr Swan and his friends that they must arrange with you or combine with you, that you are the only one who has a good system. The object of their invitation to me was, that as Mr Stephen—
son was on his way thro’ here to Italy they wanted to discuss the question whether we were going to be open enemies, or secret friends, or what. The question was a very fair one and I tried to deal with it as prudently as I could, my belief really being that if we could, on terms satisfactory to us, and which should put the question where it belongs, secure with their approbation a re-issue of our English patents and an organisation of a Company that should in some way take in both, we should then sweep the board in England. Without that we shall not get Sir Wm Thomson, although I believe we shall get Preece. Crookes, I have written to Eaton about.\(^9\) I don’t remember whether I have written about Preece with reference to his determination, that until he shall be in London and have studied the system a little more, he will be entirely independent, declaring however, meanwhile that if he does not go with us, his “mouth will be closed,” and that if he does go in with us, he will put his whole soul into it. This he will do, however only\(^d\) when he can satisfy himself that everything is sound in the technical sense, so that he can pledge his reputation to it. These English scientific men are, I find, a very close corporation, and stick together like wax, partly from affection, and partly from fear of each other. At present, Swan has got the friendship of all of them. They are proud of him, and, as you will see by Professor Forbes’s letter in the “Times” of the 22d,\(^10\) they, in the newspapers, simply assume that the Incandescent lamp enclosed in a continuous globe, etc; etc; is Mr Swan’s invention the outcome of 20 years continuous work. We have no newspaper voice in that country with which to contradict this, and, as in France, you cannot buy the publication of your communications through any respectable journals.

The second cable message was written in my presence at the dinner table on the same day as the first. I shall have a good deal to say to you about it, and the writer, when I see you. Enough for me to say at present, that, as United States Commissioner he felt it his duty to get for Mr Maxim a gold medal\(^e\) if Swan, & Lane-Fox, got medals; but that the United States Coy having two medals might have got a Diploma of Honor if he had asked for it, but he did not ask. He has in most respects satisfied me; in one or two, not quite, but the explanation is one that I cannot gainsay. He is now definitely retained by me, by a conversation I had with him the day before yesterday, after the termination of his duties as juryman, to be for Edison, day & night, at all times, in all countries, and against all persons. There will be a retaining fee to pay him when he gets home,

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and he will bring you a lot of figures and information concerning everything in the Exhibition, which will be very useful. I shall pay him £100 here for a few days’ consultation in England with Johnson and our lawyers. Bailey will also pay him a small fee for a report here. On the whole he will not do so badly as he will expect to have considerable employment with us.  

His great notion is, though to form a Museum and Technical School in New York, in which you shall be the prime mover. He is however only looking to you for aid in collecting curious things suitable for such a Museum. When he first spoke of it to me, I told him of a conversation you and I had in the very early days of the Electric Light when I said to you “if we get rich out of this, let us form an Edison laboratory or School.” Perhaps you will remember this. I think it was at Tarrytown.  

I telegraphed you last week about a point in the contract here, which telegram I will now explain, although your answer revealed to me all that I cared to know. I thought, from the cables interchanged, and in which there was frequent reference to an absorption of the Paris contract, that you might suppose that when you paid to the new syndicate, the commission or interest of 28%, which they are to have in all local business in France, and had surrendered to them the manufacturing here upon the terms agreed on, that you were to have nothing more to pay to anyone. This you might naturally think because you are making both contracts with Mr Léon. But I am informed Mr Léon has no interest left; or comparatively none, in the old contract, and cannot control the owners of it. He hopes, by offering them a chance of coming into the new Syndicate to induce them to surrender the old. By the 14th section of the old they are entitled to 5% of all such business as you are now doing with the new, and will of course, claim it. You will therefore have to pay them 5% out of anything which you receive out of the new contract. I was not sure that you understood this, and was unwilling to approve of a scheme of contract which necessarily involved that, without a clear understanding. I saw by your answer to Bailey, that you had comprehended it, and as your explanation question would require a rather long explanation, I authorised Bailey to send for me a short dispatch, substantially as follows:  

“Neither syndicate demands anything and your answer gives me all the information I require”  

I shall hurry up the contracts and get away from here on Wednesday night if I can, or on Tuesday night if possible.
will be very rapid work and will greatly disappoint Bailey, for when I parted with him last night, he expected that I would remain over for another month. There are various reasons why I cannot. In the first place I have many personal and private reasons for being at home. Next, I dread the coming month or two months here, fearing that I may have an attack of my old trouble and be laid up; but, beyond all that it appears to me that if I stayed, it will be rather thought that I stay unnecessarily, and the inconvenience to myself, or value to others will not be understood. This is rather a difficult matter to speak of, because it seems like blowing one’s own trumpet, and I don’t know anything more disagreeable than to be thought to overvalue one’s own importance. This is a risk I am unwilling to encounter under the circumstances. So I shall get through in Paris if I can. If not I will leave things in the best condition I can to have the contract executed. I will put Batchelor in the hands of a good and safe lawyer who speaks English, and the terms of the contract being all settled, there is not much risk in that, i.e., a point is arrived at, at which I can withdraw without any serious risk, although if I felt free to remain here, I can see very, very many points at which I could be of the utmost service to the European. Bailey is overworked, and excited. Batchelor is inexperienced—first rate in his place, but of slight importance in the field to which I refer. Moses, whose mind is more fruitful, is, according to Bailey’s ideas not sound, and Bailey has taken a great dislike to him, while the state of things between him and Batchelor is such as to rob Moses of most of his usefulness. I must tell you that I think the trouble between Moses & Batchelor is one of those unfortunate pieces of business in which neither party is to blame, but, which is irreconcilable. Many people have remarked in my hearing how well Moses represents you in all communications with the French and German people. He is polite, assiduous, perfectly intelligent and as faithful as a man can be. I don’t see how you could have got on without him or someone like him. Batchelor on the other hand suits the scientific and practical men exactly, but for all others, even those who speak English, he does not come up to the mark, does not see the point in conversation, and omits certain little things of finesse and tact which have been so necessary in a Congress like this, where one needed to make friends. This resulted only from lack of experience in such things. However, the friends have been made and you are at the top of the ladder in this Exhibition. Nobody for a mo-
ment questions now that you are the great man, and that you have contributed more to its interest and success than all others put together. Perhaps I ought to except one person. Siemens, I think believes himself the great man, and Professor Forbes concurs in that opinion. However, Forbes speaks very respectfully of you in this last letter and Preece has promised to take care of him entirely.

I am feeling very well now,—better than for a long time before as is proven by the fact that I have seldom in my life worked harder and more hours than during the last month. I have scarcely been to a place of amusement or interest with my wife since we reached here.

The big dynamo started on Friday night with perfect success, with one brush on each side. There was scarcely a spark to be seen. Lord Crawford looked at it for half-an-hour, and finally turned to me and said “I never saw anything run so perfectly.” Mr Swan told me it was a most “wonderful” machine. Preece said it was “splendid.” Your lights for the first time looked what they really are. The fact is, they have been pretty sick with the miserable little engine which Batchelor was able to provide.

Try and catch Freeman as he goes thro’ New York, and get his ideas about the Exhibition. I think Freeman is a very square man in every respect, and I think he is very sound on all, or nearly all the questions in which you are interested. At any rate, see him. He sails in the Britannia which sails about the time this letter goes. Bailey informs me that the Paris engineers believe your system good for 100 metres, but are doubtful whether you can distribute it at a greater distance. The editor of the Figaro told me on Saturday that he should go over to New-York to see the opening there I advised him to wait until we had been running for a month or so, and arranged to give him notice. He got me talking for half the day in giving him points about you for an article. The correspondent of the Daily News some time ago did the same and made an article which I did not like when I saw it.

Give my love to Eaton. I hope you appreciate what a man you have got in him. He is of the sort not made much more frequently than a big dynamo, or than you are.

Mrs Lowrey sends her kindest love to Mrs Edison and hopes sincerely she is better than when Major Eaton wrote a few days ago.

No decorations were given by the Exposition but something
1. Grosvenor Lowrey was general counsel for Western Union, and his firm—Porter, Lowrey, Soren, and Stone—served as its legal department. In the fall of 1878 Lowrey became Edison’s principal advisor regarding financial support for electric light experiments and was instrumental in establishing the Edison Electric Light Co. See Taylor 1978; Docs. 1459 and 1471.

2. The list sent to Lowrey has not been found but a complete list of awards was published in “Awards at the Paris Electrical Exhibition,” Engineering 32 (1881): 437–38.

3. Lowrey decided to stay until the contract for the European lighting syndicate was completed. Batchelor explained to Eaton that Lowrey was anxious to leave “but if he goes now it will probably bust this contract and I have told him so, he has therefore decided to stay and see it out.” Lowrey signed the final contract on behalf of Edison on 15 November. He cabled Edison that day summarizing affairs at his departure: “Left Paris this morning contract signed Bailey sick and incapacitated for business for present Leon party dislike Puskas and refuse to sit in board of principal company with him Batchelor understands and I advise you rely wholly on him until I arrive and explain.” Lowrey arrived in New York by 3 December. Batchelor to Eaton, 27 Oct. 1881; Edison and Edison Electric Light Co. of Europe agreement with Porges and Léon, 15 Nov. 1881; both DF (TAED D8135ZCO, D8127W9F; TAEM 58:1109, 173); Lowrey to TAE, 15 Nov. 1881, LM 1:99B (TAED LM001099B; TAEM 83:921); Batchelor to Eaton, 3 Dec. 1881, Cat. 1239:27, Batchelor (TAED MBLB4027; TAEM 93:504).

4. The cables from Swan and Barker were copied in LM 1:69B, 69C (TAED LM001069B, LM001069C; TAEM 83:907).

5. Lowrey telegraphed that “official list published today shows you in the highest class of inventors no other exhibitors of Electric Light in that class. Swan Lane fox and Maxim receive medals in class below. the subjuries had voted you five gold medals but general congress promoted you to the diploma of honor class above. this is complete success the congress having nothing higher to give.” Lowrey to TAE, 22 Oct. 1881, LM 1:71A (TAED LM001071A; TAEM 83:907).

6. James Cochran Stevenson (1825–1905) was a chemical manufacturer and public official. He succeeded his father in 1854 as head of the Jarrow Chemical Company, one of the largest chemical firms in the United Kingdom. Stevenson also played a leading role in the River Tyne Improvement Commission and served as a Member of Parliament from 1868 to 1895. Daily Telegraph, 26 May 1882, Cat. 1327, item 2197, Batchelor (TAED MBSB52197; TAEM 95:193); Oxford DNB, s.v. “Stevenson, James Cochran.”

7. Robert Spence Watson (1837–1911) was a politician, reformer, and businessman. When Swan formed his first electrical lighting company

8. Sir William Thomson (1824–1907), later Lord Kelvin, professor of natural philosophy at Glasgow University, was one of the foremost physicists and electrical engineers at this time. *DSB*, s.v. “Thomson, William”; see also Doc. 1751 n. 5.

9. William Crookes (1832–1919) was a prominent British chemist, physicist, and science publisher. His principal accomplishments lay in precise experimental technique, measurements of atomic weights, and investigations into X-ray phenomena. Edison was familiar with his writings and had subscribed to his journal *Chemical News* since 1874. *DSB*, s.v. “Crookes, William”; Israel 1998, 93; see also Docs. 1714 n. 2 and 2034. Lowrey’s letter to Eaton about Crookes has not been found. At the beginning of October Batchelor wrote Edison that Crookes was “very much opposed to Swan but . . . favorable to Maxim.” Batchelor to TAE, 1 Oct. 1881, DF (*TAED* D8135ZCC; *TAEM* 58:1082).

10. George Forbes (1849–1936), a British astronomer and electrical engineer, was a member of the awards jury at the 1881 Paris Electrical Exposition (*WWW*S, s.v. “Forbes, George”; Passer 1953, 288–90; Jonnes 2003, 287–306). In an unsigned article from Paris describing the awards given to exhibitors, Forbes gave a laudatory description of Swan’s incandescent lamp and implicitly credited him with priority by describing his lamp as the product of twenty years of labor following his original conception. He made no mention of other incandescent lighting exhibits. Forbes also reopened the controversy between Edison and David Hughes over of the microphone by noting that Hughes had received a personal diploma of honor as the “inventor of the microphone, which he generously presented to the public, special modifications of which have been patented by many people, so that the public has been deprived of the benefits of his generosity” (“The Electrical Exhibition,” *Times* (London), 22 Oct. 1881, 10).

11. At the beginning of October Batchelor also praised Barker’s work on behalf of Edison. As a Commissioner of the Exposition, Barker exercised some influence on the selection of the awards jury for incandescent lighting exhibits, ensuring that the final composition was favorable to Edison. Batchelor reported that Barker had arranged, at least initially, “so that there is not a single Englishman on the experimental jury on incandescent lamps.” He concluded that Barker “is working hard for us and ought to be taken care of as the others would gladly get him if they could.” Batchelor to TAE, 1 Oct. 1881, DF (*TAED* D8135ZCC; *TAEM* 58:1082).

12. Edison visited Lowrey’s home in Tarrytown in September 1879. Lowrey and Barker urged Edison in 1882 to assist Columbia College in establishing an electrical engineering program, using the equipment from Edison’s exhibit at the Paris Electrical Exhibition. See Doc. 1805 n. 1 and Barker to TAE, 30 May 1882, DF (*TAED* D8204ZCF; *TAEM* 60:163).

13. Edison had recently instructed Batchelor to retain Lowrey to advise on the proposed contract. On 18 October Lowrey cabled Edison:
“Seems new European syndicate cannot get Paris contract settled until after new European signed. This leaves Paris five for France outstanding future negotiations shall I consent if judge necessary to save business on basis of Bailey’s cables important answer tomorrow am acting in accord Bailey.” Edison’s reply has not been found. TAE to Batchelor, 11 Oct. 1881, Cat. 1244, Batchelor (TAED MBSB7G; TAEM 95:284); Lowrey to TAE, LM 1:66B (TAED LMo01066B; TAEM 83:905).

14. Edison cabled Bailey on 18 October:

We did not ask or require new syndicate take up Paris contract supposing that you arranged that new syndicate have everything Europe except what covered by Paris contract If old syndicate comply with conditions we are bound to fulfill Does new syndicate desire to get rid old contract and require us here to do it or do they want us to fulfill and leave them all other territory or do they want old syndicate take Paris and give up to new syndicate provincial France and the five per cent, if so do they want us to pay from our share the five per cent In writing your cables you presume too much on our knowledge here of your negotiations there. [LM 1:67A (TAED LMo01067A; TAEM 83:905)]

15. This is the essence of the cable sent in Lowrey’s name to Edison on 22 October. LM 1:66A (TAED LMo01066A; TAEM 83:907).

16. Among Lowrey’s reasons may have been the fact that his second wife, Kate Armour Lowrey, whom he married in September 1880, was pregnant with their first child, born in March 1882. Taylor 1978, 54.

17. Lowrey suffered from gout; see Doc. 1711.

18. This conflict began in late August, apparently over the extent of Batchelor’s authority over Moses. In early October Batchelor wrote Edison that Moses was “a perfect failure. I have had my hands full ever since I came here dispelling ideas he has put in Bailes’, Fabris and Lowery’s head . . . regarding the worthlessness of our patents . . . I have had a number of rows with him about it but he evidently thinks he is doing good for the company . . . If he would only turn his attention to getting articles in the papers he could put in 4 or 5 everyday, but that he wont do and when I promise articles in French he says he will give them but never does.” On 2 October Edison cabled Moses, “Do please work more as Batchelor wishes whom I must hold responsible.” Moses replied that he was working diligently for Edison and that he had asked Batchelor “if he ever had communicated with you in a way to give rise to such a message.” Batchelor denied doing so. Batchelor to TAE, 1 Oct. 1881; Moses to TAE, 9 and 31 Oct. 1881; all DF (TAED D8135ZCC, D8135ZCI, D8135ZCP; TAEM 58:1082, 1091, 1112); TAE to Moses, 2 Oct. 1881, LM 1:50C (TAED LMo01050C; TAEM 83:897).

19. There were eight Siemens brothers. Lowrey probably referred to Werner von Siemens (1816–1892), who co-discovered the principle of the self-exciting dynamo in 1866. He co-founded the German firm Siemens & Halske, which moved into electric power generation and distribution and was a major force in the worldwide development of electrical industries. He may also have meant Karl Wilhelm von Siemens (1823–1883), who emigrated to Britain, where he was known as Charles William Siemens. Also instrumental in the development of the dynamo, he was a principal in laying the transatlantic cable in 1874. He headed the
London firm of Siemens Bros., part of the family enterprises, which manufactured generators, arc lamps, submarine cables, and related equipment. He was president of the British Association in 1882 and presided over several other professional societies during his career; he was knighted in 1883. King 1962, 378–79; Doc. 811 n. 2; Oxford DNB, s.v. “Siemens, Sir (Charles) William.”

20. James Ludovic Lindsay (1847–1913), 26th Earl of Crawford and 9th Earl of Balcarras, was a prominent astronomer. He was elected fellow of the Royal Society in 1878 and president of the Royal Astronomical Society in 1878 and 1879. He served as chief British commissioner at the 1881 Paris Electrical Exposition. Oxford DNB, s.v. “Lindsay, James Ludovic.”

21. Frank Freeman was a U.S. Patent Office examiner and member of the awards jury for the Paris Electrical Exhibition. On 27 October Batchelor wrote Edison, “I wish you would personally thank Freeman if he calls on you as he has worked indefatigably to show off our things to the best possible advantage and at all times. Also another American Commissioner Lieut Maclean if he calls on you.” “Congrès International des Électriciens,” La Lumière Électrique 4 (1881): 417–20; Batchelor to TAE, 27 Oct. 1881, DF (TAED D8132ZBC; TAEM 58:518).

22. Lowrey probably referred to a long report on the unofficial opening of the Exposition. The first paragraph stated that Edison’s exhibit was “pretty well advanced, but is yet far from being so complete as the Menlo Park magicians and Mr. Batchelor, the agent, intend it be. They complained to-day of the fearful want of reliability of French workmen, who have no idea of the nature of a time engagement.” “The Electrical Exhibition at Paris,” Daily News (London), 12 Aug. 1881, Cat. 1069, item 12c, Scraps. (TAED SM069012c; TAEM 89:147).

23. Eaton’s letter to Lowrey has not been found, nor has any information on the state of Mary Edison’s health at this time.

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To John Michels

[New York,] 25th Oct [188]1

Dear Sir,

I hereby give you notice that I will at the expiration of sixty (60) days from this date stop the further publication of “Science” if in my opinion there has not been in the meantime a great improvement in the valuation of the property.

Unless you receive further notice from me you will please prepare to close up your account on that date when I will dispense with the further services of yourself and your staff.

Yours truly

Thos A Edison


1. John Michels (b. 1841?) was a journalist who, with Edison’s financial backing, started the journal Science in 1880. Doc. 1932 n. 4; Kohl-

2. Michels sent an urgent request for funds the same day. Edison had decided in February 1881 to end his financial support of *Science* but he continued to pay the journal’s bills through the end of the year. It ceased publication in March 1882. Michels subsequently tried to persuade him to invest in a company to revive it but Samuel Insull responded that Edison would “not have anything further to do with the publication of ‘Science’” (Doc. 2054; Michels to Samuel Insull, 25 Oct. 1881, 4 Feb. and 28 Apr. 1882; all DF [*TAED* D8144ZAU, D8251A, D8251E; *TAEM* 59:570, 63:662, 665]; Insull to Michels, 9 May 1882, Lbk. 12:255 [*TAED* LB012255; *TAEM* 81:639]). Edison promised Sherburne Eaton in July that he would settle a disputed personal account with Michels “to make him feel good.” Abram Hewitt and Edward Weston considered investing in the journal but Alexander Graham Bell and Gardiner Hubbard eventually bought the title and subscription lists from Michels and resumed publication in 1883 (Sherburne Eaton to TAE, 3 July 1882, DF [*TAED* D8226ZAK1; *TAEM* 61:324]; TAE to Eaton, 3 July 1882, Lbk. 7:648 [*TAED* LB007648; *TAEM* 80:712]; Kohlstedt 1980, 35). After Edison had ended his association with *Science*, Sherburne Eaton twice discouraged proposals for the Edison Electric Light Co. to pay for planting articles there. He did so with some delicacy because about that time Michels was writing a long report on New York electric lighting enterprises for the *New York Tribune* (Eaton to TAE, 29 June and undated 1882, both DF [*TAED* D8226ZAI, D8224ZDE; *TAEM* 61:317, 139]).


From Sherburne Eaton

Dear Sir:

A special meeting of the Directors of the Edison Ore Milling Company, Limited, will be held at the above address on Friday October 28th, 1881 at 3.30 P.M. for the following purposes:

1. To receive report of progress at Quonocontaug Beach, R.I.3

2. To receive report of applications for machines.4

3. To fix the price for separators and conditions of sale.5

4. To audit bills, including bill for large amount for expenses in connection with sand separations.6 Yours truly

S. B. Eaton


1. A dated and signed version of this letter was copied into a company letterbook by William Meadowcroft. LM 5:37 (*TAED* LM005037; *TAEM* 84:248).

2. The company’s offices at 65 Fifth Ave.

3. The company leased access to the beach at this location in July and

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had a separator working by early September. The machine did not work properly and was replaced in October by a new model which by this time was processing six to seven tons of ore daily. When Eaton summarized operations for the board in late October, he stated that the greatest problem was the location facing the open ocean because “captains of schooners will not anchor unless there is a N.W. wind blowing; thus we cannot be as regular in shipments as if there were a harbor or dock.” The company had recently sent an ore sample to the Poughkeepsie Iron & Steel Co., which ordered an additional seventy-five tons of processed ore and then wanted to contract for the mill’s entire output at $10 per ton.

William Meadowcroft to Edison Machine Works, 1 Oct. 1881, LM 5:8 (TAED LM005008; TAEM 84:234); Sophia Pendleton agreement with Robert Cutting, Jr., 7 July 1881, DF (TAED D8139P2; TAEM 59:184); Eaton reports to Edison Ore Milling Co., 17 Jan. 1882 and 30 Oct. 1881, both CR (TAED CG001AAI2, CG001AAI1; TAEM 97:416, 411); further details of the operation can be found in Eaton’s correspondence with M. R. Conley, who replaced W. H. Cheesman as superintendent in November, in Ore Milling Co. Letterbook, LM005 (TAED LM005; TAEM 84:210).

4. In his October report (see note 3) Eaton stated that “a large number of persons have made inquiries lately regarding the terms of sale for our separators,” among them two companies wishing to separate pulverized iron ore. Eaton noted that experiments showed that this material “is too fine and clogs up the mouth of the hopper. Mr Edison will shortly make some improvement in the hopper to meet the exigency and we can then probably dispose of several machines.” He told the board in conclusion that “we are now prepared to supply separators and to instruct parties in the use of them.”

5. The directors set the price of machines, which cost $500 to manufacture, at $1000 each plus a royalty of fifty cents per ton. Purchasers were required to use the machine only for the purposes and within the territory specified in the contract. Edison Ore Milling Co. minutes, 28 Oct. 1881, CR (TAED CG001 [image 30]; TAEM 97:414).

6. Eaton submitted bills showing disbursements of $464.93 for general company expenses and $1,921.83 for operations at Quonocontaug. Edison Ore Milling Co. minutes, 28 Oct. 1881, CR (TAED CG001 [image 29]; TAEM 97:413).

Samuel Insull to Louis Glass

[New York,] October 26th. [1881]

My Dear Mr. Glass:—

I am almost ashamed to sit down to write to you as I have given your letters the go by so long that I am thinking you have got the impression that I did not intend to answer them. I hardly like to set about excusing myself so will simply say that inasmuch as I have to put in eighteen hours solid work every day, Sunday and week days, with the most charming regularity, some of my correspondence gets overlooked. However, Frank Mc.Laughlin just came on here and he says if I do not
write to you he will shoot me. So rather than become a martyr I will send you a few lines of explanation as to the electric light. I was just looking over the applications we have got from San Francisco for the franchise for that city and I find that there are about twenty some of which are from extremely good people so you see what you have got to start out against. But I hope that a little watchfulness when the time comes to close up a contract for San Francisco we shall be able to get it for you and your associates. I enclose you herewith a few circulars which we usually send out in answer to applications for general information and if you give them to your friends to read it may in a very few words give them some slight information of our system. I also enclose you circular asking for information as to the lighting consumption of a given city. You must use your own discretion as to answering this. I would not go to much trouble about the matter. I simply send it to you to show you how systematically we set about our work. I also enclose the agreement between The Edison Electric Light Company owning the patents and The Edison Electric Illuminating Company of New York who are going to undertake the general distribution of electricity for light and power throughout Manhattan Island. This will give you some idea as to the nature of the agreement which will be made as to other cities. I think that the best thing for you to do is to get just the strongest people you can and put in an application for the franchise for San Francisco. It would be as well to have the application sent by yourself and all your associates and address it to The Edison Electric Light Company. If you send it to mine or Mr. Edison’s care I will write a note and get Mr. Edison to sign it so as to place on file the fact that he is desirous that when the franchise is granted that it should be given to you of course all things being equal as to Position and solidity of your associates, but upon this point I am sure there will be no trouble. I do not think the company will enter into any very serious negotiations until we have the first station started here in New York. You will appreciate how much better will be their position when Mr. Edison has placed beyond doubt the practicability of electric lighting on general distribution as opposed to and in competition with gas. They will be able to get a much better price for their property. Mr. Edison is very hard at work here preparing to light up his district down town about which I told you when you were here. We are making the machines down at our works at Goerck St. just as quickly as possible. We have men engaged laying the street mains at the rate of from seven
hundred to one thousand feet a night. (we do not work during the day at this work.) At our central station in Pearl St. we are now engaged in the installation of twenty-two hundred horse power Babcock & Wilcox Boilers and are also putting up a structure for the purpose of carrying the dynamos. We have the houses wired down in that district having obtained contracts by which we shall replace with electric lighting ninety per cent of the total gas lighting of that district which is about three quarters of a mile square. The gas companies are beginning to get somewhat scared down there now and we understand that they are returning to their customers the money deposited on the meter. One man told us that they not only returned him the money but also twenty two years interest added. Everything so far as inventing goes is absolutely completed and has been for some time past. The only trouble now is in the securing of machinery and if we could get that tomorrow we could light up within a month. However as matters go at present I do not suppose we shall get started before February at the earliest. Send on your application and do not think that because I have been so remiss in my attention up to this time that is is chronic with me. very truly yours,

L (carbon copy), NjWOE, DF (TAED D8120ZBH; TAEM 57:649).

1. Louis Glass (1845–1924) was secretary of the Spring Valley Mining & Irrigation Co., a hydraulic gold mining concern in Cherokee, Calif., with which Edison made arrangements to purchase platinum-bearing tailings in 1879. Glass later became general manager of the Pacific Phonograph Co. in San Francisco and California manager of the Edison General Electric Co. Docs. 1776 n. 1, 1777, and 1844 n. 1; “Glass, Louis,” Pioneers Bio.

2. In August, Glass had outlined his plans and prospective partners for a San Francisco electric lighting company. Glass to Insull, 29 Aug. 1881, DF (TAED D8120ZAW; TAEM 57:631).

3. Frank McLaughlin (d. 1907) was a telegraphic acquaintance of Edison and a former agent for the electric pen and phonograph. He became Edison’s representative to California mining interests in 1879 and took up residence in San Francisco. Docs. 1776 n. 2, 1844, and 1938.

4. Neither enclosure has been found.

5. An unsigned copy of this contract, dated only 1881 and probably a printed draft, is in DF (TAED D8122T; TAEM 57:749).

6. Glass identified and described his partners in a letter to Edison in November. In a subsequent letter inquiring about the status of their application, Glass referred to obtaining a lighting franchise for the entire state of California. Glass to TAE, 26 Nov. 1881; Glass to Insull, 16 Feb. 1882; both DF (TAED D8121H, D8220I; TAEM 57:716, 60:760).

7. Frank McLaughlin wrote a letter of introduction in July for Glass to present to Edison. McLaughlin to TAE, 15 July 1881, DF (TAED D8139Q; TAEM 59:180).
Edison’s incandescent lamp required more attention to the manufacturing process than other components of his light and power system. Producing lamps in large quantities presented the Menlo Park factory with several closely related challenges. One was standardization to ensure that lamps approximated their rated candlepower. Another was durability. A third was cost, particularly important because the wholesale price to the Edison Electric Light Co. was fixed by contract. Responsibility for all this fell on factory manager Francis Upton, who also had to train and oversee a labor force to manufacture what until recently had been a custom-made laboratory item.¹ Many of the production problems confronting Upton were variations or extensions of those that Edison had begun to address in mid-1880 while setting up the factory.² Charles Batchelor presciently warned him that “there is nothing wants such continual watching as a ‘finished process for manufacturing anything cheap’ and . . . you must always be on the look out for some unexpected trouble.”³

Unlike the Menlo Park laboratory notebooks, those used at the lamp factory provide little detail about the experiments conducted there and still less information about the rationales for them. Nevertheless, particulars about materials and processes can be gleaned from notebooks kept by John Howell, head of the testing department.⁴ Upton’s correspondence with Edison, well represented in this volume, provides an overview of the lines of investigation. An additional source is Edison’s patent applications; between April and December 1881 he executed nine applications dealing principally with manufacturing processes, and filed a similar number in 1882. Several pertain to inert gas atmospheres in lamps, or to chemical means for exhausting gas or vapor. None of these methods was used in production at this time, and the extent to which the factory adopted other new techniques is not clear. A notebook probably used by Edward Acheson and Edward Nichols provides considerable detail on the testing of lamps and of routine carbonization and manufacturing processes.⁵

The factory’s most important raw material—bamboo—possessed considerable natural variability. Manifestly unsatisfactory blanks were picked out by hand before carbonization, but even so, the resistance of filaments carbonized simultaneously in the same mold could differ by twenty ohms.⁶ This
would produce a corresponding—and unacceptable—range of intensity in finished lamps. The factory instituted a regimen for testing each lamp with a photometer and galvanometer to determine the voltage required to produce its rated candlepower. The “economy” or efficiency of special or experimental lamps was also calculated. According to detailed notes of factory operations made by Edward Acheson and Edward Nichols, this was computed either by measuring the resistance and electromotive force, or by measuring the heat given off in a calorimeter. In addition to routine tests, new materials and processes were continually being evaluated. These experiments contributed to the factory’s unrecoverable expenses, as Upton lamented in Doc. 2177.

The lifetime of each lamp was affected by the character of the carbon and the stability of the vacuum, among other factors. Select batches of finished lamps were routinely run at high voltage until they broke, and careful records were kept of how long this took. The “lamp curves” produced from these data graphically represented the range of lifetimes in each sample. Edison interpreted these results as indicators of the quality of the manufacturing process and when the average lifetimes fell in November he thought Upton “had got away off his base & was trying to get back without informing me.” This set off a spate of experiments on evacuating and sealing lamps which resulted in three patent applications at the end of 1881. Earlier in the year William Holzer had devised a method of making a more secure seal between the outer globe and inside support, and Edison took the unusual step of permitting him to apply for a patent in his own name in September. The 16-candlepower A lamps made in 1881 reportedly lasted an average of about 3,000 hours. Blackening of the globes by carbon carrying drastically reduced their illuminating efficiency long before they broke, but both Edison and Upton considered this a problem of design rather than of manufacturing.

Upton keenly appreciated the importance of lowering expenses, in part by reducing waste. He noted in September 1881 that 1,600 to 1,700 raw fibers were needed to produce 1,000 finished lamps. About 10 to 20 percent of carbonized filaments were broken or thrown out while being put in lamps. In a good week, fully 10 percent of lamps broke in the pump room, representing a significant loss of time and material. The pumps themselves routinely gave out under the pounding of mercury droplets after an average of two weeks. Labor costs were an ongoing concern and helped persuade Edison to relocate the
factory to Harrison.\textsuperscript{14} Upton kept “a full account of each man’s work” in the pump department and by May 1881 had established production rates and piecework pay scales for numerous discrete production tasks.\textsuperscript{15} Glassblowing was disproportionately expensive, and when Holzer designed a process to facilitate attachment of the exhaust tube at the top of the globe, a highly skilled operation, Edison again permitted him to file for a patent in 1883.\textsuperscript{16} Considerable effort was also given to faster means of attaining a high vacuum. The evacuation process, about five hours per lamp in June 1881, required a great investment in expensive pumps and was a production bottleneck. Upton adapted as best he could, as when he advised Edison in July 1882 to promote the half (“B”) lamps because they were cheaper to produce and “help out in the pump room to fill up odd moments when there is not time to make A lamps.”\textsuperscript{17} He also conducted ongoing experiments with modified pumps and novel desiccants to speed the evacuation process.\textsuperscript{18}

Upton had to attend to these concerns while still maintaining a high volume of production. The factory’s daily output of about 1,000 pieces was high by contemporary standards in other industries and required careful attention to balance the flow of materials. Neither Upton’s professional training nor his prior work for Edison had properly prepared him. He learned as he went, on at least one occasion shutting down lamp assembly until the supply of carbons could catch up. The factory was also the first industrial application of electric motive power, and inevitable malfunctions and delays further complicated his task.\textsuperscript{19}

2. See headnote, Doc. 1950.
3. Batchelor to Upton, 22 Aug. 1881, Batchelor (\textit{TAED MU054; TAEM 95:660}).
4. John Howell recorded results of tests on both experimental and production lamps in several notebooks kept at the factory (Cat. 1301, 1302, 1303, all Batchelor [\textit{TAED MBNo07, MBNo08, MBNo09; TAEM 91:293, 365, 438}]). This information came to Edison’s attention somewhat erratically (see e.g., Docs. 2117 esp. n. 3, and 2187).
5. Notebook #144, Hendershott (\textit{TAED Bo15}); see also headnote, Doc. 2098.
6. Notebook #144:30, Hendershott (\textit{TAED Bo15:15}).
7. Notebook #144:31–35, 61–71, Hendershott (\textit{TAED Bo15:15–17, 26–31}); see also Doc. 2129. An undated notebook kept by William Hammer, evidently before Edward Nichols left the factory in June 1881, nar-
rates the testing procedures for experimental and production lamps. Ser. 1, Box 14, Folder 9, WJH.

8. John Howell drew curves for three groups of lamps on 27 October; the graph reproduced here was for no. 480, a batch of 30 A lamps tested at 32 candlepower. Howell manually computed the average lifetime at 1,014 minutes (cf. Doc. 2150) but did not indicate how this would correlate to average lifetime at normal operating voltage. The horizontal axis represents time (in minutes); the vertical axis is a scale of the number of inoperative lamps, so that a steeply rising curve indicates a relatively rapid succession of failures. In reference to unsatisfactory test results about this time (see Doc. 2183), Upton explained to Edison that “the first part of the curve shows what the lamp is doing the last part is generally abnormal.” Cat. 1301, Batchelor (TAED MBNO07:50; TAEM 91:343); Upton to TAE, 8 Nov. 1881, DF (TAED D8123ZFC; TAEM 57:996).

9. See Doc. 2187.

10. See Doc. 2183 n. 2; U.S. Pats. 266,588, 251,536 and 264,650.

11. U.S. Pat. 264,698.


14. See Docs. 2061 and 2089.

15. Upton to TAE, 1 Sept. 1881, DF (TAED D8123ZDR; TAEM 57:956); Notebook #144:3, Hendershott (TAED Bo15:3).


17. Upton to TAE, 6 July 1882, DF (TAED D8230ZBB; TAEM 61:781); Howell and Schroeder 1927 (123–25) note that the rate of five hours per lamp was improved by shortening the stem between the pump body and dryer tube, so as to reduce the evacuated volume. One attendant could operate about fifty pumps.

18. See, e.g., Doc. 2139; Upton to TAE, 26 Aug. 1881 and 1 Sept. 1881, both DF (TAED D8123ZDP, D8123ZDR; TAEM 57:951, 956).

19. The output level was roughly that achieved a few years earlier by

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the several factories of the Singer Sewing Machine Co., which were re-
garded as models of high-volume production. Although the sewing ma-
chine was in some respects more complex than the lamp, its production
depended on established metalworking practices and an existing supply
of trained labor. Hounshell 1984, 89–96; on the factory shutdown, see
Upton to TAE, 30 July 1881, DF (TAED D8123ZDH; TAEM 57:937).

From Francis Upton


Dear Mr. Edison:

Could not some arrangement be made to pay part of our ex-
perimental expenses?

The European Light Co. propose starting a factory and are
interested in having the life of the lamp extended and the pro-
cesses cheapened.1

It would be very valuable to have them to have full transcripts
of all our curve sheets old and new. They would do well to take
them and ask for new ones paying us so much money for each
lamp used.

England could also give something and the American Co.
would be interested in the same way.

If fifty cents a lamp, of which a complete record were taken,
could be collected from each of these companies it would be a
great help to the Lamp Co. and benefit the parties mentioned
still more for it would point out to them and us how better
lamps could be made.

There is no justice in the present arrangement in which the
Lamp Co. gives everything and takes nothing. Yours Truly
Francis R. Upton.

ALS, NjWOE, DF (TAED D8123ZEW; TAEM 57:989). Letterhead of
Edison Lamp Co. “Interlined above. b“Menlo Park, N.J.,” and “188”
preprinted.

1. See headnote above.

To Edward Johnson

[New York,] Oct 30. 81

All harping on combining Swan only brings weakness2 we
can swamp all infringers without litigation give them plenty
of rope and they will kill themselves as Maxim doing here
where daily expenses seven hundred dollars no returns our
prices, economy and life lamps being impossible to infringers3

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We want solid men plenty backbone who can wait Then
plunge ahead fearing only Gas interests

Edison


1. Cable code for Edward Johnson; see App. 4.
2. See e.g., Doc. 2173, which would not yet have reached Edison. In another letter still in transit, Edward Johnson reported that “[William] Preece said to me = If you could arrange with Swan you could sweep the field.” Johnson to TAE, 22 Oct. 1881 (p. 22), DF (TAED D8133ZAJ; TAEM 58:642).
4. Johnson wrote to Samuel Insull on 1 November that he and Egisto Fabbri were

holding aloof from all considerations of either sale or barter with our opponents— Lowrey at Paris has to some extent been overpowered with the powerful sway of the English Incandescent Element and has lent an attentive ear to the talky talky members of the various tribes—and has even referred them to us—but Fabbri— though conservative in speech and general deportment has—and this I know—very decidedly put his foot down on anything that looks like a weakness in this direction. . . . We shall most certainly not do anything so unwise as to concede anything to people who have nothing but cheek to give us in return= Swan is the only man who merits the least consideration—and he only by virtue of the powerful influence he has command of— At present we are of the opinion that this influence is the growth of a misconception of the facts and we have resolved to test that question by an attempt to educate leading men up to a proper understanding of the main issues involved—then we feel we shall command their influential support and sympathy and Mr Swan bereft of that will be rendered bald indeed. [Johnson to Insull, 1 Nov. 1881, DF (TAED D8133ZAL; TAEM 58:674)]

---2179---

From Charles Batchelor

My dear Edison—

The machines at the Opera house are working splendidly but there is this trouble with all at first; after a good 5 hours run with full load on they all rub on the magnet heads— there is clearance enough in the middle of the armature and all along except at the end where the commutator is and I have to file all machines out on that end very considerable— You cannot tell this in the shop unless you run them 5 hours with full load— Another thing; after such a run you will find lots of the brass wires a little loose and these ought to be soldered again as they

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are liable to damage your armature if one should accidentally get loose I take the precaution now to solder them again in between your solderings as I think you solder too far apart—.  

What are you doing about making other sizes a 200 light machine would be good for a belt would be good?— Also for small machines?— Johnson was here yesterday and I lighted up the opera foyer for him in the afternoon—. The foyer is very fine but in my opinion the 250 full lights I have in the Grand Escalier at the Exposition (showing off the pictures so well as they do) are a finer exhibition of lighting— There is very much better satisfaction in running a lot of lights from one big machine than bothering with a lot of belts & commutators Yours  

Batchelor


1. Batchelor worked to resolve several technical problems with the Opera dynamos from October to December. The field magnets of one of the dynamos were damaged in transit in October, although it is unclear if this caused problems during operation. On 19 October Batchelor cabled Edison that one of the armatures failed after running an hour because the “brass wire on commutator end of armature rubs . . . when full load on armature being larger there this must be attended to.” Batchelor wrote the next day to say that the spare armature for the machine did not fit because the shaft was too small. On 19 November he reported that heating in the commutators caused the copper blocks to expand and short-circuit with each other, and complained that “they dont seem to be made anything like so solid as the old machines in the commutator.” On 3 December Batchelor reported that the “Opera house plant works well and all the time.” Two weeks later, however, the boiler had failed, and he was “working all hours” to repair it “but it makes a very bad impression.” Batchelor to TAE, 20 Oct., 19 Nov., and 19 Dec. 1881, all DF (TAED D8132ZBA, D8132ZBN, D8132ZBX; TAEM 58:512, 550, 575); Batchelor to TAE, 19 Oct. 1881, LM 1:68A (TAED LM001068A; TAEM 83:906); Batchelor to Sherburne Eaton, 3 Dec. 1881; Batchelor to TAE, 19 Dec. 1881; Cat. 1239:27, 53, Batchelor (TAED MBLB4027, MBLB4053; TAEM 93:504, 518).

2. Batchelor also directed Philip Seubel to resolder the brass binding wires in the armatures of the dynamos he was installing at the Strasbourg railroad station in January 1882. This was a persistent problem until at least November 1882. Batchelor to Seubel, 9 Jan. 1882, Cat. 1239:97, Batchelor (TAED MBLB4097; TAEM 93:545); Doc. 2366.

3. Edward Johnson wrote Samuel Insull on 1 November that “Batch has the Opera House all to himself, or will have in a day or so—all the others having received the notice I told you some time ago they would receive—to quit= Last Saturday he made a magnificent display in the
Grand Foyer—and the Director was wild over it. . . . He lit it up for me—and & It was certainly a treat even to my eyes.” DF (TAED D8133ZAL; TAEM 58:674).

From Edward Johnson

London OcNov 3/81.

My Dr Edison—

Crystal Palace Exhibition

The one thing which Paris failed most conspicuously in was “Reliability”! I am therefore “going for” that “Bug” more particularly than any other—though there are others almost as important =

Instead of having my entire plant of 12 machines run with one Engine I propose to run it with three (4 dynamos to each) I will draw upon my 12 machines for only about 600 Lights maximum all machines to lead to one common circuit = I will thus have a margin of 2 machines to go on Ere I draw upon the “Battery” for its nominal capacity viz: 720 Lamps—

If now a machines gives trouble & I have to stop its engine I shall stop 4 machines—thereby drawing upon the remaining 8—for my 600 Lamps or—75 Lamps Each—

I want to ask you some questions 2

1st Will this be too severe a strain on the 8—for a few minutes say 10 or 15—until we can start up again—or shut off some of the Lamps—

2nd Can I sufficiently increase my Field strength in the remaining 8 to bring my Lamps up to 16 candles—always providing my steam Power is sufficient—and will the opening of the 4 machines one at a time—but in rapid succession be likely to make my Belts slip?

3rd Will the stoppage of the Engine driving the 4 machines without opening the Dynamos—or rather—before opening them result in harm to their armatures—or in over-burdening the other 8 machines by reason of the fact that the 4 on ceasing to be active simply become low resistance arc’s across the mains? If so I will put in a switch for Each Battery of 4—so I can in an instant open the entire lot & then [some?] quickly stopping my Engine—probably save myself from any considerable wreck—such as I saw at Paris—and which was due to lack of facility for quickly stopping the Engine—

Will this sudden withdrawal of the 4 machines at one blow of a switch—too suddenly & severely tax the capacity of the other Eight?

4th
You see my point—
I am going to obtain it Even if I have to use 4 Engines & run 3 machines on Each— This would give me sufficient margin in all the above particulars would it not?=
I hope however you will tell me I can do it with 3—
My Idea is to demonstrate practically—but on a limited scale—your method of obtaining reliability by the subdivision of your Power= This I can do in the way I propose without the use of the Big Dynamo— In fact If I had only one Big Dynamo I would not show reliability at all=
I want the failure of a machine to show simply a momentary decrease of Light—but never a total Eclipse— I want to be able Even to demonstrate this by a practical Exhibition of the result of actually stopping any one of my 3 Engines—
Regulation^4
You will observe that in such an arrangement a quick & ready means of increasing the field strength is important to produce a good effect— It has occurred to me that I might obtain greater Efficiency in this respect, as well as save a machine—by dispensing with the exciting machine and let Every machine make its own field— To do so I should of course have to introduce one regulator into a common lead wire from the field of each machine thus—^5

Questions
1st Can the proper Resistance for such a Regulator be practically made for so many as 12 machines? Would the resistance of wire & other parts of the Regulator have to be $\frac{1}{12}$ of that used in the other single machine regulator—or is there a large margin?
2nd— If I stopped one Engine would the fact of the 4 machines thus ceasing to supply their own fields result in altering the conditions in respect to the other fields, and thus make it necessary to radically alter the position of my Regulator? If this is at all problematical of course I shall not attempt it= If not & you advise it—please make & ship by mail steamer the requisite Regulator & Resistances^d

I want to illustrate “The Edison system”= and not rely solely on the Exhibition of a Lamp=
In respect to the Big machine I shall hang up Photographs (Send me a Lot)^e of it—liberally—& accompany them with an
explanation of why it is not on view at the Exhibition and append an invitation to all who may care to see it in practical operation to come to the City where it is in daily use lighting up the Premises of Mr. Edison—the street Lamps—shops &c of the Holborn Viaduct. I shall take care that capital is made rather than lost by its absence from the Palace. I calculate by this & other means to make my London Establishment a sort of supplement to the Exhibition.

Engines There are no High speed Engines worthy of the name in this country and I am of the opinion that I can make quite a stir with a good one of those 20 H.P. Double Belt wheel Engines—by putting it up at the Palace & driving a Couple of Half Light Dynamos with it—240 Lamps—almost Equal to Swans standards (If I bring them up a little) This as a sort of auxilliary show to my regular outfit = I hope you have therefore sent me a good one=

Lecture Preece is preparing his Lecture on Paris Exhibition—to deliver it before the society of arts in Decr—timing it with the opening of my London shop & the Crystal Palace Exhibition=so as to create a furore— (This is his Idea— He wants some glory)

Competitors
Don’t give yourself any concern on this head— All that has been said about it has emanated from Mr Lowrey at Paris—but all here are of the opinion that all such talk is premature=

We have fully decided to do the following things before Even so much as listening to the tempter=

1st Make our Big demonstration & realize its Effect on the Public & on the would be amalgamators

2nd Thoroughly explore the literature of the subject & learn whether the proportion of ownership & rights are 98 or 99 per cent Edison & 2 or 1 per cent the rest of mankind—

3rd— And in this Preece heartily concurs— Exhaust every Effort to secure to ourselves the Scientific & Popular “Influence” of which Swan so loves to Boast as now in his possession—and upon which he principally wants to trade— This is rapidly coming to us Hopkinson being the latest addition— (I am to see him tomorrow to fully Enlist him)—

Then if we [----] find that there is still Enough of Swan remaining to buy—we may possibly throw him a small sop—but that we will is exceedingly improbable—as it dawns upon those who at first advocated this Idea of amalgamation—How much we have & How little Swan has—they rapidly recede from their position & heartily concur with us in the opinion

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that He can be anniahilated Easier than he can be bought—

Time will resolve this view into one of whole antagonism to anything [like?] havint the semblance of compromise—

Appropos of this:

Faure Battery—is These people are jubilant over their Railway success—and they see a great business in this & other fields not readily accessable to us— They have therefore been most friendly to us—and are seeking in many ways to become Identified with us— We notified them yesterday that we were prepared to supply them with Lamps by the 1000 at 5 shillings and by the 10,000 at a reduced rate= I sent them a few sockets & Lamps Today they called & were exultant over both= They say they will now throw out all other Lamps—(Maxim & Swan have thus far filled their show windows & literature) and use only the Edison— They say that at 5/— it is impossible for Swan (or others) to compete with us—that out of 100 Swan Lamps—20 will vary within as many ohms of one resistance—20 of another & the remaining 60 will be practically useless= Hows that?= This Explains the Savoy Theatre variation of Incandescence— Mr Fabbri & I are going Sunday to see a new Pullman train—on the Brighton Road—lit up with Faure Battys & Edison Lamps—

This sort of thing will Educate the people to our standard—

& popularize us— I am fitting up their (Faures)—shops with our fixtures—

These people want to know if you will entertain a proposition to build a Large Dynamo say 5 or 600 H.P.—?

Isolated Business= We have finally determined that until we get our present work in operation—our resources are too restricted to Engage in this business—and shall postpone its active development until about the 1st of January= What with a Big show in London—another at Crystal Palace—a lecture at Kensington (Preeees society of arts Exhibit & Lecture)—and all the Legal & other literary work now on hand we are of the opinion that I at least have quite as much as I can properly attend to= of course If a customer comes along who simply wants a machine & Lamps & will himself furnish all the Engineering & Electrical talent to put it in practical operation—we shall not refuse to sell to him— In fact I think in this way we shall do considerable business

London Plant— This progresses as fast as the manual Labor can be performed working night & Day— The Brick shaft will require 5 weeks for its Erection= Other work goes on meanwhile—as best it can [with?] against the obstacles of

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official hindrances & ignorant labor— It is no small job to
Plant such an outfit within the compass of the 4 walls of a City
business House— Permits of all sorts have to secured—and
were it not for the intervention of some of Mr Fabbris friends
we would today be unable to Even so much as break ground—
the permit to do so not yet having passed the various red tape
routine— We are only—as I say—able to go on because our
friends have by underground means got our doings ignored=
More anon   au revoir

Edwd. H. Johnson   Manager
“The Edison Electric Light System” (our sign)

ALS, NjWOE, DF (TAED D8133ZAM; TAEM 58:682). 4“(4 dynamos
to each)” interlined below. 6Obscured overwritten text. 4Canceled. 4Followed by dividing mark. “(Send me a Lot)” written in right margin.
4Interlined above.
1. Johnson was probably thinking not only of the Exposition but also
Charles Batchelor’s exhibition at the Paris Opera. He feared that Batch-
elor would “have a grand Bust up before many days— He is working up
too close to his capacity & he hasn’t a spare machine— He says him-
hiself—that he simply looks on stoically with the knowledge that if one
machine should fail he is dead beat.” Johnson to Samuel Insull, 1 Nov .
1881, DF (TAED D8133ZAL; TAEM 58:674).
2. Doc. 2187 includes Edison’s reply .
3. Johnson probably referred to the destruction of a 52 volt (B lamp)
dynamo, which Charles Batchelor blamed on a saboteur having put
gravel in it. Batchelor reported that “on starting up after dinner a few
days ago it immediately tore off all bars and also lugs off plates— I was
right near it at the time and rushed to save it but too late— It tore every
bar off clean and threw them in all directions.” Johnson came to believe
instead that the armature was not strong enough to withstand the strain
of starting up. Batchelor to TAE, 10 Oct. 1881; Johnson to TAE, 2 Jan .
1882; both DF (TAED D8135ZCJ, D8239B; TAEM 58:1093, 62:626).
4. Doc. 2190 includes Edison’s reply to this portion of the letter.
5. Text is “To one main,” “To other main,” and “Regulator.”
6. Completed in 1869, the Holborn Viaduct was (and remains) a com-
mercial corridor in the City of London between Holborn and Newgate
St., 80 feet wide and 1,400 feet long, across the valley of the under-
ground Fleet River and Farringdon St. It was the site of an electric
streetlight exhibition in late 1878 and early 1879. In October 1880, the
City of London was divided into three districts for the purpose of com-
paring different systems of outdoor electric illumination. London Ency .,
206; Bourne 1996, 81–82.
Preparations for a central station demonstration in London had been
underway for several months; by the end of July Gouraud had “received
a large number of cases of the London light plant.” On 22 October, the
day the big dynamo arrived in port, Johnson wrote that he and Fabbri
had found a suitable location at 57 Holborn Viaduct. He recounted de-
tails of their lengthy search, which had been constrained by local ordinances, noise considerations, a desire to situate the plant in the “foul Gas poluted air” of the City of London, and by laws granting gas companies exclusive license to dig in the streets for private lighting. The Edison interests agreed to light the Viaduct and establishments along it, including the General Post Office and City Temple, free for two months. At the end of that time, they promised to provide light for six months at the same price as gas. Gouraud to Insull, 30 July 1881; Johnson to TAE, Sherburne Eaton, and James Hood Wright, 22 Oct. 1881 (pp. 2–10); both DF (TAED D8104ZCE, D8133ZAJ; TAEM 57:172; 58:642); Bourne 1996, 82.

7. William Preece’s lecture to the Royal Society of Arts is Preece 1881; see also Doc. 2203. Edison requested fifty copies of the lecture after its publication. TAE to Johnson, 4 Jan. 1882, LM 1:129D (TAED LM001129D; TAEM 83:936).

8. Johnson had recently outlined to Samuel Insull his plans to obtain the support of leading scientists. Two weeks later he gleefully told Edison that he had got “Sir Wm Thomson on a string (at last).” However, Thomson would not endorse Edison’s lamps because, Johnson suspected, he had a prior commitment to the Swan interests. Johnson to Insull, 1 Nov. 1881; Johnson to TAE, 19 Nov. 1881; both DF (TAED D8133ZAL, D8133ZAU; TAEM 58:674, 712).

9. Electrical engineer John Hopkinson (1849–1898) set up an electrical consulting business in London in 1878, the same year he was elected a Fellow of the Royal Society. He also served frequently as an expert in patent litigation. In 1879 and 1880 Hopkinson published two fundamental papers on the theory of the dynamo, the second of which presented a graphical representation of the machine’s performance that Edison and other dynamo designers subsequently adopted (see Doc. 2067). He exhibited an alternating current machine at the Paris Exposition. In 1882 Hopkinson became a consultant for the Edison company in Britain. Bowers 1990; Oxford DNB, “Hopkinson, John”; DBB, s.v. “Hopkinson, John.”
10. The French chemical engineer Camille Faure (1840–1898) developed the first lead-acid batteries in 1880. His major innovation was a process for covering both sides of a lead plate with a paste of lead powder and sulfuric acid. This breakthrough attracted investors as it allowed for the industrial manufacture of batteries and raised hopes they could be used in mobile lighting applications such as railroad cars and ships. Ultimately his battery system failed for lack of durability. Schallenberg 1982, 51–67.

11. Johnson had apprised Edison in October that the Faure battery company “is exceedingly anxious to do business with us. They want us to sell them Lamps of various powers—in large quantities. Mr Fabbri & I concluded that was a matter for the Lamp Factory to consider” (Johnson to TAE, Sherburne Eaton, and James Wright, 22 Oct. 1881 [pp. 25–26], DF [TAED D8133ZAJ; TAEM 58:642]). About a week later Johnson reported that the Faure company was using Edison lamps exclusively and wanted to purchase large quantities. His enthusiasm diminished, however, when he realized the batteries could operate only two hours without being recharged (Johnson to Francis Upton, 11 Nov. 1881, Upton [TAED MU055; TAEM 95:661]; Johnson to TAE, 19 Nov. 1881, DF [TAED D8133ZAU; TAEM 58:712]).

12. The Savoy Theatre was completed in 1881 in the Strand and reportedly was the first public London building to be lighted electrically. Swan’s installation there eventually consisted of 1,158 lamps in six groups, operated by as many dynamos. Published accounts of it were sent to Edison and added to a scrapbook. Johnson visited the theater with William Hammer on 21 October and reported that the lamps did


14. The vast South Kensington Museum (later the Victoria and Albert Museum), dedicated to the collection of fine and useful arts from around the world, included the Patent Office Museum. *London Ency.*, s.vv. “Kensington,” “Victoria and Albert Museum.”

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New York, Nov. 4th. 1881.

My Dear Colonel:—

It is some time since I wrote you the reason being that with Mr. Johnson on the spot there was very little that I could tell you from here. I do not think matters have taken any new departure since Johnson left¹ and I merely write this so that you shall not think that I have entirely forgotten my promise to keep you posted as to progress made on this side of the water.

Edison is working very hard indeed and has been for a long time past and he has now the pleasure of seeing all his various shops running with such charming regularity that it almost becomes monotonous. Our capacity for turning out those small dynamos is almost unlimited. We have 400 now under way and when that lot is finished shall probably go ahead with another order of about the same number. Last week we turned out twenty three. This week we shall do about the same. Our Lamp Factory has a stock of 60,000 lamps so that it can keep apace with our output of machines. The main business in hand just now is the laying of street mains for the Central Station work. We do this work entirely at night and as the result of two or three night’s attention paid to it by Mr. Edison he has got it systematized so that with quite a small force we can lay one thousand feet a night. I was down to the Central Station to day and saw them putting in the first boilers. These go underneath

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¹ Samuel Insull to George Gouraud, October–December 1881, p. 248
the dynamos the latter being carried on a structure built very much after the style of the Elevated Railroad here.  

Mr Edison is now having a new track laid for his electric railroad. It will be about three miles long on perfectly level ground and is intended for experimenting on traction, speed and such like matters. He is building a passenger locomotive which will be fitted up in splendid style and which will have a maximum capacity of one hundred miles an hour. Whether it will ever be run at this rate when finished will very much depend upon the courage of the driver. I think it would be a very good speculation to insure the lives of the passengers the first time Mr. Edison determines to run at this speed. Then he is going to build a freight locomotive which will have sufficient power to draw cars each carrying tons of freight. I suppose that the whole thing will be finished in say three months or maybe a little longer. The road bed is all graded so that the permanent way will be completed in a very short time.

You may remember those two bronze medallion portraits of Mr. Edison working on his Phonograph which was got up by Mr. Kelly and which were sent over in a package of Telephones some time in the latter part of ’79 or ’80 I am not sure which. Mr. Kelly was in here the other day and I promised to see if you could do anything with a number of these. He had to give up the work in order to attend to some other matters but he is now free and could let you have a supply if anything could be done. Cannot you put Mr. Kelly in communication with the London Stereoscopic Co? Considering the honors which Edison has gained at Paris and the prominence his name will attain in connection with Johnson’s operations in London I should think they could sell a great number of them. Mr. Kelly incidentally informed me that you did not pay for these medallions. I think the cost was to be about ten dollars each. Will you send me a check for that amount so that I can hand it to him? Talking about accounts reminds me that Wilber has several times asked me to jog your memory about his fees on Ore Milling. He sent papers to you and a bill for seventy five dollars but has never received payment. The things were sent to you from Menlo Park. I think I remember them coming about August 1880.

Cannot you write us a long letter, a long one I mean; one of those very long ones something after the style of those you used to be so fond of dictating to me explaining to us the whole situation in England of electric light and kindred matters and a full account of your own impressions and the impressions of
English scientists on Mr. Edison’s exhibits at Paris. We have had everybody else’s opinion except yours and I am sure it would please Mr. Edison very much if you were favor us with your views at very considerable length.  


1. Johnson sailed to England at the end of September. See Doc. 2156.

2. See headnote, Doc. 2243.

3. James Edward Kelly (1855–1933) was a sculptor, illustrator and painter whose primary works were Civil War monuments. He made a sketch of Edison with the phonograph which appeared in the November 1878 issue of *Scribner’s Monthly* and executed a medallion of Edison’s likeness in the fall of 1879. *NCAB* 25:434; “A Night with Edison,” *Scribner’s Monthly* 17 (1878): 88–99; Gilder to TAE, 21 June 1878; Kelly to Batchelor, 22 Sept. 1879; both DF (TAED D7805ZBR, D7903ZIA; TAEM 17:115, 49:384).

4. The London Stereoscopic & Photographic Co., a partnership of George Swan Nottage and Howard John Kennard, specialized in portrait photography and advertised itself as official photographers for several international exhibitions and for the Prince and Princess of Wales. The firm also marketed scientific novelties. In 1878 Edison arranged with this company to market his phonograph in Britain. Doc. 1237 nn. 1, 7; Israel 1998, 148.

5. Zenas Wilber (d. 1889) was a patent attorney and former patent examiner. In January 1880, he and George W. Dyer took charge of Edison’s new patent applications. He was also retained by the Edison Electric Light Co. Docs. 372 n. 3, 1828 n. 1; Obituary, Aug. 1889, enclosure with Batchelor to TAE, 27 Aug. 1889, DF (TAED D8068AAN; TAEM 128:363).

6. On 30 July Gouraud promised Edison to look into the matter, but he noted that Insull’s insistence “that I never paid Wilber his fee of $75, I don’t quite understand, unless it refers to the understanding that I should do this based upon the understanding that I was to have my usual joint interest with you in the Foreign patents, but if my memory serves me, we found that your contract with the Milling Co was for all your rights in all parts of the world, in which case it was not expected that I should pay the costs of taking out the patents.” Gouraud to TAE, 30 July 1881, DF (TAED D8138Q; TAEM 59:128).

7. A reply from Gouraud, giving his views of the Paris Electrical Exposition, has not been found.

—2182—

*From Grosvenor Lowrey and Charles Batchelor*

Edison N.Y.

Legal considerations compel modifications plan originally cabled abandoning syndicate and creating three companies\(^1\) first manufacturing company capital one million five hundred thousand francs profits to be divided half to us half to capital

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second or exploitation company capital one million seventy
two per cent profits to us. third a small plant company capital
one million fifty per centum profits to us ² those proportions
of profits secured to us in all future increases of capital by f[o]unders shares which are an approved form of security de-
cidedly recommended by our French counsel property of patents for light and power belong to exploitation company
but remain in you for all other uses expenses this contract as
well as of all legal proceedings to be paid here we reserve ab-
solute right to veto without condition or penalty sites or li-
censes of any entire country also right to reject any contract
for a town or district with obligation to make a better within
three months under penalty of five percentum on contract
subsequently made for that place. Minimum capital any city or
district two million francs for every hundred thousand inhab-
itants forty five percentum of which comes to exploitation
company contract provides organization companies within
six weeks but Leon assures us capital will be ready for business
on signing contract exploitation and isolated capital to be
repaid out of profits before dividends manufacturing capital
by 10 percent yearly on profits shall we approve contract on
these principles if minor provisions are satisfactory to us we
advise acceptance

Lowbatch.³

L (telegram, copy), NjWOE, L M 1:90A (T A E D LM001090A; T A E M
83:917). Written by John Randolph.

1. The complications have not been identified. Lowrey and Batche-
lor cabled at the end of October that a contract providing for one manu-
facturing company and one exploitation company was nearly ready. On
4 November they promised to telegraph a complete synopsis of the pro-
posal the next day and urged Edison to call a special meeting of the board
of the Edison Electric Light Co. of Europe for its consideration. They
and Joshua Bailey and Theodore Puskas further assured him on 5 No-
vember that the contract was with “honorable parties” and that “capital
of the several companies will be increased to any figure that may be shown
desirable in the development of the business.” Lowrey and Batchelor to
T AE, 31 Oct. and 4 Nov. 1881; Lowrey, Batchelor, Bailey, and Puskas
to T AE, 5 Nov. 1881; LM 1:83C, 89B, 89C (T A E D LM001083C,
LM001089B, LM001089C; T A E M 83:913, 916).

2. Edison cabled Joshua Bailey the next day: “we accept contract.” He
had already given Bailey power of attorney to sign on his behalf (T AE to
Bailey, 6 Nov. 1881, LM 1:81B [T A E D LM001081B; T A E M 83:917];
T AE power of attorney to Bailey, 2 Nov. 1882, DF [T A E D D8127W1;
T A E M 58:157]). The terms given in this document are substantially
those of the 15 November agreement executed on behalf of Edison and
the Edison Electric Light Co. of Europe by Bailey, Lowrey, and Batche-
lor. The other parties to the agreement, Charles Porgès and Elie Léon, were to form the “exploitation” or patent holding company within fifteen days. Its jurisdiction encompassed France and its colonies (except Paris and its environs, where a separate “working” or utility company was to be formed within six weeks), Belgium, Denmark, the German Empire, Austria and Hungary, Russia, Italy, and Spain (its colonies excluded). The contract stipulated a somewhat more complex division of profits according to a ratio of special “founders” shares and regular dividend-bearing shares. The Compagnie Continentale Edison (holding company), the Société Industrielle et Commerciale Edison (manufacturing), and the Société Électrique Edison (isolated lighting) were incorporated on 2 February 1882 (Edison and Edison Electric Light Co. of Europe agreement with Porgès and Léon, 15 Nov. 1881; incorporation papers of Compagnie Continentale Edison, Société Industrielle et Commerciale Edison, and Société Électrique Edison, all 2 Feb. 1882; all DF [TAED D8127W9F, D8132ZBL1, D8238R, D8238S, D8238Q; TAEM 58:173, 533; 62:252, 284, 227]). Fox 1996 (184–85) provides a useful narrative of the formation of these companies.

3. Cable code for Grosvenor Lowrey and Charles Batchelor; see App. 4.

My Dear Sir,

I desire to further call your attention to the fact that the new lamps we are getting are losing their vacuums very badly indeed. The majority of the lamps we are now putting up are on the first or second night or gradually oxidise on the fourth or fifth night. I should say the average life of the lamps now furnished is about twenty-five hours1 This is undoubtedly due to poor work on sealing and may account for the difficulty in getting vacuums. While they are cold the leakage is small but whatever it may be a change has got to be made and more care taken in sealing as we did in earlier days.2 Yours very truly

Thos A Edison

LS (letterpress copy), NjWOE, Lbk. 9:259 (TAED LBoo9259; TAEM 81:92). Written by Samuel Insull; “X” at top of page.

1. Charles Batchelor complained about this time that of the 420 half lamps at the Paris Opera, five broke each night. Pointing out that many of the carbons were misshapen as well, he thought these were lamps “that the factory was glad to get rid of.” Batchelor to TAE, 8 Nov. 1881, DF (TAED D8132ZBJ; TAEM 58:530).

2. Upton replied two days later that “last week some curves were made that were very poor. I have been over all our curve sheets and reexamined all the processes of manufacture to see if I could find the trouble. I admit that we have not taken curves as often as we should and as often as we shall in future. Yet in looking back I know that we have tried. In the
photo[meter] room we have had more than a share of trouble," including a succession of four different superintendents. Upton also attributed problems to having “worked so many pump orders that we felt a little sure of being all right. I feel convinced now that the only way to learn about lamps is to make life tests, and this I shall do.” In closing, he promised that “Holzer is taking steps to have the lamps sealed much stronger than before and to run through some orders worked different ways. We are using platinum wire harder drawn than at one time as it makes much finer inside parts and is less apt to break. . . . I am doing all I can to improve the lamp and bring it up to the old standard and make 600 hours within the truth.” Upton to TAE, 8 Nov. 1881, DF (TAED D8123ZFC; TAEM 57:996).

Although the factory did not operate on 7 or 8 November while new equipment was installed, John Howell on 8 November subjected ten lamps with “inside pts with soft platinum wires” to trials of one and two days, then kept ninety others to “notice the state of vacuum before putting to one side and also at the end of 4 weeks and 3 months by vibration test.” The next day he observed the state of globes and the vacuum in 100 lamps “with the seal made with great care and in every way perfect,” another batch in which “ordinary care is used in sealing” and a third group sealed “using but little care.” These trials mark a period of more than a week, during which Edison largely lived at the factory (see Doc. 2187) and paid particular attention to the evacuation and sealing of lamps. The average lifetime of lamps tested at high intensity nearly doubled during this time. Cat. 1301, Batchelor (TAED MBN007:53–58; TAEM 91:346–51).

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[New York,] 7th Nov [1881] 1

To Hinds, Ketcham & Co.

Dear Sirs,

The discrepancy between the number of lamps per horsepower which we claim and what you obtain is due entirely to the extra friction on the belting and shafting when the extra load comes on. 2 As we have indicated at least 25 different kinds of engines varying from eighteen one hundred & eighty horsepower to ten horsepower and never got less than 12 to 14 lamps of eight candles each by the indicator card and as these engines have been indicated by many different persons who have figured the thing out both in the old manner and by planimeters 3 and have found our figures are correct we are absolutely certain the fault is at your works & not in our lamps and machines In my mind the whole trouble is due to the failure to recognize the fact that there is an enormous loss of power when transmitted through several series of belts. Were you to put in a small Armington Engine and connect the Dynamos directly with it you would doubtless get the desired result. In fact I will guarantee twelve eight candle lights per
indicated horsepower if such an engine is used and that you will have no further difficulty in the matter. If you find it inexpedient to put in a small dynamo engine we will take the Dynamos back and be just as good friends as ever.

Any night this week if the gentleman, who has indicated your present engine and made these calculations, has time he may come to Goerck St by informing me one day ahead and I will put up 150 eight candle lights on a small engine and if we do not get twelve lights per indicated horsepower I will agree to eat engine dynamo lamps and all* Yours very truly

Thos A Edison  I[nsull]

1. Hinds, Ketcham & Co. was a lithographer and printer of colored labels and show cards in New York. An Edison isolated lighting system, the first in a commercial establishment, was installed there in January 1881. See Doc. 2053.

2. In March 1881 Edison addressed difficulties that Hinds, Ketcham & Co. evidently had in running lamps at the proper intensity. No more recent complaint has been found, although Sherburne Eaton forwarded to Charles Batchelor a letter from the firm in August or September. Mechanical engineers were only beginning to study the measurement and reduction of frictional and slippage losses in belt transmission mechanisms at this time. Losses in even well-maintained millwork (systems of overhead shafts, pulleys, and belts) have been estimated between 10 and 50 percent. TAE to Hinds, Ketcham & Co., 16 Mar. 1881, Lbk. 9:69 (TAED LBoo9069; TAEM 81:34); Batchelor to Eaton, 27 Sept. 1881, Cat. 1239, Batchelor (TAED MBLB4001; TAEM 93:489); Hunter and Bryant 1991, 119–24.

3. The irregular figure drawn by the indicator represented pressure on one side of the piston with respect to time through one engine revolution. The average net pressure, given by the figure’s area, was a factor in calculating horsepower. The area was customarily estimated by marking the card into a grid. A planimeter, also called a mechanical integrator, operated “by the combined sliding and rolling motion of a small measuring wheel which has a total rotation proportional to the area enclosed by the figure the periphery of which it traverses.” Thurston 1890, 213–19.

4. The printers wrote a promotional letter to the Edison Electric Light Co. on 23 February 1882 attesting to the lighting system’s “perfection, simplicity, and the many other good features it possesses. We have found it to be entirely free from all the faults and objectionable features of other artificial lights, and is the best substitute for daylight we have ever known and almost as cheap.” That letter was subsequently published by the Edison company. Edison Electric Light Co. Bulletin 4:2–3, CR (TAED CB004; TAEM 96:676).
My Dear Sir

Referring to the request, in your letter of Oct. 31, for permission, for the Members of the American Society of Mechanical Engineers to visit my shops etc in the City, permit me to say that during my experiments on the Electric Light &c at Menlo Park where everything was under my control visitors were always welcome to visit my Laboratory and works. Now however matters are in the hands of the Company and I very much regret in this case they object to any visitors being allowed in the works. Very Truly Yours &c.

Thos A Edison

L (letterpress copy), NjWOE, Lbk. 9:271A (TAED LB009271A; TAEM 81:96). Written by Charles Mott; signed for Edison by Samuel Insull.

1. Thomas Whiteside Rae was secretary of the American Society of Mechanical Engineers from 1880 to 1882. He was son-in-law to Henry R. Worthington, a leading hydraulic engineer and a Society vice president. Sinclair 1980, 23.

2. Edison was invited to help establish the American Society of Mechanical Engineers, founded in 1880 as that profession’s first national organization. He apparently did not do so but became a lifetime member in May 1880. Sinclair 1980, 22–39; John Sweet to TAE, 24 Jan. 1880; American Society of Mechanical Engineers to TAE, 12 May 1880; both DF (TAED D8012A, D8012G; TAEM 53:469, 476).

3. Rae wrote concerning the Society’s forthcoming meeting in New York on 3 and 4 November. The Society wished “to obtain for the members, who come from all parts of the Country, the privilege of visiting and inspecting whatever there may be of professional interest in the vicinity.” He added that each member would carry a card of introduction so as “to prevent unauthorized persons from availing themselves of this opportunity.” Edison’s answer was based on his draft reply on the back of Rae’s letter. Rae to TAE, 31 Oct. 1881, DF (TAED D8129ZCH; TAEM 58:305).

I awaited the receipt of your letter asking me to forego any profit on them to which as a manufacturer I am very justly entitled. You seem to forget that I have made a heavy investment of my own personal funds in order to create an establishment where I might be enabled to turn out Dynamo machines at a low price. The figures I name to you are much less than you can get them manufactured elsewhere & will enable you to sell at a price which will kill all competition. I know also that we have an equal advantage in possessing a much better article to present to the public.

To provide funds to start the Edison Machine Works I have been obliged to sacrifice a great deal which course could only be justified by the extreme necessity of Building up such an establishment & were I to accede to your request I should have a very large capital quite unremunerative.

As a matter of fact I do not at present make a cent on a single Dynamo sent out of my works & do not expect to for some time to come. As to the lamps I sell them to you at the same price I have to pay the Lamp Co & the sockets & other sundries are also charged at prices paid Bergmann & Co.

I think if you were to get estimates from other people to turn out any number of the machines you will not wonder at my surprise at receiving your letter Yours truly

Thos A Edison

October–December 1881
2. On 29 October Gouraud wrote Edison that he believed that low cost was the best means to compete successfully with other lighting systems, at least until the technical superiority of Edison’s system became obvious. He insisted that “the outlay for all plant must be kept as low as possible— I would suggest therefore that, having regard to the fact that there are no patents & that I furnish all necessary capital, giving you half profits, you should supply the necessary plant at cost price to yourself.” Gouraud concluded that Edison would agree with him after “careful consideration.” Gouraud hoped that after receiving an adjusted list of prices to reflect cost prices, he would “be able to send you a considerable order” for lighting plants. Gouraud to TAE, 29 Oct. 1881, DF (TAED D8104ZEM; TAEM 57:253).

3. In October Edison said that he would charge the English company fifty cents for lamps intended for isolated lighting plants and forty cents for those used in central station systems (see Doc. 2170). No prices specific to the British isolated lighting business have been located, but in September 1882, an Edison Co. for Isolated Lighting catalog listed a price of approximately $1,595 for a Z dynamo with 60 A lamps and $1,860 for a Z dynamo with 120 B lamps, fully equipped with wiring and fixtures. The manufacturing costs of Edison’s dynamos are not known definitely but see App.3. The internal prices of Bergmann’s goods are unknown; Bergmann & Co. published a catalog in 1883 with prices for sockets and fixtures. Bergmann and Co., “Catalogue and Price List of Edison Light Fixtures,” 1883 (pp. 81–82); PPC (TAED CA002C:79–80; TAEM 96:263–64).

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My Dear Johnson,

Your lengthy letters are before me and I give you below my answers and comments thereto.

Yours dated Lord Mayors Day.1 We have not determined to put B & B wires in our ditches.2 Your information from outside sources is false. What we do want very badly is a wire but it is too late now for the First District. If Delany3 would go ahead and get his cable going we would use it. Of course we do not care anything about interference from Induction currents. What we want is a cheap wire for lighting cheap street lamps, winding clocks &c. The other matter namely a general system of underground Telegraphs has been abandoned for the present. Let Delany show us progress. You seem to have got badly off your base on this question. I have not the slightest objection to your being interested with Delany, but what I do desire is that Delany or some one else would produce a cheap lead covered wire cable & then I can go ahead. I will give Delany every [invitation?] if he will only use diligence.4 I am not going to use the cable made by Kruesi as it is a failure.5

[New York,] 23rd Nov [188]1

To Edward Johnson

October–December 1881 257
Yours of Nov 6th You will remember that I told Wright (of D M & Co) that the extra hurry and expense was quite unnecessary as I would get money that the Steam Dynamo would be in London and lay there absolutely useless for several weeks before it was wanted. Of course reliability is the great thing now to be established and then everything will be a success and this you know is only attainable by having a spare machine. The engine for the new steam Dynamo is ready and will be mounted on the base next Tuesday. They are putting the Iron armature together. The copper bars are all upset on one side end; the plates are all cut out and finished excepting bevelling the edges. The insulating paper is all ready. The commutator bars are all cut and they are putting the commutator together. The cores of the field magnets are all done & the finishing touches are being put on the cast iron ends. The machine will probably be shipped in twenty one days from today. What did Batchelor decide about the Paris Dynamo? Where is it going? We are negotiating now for several Isolated places where 2500 B lamps are wanted. In these cases we intend to put in two steam Dynamos one being a spare. Insull has sent you two copies of our little book. It is the first edition and very incomplete. Will send you some more in a few days. We hope soon to get out another edition which will be much more complete. Of course we do not want you to order Dynamos that you cannot dispose of but only thought we would send you a gentle insinuation that we would like to dispose of some to you.

Mr Fabbri is entirely too sensitive. He takes as slights things that are never intended as such draw wrong inferences and misunderstands motives. I think he is one of the nicest men to get along with I ever knew but is so fearfully sensitive.

About the sale of lamps to the Faure Company you know if we put up lamps in our District and invest money to light them we cannot possibly make more than $3.00 out of the stuff coming from the lamp before it dies. Now it will take $2.00 to pay proper dividends on the capital invested leaving a dollar for water. Now if you sell them to the Faure Battery Coy at $1.15 you will make sixty five cents, without any investment, before the lamp dies or in the case of a Isolated plant you make fifty cents and have no capital invested so taking all things into consideration if you can sell lamps in London for $1.15 you would make just as much as you would to invest the money in a plant necessary to work the lamps subtracting the usual interest on the money invested before determining the profit from the
sale of light through the lamp before it dies. I therefore see no 
objection to selling our lamps to the Faure Co if they will call 
it the Edison Lamp as at any time by shutting down on them 
60 or 90 days we can deprive them of all lamps by natural 
breakage

Dr Muirhead.\textsuperscript{14} This gentleman was over here snooping 
round but gave himself away after 15 minutes conversation so 
we kept closed mouths. He got no information from us but told 
us his firm (C. M. & Co.) have an order to make 10 000 lamps 
for the Lane Fox people for India and asserted that they could 
be made for $2.50 each but not under\textsuperscript{15}

You will find by looking carefully through the Journal of the 
Chemical Society of New Castle on Tyne that late in 1878 
Swan or some one for him read a paper before that Society on 
a Incandescent Electric Lamp regarding the smoke upon the 
sides of the glass walls; and in this paper he states that he used a 
pencil of carbon which of course is a give away on his 20 years 
business.\textsuperscript{16} You will notice in his lecture before the Society of 
Arts in the latter part of 80 or begining of 81 he showed that 
he knew nothing about the value of high resistance or a flexible 
filament of carbon.\textsuperscript{17} He stated that he did not believe in my 
method of working in multiple arc & that by the use of a very 
thin carbon he got higher economy. Now you know that that 
has nothing to do with economy. If you make two lamps one 
of one ohm and one of 100 ohms of the same radiating surface 
and adjust the volts so that each will give \[16?\]\textsuperscript{c} candles the 
economy of both will be the same leaving out conduction to 
the clamps &c but the current in the one ohm lamp will be one 
hundred times greater than in the 100 ohm lamp. Therefore 
when he says that economy is gained by a weaker [\-- passed?]\textsuperscript{b} 
current passing through the filament he shows that he is un-
acquainted with the first fundamental principles. He did not 
know the object of high resistance and therefore it is self evi-
dent that he never had any flexible filament until I pointed it 
out. Like his New Castle on Tyne papers, his lecture at the 
Society of Arts, & his last lecture before the British Associa-
tion\textsuperscript{18} and by an accurate comparison made [by],\textsuperscript{a} say, Hopkin-
son, you will get absolute proof that notwithstanding the enor-
mous respectability of Mr Swan he is stating things that can be 
disproved by his own statements. I desire to call your attention 
to a little fact which probably has escaped you all. Lowery 
writes some time ago that Brewer & Jensen\textsuperscript{19} were hunting up 
Swans patents & publications and that he did not think much 
of their reliability as they stated that one of Swans patents
early in 80 on an Incandescent lamp was was forestalled by one of my patents in the early part or middle of 1879. B. & J. were correct. You will find in my British Patent in which I announce the method of getting the air out of platinum in vacuo consolidating the same, that there is a statement that carbon may be treated in vacuo in the same manner, that is to say brought up gradually to great incandescence while maintaining the vacuum. This, I believe was the main feature in Swans Paper Carbon application.

I do not see that Lane Fox can restrict the claim for a filament of carbon of high resistance in a chamber made entirely of glass in high vacuum. The only case where he used carbon in a vacuum was with a pencil of carbon & all this is very muddy. I have not seen his patent for sometime but think the Provisional & Final Specifications are somewhat mixed up.

You will probably have noticed that Swan lately stated that he plated the carbon to the clamps. It seems somewhat peculiar that if that were so that he does not continue so to do. My own private opinion is that he tries to claim other peoples work & carries to extreme the idea of enormous respectability while being at heart what his compatriots would call a “bloody liar.” I remember that in 1878 Upton, Batch, & myself worked three days & nights on Seimens patent to figure out how the devil he connected up his armature & we never succeeded in doing it from the patent. I do not believe that a man however much skilled in the art could wire & connect up a Seimens Armature by reference to the patent. It is nothing more than an old Seimens armature with double coils arranged like Paccinottis. If the Seimens armature had \( \frac{1}{2} \) an inch of iron on each side of the cylinder protruding and the wire was wound thus:—

\[
\text{it would be the old Siemens armature thrown out of gear with a Gramme or Paccinotti winding}
\]

If you should have any trouble about Royalty the bar & plate machine would undoubtedly get round his patent and ultimately all machines (both Isolated & Central station machines) will be made that way.

Regarding Fabbris European proposition your statement that he proposed to pay $40,000 on the spot was the first I or anyone else here heard of it. We never received any such offer. Insull will send you by next mail copies of acct what Fabbri did propose. It was a proposition without head or tail and carried its own destruction with it. If Mr Fabbri cables us in just a way that his proposition is misunderstood he must not blame us. You will see the difference when you get Insulls copies of cables between Bailey & Fabbris proposition.
Regarding Italy we made a proposition businesslike in every way, requiring as we would from anyone else moderate guarantees for the fulfillment of the contract. Instead of replying after he received our proposition that our terms were onerous and that this and that must be altered before he could take hold of it he gets in a great huff and never answers the proposition at all. Now such a course cannot be considered businesslike or at all a fair way of treating us. I value the reputation of Drexel Morgan & Co very highly, as well as the members of the firm individually but in a matter of business, I must confess I fail to see any reason for their getting mad because we do not accept any proposition they may be pleased to make instantly.  

It appears that Mr Fabbri sometimes allows his feelings to interfere with his business. Another thing you must understand that it is a very difficult thing for me to do a thing to which every other Director offers the most decided opposition. There would never be any trouble between Mr Fabbri or Drexel Morgan & Co & myself were the interest sought to be treated entirely my own. You will find that Mr Fabbri will have my hearty support in all matters relating to English Light and in any other country where I own sole singly.

Yours of Nov 10th. I received a cable from G.E.G[ou-raud]. asking me if I would sell a share of my English Light. Now for fear that you people over there were not working in accord I was afraid to reply directly and therefore cabled him (G.E.G.) to see you, making up my mind that I would get yours and Fabbri’s consent before I sold the slightest amount. I also asked Mr Wright about it since which time I have received your letter and have seen Mr Wright and now know the situation of affairs. Of course under the circumstances I would not sell (G.E.G.) any interest whatever. Of course men whose sole capital is the art of deceiving the uninitiated will make money in proportion to his expertness in the art; but sooner or later he must come to grief, that is to say his “Capital”(!) becomes impaired to such an extent as to incapacitate him from making any more money & I should imagine that the Dukes capacity in the above direction will soon be entirely exhausted & then as you say this Telephone bubble must burst.

I wish you would ascertain what Telephone or Construction or any other companies I am a Director in (honorable or otherwise) and cable me as I desire to withdraw as a Director as I do not propose to be a Director in a Company the management of which I have nothing to do with.

So far as I my finances are concerned if [I] can get my money from the Telephone I think I can pull through. I never
had any intention of selling English Interests and very little even after I received Gouraud’s cable. I would never have sold more than \( \frac{1}{20} \) of my interest any way. I think I shall be able to pull through here all right provided that our Coy here & Batchelor help me out with the heavy stock of Dynamos I now have on hand. By the time you get this letter I shall have 90 Dynamos completed ready to ship & am turning them out at the rate of 100 a month. I can make a big Dynamo every six days & still keep up 24 “Z’s” a week. I am going into the building of small Armington Engines & hope to be able to supply a dozen of these a week.

Ascertain if Gouraud has received all the money and stock from the Oriental. I think the $10,000 he sent was a part of what he received and that he is keeping the remainder back. Gouraud has not up to this writing sent me any explanation of a/c’s. He has promised to do so but his letters bear out your statement entirely that he is postponing the settling day.—

Yours Nov 2nd. Socket. We were compelled to make the change but before it was done the subject was carefully canvassed and it was decided that the Coy should purchase all the sockets Bergmann had on hand at cost and then sell the parts back to him for what he would give for them & this arrangement has been consummated. We now send out new lamps & w[h]ere old sockets are in all, new ones free of charge to replace them; and in that way there being but few actually sold we can change them at a small expense and then forever afterwards we will be all right. You will see from the samples sent you that it is a vast improvement. It now allows us to use globes from the glass works that we had had here to throw away at a large expense. A large body of plaster of paris is used so that the strain on it is done away with and it is impossible to break a lamp loose or put such a strain on the plaster of paris as to break it. The socket is also very much better & easier to make. You will notice that Bergmann has put up a [centre?] of wood very high so that they cannot be crossed at this point. We have now got the art of mixing the plaster of Paris down to a fine point. Everything is weighed out accurately the results are always the same. Previously it was mixed by boys by guess work and was a badly botched job. All parts of the plaster of Paris are varnished so as to prevent damage from water. I am not sure that the samples thus sent you have been thus treated as we only did this on receipt of your letter about the climate. If you have sold 500 sockets say to the
Faure Coy you can substitute 500 of the new ones you standing the loss of the change. Now is the time to make this change. Plaster of Paris is the only thing that is adapted to the purpose. Every oil lamp used is fixed together in the same way and all that is required is to have the strain equalized & the proportions of the plaster correct. I am sure after you have looked the whole ground over you will agree in the wisdom of making the change now. We are resocketing all our lamps at an expense of about 1 1/4 cents per lamp, which is not very much.

You want to call the attention of the people to whom you sell lamps to the fact that the life is based on the average and that on the first two or three days some lamps will most certainly go & so on until all the bad lamps are shaken out. Be sure you explain this as people will otherwise get the impression that because some lamps go at the start our statement as to life &c must be incorrect.

You know I have not been to the Lamp Factory lately but I ascertained that the average life was running down & had got even as low as 400 hours in fact [mons?]. Upton had got away off his base & was trying to get back without informing me. So finding out the state of affairs I went down to the Factory Saturday before last & on the Monday morning following started for a grand bounce of the bugs. I had just 18 hours sleep that week without my boots being off & the consequence was that by Friday night I not only got him all right again and the bugs out but I got 10 p[er]. E[lectric].H[orse].P[ower]. lamps to give a better curve at 48 candles than had ever been got with the 8 1/2 p. E.HP. lamps. For instance I put up ten lamps taken out of a lot of 475 in a night run. The first lamp went in nine hours the next lamp in 20 hours and at 34 hours there were eight still burning. I have not seen the record; others were put up which I am told which turned out equally as well. I have so arranged matters that no retrograde movement will take place again. The life of the 10 p. E.HP. lamps will now probably be about 1000 hours. These we shall dilute with 10% of the 400 hour lamps now on hand which will bring the average to about 600 for the present. I shall now pay a visit to the Lamp Factory once a week if not twice a week. I propose to run that concern myself just as I want it. I have seen enough in the week I spent there to convince me that by about one month's solid fighting I can bring a 12 p. E.HP. lamp up to 600 hours life & further that I can make a 250 ohm 12 p. E.H.P. lamp last 600 hours. If I were you I would sell the Faure people only 8 candle lamps.

I have not seen Crookes description of a new lamp. I think
Lowrey stated that in talking with Crookes that he stated that he has been working on lamps but found in looking over my patents that I had forestalled him.

Yours of Nov [3]rd. Crystal Palace. You will have [a?] great advantage over Batch as your small machines will be far more reliable as the fields are all bored out very much larger & you will have no trouble from the rubbing of the Armatures

Your commutators are also better & you will have no trouble from high & low blocks. The contacts between the base connected to the wires and the commutator blocks are very much better in your machines. We have just devised a new brush holder which is plus ultra. It is one that you can put right on the Brush Holder Arm take it off or do anything with it without stopping the machine. We now send these brush holders with each machine two to hold the regular brushes & an extra one that can be fixed on the machine in about five seconds thus the regular brush can be taken off & fixed while you are running your machines. You will therefore not have the slightest difficulty as by using this extra relief brush you can keep your regular brushes in prime order at all times while the machines are in motion. I have given orders today to ship sixty of these to you and sixty to Gouraud. I suppose you will want a supply of brushes. We have got up a automatic machine for making these brushes. I do not know what the price of the brushes will be anyway it will be quite cheap.

Below find answers to your questions:—

First. The machines will carry 75 lamps but of course will get very hot in the course of several hours but even 85 or 90 can be run for a few minutes. We have run 90 for two hours but this is a very heavy strain. The Belts are liable to slip so you want to look out that all your belts are tight as this is a bad bug when running the machines in multiple arc as if some of the belts are loose the other machines will do all the work and it will be like putting 100 lights on a machine.

Second. The fields of your machines will run 90 lights at 16 candles if all the resistance is cut out always provided your belt is tight and the bobbins keep up the speed. Taking off the four machines one at a time in rapid succession will not make the belts slip to any material degree if they are very tight in the first case. You should use a belt which is the full width of the pulley and it should if possible be as horizontal as possible. If you use a countershaft and the belt moves slower on the countershaft you will have to increase its width to make up for the slowness in speed. A certain number of square inches of
belt must pass a given point in a given time to convey a given power.

Third. If you wish to stop one of the engines driving four machines without opening the Dynamos it would not harm the armatures of the Dynamos but the remaining eight would supply current to those four and keep them running as motors in the same direction so that if you shut off same your engine will keep on just the same. That is a little trick that fooled them down at Goerck St the other day. They thought they had made a big discovery. So the eight machines would have to run all the lights these four machines & the engines besides. They would not become low resistance arcs from this fact but continue as motors there being a counter electro motive force which is an equivalent of resistance. The sudden withdrawal of the four machines at one blow of the Switch would not over tax the other eight electrically only it would tend to make the belts slip if they were allowed to be too loose. You will remember that at Menlo Park we never had any trouble with our engines. All our machines were in multiple arc. We ran for months without trouble except that caused by the effect of the weather on the belt which might have been prevented. We connected two more machines than was required to run the whole of the lights. In case of a cross on one of them we simply throw cut out that machine. If we wanted to fix a machine we moved the Dynamo loosened the belt, fixed it, tightened the belt again & started up.

I see you propose to use four Dynamos with one engine mechanically separate from the others. This is all right provided your engines govern well and your speed of all the sets are correct & even if they are a little out, say one set of Dynamos run at 1160 or 70, & another at 1200 the ones running the highest speed will do a little more work. I suppose if one Dynamo of the four should get wrong you will simply throw it out & fix it. If the engine gets wrong you would then throw off the Dynamos & stop the engine. If you do it in this manner I do not see how you can fail to have reliability. Yours truly

Thos A Edison I[nsull]
2. Berthoud-Borel cable, an insulated telegraph cable patented and manufactured by a French firm, could be manufactured relatively cheaply in great lengths. It consisted of copper wires “wound in cotton and bathed in parafin and rosin, the whole hermetically inclosed, in perfect contact and under pressure within a lead envelope,” making it especially suited for underground use. The cable was exhibited successfully at the 1878 Paris electrical exposition. In the latter half of 1881, Edison became involved with the effort of Ernst Biedermann, a Geneva merchant associated with Edison’s electric light and power interests in Switzerland, to establish the United States Underground Cable Co. for manufacturing the cable in the U.S. (U.S. Underground Cable Co. prospectus, n.d. [1881], DF [TAED D8122U; TAEM 57:753]; Dredge 1882–85, 1:333–37; TAE to S. L. M. Barlow, 26 Nov. 1880, Lbk. 6:508 [TAED LB006508; TAEM 80:431]; Biedermann to Insull, 16 Aug. 1881, Miller [TAED HM810154A; TAEM 86:417]; on Biedermann see Docs. 1878 n. 2, and 1962).


4. Johnson, George Gouraud, and Delany jointly filed a British patent specification (Brit. Pat. 2,532 [1881]) on an anti-induction cable in June (Dredge 1882–85, 2:clxx–clxxi). Johnson wrote on 9 November that “My communications from DeLany in re to the progress of our cable sales give unpleasant impressions— It seems you have finally determined upon putting down wires in your trenches & in using the B&B wires for the purpose— It is of course significant that with all my Correspondence from New York I should learn of this only through an outside source.” He promised that regardless of the commercial viability of the Delany wire he would not “be led into an opposition shop” and would forgo his interest because “money hasn’t sufficient power over me to lead me to reverse my position of the past 10 years.” He later agreed to arrange for Delany to give Edison a sample for testing. Johnson to TAE, 9 Nov. and 11 Dec. (p. 2) 1881, both DF (TAED D8133ZAQ, D8133ZBD; TAEM 58:696, 728).

5. In August, John Kruesi made several forms of insulated wire in metal tubes. Near the end of the month he reported that “the insulation is perfect.” Edison’s basic conductor cable design was of two semicircular copper rods, held apart by cardboard washers, placed in a metal tube that was then filled with an insulating compound such as asphaltum. Kruesi to Samuel Insull, 18 and 20 Aug. 1881; Kruesi to TAE, 22 Aug. 1881; all DF (TAED D8130P, D8130Q, D8130R; TAEM 58:361–62, 364); Dredge 1882–85, 1:347, 611–12, 614; Francis Jehl’s tests of Kruesi’s insulated conductor are recorded in N-81-04-06:165–69, Lab. (TAED N223:79–81; TAEM 41:115–17).

6. DF (TAED D8104ZER; TAEM 57:260).

7. James Hood Wright (1836–1894), a partner in Drexel, Morgan & Co., was among the original stockholders of the Edison Tube Works and a significant shareholder in the Edison Electric Light Co. NCAB 33:443; Doc. 2058 n. 4; Edison Electric Light Co. list of stockholders, 1 July 1882, DF (TAED D8224ZAP1; TAEM 61:45).
8. Johnson wrote (see note 6; p.1) that “the machine upon which you worked night & Day & spent some hundreds of Extra money lies on the Dock yet awaiting the Completion of its final resting place. Without the knowledge I had of it however I should have made bad mistakes. . . . Mr Fabbri is therefore not wholly dissatisfied with the Delay—in fact he agrees that it has been all conducive to better work now & consequently to Earlier success.”

9. See Doc. 2180.

10. It was not shipped until mid-February. See Doc. 2228.

11. It is not known what plans Batchelor had for this machine before it was destroyed (see headnote, Doc. 2122).

12. This was probably the Edison Electric Light Co.’s *Instructions for the Installation of Isolated Plant* (1881), a seventy-six page booklet (plus appendices) “published exclusively for the private use of the agents of the Edison Company for Isolated Lighting.” It included specific topics such as the dynamo and its care, switches, fixtures, fuses, and lamps; it also contained more general discussions of electric energy and resistance.

13. See Doc. 2180.

14. Alexander Muirhead (1848–1920), a noted British telegraph and electrical engineer, had visited Menlo Park in 1878. He traveled extensively as a scientific advisor and a director of Latimer Clark, Muirhead, & Co., an engineering and manufacturing firm co-founded by his father. Upon arriving in New York on 5 October for a “short visit,” he wired Edison to arrange a meeting. Johnson warned Edison to “look out for him” because his partner, Latimer Clark, was an advisor to Swan. *Oxford DNB*, s.v. “Muirhead, Alexander”; *DBB*, s.v. “Muirhead, Alexander”; Doc. 1339 n. 1; Muirhead to TAE, 5 Oct. 1881; Johnson to TAE, 6 Nov. 1881 (p. 5); both DF (*TAED* D8104ZDM, D8104ZER; *TAEM* 57:225, 260).

15. Johnson wrote Edison on 11 December that Muirhead had called upon him again “yesterday and occupied my time for nearly 2 hours in trying to induce me to let him have Lamps and to generally supply him with material and advice in respect to the prosecution of some experiments.” Johnson recounted that he “only got rid of him finally by giving him definitely to understand that in my judgment there had already been enough attempts at appropriating Mr. Edison’s invention without his leave or license and that I did not purpose being the medium through which the same thing might occur again.” He offered, however, to sell outright 10,000 lamps “much better than he could make them and at a price far below that which they would cost him. This question of selling Lamps has been carefully considered by us and we have decided that in cases where large numbers are required, making it worth while for us to give the matter attention, we will sell, but we will not occupy our time or our energies in retail business.” Johnson to TAE, 11 Dec. 1881 (pp. 5–6), DF (*TAED* D8133ZBD; *TAEM* 58:728).

16. This paper and the December 1878 demonstration were reported in Proctor 1879; see also Doc. 2165 n. 2.

17. This lecture has not been found or otherwise identified but see Bowers 1982 (113–15) regarding Swan’s demonstrations. Swan exhibited twenty of his lamps at the Literary and Philosophical Society of Newcastle in October 1880. He also gave a demonstration in London at the Society of Civil Engineers on 24 November and, the next day, exhib-
ited thirty-six lamps to the Society of Telegraph Engineers. Swan made a broad priority claim to having invented the incandescent lamp with a filament of carbon, on the basis of unpublished experiments, as early as January 1880. Doc. 2022 n. 6; Chirnside 1979, 99–100; Swan 1946, 28; “Incandescent Electric Lights,” Nature 23 (1880): 104–5.

18. Swan presented a paper to Section G (Mechanical Science) of the British Association for the Advancement of Science on 5 September. The paper was identified in the Association’s report of transactions of the sections at the annual meeting but was not reprinted. “On the Swan Incandescent Lamp,” Report of the British Association, 1881, 5.

19. Grosvenor Lowrey’s letter has not been found. Edward Brewer and Peter Jensen were patent agents in London whom Lemuel Serrell used in connection with Edison’s British specifications. See Doc. 1033 n. 1.

20. Edison referred to his British Patent 2,402 (1879), Cat. 1321, Batchelor (TAED MBP017; TAEM 92:118). His remarks on Swan may have been prompted by the summary of Shelford Bidwell’s legal opinion that solicitor Theodore Waterhouse provided to Johnson on 11 November and which Johnson forwarded to Edison the next day. Waterhouse agreed with Bidwell that Edison’s fundamental British carbon lamp patent of November 1879

will give him a monopoly of the incandescent lamp as now manufactured, provided (1) that there was no prior publication by Mr. Swan or any one else of such a nature as to make the lamp on that date no longer new, & (2) that Mr. Swan’s Patent of 2nd January 1880 does not prevent Mr. Edison from exhausting the air from his lamp while the carbon is incandescent. I understand that Mr. Edison made his lamp in this way at the date of this patent of 10th Novr 1879 but he does not claim this detail, and does not in fact in that patent allude to it. I should have supposed that he then relied upon the description of the similar process as applied to metal conductors in his previous patent of 7th June 1879, & there stated to be applicable to carbon sticks, but for the fact that in his Patent of the 2nd February 1881 he has a claim No. 4 which appears to be identical with Swan’s claim of the 2nd January 1880. The fact that this claim was made after Swans is, under English law, a damaging feature in our case. I cannot however think that on this point we need feel any great apprehension. The more important question is as to the publication of some descriptions of the lamp prior to the 10th Novr 1879. Mr. Swan alleges in his Lecture at Newcastle on the 20th Octr 1880 that he exhibited such a lamp as that which Mr. Edison claims as long ago as 1878. But as yet we have his assertion only for this statement, & it does not follow that exhibition would be equivalent to publication. [Waterhouse to Johnson, 12 Nov. 1881, DF (TAED D8133ZAS; TAEM 58:706)]

In his cover letter, Johnson reviewed the main features of Swan’s public claims and concluded that he

will be wholly unable to prove prior publication—and that consequently the issue is as between your Patents and others on various features—details—in fact simply a question of how much we shall have to make Public ourselves by reason of not having it properly
protected = Take for instance the Swan Patent on heating the carbons during process of obtaining the vacuum — You apply this process to metals & remark that it may be applied to “sticks of Carbon”— but when you come to your Carbon Patents you make no allusion to it — and no where do you claim it for carbon — Swan jumps in & applies it to carbon filaments & claims it = Now this claim can easily be upset no doubt — but only by proving in our Patents and in other ways “Publication” = We cannot so amend or Emend our Patents as to get in a claim on the process as applied to your present carbon Lamp — at least such is our present opinion.

[Johnson to TAE, 12 Nov. 1881 (pp. 3–4), DF (TAED D8133ZAR; TAEM 58:698)]

The Edison Electric Light Co. published a detailed polemical analysis of Edison’s and Swan’s respective patent positions in the U.S. in its 27 July 1882 Bulletin (CR [TAED CB012; TAEM 96:728]). In early December, Insull sent Johnson additional comments from Edison regarding Bidwell’s statements (Insull to Johnson, 2 Dec. 1881, Lbk. 9:400 [TAED LB009400; TAEM 81:153]). Johnson proposed in early November to re-search the legal soundness of Edison’s lamp patents “in a most thorough manner.” In addition to Theodore Waterhouse, who had advised the Edison telephone interests, he had retained John Henry Johnson (also involved in the telephone patents) and Bidwell, “an Expert in Electric lighting & in Patent Law (a member of the English Jury at Paris)” (Johnson to Insull, 1 Nov. 1881, DF [TAED D8133ZAL; TAEM 58:674]).

21. Edison was probably thinking of St. George Lane Fox’s British Patent 1,122 (1879) for an incandescent “candle,” formed of a mixture of a finely ground conducting material such as plumbago with a non-conducting material, operated in a vacuum. The specification was filed on 20 March 1879; Lane Fox had several other patents for carbon filaments in vacuum, but these were dated after Edison’s fundamental incandescent carbon lamp specification. Dredge 1882–85, 2:lxviii, 1:647–58.

22. See Doc. 2165.

23. The drawing was not reproduced.

24. The conceptual similarities between the basic Siemens dynamo and Edison’s wire-wound armature had already caused conflicts in the U.S. and German patent offices. In his 12 November letter Johnson asked if Edison knew why William Siemens had failed to get a U.S. patent (see Doc. 1851). Johnson also recommended a thorough review of Edison’s British dynamo patents. In the meantime, he asked if he should agree to the royalty which Siemens had evidently requested: “some of us view that as the wiser course whilst others oppose it — Siemens is said to be a man who prefers a Royalty to a litigation.” Edison later cabled him: “Dont offer Siemens royalty.” Johnson to TAE, 12 Nov. 1881, DF (TAED D8133ZAR; TAEM 58:698); Johnson to TAE, 5 Dec. 1881; TAE to Johnson, 5 Dec. 1881; LM 1:109C, 110A (TAED LM001109C, LM001110A; TAEM 83:926–27).

In reply to Edison’s statements, Johnson asked:

Am I to understand that you hold your bar and plate machine not to be a Siemen’s armature? Barker will tell you that Sir William Thomson pronounced it to be nothing more nor less than a Siemens
armature. . . . I gather that your idea is that Siemen’s patent is bad because not sufficiently described. I am afraid that that will prove to be a difficult position to maintain. He will be able to call hundreds of experts to testify to the contrary. In view of the importance of this matter and of Siemen’s possible action pending our negotiations here we have considered it wise not to hasten the sale or public use of the small Dynamos. Of course the particular use that we are making of the large Dynamos does not give him a chance for an injunction as we are not using it at present for profit. We do not care to do anything to risk an injunction from him at the present moment. [Johnson to TAE, 11 Dec. 1881 (pp. 12–13), DF (TAED D8133ZBD; TAEM 58:728)]

25. The intended letter to Johnson has not been found. Johnson had complained to Edison in his 6 November letter (see note 6; pp. 10–11) that “Insull tells me you all think I am ‘off my base’ in the matter of his [Fabbi’s] proposition for Europe— Well If I am then so is Lowrey for he distinctly told me that there is nothing in Bailey’s present proposition which is not also included in Fabbris.” He reported that Fabbi also “proposed to pay on the spot $40,000—which would have put the Co out of debt= Insull speaks of 100,000 Francs for manf’g purposes where his proposition was 1,000,000, (million)—with 500,000 more for sending experimental plants on to the Continent &c &c.”

26. Nothing is known of the proposed terms. In his 6 November letter (see note 6; p. 11), Johnson explained that Fabbi felt “you have broken a promise made to him that he should have Italy on the same terms as could be obtained from any other parties— In short I gather from it all that Fabbi claims some consideration for the guarantees of good faith which his propositions bring—which you refuse to accord—but make it simply a matter of Dollars & Cents as between him & parties who give you no guarantee either in their names or in more substantial stuff.”

27. DF (TAED D8104ZES; TAEM 57:274).

28. George Gouraud inquired by cable on 9 November whether Edison would “sell me part of your interest in Drexel Morgan and Companies light contract.” Edison answered that he should see Johnson, whom he instructed to talk with Gouraud and “report fully.” Johnson cabled the next day that it was “imperative” for Edison to retain his full interest (Gouraud to TAE, 9 Nov. 1881; TAE to Gouraud, 9 Nov. 1881; TAE to Johnson, 9 Nov. 1881; Johnson to TAE, 10 Nov. 1881; LM 1:95A, 96A, 95B, 97B [TAED LM001095A, LM001096A, LM001095B, LM001097B; TAEM 8:3919–920]). He explained in his 10 November letter (see note 27) that Fabbi had “found on investigation that if he wants to bring into this thing the character of men he has been contemplating he must not have G.E.G. and . . . that G.E.G. is not the sort of man that good men will associate with in business.” Johnson provided more details of Gouraud’s electric light dealings in December (Johnson to TAE, 23 Dec. 1881, DF [TAED D8104ZFM; TAEM 57:314]).

29. In his 10 November letter (see note 27) Johnson made several derisive allusions to Gouraud as “the Duke,” whom he suggested had tried to mount a “coup” against Edison’s British electric light interests.

30. No letter from Johnson on 2 November has been found, but he dated a letter of 8 November in a way that could have been misread. In
it, Johnson complained that he had learned from Upton of a plan to alter the design of the lamp socket “to avoid the breaking of the Plaster &c— This in my judgment is radically wrong. It is of the utmost importance that once having established a standard in anything we should not depart from it— I have sold 1000 sockets & shall have to sell several thousand more ere the Lamps I have on hand and which I am now ordering shall have been disposed of.” He urged that “the proper & only way is to use on the Lamp something more substantial than Plaster— It is bad for other reasons than want of strength— It softens under certain conditions and gradually crumbles.” He suggested celluloid instead. Edison at first blamed the problem on faulty manufacturing by Sigmund Bergmann, but Bergmann also urged him to find a substitute for the plaster. Johnson to TAE, 8 Nov. 1881; Bergmann to TAE, 14 Oct. 1881; both DF (TAED D81133ZAP, D8101E; TAEM 58:693, 57:13); TAE to Charles Batchelor, 13 Oct. 1881, LM 1:63 (TAED LM001063B; TAEM 83:903).

The socket was altered to accommodate a slightly modified lamp base. In the base with the bevel contact ring adopted in 1880 (see Doc. 1988), screwing the lamp into the socket placed considerable tension on the plaster of Paris insulation between the wire leads, causing frequent breakage. To correct this, one lead was connected to the screw shell and the other to a small metallic button at the bottom of the base. Screwing this base into the socket compressed the plaster, which was far less injurious. This design with the button has remained essentially unchanged since that time. Howell and Schroeder 1927 (183–86) attribute the change to the middle of 1881; Jehl 1937–41 (808) describes but does not date it. Edison executed a patent application for a similar, though not necessarily identical, design on 22 November. U.S. Pat. 317,031.

31. In late October, Edison made notes for a patent application on a socket made of “wood pulp or other suitable insulating compound which will harden on drying either with or without compression— Method & means of giving the glass part a strong abutment to prevent its becoming loose therein.” He never filed this application. Cat. 1147, Scraps. (TAED NM016:104; TAEM 44:328).

32. See Doc. 2183.

33. William Crookes filed a British provisional patent application on 31 August (3,799) for a lamp with a carbon filament enclosed in an exhausted glass globe, through which platinum wires were sealed. Earlier in the year, Crookes filed two specifications for increasing the density of uncarbonized filaments by partially dissolving the cellulose in the paper or cotton. He also filed a specification for electroplating the carbon to platinum wires. Dredge 1882–85, 2:ccxii–ccxiii, cli, clxxiii–clxxiv, clxv; Fournier d’Albe 1923, chap. 15.

34. Doc. 2180.

35. This letter is continued in Doc. 2190.

Photograph of the modified screw base adopted by late 1881. Except for different materials and altered dimensions, this is the design of bulb base used in incandescent bulbs to the present day.
My dear Edison:—

Thanks for your telegram of the 12th and your letter of the 21st. I did not reply by telegraph to the question you asked in the letter because I could not recollect at once the circumstances.¹ Even now I do not recall clearly that any special form of apparatus was talked of. I remember very well that we talked during that expedition upon electricity as a motive power and upon propelling railroad cars by it. We discussed together, as I recall it, the machines in use as electric generators and the economy of their reversal so as to develop power. I had had a Gramme machine in use since 1875 and gave it always the preference over the Siemens machine. This is my recollection of what passed between us but I am afraid it is too general to be of any service to you.

I am much obliged to you also for the things you sent over to me. I made use of them as you saw in the paper I sent, before the Academy to correct and neutralize the impression given a year ago in favor of the Maxim lamp. Everybody was very much pleased and fully convinced that you were a long way ahead of everybody else.² By the way, did you notice in Nature for Nov. 3, page 16, at bottom of the page, a very complimentary allusion to your system of lighting?³

I write now to say that I expect to come over to New York on Friday morning in the 7:35 train; and that I will come at once up to 65 Fifth Avenue to see you. I shall reach there about half past nine as I suppose. There are lots of matters I want to talk over with you and we can arrange for an hour to chat quietly together. I shall probably remain till Sunday night, possibly until Monday night.⁴ I have an appointment at Drexel & Co’s about one on Friday. Mr. Fabbri wanted me to go in and see Mr. Wright about the London outlook, which is fine. I saw Mr. A. J. Drexel⁵ here this afternoon and he is very much interested in the success of the London Company.

Hoping to see you on Friday I am Cordially yours

George F. Barker.


1. Edison’s telegram has not been found. He asked in the letter if Barker could “recollect my speaking to you about my Electric Rail Road when I was returning from my trip to the West? Please wire me in the morning simply ‘yes’ or ‘no.’ I want this information in connection with the Rail Road Interference with Siemens.” On 9 December, Barker testified on Edison’s behalf in this proceeding as to the general nature of
conversations about electric power and transmission during their trip in July and August 1878. TAE to Barker, 21 Nov. 1881, Lbk. 9:313 (TAED LBoo9313; TAEM 81:106); Barker’s testimony, 178–85, Edison v. Siemens v. Field, Lit. (TAED QDo01178; TAEM 46:94).

2. At Grosvenor Lowrey’s suggestion, Barker planned to present a paper at the National Academy of Science’s November meeting in Philadelphia “as an offset to the Maxim blast last fall in New York” (see Docs. 2022 and 2033). This paper has not been found, but Barker requested from Edison 100 lamps, several chandeliers, safety catches, switches, conductors, and “whatever else you think would help me to explain the system as exhibited” in Paris. Edison gave orders the next day for these items to be sent. Barker to TAE, 11 Nov. 1881, DF (TAED D8135ZCS; TAEM 58:1119); TAE to Electric Tube Co., TAE to Edison Lamp Co., TAE to Bergmann & Co., all 12 Nov. 1881, Lbk. 9:288, 289, 291 (TAED LBoo9288, LBoo9289, LBoo9291; TAEM 81:99–101).

3. An unsigned editorial notice of the forthcoming Crystal Palace exhibition stated that Edison’s display had aroused “very great interest. . . . The effect produced by it in Paris was quite startling, and it is generally believed that Mr. Edison has solved the problem that he set himself, viz. to produce a light to supersede gas in our houses.” “Notes,” Nature 25 (1881): 16.

4. Barker left Edison the evening of Sunday, 27 November; nothing is known of their conversation. He planned to return to New York in two weeks at Edison’s request, probably to testify in the railroad interference case (see note 1). He hoped at that time additionally “to arrange for a conference between Mr. L[owrey], yourself & myself. I should like to meet him and there are some matters to be talked over between us.” Barker also inquired whether Edison knew anything about the American Electric Light Co. (It is not clear if this was the Connecticut company formed to make electric lamps under license from Elihu Thomson and Edwin Houston, or the peripherally-related Massachusetts firm of the same name that Edison later concluded was an investment fraud.) In January 1882, Barker received from Edison a gift of two shares in the Edison Electric Light Co. and twenty-five in the European light company, which he accepted with prose but somewhat awkward thanks “as evidence that you believe that my friendship has been sincere.” Barker to TAE, 7 Dec. 1881 and 13 Jan. 1882, both DF (TAED D8135ZCV, D8204C; TAEM 58:1129, 60:51); on the American Electric Light Co., see Passer 1953, 24–25; Carlson 1991, chap. 4; and Doc. 2264.


—2189—

From Sherburne Eaton

Mr. Edison,

The application of Col. Logan and Major Mcl. Laughlin for the Isolated business in California is just received by me. I will bring it up at the next meeting.

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We have organized the Isolated Company as follows, viz. President, Eaton; Vice President not to be filled at present; Treasurer, Fabbri; Secty., Goddard; Ex[ecutive]. Com[mittee]. Banker, Fabbri and Eaton (when Mr. Lowrey comes I will resign from the Ex. Com. if he wishes it. I would still be a member ex officio.) Mr. Tracy Edson resigned as a Director and on recommendation of Mr. Adams and Mr. Banker his vacancy was filled by the election of Mr. John H. Flagler. My compensation for acting as President of the company was fixed as follows, namely, a call was given me for one year at par on the stock left in the treasury, which will be about eighty shares of stock. How does this last matter suit you? I do not care much about it as I had about as soon work for nothing and take my chances by and by as accept a call like that. It was Banker’s suggestion. However, it went on the minutes of the meeting and I am willing to let it stand.

S. B. Eaton per Mc.G[owan].

TL, NjWOE, DF (TAED D8121G; TAEM 57:715). a Mistyped. b Closing parenthesis written by hand.

1. Within six days of Eaton’s letter the company selected the application of Col. James C. Logan and Frank McLaughlin, who represented a group of investors organized by Louis Glass (see Doc. 2176). McLaughlin, Logan, and Glass were all connected to Edison’s mining interests in Oroville, Calif.; according to McLaughlin, Logan (b. 1847?) was the business partner of California Governor George C. Perkins, also among the prospective investors. Ladd to TAE, 29 Nov. 1881; Glass to TAE, 26 Nov. 1881; McLaughlin to James Banker and Robert Cutting, 10 Nov. 1880; Glass to Insull, 16 Feb. 1882; all DF (TAED D8120ZBT, D8121H, D8032ZBH, D8220I; TAEM 57:662, 716; 54:527; 60:760); Logan and McLaughlin agreement with Insull, 7 Feb. 1882, Miller (TAED HM820156B; TAEM 86:451); Teisch 2001, 241; U.S. Bureau of the Census 1970, roll T9-63, p. 235.3000, image 473 [Oroville, Butte, Calif.].

2. Samuel Insull explained to an unrelated correspondent that the “demand for lighting mills factories etc.” had taxed the Edison Electric Light Co.’s manufacturing abilities “to their full capacity, so that now a separate company is in formation for the relief of the Parent Company from this special branch of lighting.” An article in the New York Herald on 25 November announced the organization of the Edison Company for Isolated Lighting and the election of officers along the lines described by Eaton’s letter. It stated that Miller Moore was the general manager and that the Board of Directors consisted of Edison, Eaton, Fabbri, John Flagler, Grosvenor Lowrey, and William Meadowcroft. In May 1882, those members of the Board of Directors who were also directors of the Edison Electric Light Co. were replaced to avoid conflicts of interest in the legal relationship between the two companies; Egisto Fabbri was replaced by his brother Ernesto, Banker by Moore, and Lowrey by Goddard. At the time of its formation the Isolated Company had a capital stock of $500,000; the parent Edison Electric Light Co.
held half of this in exchange for patent licenses. The Isolated Co. was authorized to operate in areas without illuminating gas service. Insull to Charles Davis, 17 Nov. 1881, Lbk. 9:300 (TAED LB009300; TAEM 81:104); “Edison’s Isolated Company,” New York Herald, 25 Nov. 1881, Cat. 1243, item 1768, Batchelor (TAED MBSB41768; TAEM 95:41); Agreement between Edison Company for Isolated Lighting and Edison Electric Light Co., 26 Apr. 1882, Defendant’s Exhibit, Edison Electric Light Co. v. U.S. Electric Lighting Co., 4:2363, Lit. (TAED QD012E2363; TAEM 47:1004).

3. Edward Dean Adams (1846–1931) was a financier and engineer who served as a director of the Edison Electric Light Co. from 1882 to 1886 and of the Edison Electric Illuminating Co. of New York from 1884 to 1889. He was later instrumental in the financing and construction of the hydroelectric power station at Niagara Falls. ANB, s.v. “Adams, Edward Dean”; “Adams, Edward Dean,” Pioneers Bio.

4. John Haldane Flagler (1836–1922) was a prominent businessman in the iron and steel industry. DAB, s.v. “Flagler, John Haldane.”

My Dear Johnson,

In continuation of my letter of 23rd inst I beg to state:—

Regarding the regulation of course when you throw of one Dynamo the effect would be scarcely noticeable. The engines should regulate good instantly bringing it up to snuff. Your method of regulating by connecting all the fields to one main line and all the other ends of the fields to the regulator in multiple arc and the other end of the regulator to the other main line is correct The resistance of all the twelve fields would be three ohms which is equal to about thirty or forty lamps. The resistance coil in this case would have to have considerable radiating surface. The part of the regulator which you have might do but it would be better to have them heavier and make better contact. I will have Clarke figure out the radiating surface & sizes of coils you will need & Insull will start Bergmann on making them & we will ship them as early as possible but if you want to use a regulator before this reaches you, you can multiple arc the coils from six or seven of your regulators Boxes. You can ascertain the heat there would be on a coil by putting fifty lamps on a machine & putting the coil in the main line between the machine and the lamps & bring the lamps up to 16 candles. As the resistance of all the fields is but three or four ohms of course the value of a ohm for regulating is tremendously increased and therefore as you approach the sixteen candles your coils will have to be subdivided into 1/10 of an ohm or perhaps 1/4 of an ohm—or something like that.

To Edward Johnson

[New York,] 27th Nov [1881]
You ask if the coils should be $\frac{1}{12}$ of a single machine regulator.

No! Not so bad as that. I think that of the coils of six single machine regulators—that is all the three ohm coils multiple arced together & then connected to the next series of coils so that the whole would act as one box. Then it would answer for the reason that the present box does not get hot at all but whether the subdivision is ever enough it would be difficult to say but will ask Clark—I mean whether it will make too great a difference from one notch to another? For fear that you may not understand my meaning I will say suppose we had a coil of four ohms and it got too hot by multiple arcing around it another coil of four ohms the resistance would be reduced one half & the surface doubled & so on.

In answer to your second question about regulation, the stoppage of one engine with four Dynamos ceasing to supply their own fields would not alter the other fields at all but the proportion of average loss in the machines to that in the lamps would be altered and you would therefore have to bring up the field in the remaining eight.

Cannot you get a photograph of about two or three feet square made of the big Dynamo?

I send you a sketch made by Clarke. I think he misapprehends what you want to do as I gain the impression that your shaft & engines & four Dynamos is to be entirely separate from the remaining sets—each set being entirely separate from the other & having no connection except electrically.

The small engines ordered by you some time ago are going on very slowly the parties who are making them not having much facilities. We shall soon receive their latest model which they guarantee to run fourteen consecutive days & nights without stopping one instant. We are going to build a lot of these engines at Goerck Street.

If you can possibly use mercury on your Dynamos it would be a good thing. It is essential for the successful running of a Dynamo (& all our men are now taught so) that before starting up the brushes should be taken off on the ends, nicely cleaned and set exactly right so that the distance from the point of contact of one brush to the point of contact of the other brush is equal on both sides of the commutator & we find when these things are done no trouble is developed in the evenings run.

In using mercury it will not do to apply it to a commutator which has never had it on when the same has been running &
is hot. If the mercury is applied in the manner known to Ham-
mer & I believe also to your own good self when the commuta-
tor is cold & then when running it will keep cold & there will
no sparking at all. But in case you cannot use the mercury a rag
very slightly moistened with oil or electrotypers plumbago has
been found to be a good thing for the commutator.

Another thing in this connection is that we so lace our belt
that the movement of it surfaces which to give motion to the
bobbin. This smoothes the commutator & bearings.\(^3\) Hood
will understand how to do this by lacing the belt slightly out of
truth.

I suppose you intend to carry out in every particular the
Safety Catch business. This is growing in importance every
day here. We so far are safe but the arc men are rapidly having
their business ruined by the fires which they cause. In fact in
the last ten days their business has come to a standstill & all
the Arc men have appealed to the Board of Underwriters to
have a Committee appointed

The S.S. City of [Worcester?]\(^5\) Worcester on which two
Dynamos and a Hampson Engine were placed still continues
to work satisfactory without any breakdown\(^6\)

Very strange to say Mr Villiard who has just returned from
Oregon was asked by Maj Eaton “What has become of those
Dynamos that were put on the S.S. Columbia”\(^7\) & he replied
“They are working perfectly” Where upon the Major asked
if the boat is still lighted throughout with our light “Yes” re-
plied H Villiard “They work to perfection & have never given
our people the slightest trouble.” This whole affair seems to me
very funny. I supposed the lights had been extinguished long
ago although I can now remember having sent them about 600
lamps eight months ago.\(^8\)

I have got the nicest thing for the Isolated Business you ever
saw for notifying when the lights go beyond eight or sixteen
candles as the case may be. I have been fishing for it for a long
time & have always felt uneasy not to have had it. It was a far
more difficult thing to get than I at first supposed It is now
working “bang up” downstairs here. It is a box about 8 inches
high wide\(^6\) 14 inches long & 6 inches thick, provided with two
binding posts & is multiplied arced across\(^3\) the line just like a
lamp. Underneath the box is a vibrating bell. Inside the box
is a long electro-magnet of seventy ohms resistance & in the
same circuit is 70 ohms of coil resistance the total of which
(140 ohms) is equal to a lamp. The magnet weighs about 20 lbs
the armature about one lb. The armature is set about an inch

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away from the magnet & has a powerful retractile spring arranged so that it cannot vary. The whole thing is on a solid iron base. The armature lever plays between points one of which is platinized. We put this across the line. Say it is used with a machine running at 105 volts. The retractile spring is so adjusted so that when the electromotive force is brought one volt higher the circuit closes & the vibrating bell (which gets its current from one of the coils in the Box by shunting) rings. Thus if the electromotive force increases or in other words if the lights go above 16 candles the bell rings & it will do it every time. The whole apparatus can be kicked across the room & not withstanding any ill usage it will when put up again ring at the proper point. It has brought out in one evening at 65 5th Ave. the terrible irregularity of those Hampson Engines. Now with this machine if we sell a Isolated Plant to go with lamps of say 106 volts we send one of these indicators with it & all we have to do is to so regulate it that it will ring at 107 volts. Then when the bell rings the customer knows his lamps are too high & all he has to do is to move the handle of the Regulator Box & so bring down the candle power & thus stop the ringing. I congratulate myself that this is a pretty good thing for Isolated business as without it we should constantly be at variance with purchasers as to the life of our lamps. Not only is it a good thing for Isolated business but we have come to the conclusion that it is a better standard of electromotive force than a standard battery. I will send you one (as soon as [I can?]) adjusted for [105?] volts. If you like it you can use your judgement about ordering more, but before I send it & before you say anything to anybody about it I must secure the patent in England. So say nothing to anyone until I say so.

I do not see how you got Preece I supposed he was dead against me. What is your impression about him Do you really think that he thought Hughes microphone worked on a different principle to the Carbon Telephone & that after a while he found he was mistaken & that my tirade against him was too severe to permit of his acknowledging that he did not at first understand the principle involved. If not what are the facts? Are they as I supposed write me fully on this! He is certainly a very active man but he should not make such strong statements about new things as he is compelled to eat too much boiled crow afterwards. I wonder how the meal suits his digestion this time.

About competitors referred to in one of your letters the foolishness of forming an alliance with any of them is such an
enormously long subject to deal with & I think you know the old old story well enough without my giving any explanation. If we cannot raise enough money in London to put up one station without the assistance & prestige (---) of Swan I think we had better sell out & go west. And if we can get up one station we shall not want Mr Swan as the Station will be the most influential thing in England for our purpose & the a\textsuperscript{e} man who tried to steal my lamp would never be able to compete with gas at eighty five cents per 1000 ft. If you could get the Gas Companies to stop making gas I should be satisfied!!. By the way in connection with this I took a report of the London Gas Companies & while I am not an accountant I worked out what would be the cost of 1000 ft of gas not in the holder but made distributed sold and wiped off the books in the event of competition with the Electric Light depriving them of one half of their total business. I forget the exact figures but I fancy I made it that now their gas costs them fifty four cents 1000 ft\textsuperscript{11} & that it would cost 97 cts if half their business was taken away. This of course is very important & would be very useful to Mr Fabbri in his negotiations when this question would come up as people would say that we must make light for sixty cents at least to make anything & compete with the Gas Companies which would be true if all our light were sold without taking any of the Gas Coys customers away. I think there is an analysis published yearly of the reports of the London Gas Companies by a man by name of Field I think although I am not quite sure of the name.\textsuperscript{12} You could get the book at the office of the Gas Light Journal or as Insull suggests from Mr Kingsbury. For a small sum of money I think the same man who makes this analysis could give the cost of Gas in London if the output of the Companies is reduced one fifth one quarter one third one half & three quarters. This would be very valuable. I suppose you will have to fix up a good many of our patents for disclaimer but you will notice that from the time of the Spiral carbon carbon\textsuperscript{e} filament up to the present time all our applications have their Provisionals exactly like the Finals. And more over the patents are not voluminous but each particular thing is given a patent by itself. That Platinum patent where it speaks of getting the air out of the carbon in a vacuum\textsuperscript{13} should be carefully handled for any disclaimer if one is necessary. You will notice that my Platinum Patents have the idea of high resistance & multiple arcing running through them. You will see one of the patents has the system patented as a whole.
might get an opinion as to whether we could hold this at law provided all the claims of the system is new.

About the Faure Battery I do not go very much on this for several reasons. It appears to me that the practicable way to light Rail Road trains would be first to use gas as they does on the Penn. R.R. or in case they must have the electric light a small high speed engine with a 80 half light Dynamo in an iron box on the front of a locomotive & take steam from the boiler. A two horse power engine could be made to run 1500 revolutions a minute with say 120 or 130 lbs boiler pressure

I think the economy set down in their reports is Laboratory Economy & not obtainable in practice say 100 batteries in the hands of 20 or 30 different people

I return the letters as to Faure. We cannot deal with such matters from here. They certainly belong to your office.

I would entertain a proposition to build a Dynamo of any horsepower up to 1000 but I think it would be a mistake for them to have one larger than the one that will be sent from here as a spare. If they want it for charging batteries they could get have a Dynamo on each side of a 300 h.p. engine & so get the desired result.

I would prefer that you give me the plan you think should be adopted as to financing the thing there & I would give you my opinion on it better than I can originate a plan here as I do not know the conditions as you do. Very truly Yours

Thos A Edison

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1. Edison’s letter is Doc. 2187, written in reply to Doc. 2180.
2. Not found.
3. These were probably Armington & Sims engines. That firm had recently announced that another of Edison’s orders was delayed by preparations to move their works from Lawrence, Mass., to Providence, R.I., and by their manufacture of special tools to accommodate future large orders. Johnson had complained about the quality of British engines (see Doc. 2180) but arranged about this time to borrow three for the Crystal Palace. Armington & Sims to TAE, 12 Nov. 1881, DF (TAED D8129ZCO; TAEM 58:314).
4. See Doc. 2149.
5. Edison was referring to lateral end-play of the armature shaft.
6. The City of Worcester entered service between New York and New London, Conn., in late September 1881. It was the first steamer on Long Island Sound illuminated by electricity. The ship had 325 B lamps operated by Z dynamos. Edison Co. for Isolated Lighting brochure, 1 Sept.
The new steamship *Columbia* of Henry Villard’s Oregon Railway and Navigation Co. was lighted by an Edison isolated plant in 1880. See Doc. 1892.

These lamps were requested in mid-1880 but not sent until April 1881. See Doc. 2002; Francis Upton to TAE, 4 Apr. 1881; Philip Dyer to TAE, 16 Apr. 1881; both DF (TAED D8123ZAP, D8123ZAX; TAEM 57:839, 851).

Edison executed a U.S. patent application for this device on 27 September and incorporated it into a British provisional specification (1,023 [1882]) filed on 3 March. Edison also described the instrument more completely in Doc. 2201. He sent two to Johnson, with detailed calibration instructions, in mid-January. U.S. Pat. 265,776; Dredge 1882–85, 2:cclxxiii; TAE to Johnson, 16 Jan. 1882, Lbk. 11:85 (TAED LB011085; TAEM 81:264).
10. Johnson had written Edison in late October that he had “sought out Preece—and after a 3 Hours session at Breakfast convinced him that his interests were with us—He was very frank & cordial & said that if on investigation he found the Edison system promised the most in the matter of solving the question He wanted to be identified with it I told him we wanted him.” On 12 November Johnson reported that Preece had gone to Newcastle in search of evidence concerning Swan’s exhibition of carbonized paper incandescent lamps. Johnson to TAE, 22 Oct. (p. 19) and 12 Nov. 1881, both DF (TAED D8133ZAJ, D8133ZAR; TAEM 58:642, 698).


12. John W. Field annually compiled Field’s Analysis of the Accounts of the Principal Gas Undertakings in England Scotland and Ireland.


14. At the end of December, Johnson reported that the “Faure battery concern is a fizzle; it has played out in France and has played out here. It is now denominated as the ‘rotten battery’ in as much as the felt rots and the batteries are so short-lived as to make their first cost an impassible barrier to their general use.” Johnson to Upton, 30 Dec. 1881, Upton (TAED MU058; TAEM 95:668).

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Menlo Park, N.J., Nov. 28 1881

From Francis Upton

Dear Mr. Edison:

I enclose letter from Branner showing that he has not received our last letters.

In Oct. I received a letter from him dated July 17 saying that he should start direct for the States then by Oct 1, some days before the receipt of his letter. I wrote to him at St. Thomas.
that there was no use of his going to Cuba and also to Para saying that we wanted full samples of all the fibres he could get. The latter letter was short as I did not expect it to reach him.

I think it would be well to recall him by telegraph. Yours Truly

Francis R Upton.

(Cable Branner Para Return. Edison\textsuperscript{c}
write Upton to \textsuperscript{[email protected]}\textsuperscript{d} we\textsuperscript{e} have done so \& ask him to send cost of cable— Send back Branners letter\textsuperscript{f}

ALS, NjWOE, DF (\textit{TAED} D8123ZFO; \textit{TAEM} 57:1011). Letterhead of Edison Lamp Co. “Menlo Park, N.J.,” and “188” preprinted. \textsuperscript{c}Obscured overwritten text. \textsuperscript{d}Followed by dividing mark. \textsuperscript{e}Canceled. \textsuperscript{f}Interlined above. \textsuperscript{c}Marginalia written by Samuel Insull.

1. John Casper Branner (1850–1922) was a botanist and geologist whom Edison dispatched to South America in late 1880. Branner spent about a year there searching for natural fibers to use as lamp filaments (see Doc. 2012); his letters from Brazil and Argentina are in Edison Electric Lamp Co.—General, (D-81-23), DF (\textit{TAED} D8123; \textit{TAEM} 57:756).

2. Branner was waiting to hear if he should remain in Brazil, go on to the West Indies, or return to the U.S. (Branner to Edison Lamp Co., 29 Oct. 1881, DF [\textit{TAED} D8123ZEY; \textit{TAEM} 57:991]). Upton had also sent to Edison Branner’s previous letter, of 19 September, showing that Branner had received Upton’s 11 August letter (Branner to Edison Lamp Co., 19 Sept. 1881; Upton to Edison, 19 Oct. 1881; both DF [\textit{TAED} D8123ZDU, D8123ZEJ; \textit{TAEM} 57:962, 980]).

3. Branner to TAE, 17 July 1881, DF (\textit{TAED} D8123ZDB; \textit{TAEM} 57:930).

4. These letters have not been found. Around 27 August, on the last page of a letter from Branner, Edison had written to Upton: “If you want any particular fibre for ‘A’ lamps you had better write Branner. Do you ever write him in answer to his letters.” TAE to Upton, 27 Aug. 1881, on Branner to Upton, 2 July 1882; both DF (\textit{TAED} D8123ZCT, D8123ZCU; \textit{TAEM} 57:920, 923).

5. Edison cabled Branner on 1 December to “Return.” LM 1:104D (\textit{TAED} LMo01104D; \textit{TAEM} 83:924).

6. Samuel Insull reported to Upton on 1 December that he had sent the cable and was returning Branner’s letters. Lbk. 9:392 (\textit{TAED} LBo09392; \textit{TAEM} 81:150).
Claim Vertical Coil — Coils arranged to form arch. 2 coils plated together. Vertical Coil with conductor of Carbon running through interior =

A spiral formed of wood or woody or natural fibre with the thickened ends coils & carbonized in a spiral form & secured by plating above.

Sep patent

mention can all be one ckt
Mention in this case that separation produced by the film of an earthy oxide.\textsuperscript{4d}

in connection with indicator of candle power or electromotive force\textsuperscript{5}

Dynamo Leakage this decrease tendency to crossing\textsuperscript{6}

Patent. Silvered or ground\textsuperscript{7c}
Patent  Method of making filaments of Carbon dif candle power & Res—

Witness  S. D Mott

[B]  

[Witness:] Dyer
1. On 25 November, Francis Upton wrote from the lamp factory that he wanted Edison "to come here to make a series of experiments on spirals. I have been thinking about the matter and am convinced that 13 or 14 per H.P. of 16 candles is possible. I wish you would make out a list of material you will need for experimenting and I will try to have it ready for you" (Upton to TAE, DF [TAED D8123ZFL; TAEM 57:1009]). Edison subsequently spent about two weeks at Menlo Park experimenting with high-resistance lamps (see Docs. 2197 and 2202). In designing such a lamp Edison drew on his 1878 "Elect[ric] Light Law" based on his observation that coiling a wire to reduce its radiating surface by a certain proportion would raise its temperature by the same ratio or proportionately reduce the amount of energy needed to maintain the original temperature (see Doc. 1577).

2. On 5 December Edison signed a patent application (Case 379) for spiral carbon filaments that would have high resistance and relatively small radiating surface. The coils in the sketch below and those marked "2" and "1" were represented in two patent drawings. Coils could be comprised of multiple carbons, either wound concentrically as in figure 2, or joined end-to-end as in figure 1. Edison’s application was rejected twice and abandoned but subsequently reinstated; the patent issued in 1888. Pat. App. 379,770; Patent Application Casebook E-2537:102; Patent Application Drawings (Case Nos. 179–699); PS (TAED PT021102, PT023:50; TAEM 45:743, 868).

3. The following figure represents a high resistance filament constructed by electroplating a number of straight filament segments end-to-end to form a zigzag shape. It was the basis for a patent application that Edison executed on 13 December. U.S. Pat. 358,600.

4. Edison executed a patent application on 15 December for two filaments placed close together as shown. The ends of one filament were electroplated to those of the other. Edison used a “filling of an earthy oxide, or other suitable insulating material” to hold them apart. Near the end of the evacuation process, the filaments “are heated by an electric current to an incandescence higher than that at which they are intended to be used. This heat decomposes the material between the carbons, which is removed or partially removed from the globe with the air.” Edison again did not specify the purpose of this design, which presumably
would provide greater illumination than an ordinary lamp. U.S. Pat. 264,652.

5. This unclear sketch may depict a mechanism for manually adjusting the position of commutator brushes to regulate voltage in response to changing electrical load. Edison executed a patent application on 15 December for such means that “will not require in their operation and adjustment the attention of a person skilled in the working of electrical apparatus. This I accomplish by constructing and arranging the commutator-brushes so that they can be readily shifted to and can be conveniently and securely held in any desired position between the point of greatest generation and that of no generation, and by providing at the machine an indicator or alarm which will show in a simple manner the condition of the current” (such as that described in Doc. 2190). In this arrangement “the commutator-brushes are mounted upon arms projecting from a pivoted yoke which surrounds the armature-shaft and turns upon the axis of rotation” to positions of greater or lesser potential. U.S. Pat. 278,419.

6. This figure appears to represent semicircular conductors connecting paired armature bars. Edison executed a patent application on 1 May 1882 for an armature with these conductors instead of the solid end plates, although the stated rationale referred only to simplifying construction rather than preventing short circuits. U.S. Pat. 268,205.

7. This sketch may be related to the reusable lamps that Edison designed in May (see Doc. 2102); however, there are no related patent applications from around this time.

8. Edison executed a patent application on 13 December for a method of manufacturing lamp filaments of various specific candlepower and electrical characteristics from filament blanks of nearly the same dimensions and resistance. The device shown, similar to the patent drawing, was for “electroplating the carbon filaments for a portion of their length, preferably of copper, the non-plated portion alone becoming incandescent. Carbon filaments of a loop, arch, or horseshoe shape are plated preferably from their ends, . . . the center of the incandescent portion of the carbons being at the central point of their length and the candlepower and resistance of the carbons being dependent upon the extent of their non-plated portion.” U.S. Pat. 264,653.

9. Mott signed below this drawing, but it is not clear if this should be construed as witnessing only this drawing or others as well.
10. This drawing was substantially incorporated into a patent application that Edison signed on 17 January for automating the dynamo regulation process. Like the December application discussed in note 5, this patent described a mechanism “for automatically shifting the position (relative to the neutral line) of the commutator brushes upon the commutator-cylinder” so as to control the voltage applied to the outside circuit. However, this mechanism was to be “operated entirely and continuously by the variations of resistance in the external circuit” and to “have a continuous operation—that is to say, one not dependent upon and limited by the play of an armature-lever, but accomplished by a continuous revolution” of a worm gear and two ratchet wheels. Each wheel was acted upon by a pawl in response to an electromagnet in a shunt circuit when the current became too strong or weak. U.S. Pat. 265,779.

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Technical Note: Incandescent Lamp

[A] [New York,] Nov 28 '81

patent.¹

One side² of the clamps shall be heavier than the other and to prevent melting by the electrical carrying

[B] [C]

patent²

Witness S D. Mott

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1. There is no evidence that Edison filed a patent application related to this sketch.

2. Edison executed a patent application covering these lamps on 5 December. It was not filed until August 1882. It was promptly rejected by the Patent Office but eventually reinstated; the patent issued in 1891. The patent contained one drawing, the same as figure C; another drawing, like figure B above, was dropped. In the patent, Edison explained that between the two conventional leading-in wires “is sealed a third, which extends up between the limbs of the carbon, and is attached at the center of the arch or loop by electroplating thereto. When all these wires are properly connected to the system, the current passes through the central wire and is divided between the two limbs of the carbon, the latter thus being in multiple arc. If the central wire is disconnected and the two limbs attached to opposite wires of the system, the two are of course in series, or if one limb of the carbon is disconnected the other may be used separately.” Patent Application Casebook E-2537:100; Patent Application Drawings (Case Nos. 179–699); PS (TAED PT021100, PT023:49; TAEM 45:742, 867); U.S. Pat. 454,558.

[New York, November 1881²]

Mr T. A. Edison the papers & Magazines³ that I send to you are³ Weeklys⁴

Scientific American
"  Supplement
American Machinist
Progress

Monthly⁴

Science
Druggist Circular
American Journal of Science
Builder & Woodworker
Philadelphia Photographer
Manufacturer & Builder
Scientific News
Popular Science Monthly
Self Instructor
Journal of Chemistry

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For Mrs Edison
Weekly

- New York Weekly
- Chimney Corner
- Harpers Young People
- American Queen
- Fiction
- Frank Leslie’s Ill’s
- Pictorial War Record
- Puck
- Harpers Weekly
  - " Bazar
- Waverly Magazine
- Art Interchange

Monthly

- Art Amateur
- Demorest Magazine
- Druggist Circular
- Leslie’s Lady’s Magazine
- Munroes Fashion Bazar
- Nursery Monthly
- Popular
  - " Stoddards Musical
- Vicks Monthly
- Young Ladies Journal
- Revue De La Mode

Comes Twice a year

- What to Wear
- Portfolio

Newark Sunday Call
  - " Daily Advertiser

Mrs Van Cleve Metuchen N.J.

Monthly

- Art Amateur
- St Nicholas

AD, NjWOE, DF (TAED D8111N; TAEM 57:473). “& Magazines” interlined above. "Written outside of right brace enclosing list that follows. Followed by “over” to indicate page turn. "Comes Twice a year" written outside of right brace enclosing list that follows.
1. George Van Ness was a Newark dealer who had been selling magazines to Edison since at least 1878. *TAEMG1–2*, s.v. “Van Ness, George.”

2. Date supplied from docket on reverse.

3. Because many of the titles in this document are either well known or self-evident, the editors have chosen to present the subscription list without individual descriptions. Information on many of these titles may be found in Mott 1938–68, vols. 2–3. Edison replied to Van Ness on 1 December and listed the magazines he wanted to discontinue. That list matches the magazines crossed out in this document. Edison also requested Van Ness to “supply Mrs Edison’s papers more regularly she complains very much of your irregularity and uncertainty.” On 3 December Edison directed Van Ness to send the magazines to his and Mary’s residence at 72 Fifth Ave., and correspondence and bills to his office at 65 Fifth Ave. TAE to Van Ness, 1 Dec. 1881, Lbk. 9:388 (*TAED* LB009388; *TAEM* 81:148); TAE marginalia on Van Ness to TAE, 3 Dec. 1881, DF (*TAED* D8111P; *TAEM* 57:477).

4. Hattie Van Cleve, wife of Edison’s employee Cornelius Van Cleve, was Mary Stilwell Edison’s half-sister. Headnote, Doc. 733.

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**Samuel Insull to Henry Villard**

[New York,] 2nd Dec [188]1

Dear Sir,

After my interview with you yesterday I went to Menlo Park to see Mr Edison and upon my relating to him the substance of our conversation he stated that he should suspend work upon his Electric Rail Road until such time as he is in a position to pay for it himself.1 Yours truly

Saml Insull Private Secy

ALS (letterpress copy), NjWOE, Lbk. 9:302 (*TAED* LB009392A; *TAEM* 81:150).

1. Nothing more is known of the conversation with Insull; at this time Villard was stretching his personal and corporate financial resources to push rapid construction of the Northern Pacific Railway. On 22 November Edison had submitted to Villard an itemized bill totaling $6,186.50 for work on the electric railroad, in accord with their September contract (Doc. 2152). De Borchgrave and Cullen 2001, 320–24; Villard 1904, 2:299–302; TAE to Villard, 22 Nov. 1881, Lbk. 9:314 (*TAED* LB009314A; *TAEM* 81:107).

In February 1882, about the time that substantive electric railroad experiments resumed, Edison estimated the cost of constructing a line of unspecified length at about $25,000. In March, the Oregon & Trans-Continental Co. agreed that Villard’s 1881 loan of $12,000 would be considered an outright payment should Villard or his representative consider Edison’s experiments a success by 1 July 1882. At that time, however, Edison repaid the loan with interest (Cost Estimate, 25 Feb. 1882, Cat. 2174, Scraps. [*TAED* SB012ACE; *TAEM* 89:380]; TAE agreement with Oregon & Trans-Continental Co., 2 Mar. 1882; Oregon & Trans-Continental Co. to TAE, 1 July 1882; both DF [*TAED* D8249D,

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D8249D1; TAEM 63:589, 591]). In October 1882, the Edison Electric Light Co. reported to stockholders that

Villard has withdrawn from his arrangement with Mr. Edison and the latter has gone on with the installation at his own expense. The road was built and cars have been run over it experimentally since last Spring. The experiments, however, are not yet entirely completed to Mr. Edison’s satisfaction, but as soon as he can find time from the pressure of more imperative matters, namely, those connected with the electric lighting branch of our business, he expects to go on with these experiments and perfect the railway for practical use. Until that is done no steps will probably be taken towards the formation of a company for exploiting the Edison Electric Railway and the whole subject remains substantially where it was one year ago. [Edison Electric Light Co., Board of Directors Report, 24 Oct. 1882, DF (TAED D8224ZBJ; TAEM 61:86)]

By December 1883 Edison estimated that he had spent $38,541.80 in developing his electric railway, and considered that he had a “valid claim” to recover this amount from the Edison Electric Light Co. (TAE to Eaton, 13 Dec. 1883, DF [TAED D8316BSG; TAEM 65:809]). Edison’s railway accounts with Villard are in Ledger #5, Accts.; see entries indexed under “Villard, H.” (TAED AB003:11; TAEM 87:384).

My dear Edison—

I have succeeded in putting all our men (that is Hennis¹, Suebel, Force, Acheson, Hipple,² on the payroll of the different companies from the 15th of November. In regard to Force during the time he is with me I wish you would continue to pay his wife $12 per week as you have all along done and I shall refund you the same every three months from his salary.— Also dont fail to let me know how much you have paid Mrs Suebel so that I can refund you that—³

No doubt you think we are a long time getting started in manufacturing but it has been very difficult indeed to find the right place— I have been in no less than 53 mills and factories within 100 miles of Paris and have often thought of splitting it up into 3 or 4 shops, but now I think I have a prospect of getting the building shown in the enclosed drawing.⁴ Of course we could not buy this from our capital but I have been working on Leon and Lebey⁵ two of our directors to buy it and rent it to us which I believe they will do— It is built of stone and brick and is just as good looking as it is in picture— It is outside the walls but at such a short distance that it is practically the same thing as being inside— I dont like to say now that I

Paris, le 14 Decembre 1888

From Charles Batchelor
shall have it but I am making strenuous efforts and the prospect looks good— We have had 2 meetings of our intended boards and they propose to meet every night to transact business every night at 4 p.m. so the ball has fairly opened— Porges the head and front of the concern is a very peculiar man as probably Mr Lowery has told you, I find however that I can get anything I want by simply making him believe that he is the originator of the desire to have the thing I want— On the boards when anything was proposed (no matter what) he starts off with a loud blustering objection on general principles and succeeds in satisfying himself in about 5 minutes that the man who proposed it is a damn fool afterwards when the proposer insists he takes up the proposition himself and does all you want as if it was his own I have an amicable row over everything ending in my getting all I want— I have done my best to procure for Dr Moses a position in the formation of companies for Germany which would be very lucrative; and he is now under consideration by the boards— I am afraid that Porges who was very favorable to him, has been literally talked to death by him, and feels that he dont want to bother with it till everything else is done towards factory etc— Mr Bailey who is recovering asked me also to tell Porges that it would be exceedingly disagreeable to him to work with Moses so that A thing I of course would not do, but it makes it hard for me to work for him— He wants an exclusive agency for the whole of the German Empire with 2% interest in everything, (whether he works or not) and all expenses and $200 per month besides— Of course when this proposition was passed round we all with one accord put our pens through the word exclusive— Lots of my lamp factory stuff I am making outside so as to be ready when I have my factory —

Tell Kruesi to get a Frenchman and learn him all the business and I will take him Tell him I dont want a high salary man Yours

Batchelor

ALS, NjWOE, DF (TAED D8132ZBV; TAEM 58:570); letterpress copy in Cat. 1239, Batchelor (TAED MBLB4042; TAEM 93:510). Letterhead of Chas. Batchelor. “‘Paris, le” and “‘188” preprinted. b“per month” interlined above.

1. Charles Hennis had significant responsibility for setting up the Edison central station in Milan in 1883. Batchelor to Hennis, 16 Jan. 1883, Cat. 1239:433; Batchelor to Hennis, 31 July 1883, Cat. 1331:116; both Batchelor (TAED MBLB4433, MBLB3116; TAEM 93:773, 402).
2. James Hipple (c. 1855–1917) began working in 1880 as a glassblowing assistant at the Menlo Park laboratory; later he assisted William
Holzer in setting up the glass blowing department at the lamp factory. He went to Paris in 1881. Doc. 1926 n. 2; TAEB 5, App. 2; Jehl 1937–41, 898.

3. Before going to Paris, Philip Seubel arranged for Edison to send thirty dollars every month to his wife in Canton, Ohio, but Insull reportedly failed to do this before October. In February 1882, Batchelor asked Edison to advance Seubel’s wife and two children first class passage to France. Seubel to TAE, 21 June 1881; Batchelor to TAE, 5 Oct. 1881 and 14 Feb. 1882; all DF (TAED D8135O, D8135ZCF; D8238ZAA; TAEM 58:900, 1087; 62:322).


5. Georges Lebey, a member of the Paris Bourse, was a founding director of the Société Électrique Edison and the Compagnie Continentale Edison. Articles of Incorporation, both 2 Feb. 1882, both DF (TAED D8238Q, D8238R; TAEM 62:227, 252); BDF, s.v. “Lebey, André.”


7. Moses complained in a letter to Edison this day that he had been invited to help form the European companies but, having obtained Edison’s permission to remain, found that Porges refused the terms he proposed. He reported that Batchelor had then promised to help him obtain a position but, he claimed, had failed to speak on his behalf at the decisive meeting. Moses then applied to Edison, who did not reply directly but offered him, though Batchelor, $500 to “meet immediate wants.” Batchelor denied having acted in bad faith, telling Insull later that “everybody that he [Moses] had anything to do with considered him such an infernal bore that he actually cut the position out of his own October–December 1881
hands, or as one or two expressed themselves to me, ‘they did not wish

New York Decr. 20. 1881

To Edward Johnson

Dear Sir

I beg to confirm dispatch receipt of cable as follows.¹

“Vital have accurate general basis show cost not exceeding gas cable proper method with figures mailing complete showing main reliance commercial position am in accord Fabri.”²

I give below very rough estimate of cost of Central Station for your personal use³

Central Station of one square mile 33 000 ten candle jets.

Investment

- Dynamos @ 7,500—200 h.p each forced to 250 $90,000
- Boilers ($12 per h.p.) say 28,000
- Stacks 10,000
- Piping foundations boilers, blowers Ex[haust]. Engine. coal 8,000
- Iron structure erected 8,000
- Foundations 3,000
- Fire proof floors 3,000
- Station regulation apparatus 3,000
- Meters 10,000
- Erecting appliances fixing station 10,000
- Mains and feeders 200,000
- Total Invest plant $373,000

Running Expenses one year

- Labor 12,000
- Bad debts 1,000
- Coal 16,000
- Oil waste 2,500
- Rent 12,000
- Executive 6,000
- Lamps 19,800
- Depreciation 8,000
- Meter Men 4,000
- Taxes 3,000
- Water 2,000
- Total $86,300

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33,000 Lamps 3 hours daily 300 days
5 feet per hour is 148 500 000 feet at 85¢ per M. = $126,220
Gross receipts
Expenses $86,300 = Net profit $39,920
or over 10 per cent on investment.
Sold at $1 = per M. would equal $148,500 giving profit of
$62,200 or over 16 per cent.
This will give you a rough idea of cost and profit but it is im-
possible to estimate exactly when my knowledge of conditions
on the other side are so slight. Yours truly
Thos A Edison

P.S. Following please find copy of cable sent you in reply to
one quoted above.4
Fifty–seven London5 (Sent Decr 15. 81) Can only give very
rough estimate at present Investment in good portions Lon-
don for every thousand feet equivalent sold be from two dol-
ars seventy five cents to two dollars ninety cents and will pay
little more than eleven percent on whole of actual investment
taking a ten candle electric to equal ordinary five foot London
burner. Have been working at Menlo two weeks getting high
resistance lamps to admit competition London Gas have got
ten candle lamps two hundred eighty ohms, will mail detailed
estimates”6 Thos A Edison

1. This is the full text of Johnson’s cable to Edison, received on 8 De-
cember. On 14 December, Edison replied that he was “busy collecting
data estimate comparative cost ready in few days.” LM 1:112C, 115B
(TAED LMo01112C, LMo01115B; TAEM 83:928–30).
2. This refers to a stipulation (clause 17) in the draft contract negoti-
ated by Egisto Fabbri with financial backers of the prospective Edison
company in Britain. Before the company was organized, William Thom-
son and Frederick Bramwell were to certify that the Edison central sta-
tion system could compete economically with gas. Theodore Waterhouse
to Johnson, 11 Jan. 1882; Edward Bouverie to Johnson, 25 Jan. 1882; both
DF (TAED D8239G, D8239P; TAEM 62:670, 738); see also Doc. 2203.
4. Following is the full text of Edison’s cable to Johnson on 15 De-
cember. LM 1:117C (TAED LMo01117C; TAEM 83:930).
5. Cable code for Edward Johnson; see App. 4.
6. A 5 January itemized estimate typed on Edison Electric Light Co.
letterhead for a “Central Station of one square mile—containing 33,000
ten candle jets,” operated by twelve 200 horsepower dynamos, was pre-
sumably intended for London. The figures in that estimate are compa-
rable to those given above by Edison; significant deviations include esti-
mates of $12,000 apiece for engines, $36,000 for boilers, and only $2,500 for smokestacks. Considerably more was allotted for coal and less for rent. Edison Electric Light Co. cost estimate, DF (TAED D8224111; TAEM 61:3).

Another set of itemized estimates for various unidentified isolated installations was also typed and dated 5 January. The prices of dynamos and equipment in that list is very similar to those in a promotional booklet published by the Edison Co. for Isolated Lighting in September 1882. Edison Electric Light Co. cost estimate, DF (TAED D8221A; TAEM 60:845); 1 Sept. 1882 circular, PPC (TAED CA002A; TAEM 96:103); see also App. 3.

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**Samuel Insull to Naomi Chipman**

[New York,] 21st Dec [188]1

Madam,

I am directed by Mr Edison to state that he will vacate his appartment in your house one week from this date.1 Yours truly,

Saml Insull Secretary

ALS (letterpress copy), NjWOE, Lbk. 9:466A (TAED LBoo9466A; TAEM 81:172).

1. Edison and his wife had apparently spent much of their time at Menlo Park from late November. It is not clear when they actually left the Chipman boarding house. Cf. Doc. 2245.

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**To W. H. Patton**

[New York,] 29th Dec [188]1

Dear Sir,

The trouble as to the transmission of power by electricity is that the demand is so great for machines that our Directors do not feel inclined to send out any machines simply for an experiment at their expense.2 I talked to one or two of them about the matter and they remark “why does not Mackay try the experiment at his own expense as if successful the result would be more profitable to him than to us As far as I am personally concerned I should like to try it very much for the mere science of the thing Yours truly

Thos A Edison [nsull]


1. W. H. Patton was a mine superintendent (1878–1887) for the Consolidated Virginia Co., the so-called “Bonanza Firm” of the Nevada Comstock. Edison addressed this letter to him in Virginia City, Nev., at the Ophir Silver Mining Co., which the Consolidated Virginia had ac-
quired in 1878. Patton and Edison had corresponded in 1880 about using electric power generated at the Carson River in the Comstock mines. Smith 1943, 240, 213; Docs. 1949, 1957, and 1967; for a similar proposal see also Doc. 1788.

2. Patton wrote on 5 December, after having heard nothing recently from Edison about “the ‘transmission of power by Electricity’ business.” He advised that the Brush interests were active in the area “and have made propositions in regard to the same business—Will you please advise me what your Co. proposes to do—so that I will know whether to entertain any proposition from them.” Patton to TAE, 5 Dec. 1881, DF (TAED D8138ZAJ; TAEM 59:147).

3. John MacKay (1831–1902) became wealthy as the majority partner in Nevada’s most lucrative Comstock mines. By 1881 he was established in New York, where he and publisher James Gordon Bennett formed the Commercial Cable Co. DAB, s.v. “Mackay, John William.”

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London, E.C. Dec. 29th 1881

My dear Edison,

I am very sorry to say that I am met on all sides by astonishment at the price I ask for our Dynamos, namely £200. I gave Sir William Thomson a price for 3 Dynamos £180 each. He wanted it for the purpose of supplying a friend of his who had a large Factory and was about introducing Electric Light. Sir William writes to me to say that Siemens’ machines have been adopted instead of ours on account of the price, namely £90 each. He does’nt say however, anything about Economic efficiency of the Siemens’ machine. This seems to be a very difficult bit of information to obtain. The Paris Electric Exhibition offers no data and as far as I have been able to find none can be had anywhere. I have written Thomson a letter calling his attention to the fact that his rejection of our machines is simply based on their cost and that he gives no information whatever as to whether the difference in the economy of coal consumption will not more than compensate for the difference of cost.1 I have asked him to accord me an interview to discuss this whole matter with him I agreeing to go up to Glasgow for the purpose. I have informed him that the Dynamo I sent him shall not be returned to me until he has either Endorsed it or condemned it, and have further asked him if he is prepared to officially pass upon the economy of our small Dynamos independent of the larger and more important experiments he is to make with our Central Station Plant later on.2 I think I can secure his services for this purpose in which case I will have his findings printed in Circular form and will use them for the

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purpose of obtaining a fair price for our Dynamos. Meantime there is no doubt in my mind but that we have got to very considerably reduce our price. I find that by paying you $570 on board ship in New York that by the time we come to sell the Dynamo it costs us $620. Now add 25 per cent only as a margin of profit; it stands us in $775 equal to £155. Now if any reduction of price can be had anywhere so that I may sell these Dynamos for £150 I think I can successfully compete with Siemens and Gramme by making full use of the facts as to superior economy etc. There is no disputing the fact that a very large proportion of the people who want isolated plants have a surplus of power which they count whether rightly or wrongly as now wasted and they look more particularly to first cost than they do to running expenses. I have taken the ground that I do not care for this class of business but I am afraid that if we ignore it we will find it very difficult to secure much trade in other directions. Please carefully consider this whole matter and see if you cannot somehow reduce the first cost to me. In every other respect we are fully able to hold our own. I have the Steam Dynamo together and can be ready to run in a very few days. I propose to run it as a Steam Engine simply for some time to ease up the bearings, get the knock out of the Steam Engine and generally to make it an efficient machine before applying the current. Meantime I am pushing forward the preparation necessary to receive the other Dynamo. My contract with the City is to commence Lighting on the 1st February. I want to have the second machine in place by that time and several days have now elapsed since you reported it as ready for trial but I have heard nothing from you.

Preece’s second Lecture at the Society of Arts for the benefit of the Juvenile members came off last night and as you will see by the notice sent you, was illuminated by the Edison Light in a very satisfactory manner. You will notice in the “Daily News” article a reference to my new chandelier. It is not the Chandelier about which I have been writing to you but is a small one on the same principle. I think you will have a more glowing account of the large one as the effect will be much finer. In the small one the flowers are too large for the other parts of the fixtures thus making it appear out of proportion. Two Lamps gave out last night during the Lecture, one gave way in the carbon and the other arc’d. Am I going to have serious trouble in this respect here and at Crystal Palace? I hope not. I will have some 2,000 Lamps in operation at one time; if they are going to give way rapidly I will need a large force of
men to keep replacing them which will necessarily attract considerable attention. Crystal Palace will be ready to open up the later part of next week. No one else is so far advanced. I therefore expect to be the first one to light up which of course will be a card for the Edison Light. Everybody else is at work and the exhibition promises to be a decided success. Batchelor is shipping me all your other Exhibits and I am getting them into position. What about motors? We need them both here and at Crystal Palace. You have not shown a motor on this side yet and it is exceedingly important that you should do so. I have a floor of this building fitted up as a Laboratory and repair shop and am arranging to drive the machinery (a few light lathes) by a motor. I also want to show one at Crystal Palace. Please send forward at once if you can do so, if not please tell me that you cannot and why. The price List of Armington & Sims Engines you sent me is rather meagre. I will, however, have some Engineer to interpret it for me. Very truly Yours,

Edwd H. Johnson

If you will let Mr Fabbri read this you will save me double work EHJ

1. This correspondence between Johnson and William Thomson has not been found.
2. This refers to the stipulation proposed by London investors that Thomson attest to the economic efficiency of the Edison central station system.
3. Edison cabled on 19 December that the dynamo was “almost completed” and would be tested in two days. LM 1:121 (TAED LM001121A; TAEM 83:932).
5. Johnson wrote from 57 Holborn Viaduct. The building also had some office space for the British company and sleeping quarters for some of the engineers. William Hammer to William Alexander Hammer [father], 13 Nov. 1881, Ser. 1, Box 1, WJH.
My Dear Batchelor

In putting out a great number of plants as we are now doing we have found it necessary to have a Regulator for the candle power of our lamps as the parties using the light are apt to run the lamps up very high & thus cause a great many breakages. Thus the average life would be shortened great dissatisfaction caused and people get the impression that our statement as to life were not true. So I have devised an Indicator which works beautifully and I advise that hereafter all Isolated Plants shall be accompanied by one of them. I will send you one with your model “Z” Dynamo provided our patents have been secured in France and other countries. It consists of an apparatus which is placed across the line just as if it were an ordinary lamp. It has a magnet with cores about eight inches long and an inch thick & is wound with wire so as to give the magnet a resistance of seventy ohms. In the same circuit is seventy ohms resistance, making a total resistance equal to the lamp. This magnet is provided with an armature (about four inches long and an inch thick) of iron fastened to a large sliding armature lever arranged to work the same as a relay. A large brass spiral spring made of $\frac{1}{8}$ in with the spiral being about $\frac{3}{4}$ in diameter & 4 in long is used to adjust it and is arranged so that with the proper adjustment is obtained it cannot alter. The whole thing is enclosed in a box. The big magnet acting as a relay closes the circuit in which there is a vibrating burglar alarm and which makes a great noise the circuit being a derived one closed round one of the resistances of the device enough current is obtained to ring the bell violently.

The machine is set in the following manner: Suppose that we sent out a Dynamo machine and lamps which give sixteen candles at one hundred volts. Then we take one of these boxes and put it on a circuit which is adjusted just 100 volts & so adjust the armature of the Regulator that by increasing the volts by one the [raise?] of current will attract the armature close the derived circuit and the bell will commence to ring. One volt only makes a difference of half a candle but the bell always works on this variation. Now you see if this the Regulator is put in the Lamp circuit & the machine is first started & the bell rings the attendant at once knows the candle power is too high and he adjusts the field magnets resistance just enough to stop the bell ringing & then he knows his lamps are not more than sixteen candles & thereafter it is impossible for any of the lamps to go above $16\frac{1}{2}$ candles without the bell ringing
we find this apparatus is very reliable & brings out very conspicuously the bad governing of our small engines. when the B lamps are used the extra 70 ohms resistance is thrown out leaving only the magnet in which is the same resistance as the B lamps. So all you have to do is that when you send out a plant you must adjust the Indicating machine at your Works and send it out with it. It is so reliable that we shall use it in the Central station in the place of an Electric Dynameter for gauging the volts.2 Bergmann is making them at $25.00 but we hope to get them much cheaper than that.

We received your cable about the model Z Dynamo.3 This will be sent to you very shortly via Hamburg You must not take it into France until you have got the proper authorization from the authorities as it is necessary to take very great care that nothing is done to vitiate the patents The Paris Opera House Dynamos were ordered to be shipped to Puskas & Bailey. If I had done so my patents would have been endangered. I sent them to Geo Walker as Exhibition material as Exhibition material. In ordering stuff from here you must be very careful about this authorization & even when you have the authority I shall always ship to Hamburg & let you get the forwarding done at your end. I am told that anything imported without the proper authorization vitiated the patent and can be taken advantage of by our competitors and that the authorities cannot make a retrospective authorization so as to make the patent good again. They cannot legally do so according to French law.

We are building a model Disc Dynamo for B lamps the same as you have at Paris and which was built at Menlo Park. We can send you the working drawings of the armature after we have thoroughly tested it if you desire.

Regarding the large Dynamo we are building six for the Illuminating Coy and could start another one as a model for you but would like to have the Coy over there send a formal order. However I think the drawings will be sufficient for you as we have got them absolutely correct so I think you can do just as well with them with explanations from us just as well as with a model Dynamo.

I spend a great portion of my time now at the Lamp Factory Upton had got badly mixed regarding the life of the lamps but now we make a curve of each days run so we know exactly what we are about and those curves show that the ten per Horse-power have an average life exceeding eight hundred hours and I am gradually increasing this. I am also working on spirals with great success.4 I shall undoubtedly succeed in making
280 ohm A lamps 12 per horse power 600 hour life but do not promise this. This is of course sub rosa. I shall also be able in the course of six or seven weeks to materially reduce the cost of the lamps so that we can make some profit on them.

We sold 2000 resistance lamps to the Western Union to be used as Resistances on their telegraph lines at seventy five cent each.

We have had the steam on the big English machine (for spare) We had 1300 lamps on it for several hours We have some trouble with the brushes but I shall get them all right in a day or so & then shall ship the machine to Johnson

We are progressing very well with the Rail Road. The Locomotive is being built at Goerck St & will be finished in a week or so. Hughes is laying the track 

Yours very truly

Thos A Edison

[New York,] 31st Dec [1881]

To Edward Johnson

Regarding your cable about 280 ohm lamps since I said what where the chances as to Fabbri making an arrangement in England I knew the economy business would come to the front and therefore I immediately went to Menlo Park and devoted myself to the production of a high resistance lamp. I have made two or three of them of 280 ohms which work fairly but I think the life is not more than two hundred hours. I shall probably be able in the course of three or four weeks (the holidays having delayed me: we closed down for two weeks) to get

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the life up to 600 hours and 11 or 12 p. H.P. Those I have made were 16 candle lamps. I am going to try and make them 10 candles and still have 280 ohms resistance as I believe the ten candle jet giving about 16 effective candles will be the equivalent of any five foot burners in the City of London because I find that in practice in the hands of the public 5 ft of gas which should give sixteen candles does not give eight candles although with a new burner and in the hands of an Expert sixteen candles can be obtained. I therefore hope and believe that I shall be able to get 19 lights of ten candles each 280 ohms resistance per electrical horsepower which means we can sell light at 85 cents and make a profit of ten to fifteen per cent on the money actually invested if I am not mistaken as to prices of material over there. But perhaps we shall not be required to sell it so low as can sell gas of 20 candlepower which gives about 12 effective is sold for £1.04. Of course you cannot expect to make a wonderfully good showing on the First Station as you will have the disadvantage of having to work up green men & there will be considerable initial cost and [------] expenses which being chargeable to one station instead of to a [great?] number which will bring the investment up but I [base?] my [estimate?] on several stations. But when it comes to fifteen or twenty stations then we shall do very much better. If we had fifteen stations the London Gas Companies could not sell gas for 85 cents but would be compelled to sell it for about $1.30 to $1.70 on account of the lessened output as I have previously explained.

The London Gas Companies, the public understand, pay 10% but if you look at their statement you will find that most of their Capital is in Debenture Bonds which only pay 5%. If we were allowed to bond a portion of our investment at 5% and represent the other portion by stock then the 10% or [15?]% would be greatly increased.

We started some time back on making your 100 candlepower lamps. I suppose you intend to use them on the street but I should [try?] the effect of a mass of seven lamps in a pyramid as well. You do not say anything about meters but I have ordered fifty & Francis Jehl will go over to you with them as soon as they are ready & teach a man for you to deal with them. This meter business is very [sticking?] we should know what size meters you want we only make meters which will answer for one light up to twenty. We intend, & if it is absolutely essential for you we can make one from twenty to fifty. [When?] a person has 100 lights two fifty light meters can be used.
We have just got a Safety Catch to be placed on the Dynamo in the Main Circuit. Perhaps you would take some.

You have not told us how you like the new socket and the tip on the lamp. We have no more trouble from this source now.\(^5\)

It would be well for you to have in your Holborn Station a two light gas meter and to have Hammer fix it up so that you can screw different burners and then get their candle power and at the same time ascertain their cubic feet. You may learn considerable by this and it will aid you in your explanations. You should get a work called, I think, “Common Sense for Gas Users.”\(^6\) It is about \(\frac{1}{4}\) in thick, 6 in long & \(4\frac{1}{2}\) in broad & has a yellow cover. It gives some very valuable “information” and is exceedingly plain. It illustrates the size of gas jets, the candle power and the amount of gas used and tells something against the gas companies although written by a gas man. It absolutely asserts that in the City of London the average amount of candle power obtained for 5 ft of sixteen candle gas does not exceed seven candles and I can readily believe this as you will remember our test at Bergmanns on Metropolitan Gas (21 candle power)\(^7\) The highest was eleven candles burning six feet of gas and the worst case was were one burner was using seven feet and only gave \(4\frac{1}{2}\) candles. This is explained by the fact that if you have a jet of with a certain opening and a certain pressure of gas and both remain relative to each other & five feet of gas pass increasing the pressure so as to pass eight feet will cause your current to act upon the flame like a Bunsen burner\(^8\) & reduce the candle power down as low as five or six candles although the gas consumed is increased from five to eight feet. If the slit gets increased as it does after \(--\)\(^9\) weeks burning, and gradually gets worse, the pressure remaining constant the amount of gas will be reduced from five feet to perhaps \(4\frac{1}{2}\) ft but it will blow so \(\text{that}\)\(^b\) this Bunsen burner action the candle power will go down to 4 or 5 candles. But if it be an Iron jet the whole hole will be increased from oxidation and the pressure remaining constant it will consume more gas and the candle power will be reduced by lack of oxygen as it was decreased by increased oxygen. Now the pressure constantly varies slightly in the mains but greatly within the House. This great fall of pressure and change of pressure in the House is due to the \(--\)\(^d\) permission of the Gas Companies for to the public to get their own gas fittings done by anybody. The consequence is that competition has caused the introduction of pipes incapable of carrying the gas throughout

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the building without great loss of pressure. Hence the jets will vary in candle power throughout the building.

Another thing the larger the flame the greater the economy as the heated body is more compact and the total surface of the jet exposed to the air is small but when the jet is streaky the total surface of the jet exposed to the air is increased but this not only lowers the diameter of the flame but increases the velocity of the flow and both tend to reduce the candle power. In fact the distribution of gas is in practice a very difficult matter and the talk of the gas people about candle power is all nonsense. Were it possible to make burners that would never deteriorate & that the pressure in every part of a City and House was constant this Gas Distribution would be perfect but a new burner will deteriorate from the very moment it is put in and in three weeks it will not give near the result first obtained. A burner taken from one house in which say ten candles were obtained from five feet of gas would if taken to another house give entirely different results as the pressure might be different in the other house and as the absolute definite relation between the size of the orifice and the pressure to obtain the best result. You can see that these conditions are utterly unattainable in practice.

It perhaps might be a good idea to keep your eye out on some square mile in London in which there is a slum near the center in which we could obtain a building cheap and if you decide on a District it might be well to hire a canvasser to obtain statistics. We can furnish you the form of books from which you can get up what is required.

Putting in this Central Station will be very much easier than I at first imagined. The men are easily broken in at laying tubes and the more I keep at it the more I am convinced that it is much easier to put in a Central Station & operate a square mile than to put in 15 small Dynamos boilers & operate a mill.

I suppose in going over from one machine to another at Holborn Viaduct you will stop one dead and then start the other and have no special appliances to take the current off one & put it on the other. This would only occasion a momentary interruption but as it will occur so seldom I do not suppose you will want anything special.

When you first start up it would be a good idea to have an ice box and keep ice on hand until your bearings get worn down.

I wish you would have sent me a tabulated statement of prices of following:

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Steam coal, Gas coal, Pea coal, Buckwheat coal & Coal Dust.
(Delivered in London & at the pit mouth & the cheapest method of transportation)

Real Estate in London (this should be voluminous)
Gas Pipes
Raw Iron
Cast Iron
Iron Forgings
Angle Iron the same as on the Elevated Rail Road Structure
Day laborers
Firemen
Ordinary Good Engineers
Draughtsmen
Carpenters
Masons
No 10 98% conductivity wire uncovered & covered

& price lists of everything you think would assist me in calculating I should also like to be posted on Municipal & General laws on Steam Engines & Boilers & erecting chimneys

I cabled you the other day to get an article from Il Nuvo Cimento which is to be found in the British Museum. The Magazine was for 1874. My impression is that Paccinotti published in Il Nuvo Cimento in ’74 or ’75 a Dynamo machine in which the field magnet was shunted around the commutator brushes the same as with our “Z” Dynamo. In fact I saw the article the other day in the Electrician or “La Luminiere Electrique” or Telegraphic Journal which stated that Paccinotti published such an article in 1874 in Il Nuvo Cimento.

Yours very truly

Thos A Edison

L. (letterpress copy), NjWOE, DF (TAED D8133ZBS; TAEM 58:820).


2. Johnson replied on 19 January that he did “not think well of a 10 Candle Lamp. The people in London want more light than they now get, and although 10 Candles may be above the average of a London gas burner and therefore a good standard for calculating cost it is not
sufficient to meet the requirements of the people who want Electric Light. They are mostly heavy consumers of gas and have adopted the best burner and in their hands gas consumption is much more carefully looked after than it is in the hands of an average consumer.” In a separate letter, he also pointed out that “the B. machines are no good here—people want more light not less— The atmosphere is so heavy that it takes more light at one point than it does in N.Y.” Johnson to TAE, 19 Jan. 1882 (pp. 1, 3) and 8 Jan. 1882 (p. 7), both DF (TAED D8239I, D8239D; TAEM 62:675, 659).

3. See Doc. 2190. Johnson had recently cautioned that gas producers’ loss of economies of scale would be “more apparent than real” because of the increasing use of gas for heat and power. He noted, however, that these other uses would probably cause a deterioration in the quality of illuminating gas. In his 19 January reply to this document, Johnson also pointed to a trend toward increasing the brilliancy of gas street lighting by aggregating more burners in each lamp. He surmised that overall demand for gas would be “maintained on one street by just that which it loses by virtue of the Electric Light on another street. My opinion is therefore that it will not do to rely too much upon the statistics which were prepared a year or two back.” Johnson to TAE, 11 Dec. 1881 (p. 27) and 19 Jan. 1882 (p. 3), both DF (TAED D8133ZBD, D8239I; TAEM 58:728, 62:675).

4. Johnson stated in his 19 January letter (see note 2; pp. 3–4) that “the absence of the meter is the only drawback to the completeness of our system. I do not want any large meters. Meters from 1 to 20 lights will be quite sufficient.”

5. On the new socket and lamp base with the “tip,” see Doc. 2187 n. 30.


7. Edison made a series of tests of the practical illuminating power of commercial gas in September 1880; see Doc. 1990.

8. That is, draw in a greater volume of air to produce a hotter and less luminous flame.

9. Edison discussed this in more detail in Doc. 2203.


11. Edison instructed Johnson on 9 December to “Go British Museum Translate from Nuovo Cimento Eighteen seventy four Pacinotti article on Shunt Dynamo.” Johnson replied that Theodore Waterhouse would immediately attend to “your several reference in regard to the do-ings of Swan, Pacinotti, and others” (LM 1:113A [TAED LM001113A; TAEM 83:928]); Edison’s draft (incorrectly dated 28 December) is in DF [TAED D8120ZCF; TAEM 57:686]; Johnson to TAE, 11 Dec. 1881 [p. 6], DF [TAED D8133ZBD; TAEM 58:728]). The 1874 article reportedly described a machine built by Pacinotti in 1873 and recently exhibited in Paris. According to the *Scientific American*, it was a “shunt dynamo—that is to say, the current generated is divided in parallel circuit between the fixed electro-magnet and the external resistance. This is done by means of two pairs of brushes making contact with different sections of the revolving commutator.” Edison wanted the article as evidence to undermine the Siemens patent position. On 6 December he confirmed instructions already cabled to Johnson: “Dont offer Siemens royalty Have written Am searching.” He added that he was “now looking up further information & shall hope to communicate further.

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with you on the subject” (Dredge 1882–85, 1:134–35; “The International Exhibition and Congress of Electricity at Paris,” *Sci. Am.* 45 (1881): 377; TAE to Johnson, 6 Dec. 1881, Lbk. 9:412 [TAED Lbk009412; TAEM 81:155]; see also Doc. 2203). The Siemens machine with the field coil in a shunt circuit was introduced in March 1880 and is described in Dredge 1882–85 (1:284–88). The relationships among the Pacinotti, Gramme, and Siemens machines had created confusion in Great Britain for at least several years (Higgs and Brittle 1878, 65–68, 86).

12. The article to which Edison referred has not been identified.