Thomas A. Edison:
Sketch of Activities, 1874–1881

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ABOUT 10 YEARS AGO A PROJECT WAS started to provide permanent care for the records and instruments in the Laboratory of Thomas A. Edison, at West Orange, New Jersey. One of the first requirements was cataloguing the library of approximately 10,000 volumes, most of which had been purchased by Edison in connection with his numerous investigations. This cataloguing took a little over two years, and in the process a number of interesting volumes were discovered, many of them containing marginal notes made by Edison.

Among the discoveries was a bound copy of the first volume of *Science* covering the six-month period, July 3–December 31, 1880. The true significance of this discovery was not realized until several years later, when we began to read and file the old correspondence which for 50 years or more had remained tightly folded and packaged in several dozen small wooden boxes, apparently just as it had been packed for shipment from Menlo Park to West Orange about 1887. In this correspondence we discovered letters, for the most part received by Edison from John Michels, first editor of *Science*, revealing that Edison had undertaken to finance publication of the magazine for one year beginning in the spring of 1880, and had, in fact, continued to do so until the last issue of 1881, 18 months later. The issues of 1881 are not in the library.

Pasted on the back cover of an old scrapbook discovered in Edison's library was the following telegram on the letterhead of the Automatic Telegraph Company, George Harrington, president, and J. C. Reiff, secretary and treasurer:

Philadelphia, November 4, 1874

T. A. Edison
Newark

The National Academy of Sciences, Professor Henry, President, is now in session at the University of Pennsylvania in this city. Will you come on either Wednesday or Thursday and exhibit your remarkable electromotograph to them? Letter by mail.

George F. Barker
Editor, Franklin Institute Journal

Farther back in the body of the book was found the letter to which the telegram referred:

Journal of the Franklin Institute
Editor's Office
Philadelphia, Nov. 3, 1874

My dear Sir:

It occurred to me while examining the remarkable little instrument of yours—the motograph—at the Franklin Institute Exhibition this evening, that perhaps you would be willing to come on and show it to the highest scientific body in this country, The National Academy of Sciences, of which Professor Henry is President, now in session in this city. Mr. Patrick was good enough to say he would send you a message from me and I wrote one. I send this letter to explain matters more fully.

The first notice I saw of your curious discovery was in the London Journal of the Telegraph. I at once became very much interested in it, as a scientific fact of very important bearing in many directions, and I have had it in mind ever since to write

This issue of *Science* is dedicated to the commemoration of the centennial of Thomas A. Edison's birth on February 11, 1847 at Milan, Ohio.

A visit made to the Thomas A. Edison Laboratory at West Orange, New Jersey, while plans were being made for the issue, disclosed some little-known facts about the relationship between the founding of this magazine and Thomas Edison's busy life in 1880 and the years immediately preceding that time.

Evidence is presented here that Edison found time to establish a weekly journal for American scientists which would, in the American scene, fill the position occupied by *Nature*, which had been established in 1869 in England.

The evidence seems to be clear cut in showing that the founding of *Science* will have to be pushed back from 1883, when the magazine appeared as Volume 1, Number 1, to 1880, when there was also a Volume 1, Number 1.

and ask you to prepare me an article for this Journal describing it and if possible, illustrating it. This request I have now to make. If you really cannot do it, can you not place me in possession of the facts and material so that I can make up a paper on it.

I am very anxious too that the Franklin Institute should recognize the merit of this discovery and properly reward it. As a member of the Board of Managers I shall be very glad to do what I can toward this end. So that if you can make it convenient to come on either tomorrow or Thursday, there are several matters we can profitably talk over.

I am Professor of Physics in the University of Pennsylvania (Locust & 34th Sts.) and shall be glad to see you there when you come, or at my house, 408 S. 41st St.

Trusting that you may be able to run down here for a day and see us, I remain

Truly yours,
George F. Barker

T. A. Edison, Esq.

We know from a letter he wrote on November 8 to his father in Port Huron, Michigan, that Edison attended the session of the National Academy of Sciences and demonstrated his electromotograph. Although this discovery did not become very well known, its application several years later to the telegraph brought Edison $100,000, which he characteristically insisted on receiving at the rate of $6,000 a year for the 17-year life of the patent. This was his method of financing his research over a long period, for he knew if he received the money all at one time he would in all likelihood spend it much faster. About four years later another application of this electromotograph principle was made by Edison in his chalk telephone receiver. This brought him more than $100,000.

In the meantime, however, Edison had grown tired of the limitations imposed on him by his many manufacturing interests in Newark and had left these in the hands of associates, building himself a new laboratory at Menlo Park, New Jersey, where he could be away from the distractions of city life but at the same time approximately halfway between New York and Philadelphia. The construction of this laboratory, started in January 1876, seems to have strained his resources, and he was apparently somewhat short of cash until the invention of the phonograph in August 1877. Although it was at that time a very imperfect recording and reproducing instrument, it took the public fancy, and on April 18, 1878, Edison again was asked to demonstrate the new machine before a meeting of the National Academy of Sciences in Washington.

Edison persuaded his assistant, Charles Batchelor, to accompany him to Washington, and as they descended from the train, Edison wearing a new suit of checkered pattern (see cover), the two were met by Uriah Painter, well-known newspaper correspondent, bearing news that Gail Hamilton, niece of James G. Blaine, wanted the instrument brought to her apartment to show some of the prominent members of Congress and the diplomatic corps, and that later President Hayes wanted it demonstrated at the White House.

After breakfast at the Willard, they drove to the home of Joseph Henry, secretary of the Smithsonian Institution, and demonstrated the machine in his parlor. In the late afternoon they arrived at the meeting of the Academy, where a recording was made in which the speaking phonograph, as it was then called, expressed thanks for the honor of being requested to present itself before the Academy. After making the recording, Edison left the room and allowed the crank of the machine to be turned by his assistant to prevent a repetition of what had occurred at a demonstration of the machine before the French Academy, when several of the French scientists left the room in indignation because they believed they were being fooled by a ventriloquist. Edison's friend, Prof. Barker, followed with a paper describing Edison's achievement in transmitting speech over 140 miles by means of his carbon telephone transmitter and induction coil. It was nearly midnight when word came that President Hayes was ready to see the machine and nearly 3:00 A.M. before Edison left the White House.

As the warm weather of summer approached, Edison, who apparently showed signs of strain from not having had any relaxation for many years, was persuaded by Prof. Barker, no doubt with the assistance of Mrs. Edison, to take a real vacation. The scientific world was preparing several expeditions to observe an eclipse of the sun which was to occur on July 29, 1878, the path of totality crossing Wyoming and Texas. Of course, it was hard for Edison to justify taking a vacation without accomplishing something, so he took with him his recently developed microtasimeter—an instrument utilizing the varying pressures produced by the expansion of a hard rubber rod on a carbon microphone. In this way, extremely slight variations in temperature could be indicated electrically on the dial of a galvanometer. Prof. S. P. Langley, of Allegheny University, had suggested the device to Edison, and it is interesting to note that it was afterward superseded by Langley's Bolometer utilizing the varying electrical resistance of selenium for the same purpose.

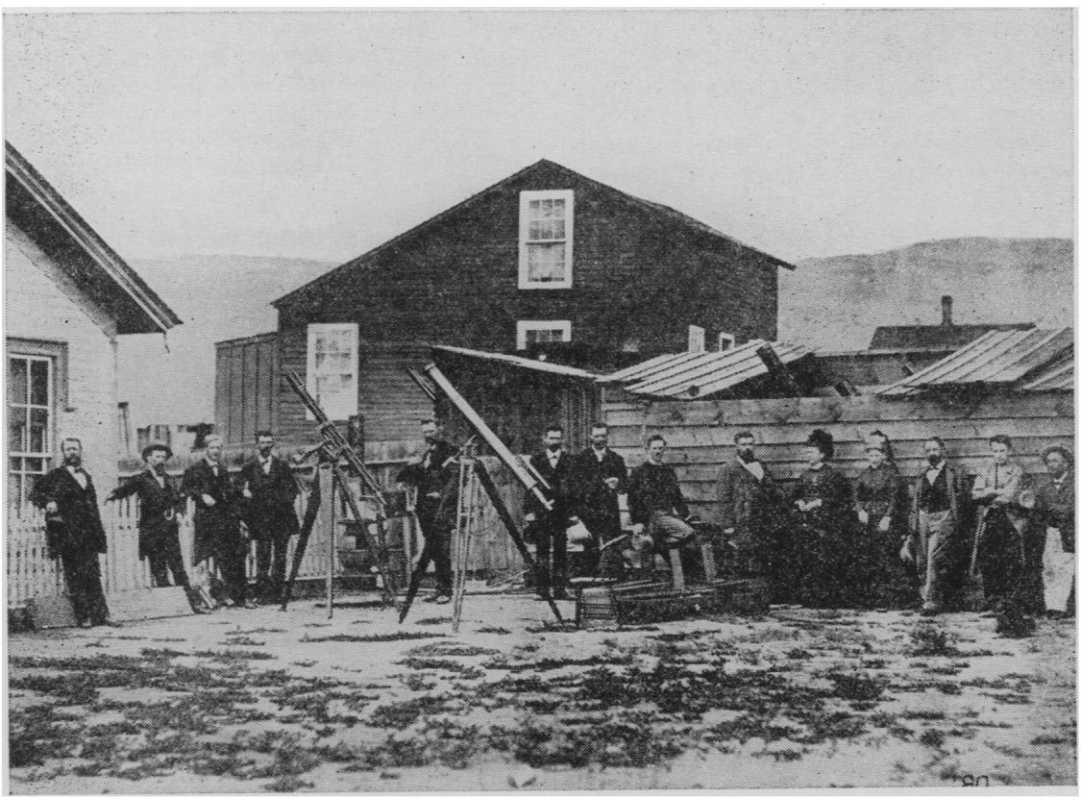
Edison left Menlo Park early in July, armed with the microtasimeter and also a pass obtained through the courtesy of Mr. Jay Gould, who then controlled the Union Pacific, allowing Edison to ride on the cowcatchers of the locomotives. We do not know whether Prof. Barker traveled with Edison, but he was one of the group that assembled at Rawlins, Wyoming. This group also included Prof. Henry Morton; Prof. James C. Watson, director of the observatory at Ann Arbor, and Mrs. Watson; Prof. Henry Draper, previously of New York University, and Mrs. Draper; and Prof. J. Norman Lockyer, British astronomer and founder of *Nature*.

Prof. Samuel P. Langley observed the same eclipse at Pikes Peak, Colorado, and Prof. Asaph Hall at La Junta, Colorado. Edison's roommate at Rawlins was Marshall Fox, correspondent of the New York *Herald*, who several years later was to scoop the world on announcement of the successful incandescent lamp.

The details of the various expeditions, all of which were successful, are covered in a large volume published by the U. S. Naval Observatory, but for our purposes this expedition was important because it stimulated Edison, through contacts and observations made on the trip, to a consideration of the many ways in which electricity could be utilized in opening this territory. Edison observed that there were vast regions so inadequately supplied with steam railroad facilities that it was necessary in many places to haul grain 200 miles or more by horse and wagon for shipment by railroad to the East. This observation resulted, on his return, in building of the first experimental electric railroad at Menlo Park to demonstrate the feasibility of electric railroads as a system of feeders for steam roads (see *Science*, 1880, p. 5).

There must have been many interesting conversations among the group and, after the immediate work of observing the eclipse was completed, Edison, with Prof. Barker, Major Thornberg, and several soldiers, went hunting in the Ute country about 100 miles south of the railroad. A few months later, the Major and 30 soldiers were ambushed near the spot at which the hunting party had camped, and all were killed.

Edison continued his trip West, visiting Virginia City and Yosemite, and meeting a few of his old cronies of telegraph days. He arrived at Yosemite about the middle of the afternoon, rode to the top of Glacier Point, went down the trail after dark, and started for Mariposa the next morning, proudly asserting that only one man had beaten his time—Horace Greeley. Greeley reached the valley after dark and left it before daylight.



The Draper Eclipse Expedition. Left to right: George F. Barker, University of Pennsylvania, editor of the *Journal of the Franklin Institute*; Robert M. Galbraith, master mechanic, Union Pacific Railroad; Henry Morton, president, Stevens Institute; —— Bloomfield; —— Meyers; D. H. Talbot, Sioux City; M. F. Rae; Marshall Fox, New York *Herald* correspondent; James C. Watson; Mrs. A. H. Watson; Mrs. Henry Draper; Henry Draper; Thomas A. Edison; and J. Norman Lockyer, editor of *Nature*, London.

Edison was much impressed by the difficulty experienced by miners in drilling and boring. Watching them, he turned to Prof. Barker and asked: "Why can't the power of that river be transmitted to these men by electricity?" On the way home across the plains, the idea grew on him and, in discussing it with Prof. Barker, plans were made to visit the latter's friend, William Wallace, a

manufacturer of electric dynamos and arc lights, at Ansonia, Connecticut.

The party arrived home late in August, and on September 8, Prof. Barker, Prof. Charles Frederick Chandler of Columbia University, and Edison went to Ansonia. In their honor Wallace had connected his most recent dynamo and lighted eight arc lamps. Edison was greatly interested and went from one apparatus to the other, making calculations of the power of the machines and amount of light produced. Before leaving, he said to Wallace: "I believe I can beat you making electric lights. I don't think you are working in the right direction."

On his return to Menlo Park, everything else, including the phonograph, was tossed aside, and he started a thorough investigation of illumination by gas. He made a careful survey of a number of gas lights in every building in several blocks of New York City and the length of time each light was burned. [This is one of the first market surveys on record. Ed.] His object was to produce an electric lighting system which would have the simplicity of gas and be capable of general distribution and adaptable to all requirements of natural, artificial, and commercial conditions. It was necessary that the lamp be simple and light in weight, cheaper than gas, noiseless and inoffensive, and distinguishable from all previous types of electrical illumination in that it must be possible to turn each light on and off individually. In fact, this was the real problem in his system of lighting, and was known in scientific circles at that time as the problem of "subdivision of the current."

From this time on things moved speedily. Edison's friend and legal adviser, Grosvenor P. Lowrey, arranged for the necessary financial backing for incorporation, on October 24, 1878, of the Edison Electric Light Company. The corporation was a Wall Street organization and contained among its list of incorporators several of the firm of J. Pierpont Morgan and Company. Half of the $300,000 capital was made available to Edison to equip his laboratory for investigation. Three days short of a year from this date the first successful incandescent lamp burned out its 40 hours of life at Menlo Park. In the December 21, 1879 issue of the New York *Herald*, a full-page article by Marshall Fox announced the successful lamp to the world.

During this year, Edison not only solved the problems connected with the lamp but also produced the first electric generator with an efficiency exceeding 50 per cent. The efficiency of the 1879 generator was rated at over 90 per cent. Technicians had assured Edison that an efficiency of over 50 per cent was theoretically impossible, just as scientists of England had testified before a parliamentary investigating committee that it was impossible for Edison to solve the problem of subdivision of current. The only known exception among the scientists was Prof. John Tyndall, who, in his address on the electric light before the Royal Institution on January 17, 1879, gave evidence of a thorough understanding of the relationship between the pure scientist and the inventor when he said:

> It was my custom some years ago, whenever I needed a new and complicated instrument, to sit down beside its proposed constructor, and to talk the matter over with him. The study of the inventor's mind which this habit opened out was always of the highest interest to me. I particularly well remember the impression made upon me on such occasions by the late Mr. Becker, a philosophical instrument maker in Lambeth. This man's life was a struggle, and the reason of it was not far to seek. No matter how commercially lucrative the work upon which he was engaged might be, he would instantly turn aside from it to seize and realize the ideas of a scientific man. He had an inventor's power, and an inventor's delight in its exercise. The late Mr. Becker possessed the same power in a very considerable degree. On the Continent, Froment, Breguet, Sauerwald, and others might be mentioned as eminent instances of ability of this kind. Such minds resemble a liquid on the point of crystallization. Stirred by a hint, crystals of constructive thought immediately shoot through them. That Mr. Edison possesses this intuitive power in no common measure is proved by what he has already accomplished. He has the penetration to seize the relationship of facts and principles, and the art to reduce them to novel and concrete combinations. Hence, though he has thus far accomplished nothing that we can recognize as new in relation to the electric light, an adverse opinion as to his ability to solve the complicated problem on which he is engaged would be unwarranted. . . . Knowing something of the intricacy of the practical problem, I should certainly prefer seeing it in Mr. Edison's hands to having it in mine.

Had Edison been greatly impressed by the statements of well-recognized authorities, he would perhaps never have continued his experiments on distribution of electricity for light and power, but he had a firm hold on general principles and was perhaps luckily unaware of some details which seemed to indicate to more theoretical minds that the problem could not be solved. One of his favorite observations was that when he started to work on a problem he was told it could not be done, and after the problem was solved many people claimed priority.

Marshall Fox's article in the New York *Herald*, December 21, 1879, announced that on December 31 Edison would give a public demonstration of the light at Menlo Park. The announcement apparently put the Laboratory on a spot, for there was a great deal of rushing around in preparation for the exhibit scheduled in 10 days. However, on that New Year's Eve, everything was ready. Special trains were run to Menlo from New York and Philadelphia, and those who visited the demonstration considered it well worth their time. It is regrettable that no registry was kept of the visitors, but we know that many prominent people were there.

The filaments used in this demonstration were carbonized cardboard filaments, whereas that used in the original lamp was a carbonized sewing thread. Still, Edison did not believe he had the best possible form of

carbon for his lamps. Early in 1880 he hit on the idea of using bamboo, as this was one of the few substances in nature with a perfectly straight grain long enough to be used as a filament, and he immediately instituted a search throughout the world to find the best possible bamboo fiber for the purpose.

During this year he also introduced new and more efficient generators and worked on the design of meters, fuses, sockets, switches, electrical conductors, and many other items necessary for installing lighting in the first district of New York.

The cost of the electric light was a foremost question. Edison was asked this question many times every day, and, since whatever he or his mathematician, Francis Upton, said was immediately pounced upon by other mathematicians and proved wrong, the inventor invited his friend, Prof. Barker, and three other scientists to visit the Laboratory, measure the lamp, and give an unbiased report. The favorable verdict was presented to the world by Prof. Barker in a lecture before the Franklin Institute, Philadelphia, March 24, 1880.

In May of this year, the first commercial installation of Edison's light was made on the steamship *Columbia*, which pessimists predicted would burn before it rounded Cape Horn. However, the original installation, with no changes other than the replacement of lamps, remained in satisfactory operation for 15 years.

In the meantime Edison's assistants at Menlo had been laying track and designing engine and cars for the first electric railroad, which went into operation May 13.

Also, many installations were made in local hotels, theaters, and private mansions at this time. These were known as isolated stations as contrasted with central stations for commercial distribution.

The Edison Electric Light Company wanted to remain simply a holder of patents and licensor of installations of the Edison system, and not go into manufacturing. For manufacture of machines and tools as well as lamps the Edison Lamp Works was established at Menlo Park on October 1, 1880, and a year later moved to Harrison, New Jersey, present location of the General Electric Company's plant. Most electric fixtures, such as sockets, switches, and chandeliers, were made by one of Edison's old Newark associates, Sigmund Bergmann, in his shop at 17th Street and Avenue B, New York. For manufacture of underground conductors, a plant known as the Electric Tube Company was set up at 65 Washington Street.

The early dynamos and motors were made at Menlo Park, but with the Jumbo dynamo, facilities at Menlo were soon overstrained, so in the early part of March 1881, Edison and his newly-arrived secretary from England, Samuel Insull, leased for the Edison Machine Works the plant of the Aetna Iron Works, 104 Goerck Street, New York. It was here the Jumbo dynamos were made for subsequent central stations. These machines were the first electrical generators directly connected on the same shaft with the steam engine which drove them, and it was necessary to have a steam engine especially designed by the firm of Armington and Sims. Total weight of dynamo and engine was over 30 tons. The first of these dynamos was shipped to the Paris Exposition of 1881.

On October 21, 1881, exactly two years after birth of the first successful lamp, the Conservatory of Music in Paris was crowded with a distinguished gathering of officials, jurors, commissioners, cabinet ministers, exhibitors, and the general populace, to witness the awards of the Paris Exposition. Edison's first knowledge of his sweeping victory came by cable: "Official list published today shows you in highest class of inventors. No other exhibitor of electric light in that class. Swan, Lane-Fox, and Maxim received medals in class below. The sub-jury had voted you five gold medals but General Congress promoted you to the Diploma of Honor. This is complete success, the Congress having nothing higher to give."

This was followed by a cable from Prof. Barker, United States representative on the Commission of Judges, who nearly a year previously deserted Edison and said of Maxim: "For years I have been an admirer of Edison's search for the true solution of the electric light problem, and I can testify to the unremitting energy and exhaustive nature of his search, but another man found it." In contrast with this statement, his cable from Paris read as follows: "Accept my congratulations. You have distanced all competitors and obtained a Diploma of Honor, the highest award given in the Exposition. No person in any class in which you were an exhibitor received a like award."

Although we have covered only a few years of Edison's life, they were extremely active, and the nature and quantity of work demanding his attention during the inception of *Science* show why he was able to give little attention to its editorial policy and why most of the correspondence and business was carried on by his assistants, Samuel Insull and S. L. Griffin.

I believe Edison's agreement to finance the magazine for a short period is explained by a philosophy he developed at the time of his first invention, for which there was no demand. From that time he determined never to waste time and energy on a thing not commercially needed, and he believed definite need for a project would insure its success.

One of the early letters relating to *Science* stated it was to fill the place in this country served by the magazine *Nature* in England, and it is perhaps worth while to note that Prof. J. Norman Lockyer, who was on the Eclipse Expedition, was founder of *Nature* and its editor for many years. There is, therefore, a possibility that some of the conversations on this vacation trip were responsible for the origin of *Science*.