Edison: Synagogues

Edison temple to celebrate 30th anniversary in 1991

Edison Twp. Pub. Library
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Before present synagogue was built, congregation met in church building

By David C. Sheehan

EDISON — There is a verse in the Book of Exodus which reads, "and let them make me a sanctuary that I may dwell among them."

To many Edison residents, this was something more than a passage from the Old Testament. It posed a challenge and an opportunity to form Edison's first Reform synagogue.

This challenge was taken up by seven area families who were discouraged that the rapidly growing community of Edison had no Reform congregation or temple.

In early 1961, Rabbi Albert Baum of the New Congregations Department of the Union of American Hebrew Congregations met with local families at the Edison home of Mr. and Mrs. Marvin Rosmarin. Records show that "representatives of the families of Neal Bregman, Bernard Effman, Richard Ellner, Roy Kern, Herbert Pine and Jesse Taub" were in attendance, and Rosmarin was selected as the congregation's first president.

Evidence of the need and support for a Reform congregation became apparent. From the energy generated at the July 1961 meeting of seven families, the congregation burgeoned into a "going congregation" of 75 families.

"Temple Emanu-El was the right idea at the right time and at the right place," said Rosmarin. "Our congregation was envisioned as the Reform/liberal alternative for those Jews seeking a meaningful, modern religious experience. In the space of a few months we went from a handful of prospective members to a congregation with full High Holiday services."

St. Stephen's Evangelical Lutheran Church in the Clara Barton section of the township made its Fellowship Hall available to Temple Emanu-El for its services and, thus, on August 25, 1961, Temple Emanu-El held its first service.

In attendance were the Rev. K. Kirkegaard Jensen, pastor of St. Stephen's, and the late Mayor Anthony Yelencsics, who welcomed the new congregation to Edison. Later, in 1962, the mayor and his wife presented the temple with a gift of *rimonim* — silver Torah crowns.

After the first service, *oneg shabbat*, a sabbath reception, was sponsored and hosted by the Rosmarins. A new congregation had been born.

Shortly after the first services, the temple's sisterhood was formed, consisting of 12 women. The sisterhood grew rapidly.

Still, with no permanent structure to call their home, congregants and organizations of the new temple met throughout the township — "the Fords Firehouse, the Fords Junior High, Clara Barton Elementary and the Wellsley Methodist Church" are listed in the temple's history as places where they met.

The congregation used St. Stephen's Fellowship Hall, Pleasant Avenue, and held services there regularly, but, before long, the congregation grew from 75 to more than 175 families, and Fellowship Hall became inadequate to serve the needs of Temple Emanu-El.

Thus, the congregation purchased the now-unused St. Stephen's Lutheran Church. St. Stephen's, too, had outgrown its Pleasant Avenue building and built its current church building near Grandview Avenue.

In 1963, Rabbi Paul Levenson assumed the duties of full-time rabbi, and in 1964, William Rabin became president of the congregation.

In 1966, Rabbi Abraham Sheingold assumed the pulpit, and Roy Kern, the presidency. It also was in that year that an architect was retained, contracts were signed and slightly more than 4 acres of land was purchased from Edison Township on James Street. Temple Emanu-El was well on its way to having a permanent home.

Interestingly, while the new temple was yet under construction, 1968's *Selichot* services were held by the congregation within the framework of the floorless and roofless structure. The temple's 25th Anniversary history notes, "our candlelight brightened the night."

It was also at that time that the temple's current rabbi, Alfred Landsberg, joined the congregation. It was in 1968, too, that Bernice and Marvin Rosmarin purchased a Holocaust Torah from the Westminster Synagogue, London, England.

These sacred scrolls had been captured by the Nazis in World War II and were, for more than 20 years, hidden and forgotten in a Nazi "museum" in Prague, Czechoslovakia. According to published reports, "When the Nazis marched across Europe in World War II, they burned synagogues along their way and destroyed and desecrated prayer books and other items of the Jewish ritual."

—Photo by Thomas R. DeCaro

Construction of Temple Emanu-El, located on James Street across from John F. Kennedy Medical Center, began in 1968, but the Edison congregation was formed seven years earlier by seven local families.

"They had some sort of weird notion," Sheingold was reported as saying, "of setting up a museum — I guess to show what they had done. They save a lot of scrolls that way."

The report continues: "From throughout Central and Eastern Europe, many of the Jewish ritual objects were sent to Prague where they were assembled at a special museum. There is no indication of where the synagogue's Torah originated.

"Torahs are made of parchment and wrapped around two wooden poles or rollers. The text of the Torah must be letter-perfect. A Torah with two scribbal errors may not be used in worship," the report concludes.

The James Street synagogue is a contemporary structure composed of natural, exposed cedar and block. The interior is open, airy and made of natural materials as well.

Two sections of 10 rows of pews facing the bema and a large modern brass "eternal flame" sculpture are the dominant characteristics of the sanctuary. The rooms are described as "flexible" in that there are movable, accordion-like walls throughout. Meeting rooms, classrooms, a kitchen and offices complete the structure.

The year 1970 saw the first holiday service celebrated at Temple Emanu-El. That year was notable also in that Fran Tillis was elected president — the first woman president of a congregation in the state and the second woman to hold the office in the country. It was also 1970 that the school annex was completed at the James Street site.

Temple Emanu-El, from its start, has been an active, contributing member of the Edison Township community. Temple Seders have been held for residents of Woodbridge State School, and the temple has made its mark also in its care for the homeless and hungry, its Men's Club blood drives and its many other projects.

Next year will mark the 30th anniversary of the Temple Emanu-El. And while 30 years may well be compared to the blink of an eye when contrasted to the thousands of years of Jewish history, it can be said that Temple Emanu-El and its congregants have made significant, long-lasting contributions to the spiritual, cultural and architectural history and heritage of Edison.

David C. Sheehan is president and co-founder of the Edison Township Historical Society, and this article is one in a series by society members on the history of the area.

Edison: Synagogues

Review 11/16/90

Organized in 1952, congregation stays active

By David C. Sheehan

EDISON — One of the most evident threads that runs through the history of the township and the churches and synagogues that serve its residents is a spirit of community, helpfulness, neighborhood and ecumenism.

The examples of it are many.

Temple Emanu-El, now on James Street, held many of its first worship services in Fellowship Hall of St. Stephen's Lutheran Church. The congregation held other services and functions in the Raritan Engine Company No. 2 firehouse and in Wesley Methodist Church. Eventually, Temple Emanu-El was able to construct its present sanctuary on land purchased from the township.

Following a destructive fire at Wesley Methodist Church, Temple Emanu-El made the generous loan of its organ so that Wesley Methodist could continue to accompany its Sunday services with music.

St. Matthew's Roman Catholic Church conducted some of its first worship services in such diverse locations as Stelton School's auditorium, St. Margaret Mary's Church in Bonhamtown, St. Francis Church in Metuchen, the Linwood Ballroom and even in the Westinghouse plant's cafeteria. And its first efforts to establish a religious education program was assisted by nuns from neighboring St. Paul's Church in Highland Park.

The Edison Jewish Community Center, Temple Beth-El, is no exception to this tradition of neighborliness, generosity and cooperation by the citizens and businesses of Edison.

Temple records indicate that the then "Raritan Township Jewish Community Center, composed of married couples in their 30s was formally organized in the month of June" 1952.

"The congregation was formed in New Brunswick on Liberty Street by about 12 families from the Old Post Homes development," the records continue. In 1953, the temple's sisterhood was organized "and their meetings were held in the cafeteria of St. Matthew's School. Sunday School classes that year were conducted at Lincoln School."

Religious services of the congregation were held at such diverse places as Raritan Engine Company No. 1, Raritan Engine Company No. 2 and, like St. Matthew's Roman Catholic Church had done, at the Linwood Grove Ballroom.

The Edison Jewish Community Center in 1954 held High Holy Days services in the Italian-American Club, and in 1955 "these religious services were conducted in a needle factory building on Route 27 and Plainfield Avenue and at the auto workers' union hall on Vineyard Road."

It became obvious to the congregants of Temple Beth-El that "the congregation could not long exist without a building to house its many functions."

Accordingly, the new congregation acquired land in 1954 on Jefferson Boulevard, and construction of the temple began the following year.

Still, involvement by various groups within the township did not end with the successful completion of the new sanctuary. For instance, according to the temple's history, "Father James Duffy of St. Matthew's Catholic Church opened his parish building to projects for raising funds."

Many original members of the congregation, including "Warren Wilentz, Leonard Berg, Herbert Tanzman and Herman Breitkopf worked on committees for these fund raising projects."

Reflecting the youth of the congregants themselves and the newness of their house of worship, it was fitting that Edison's newest congregation chose as their "first religious leader, Rabbi Sladowsky (who) was hired in 1956 at the age of 24 years."

Other milestone years for the temple include 1957, when the temple's first Torah was received as a gift from Mr. and Mrs. Manuel Freeman; 1958, when the congregation adopted its current name, Edison Jewish Community Center, Congregation Beth-El; and 1959, when the rabbi's home was built on Redwood Avenue.

The original Jefferson Boulevard structure was designed by architect Ernest Levine, and ground-breaking ceremonies were conducted on September 26, 1955. An addition, which was necessary for the growing religious community, was designed by John MacWilliams, and ground was broken for it in April 1967.

The addition provided 75,000 square feet of classrooms, a kitchen, offices and meeting rooms to the original contemporary-style building.

A second Torah was donated to the congregation by Dr. and Mrs. Kallman and Dr. and Mrs. Eugene Trachtenberg. Mr. and Mrs. Radowitz, presented the temple with three Torahs which originally were "part of the Harrison Jewish Community Center, no longer in existence."

The temple today is an active place. A sisterhood, a men's club and various committees help to maintain the congregation's busy schedule. A testament to the congregation's dedication and devotion to its town is evident in the number of the founding members who still worship at the Edison Jewish Community Center, Congregation Beth-El.

Construction on Congregation Beth-El's synagogue, Jefferson Boulevard, Edison, began in 1955, three years after the congregation was organized by about 12 families from the Old Post Homes development.

Many have witnessed the growth of Edison from a sparsely populated, rural collection of incohesive neighborhoods and villages into a prosperous population and industrial center — ranking now as the sixth largest municipality in New Jersey.

With that growth, the spirit of community and neighborhood presumably would fall victim to that growth. Belying that theory, however, is this collection of histories which makes evident that the fact that neighbor knows neighbor and the citizens of this township care about and care for each other. The township's many civic and cultural organizations and volunteer and career emergency service organizations are examples of the concern and spirit of sharing present in the township.

The Edison Jewish Community Center, Congregation Beth-El, has both received and bestowed this same spirit during its near four-decade history in Edison.

David C. Sheehan is president and co-founder of the Edison Township Historical Society, and this is one in a series by society members on the history of the area.

EDISON, Thomas A.
1979

THE WEEK IN REVIEW

"ASK AT DESK"

ANNIVERSARY

Tom Edison's power play

HE WAS a scruffy, contentious punk from the Midwest who went to work at the age of 12 but couldn't keep a job.

Brilliant and obtuse, charming and irascible, profane and profound, yet almost childlike in his innocence.

He despised cigarettes but chewed tobacco incessantly — a bulging cheek his trademark — and smoked 20 cigars a day for most of his 84 years.

A nervy boy, he managed to become a millionaire in his 30s, but he couldn't manage money.

All this was Thomas Alva Edison.

One hundred years ago next week, Edison flipped a switch in rural New Jersey, turning on a new way of life for the world.

Never mind that the real date is lost in history, somewhere in that maze of fact and fantasy.

That he was a lousy money manager was obvious, especially to his wife Mary. However much he earned, he spent more, not on luxuries but on an old curiosity shop of lab equipment.

At 28 he abandoned high-rent Newark in favor of a hilltop farm in nearby Menlo Park.

Edison's habitat had changed, but his habits hadn't. He still spent money. When he slept, it was often at odd hours, often on crumpled up newspapers beneath a stairway crawl space.

No wonder then that with his Victorian aversion to water — he believed that taking off one's clothes changed the body chemistry and induced insomnia — his wife often barred him from their bed.

But Edison had two things going for him — practicality, and checkbooks of the likes of Jay Gould and the Vanderbilts.

He raised eyebrows by forming the Edison Electric Company a year before he actually produced a working light bulb. He used the proceeds to develop one.

Not quite 31, and Edison was "the Napoleon of Science" with 116 patents to his credit. At his death in 1931 the Wizard of Menlo Park had 1093 patents — no one has ever topped that — including the phonograph, which was scorned by some as a ventriloquist's trick.

Thomas Alva Edison at his work-desk.

He was a mechanical artist without equal. He disdained time. Many nights he sat, like a meditating alchemist, at a table in the rear of his lab, a single gas jet playing over his features.

Work didn't mean a thing to Edison, for as he confided: "We're here to turn night into day."

"My light is perfected," Edison would exclaim on New Year's Eve 1879, as he watched 300 pilgrims drawn to town by the soft yellow-orange beacons in his lab, the railroad station, and half a dozen houses.

Edison captured imaginations of everyone, everywhere. In a century of invention he was the acknowledged master of them all.

October 20, 1929. Herbert Hoover, in office only seven months, steamed west in his Presidential train to Dearborn, Michigan, for *the* event of the year — 50th anniversary of that day the lights first went on.

All over the world, electric signs proclaimed the occasion. In Edison's birthplace of Milan, Ohio, his picture hung in just about every window in town.

"Amazing," Edison would say with difficulty — not age, just the ever-present tobacco plug — as he inspected his old lab which Henry Ford had moved to Greenfield Village, spit stains and all. "Why, he's even got the goddamned Jersey clay here."

Edison watched intently as a boy hawked papers at the depot. He recalled his own childhood vendor days on the Grand Trunk Railroad run to Detroit, and when the boy put down his basket, Edison picked it up and began shouting: "Candy! Apples! Chewing Gum!"

Caught by the spirit, Hoover gave Edison a quarter. A week later the Stock Market would crash and the apple would be the nickel road to survival for many Americans. Two more years and Hoover was poised to walk into oblivion; Edison into the neon of a world's eternal gratitude.

Chemistry

SEPTEMBER 1970

Thomas Edison:

Thomas Edison often said that chemistry was his favorite subject. He was not a specialist, but had skills in all fields of science and engineering. He did little in the way of scientific publishing and lecturing. However, the disclosures in his patents, as well as the technology which went into the multitude of new things he developed, are ample evidence that he was an able and successful chemist.

Thomas Edison was born February 11, 1847, in Milan, Ohio. The family moved in 1854 to Port Huron, Mich., where his formal education began at the age of eight. The schoolmaster considered Thomas too backward to learn; so his mother removed him from school and taught him herself. He soon became a rapid and ardent reader and, by the age of nine, had found that science was his favorite subject. In 1859, a railroad opened between Port Huron and Detroit, and Thomas got the job as newsboy and general salesman of miscellaneous items on the daily train leaving at 7 a.m. and returning at 9:30 p.m. His job on the train, plus an hour each way with horse and cart to get from his home to the station, constituted a 16½-hour working day. Obviously, he was past any help from his mother with his education. However, he was already on the road to self-education: An eight-hour layover in Detroit allowed him time in the public library, where he read the books shelf by shelf, and in the railway repair shops the congenial men answered his many questions and at times let him operate some of the machines.

At the age of 10, Thomas started to accumulate a chemistry set; at one time it consisted of 200 bottles of materials, as well as various kinds of wire, wet batteries, and telegraph instruments which he had built himself. While a newsboy, he learned the art of sending and receiving messages by the Morse code, and in 1863 became a telegraph operator at Port Huron. This vocation supported him in many cities in the Midwest, his frequent moves resulting from his inability to hold a job—he would neglect duties in order to read and experiment with batteries and equipment. However, by 1871, he was succeeding in Newark, N. J., as a manufacturer of telegraph equipment, and inventing, as time permitted.

In 1876, he decided to concentrate on research and development and had his father, a none-too-prosperous carpenter, build a laboratory structure at Menlo Park, N. J. This spacious wooden two-story building was the first industrial research laboratory in the United States. The second floor was devoted to bench-scale-type work. About 1400 bottles of chemicals and natural products were on shelves along most of the wall space.

Edison's improvements of the telegraph and telephone, plus his electric light invention, resulted in sufficient income for him to establish bigger and better laboratory quarters at West Orange, N. J., in 1887. This installation, now a National Historic Site, included four one-story brick laboratory buildings, each 100 × 25 feet, one of which was devoted entirely to chemistry. The main building, 250 × 50 feet, had three stories.

At both Menlo Park and West Orange, Edison pioneered the concept of the modern chemical research laboratory, with organized technical investigations backed up with expert mechanics and machinists, glass-blowers,

Courtesy Smithsonian Institution

Edison's phonograph

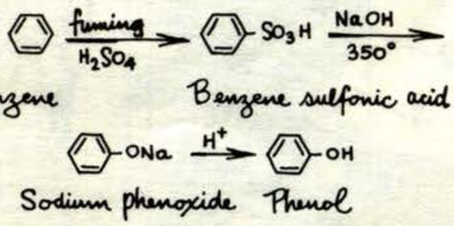
Pioneer of Applied Chemistry

Byron M. Vanderbilt,
Scotch Plains, N.J.

supplies for all operations, a staffed library, a patent department, and a clerical staff. The stockroom at West Orange probably had the most varied and complete inventory of chemicals and accessory materials (said to be 8000 items) of any laboratory in the world at that time. As for his shop, Edison boasted that he could make anything from a lady's watch to a locomotive.

Chemical Industry's Status

In the late 19th century there was only a limited U. S. inorganic chemical industry—only heavy chemicals were made. Organic chemical manufacturing was largely nonexistent, except for minor operations of recovering chemicals from natural products, such as glycerin from the saponification of fats. Although the steel industry produced coke, there was no plant for recovery of coal tar chemicals from the coke oven gases. Thus, simple compounds like benzene and toluene were not produced in the U. S. Chemicals in general, and organic chemicals in particular, were imported primarily from Germany and England. The British embargo and blockade shut off such supplies in the fall of 1914. Edison moved rapidly to manufacture several organic chemicals for his own use and synthesized phenol via the sulfonation-caustic fusion route, which was the first successful manufacture of synthetic phenol in the U. S.



Edison manufactured nitrobenzene, aniline, para-aminophenol, and phenylene diamine (margin). In cooperation with several steel companies, he set up plants to recover benzene, toluene, and other coal tar chemicals from coking operations. In 1917 to 1918, when the various chemicals became available from chemical manufacturers, Edison shut down his improvised chemical plants.

The only plastic commercially available during Edison's time was celluloid, a nitrated cellulose plasticized with camphor. The only elastomer was natural rubber, and it was of low quality because the only source was wild *Hevea* trees growing in the tropical areas of South America and Africa. Resins were from natural sources only.

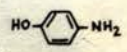
Industrial research chemists did not exist before 1900 and the few chemists who worked in industry were routine analysts. Graduates in chemistry went primarily into teaching and those seeking graduate study usually went to Germany. In 1876, the American Chemical Society was organized by a handful of academic people but the Society did not concern itself with applied chemistry until 1909, when publication of *Industrial and Engineering Chemistry* was initiated.

Chemistry in Developing the Electric Light

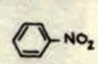
Edison's developments were of a highly varied nature, ranging from preserving food in vacuum to the design of massive roller mills for crushing ores. The two inventions usually considered his greatest were the electric light and the phonograph. His development of the incandescent light illustrates the part which chemistry played in one of his inventions.

Edison was a latecomer in the search to develop a practical electric light for indoor lighting. When he began work in September 1878, carbon arc lights were already sputtering at certain outdoor locations. In April 1879, Charles Brush installed 12 arc lights on 18-foot posts for lighting a thoroughfare in Cleveland. Incandescent lights using metal wires and carbon strips and rods were being worked on by others.

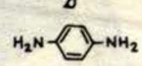
After diligent study, Edison concluded that the road to success in subdividing the electric current, so that it could be delivered to customers as was gas, lay in the use of high-resistance incandescent lights wired in parallel. Adequate current in large feeder lines would provide constant pressure—voltage, so that all lamps, regardless of distance from the source, would be supplied current on a comparable basis.



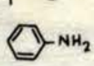
Para-aminophenol



Nitrobenzene



Para-phenylenediamine



Aniline

Although dozens of new devices had to be worked out to make Edison's projected lighting system a success, the most crucial was the light itself—the heart of which was the heating element. Edison realized that to get an incandescent element of 100- to 500-ohms resistance, he had to use a poor conductor of thread-like dimensions. Platinum wires of different thicknesses and lengths were studied, using a direct current of 110 volts. However, the melting point of platinum was too close to the temperature at which the wire gave adequate light to be practical. Development of a device to shut off the current, before melting the platinum, proved impractical as did coating the platinum wire with various oxides, such as that of zirconium. While working with platinum filaments, Edison realized that after current had passed through such a wire, it became more brittle and could be heated to a higher temperature before melting. He interpreted this to mean that dissolved gases were being driven from the platinum.

Edison then studied the intermittent heating and cooling of platinum wires in vacuo which resulted in the preparation of improved filaments. The conventional vacuum pump was the plunger type with valves. To study the effect of a more perfect vacuum in the preparation and use of incandescent filaments, Edison took steps to get a Sprengel pump (see below). This German-made pump is based on the principle of mercury flowing down a long Y-tube with one arm of the Y connected to the tube to be evacuated. Fortunately, he learned that such a pump had recently been received at the College of New Jersey (now Princeton University), and borrowed it. Its use resulted in filaments of platinum lasting several hours before failing.

Edison then tried a highly evacuated glass bulb which meant that the inlet and outlet wires had to be tightly sealed within the glass, and that metal and glass of like degrees of thermal expansion and contraction had to be used. Use of platinum wires (14 mils in diameter) and a white lead glass obtained from the Eimer and Amend Co. met this requirement. Edison's original idea was that the glass base containing the incandescent unit would fit into the light bulb by means of a ground glass joint. Thus, when the lamp failed, it would be returned to the central lighting company and the filament replaced. The decision to use a permanent high-vacuum lamp meant that the glass bulb had to be sealed into one piece. In that way, the light would be discarded once the filament failed. This was a daring decision to make because the ultimate cost of manufacturing a successful lamp was unknown.

In spite of the improved vacuum obtained with the Sprengel pump, which was as low as one-millionth of an atmosphere, Edison found that platinum filament lights which would "burn" more than a few hours could not be made. Use of chromium, nickel, molybdenum, osmium, boron, and silicon gave even less promising results. The high melting point and stable properties of tungsten were known, but it was too brittle to be fabricated. Edison then turned to carbon, reasoning that use of an excellent vacuum would not allow it to burn to any degree; and that in a vacuum, no convection gas currents would be present to hasten the physical disintegration of the fragile filament. Although it was known that carbon could be heated to a red heat without mass sublimation, it was not known whether carbon as a thin filament could be heated to a white heat in a vacuum without sublimation and overall disintegration.

Edison's first successful experimental light was with a carbonized cotton thread. The ends of a thread, of proper length, were first adjoined to short pieces of platinum wire. The thread was then bent into a U shape, and placed in powdered carbon in an earthenware crucible and the lid cemented on with fire clay. Then it was placed in a muffle furnace and slowly raised to maximum temperature—about 800° C. After heating several hours, the crucible was removed and allowed to cool slowly. One of the most difficult operations in

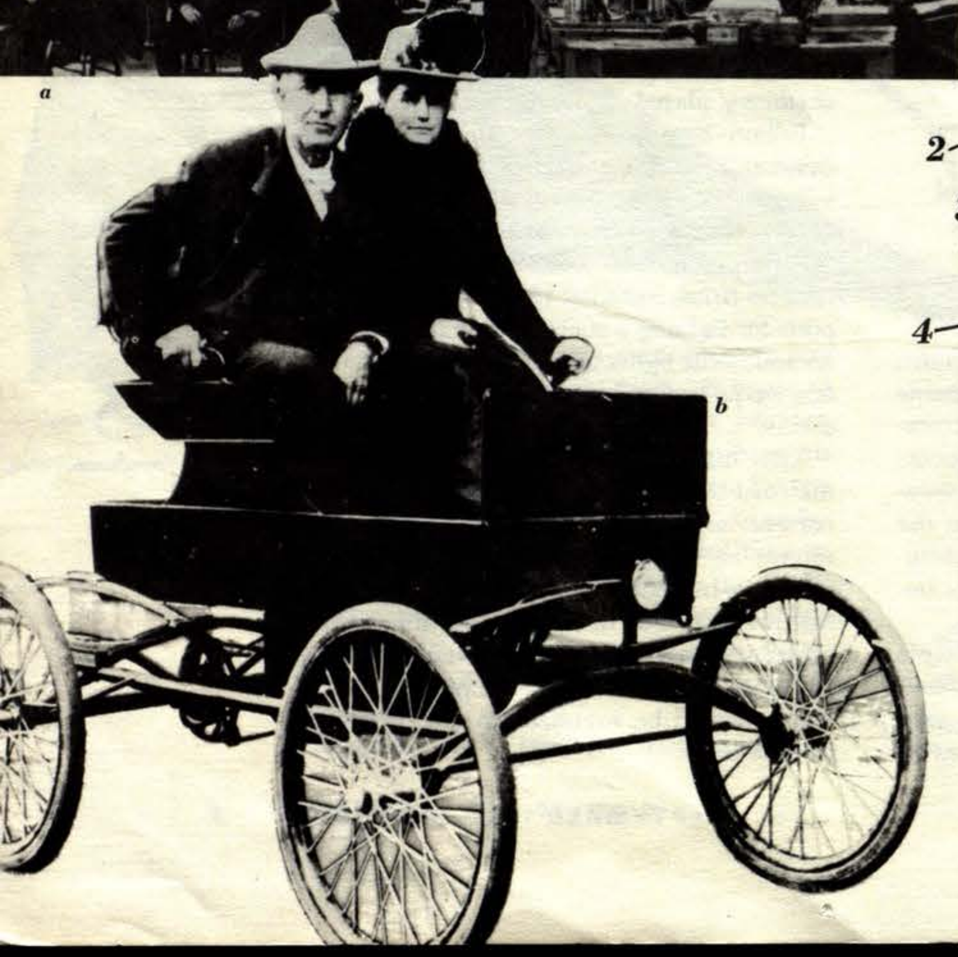
a, Upstairs room of Menlo Park laboratory. Organ, a gift to Edison (center, wearing cap), provided music for group singing of late workers following a midnight meal
Courtesy National Park Service

b, Edison in one of the first electric runabouts

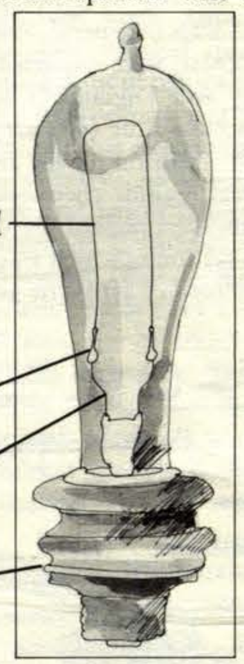
c, Type of lamp first used in commercial installations

d, Sprengel pump

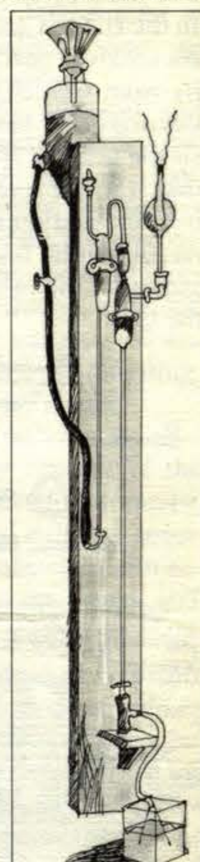
a



b



1, carbon filament;
2, platinum clamps;
3, platinum wire;
4, wooden screw base
c



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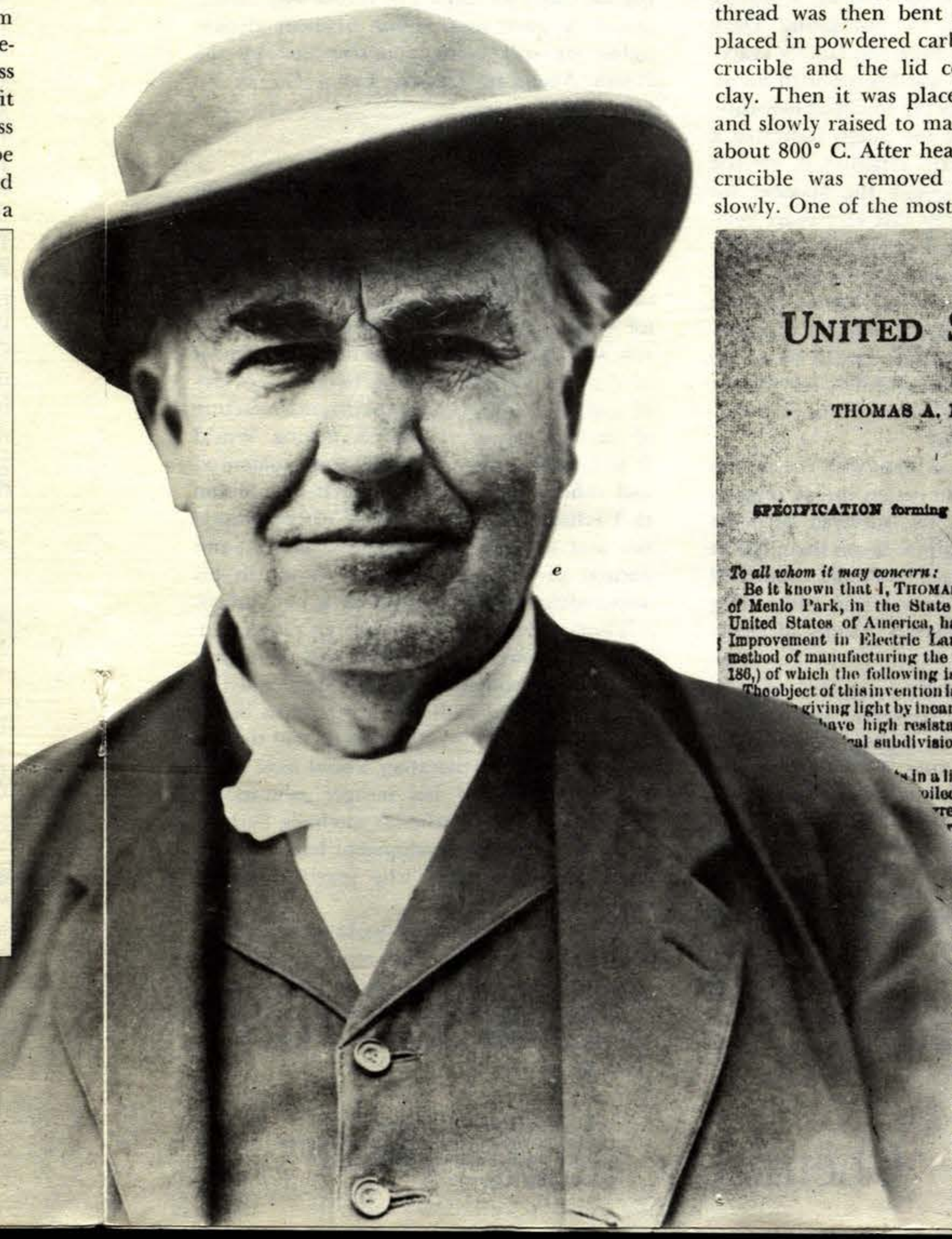
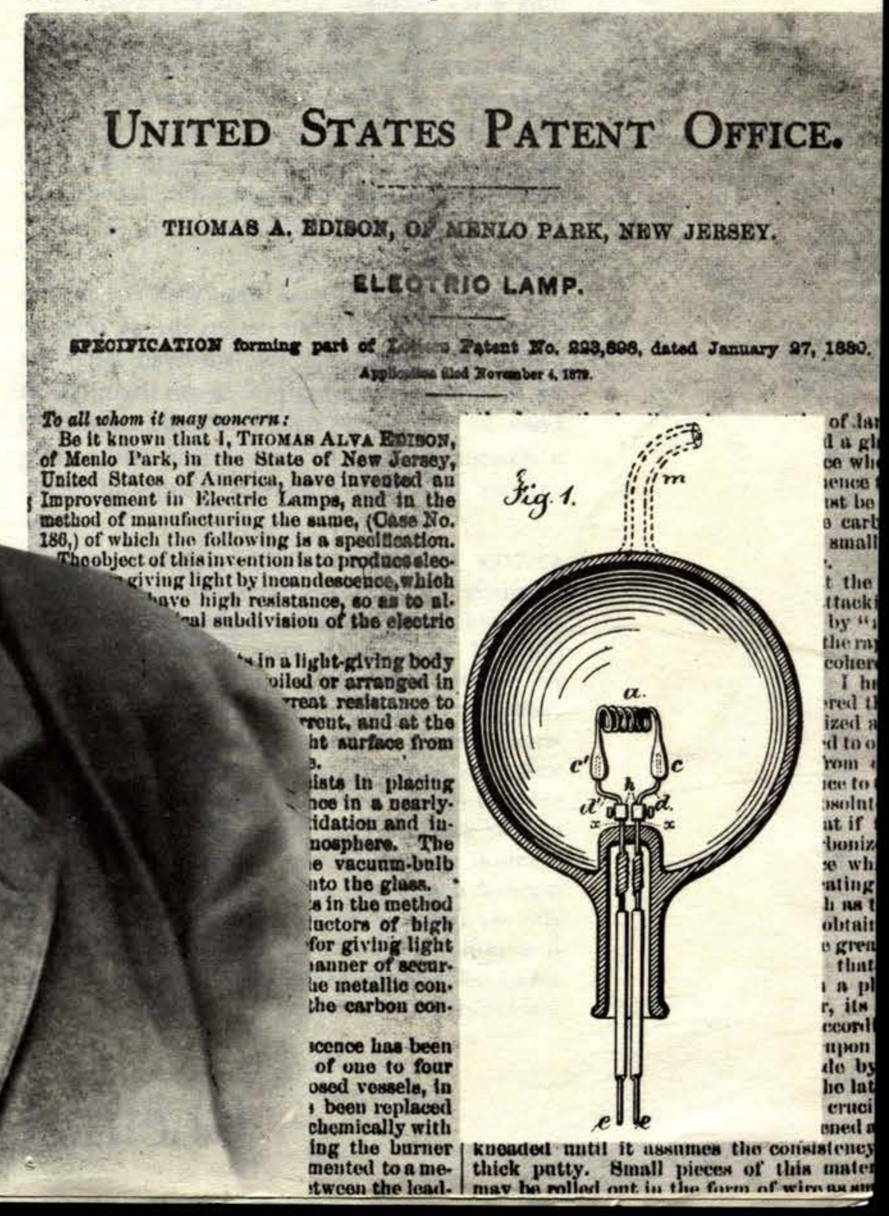


e

e, Edison, about 1896
Courtesy National Park Service

f, Patent and diagram (inset) for the electric lamp



UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 223,898, dated January 27, 1880.

Application filed November 4, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America, have invented an Improvement in Electric Lamps, and in the method of manufacturing the same, (Case No. 186,) of which the following is a specification.

The object of this invention is to produce elec- ... giving light by incandescence, which ... have high resistance, so as to al- ... al subdivision of the electric ...

... in a light-giving body ... oiled or arranged in ... reat resistance to ... rrent, and at the ... ht surface from ...

... ists in placing ... nce in a nearly- ... idation and in- ... nosphere. The ... e vacuum-bulb ... nto the glass. ... s in the method ... luctors of high ... for giving light ... anner of secur- ... he metallic con- ... the carbon con- ...

... scence has been ... of one to four ... osed vessels, in ... been replaced ... chemically with ... ing the burner ... mented to a me- ... tween the lead- ...

kneaded until it assumes the consistency ... thick putty. Small pieces of this mater... may be rolled out in the form of wire as ...

fabrication of the light was the fastening of the wires cemented to the fragile carbon loop to the lead-in platinum wires by means of very small clamps. Charles Batchelor, a former watchmaker who was Edison's chief laboratory assistant, was the only one of his staff who could carry out this delicate operation with any success. The glass base containing the carbon filament was then sealed to a bulb which had been blown from 7/8-inch tubing. This was another operation requiring great skill. Edison hired an expert glassblower, Ludwig Boehm, who learned his trade from Heinrich Geissler, a German manufacturer of special scientific equipment who was considered the master glassblower of his day.

A portion of the original 7/8-inch tubing was left on the other end of the bulb for attaching to the Sprengel pump for evacuating. Once it was evident that the bulb was largely evacuated, the glass surface was heated with an alcohol lamp to evaporate the adsorbed moisture. When the behavior of the pump indicated a good vacuum was again established, electric current was passed through the filament for only a few seconds. Even this very short heating caused the degree of vacuum to fall drastically owing to gases evolved from the carbon. This was continued until there was no increase in pressure on bringing the filament to incandescence. The bulb was then sealed off at the top while pumping was continued, leaving the tip—characteristic of all light bulbs manufactured up to about 1920.

Edison's experimental lamp with the carbon filament, prepared from cotton thread impregnated with lampblack tar, survived 40 hours of continuous illumination. It was then that he knew he was on the right track and conducted a systematic study of carbonizing and testing various cellulosic materials, gunks of finely divided carbon and graphite worked into filaments, and even hair from some of his well bearded employees. His first commercial lamps had filaments made from cardboard, but bamboo fibers proved best and were used commercially for about 10 years. When regenerated cellulose, now called rayon, became available as continuous fibers, it replaced the bamboo. Union Carbide Corp. and other U. S. companies, currently manufacturing carbon and graphite fibers, have also found rayon to be the best starting raw material in spite of the dozens of new synthetic and natural fibers available. Beginning in 1906, carbon filaments in incandescent lights were replaced by metal, presently tungsten. Thus, Edison's carbon-type filament was the mainstay of electric lighting for about 25 years. The reader may be surprised to learn that carbon filament electric lights are still being manufactured by the North American Electric Lamp Co. of St. Louis, Mo.

Other Inventions

Chemistry played a major role in many of Edison's developments such as insulation for electric wiring, an electrolytic process to meter electricity for users, plastic and resin compositions for phonographic records, and binders for briquettes of finely divided iron ore. Edison was also responsible for the development of the first alkaline storage battery, recovery of coal tar chemicals from coking, manufacture of various organic chemicals during World War I, and recovery of rubber from goldenrod and other plants. It is the writer's opinion that Edison's broad knowledge of the properties and behavior of chemicals, metals, and natural products was a major factor in his outstanding success in developing new things.

Thomas Edison was basically an experimentalist. He always found time to carry out some of the actual physical work himself, and this continued up to within a few months of his death at the age of 84. It has been said that no modern research laboratory would have hired Edison because of his meager educational background and unorthodox methods. Perhaps we in research and development have much to learn from this man "who invented almost everything."

There have been many books written about Thomas Edison but the most recent, and probably the most complete, biography is "Edison, A Biography," by Matthew Josephson, McGraw-Hill Book Co., New York, N. Y., 1959. Ω

BYRON M. VANDERBILT received an A.B. in chemistry from Indiana University and both his M.S. and Ph.D. degrees in organic chemistry and chemical engineering from Purdue University. From 1962 to 1964, he was editor of the quarterly, Industrial & Engineering Chemistry Product Research and Development, *and he has to his credit numerous publications in the fields of petrochemicals, elastomers, and plastics. Until 1968, he held various administrative and scientific positions in chemical research at Esso Research and Engineering and is presently a part-time consultant. He is also the inventor or coinventor on 83 patents and is working on a book, "Thomas Edison, Chemist," which will be published in 1971 by American Chemical Society Publications.*

A reprint from **Chemistry**

Vol. 43, September 1970, Pages 8-12

Edison, Thomas A.

ASK AT DESK

Approx. date –
Aug - 1877

70

The Menlo Park Story

Greenfield Village & Henry Ford Museum
Dearborn, Michigan

Cover illustration and left: **Front entrance and ground floor of the Menlo Park laboratory as preserved at Greenfield Village, Dearborn, Michigan. The building was lighted with similar cardboard filament lamps during the public demonstration of Thomas Alva Edison's electrical engineering system presented at Menlo Park, New Jersey, on New Year's Eve, 1879. This was the first time that electricity was subdivided into heat, light, power, and communication.**

The Menlo Park Story

by
Robert G. Koolakian
Associate Curator, Edisoniana

The Edison Institute, conceived and dedicated to honor Thomas Alva Edison (1847-1931), symbolizes 300 years of American inventive and cultural development. The dedication on October 21, 1929, marked an important event in the life of its founders, Henry and Clara Ford and their son Edsel, and was the beginning of an unprecedented era of historic preservation in America.

Visitors often ask why Mr. Ford chose to immortalize the memory of his lifelong friend and idol, Thomas Edison. For Henry Ford, history was – first and foremost – a vast composite of the accomplishments of the common man. He felt that Mr. Edison was the personification of the American man. He possessed extraordinary abilities which he used to benefit mankind.

Thomas Alva Edison's fertile mind transformed a world of candlelight, oil, and kerosene into one of reliable electric illumination. He ushered in the age of recorded sound and motion pictures. More than any other American, he contributed to the later shape of the Industrial Revolution through the development of practical electrical engineering at Menlo Park, the world's first industrial research complex.

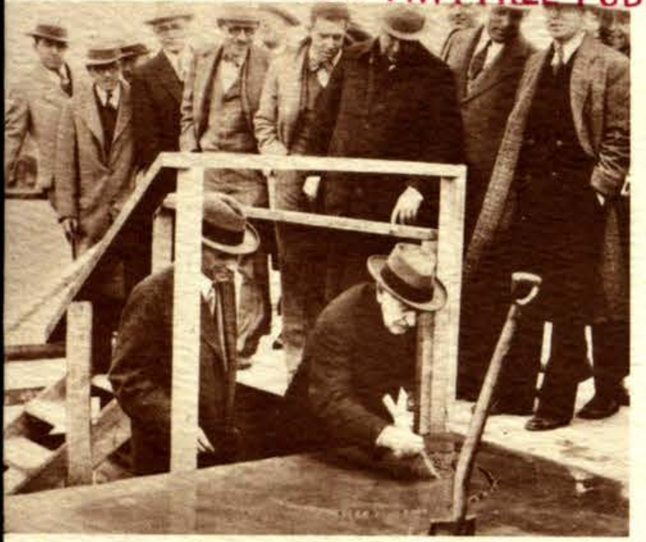
Henry Ford met Thomas Edison, the "Wizard of Menlo Park," for the first time at the annual convention of the Association of Edison Illuminating Companies at Manhattan Beach, Long Island, on August 11, 1896. As Chief Engineer of the Edison Illuminating Company of Detroit, Mr. Ford was chosen as a representative to that meeting. During the course of conversation, Mr. Edison learned of Henry Ford's work on a gasoline-driven vehicle and expressed interest in it. After questioning young Ford, Edison brought his fist down on the banquet table with a bang and stated: "Young man, that's the thing! You have it – the self-contained unit carrying its own fuel with it! Keep at it!"

By the time of that meeting, the transforming effects of the Edisonian Revolution were well in progress. Many of Edison's early achievements were in the area of advanced telegraphy. The 420 inventions developed at the Menlo Park Compound in New Jersey – including the phonograph, telephone transmitter, stencil duplicator, incandescent lamp, and the perfection of electrical engineering – heralded vast changes in the domestic and industrial character of the times.

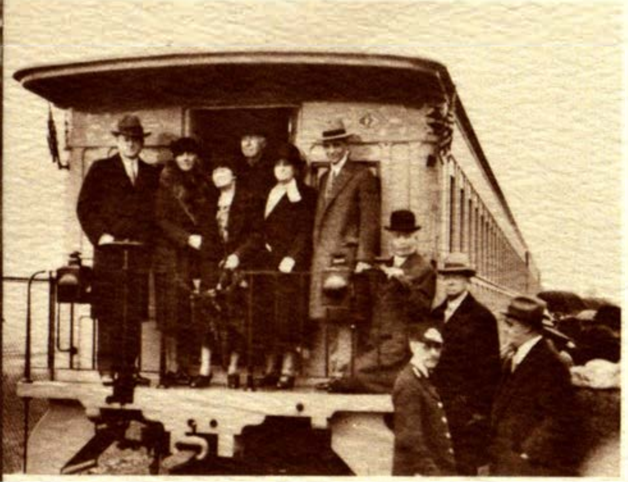
After years of growing friendship, Henry Ford sought to memorialize the work of Mr. Edison by carefully moving the entire Menlo Park Laboratory Compound to Greenfield Village for preservation, and by establishing The Edison Institute as a lasting tribute to the inventor.

Throughout the post World War I period, Henry Ford actively gathered numerous pieces of Edisoniana. He designated given areas of the Ford Engineering Laboratories at Dearborn, Michigan, as a repository for the impressive collection, which soon outgrew its accommodations. On May 7, 1928, he arranged to purchase the Menlo Park, New Jersey, property and began to plan the systematic excavation and transfer of the laboratory buildings to Greenfield Village. The project required the meticulous removal of boards, bricks, stones, early relics, and even the red, top layer of New Jersey soil. One-and-one-half years were consumed before final, faithful reassembly was achieved. The painstaking installation of these seven orig-

Left: On the evening of October 21, 1929, in celebration of the 50th anniversary of Thomas A. Edison's creation of the incandescent lamp, over 300 world leaders, scientists, citizens, and educators from all over the world gathered together at one of the most distinguished banquets ever held. Following the banquet, the aging inventor, President Hoover and Mr. Ford adjourned to the Menlo Park laboratory, which had been newly re-erected and preserved at Greenfield Village. At that time Edison's re-creation of his first lamp not only signaled the anniversary of that immortal event, but it also symbolized the dedication of The Edison Institute in his honor.



Top: Thomas Alva Edison and Henry Ford at the laying of the cornerstone for the Henry Ford Museum, September 27, 1928. To symbolize the union of agriculture and industry, Mr. Edison thrust Luther Burbank's spade into the wet cement, then imprinted his own footsteps, and inscribed his name and the date.

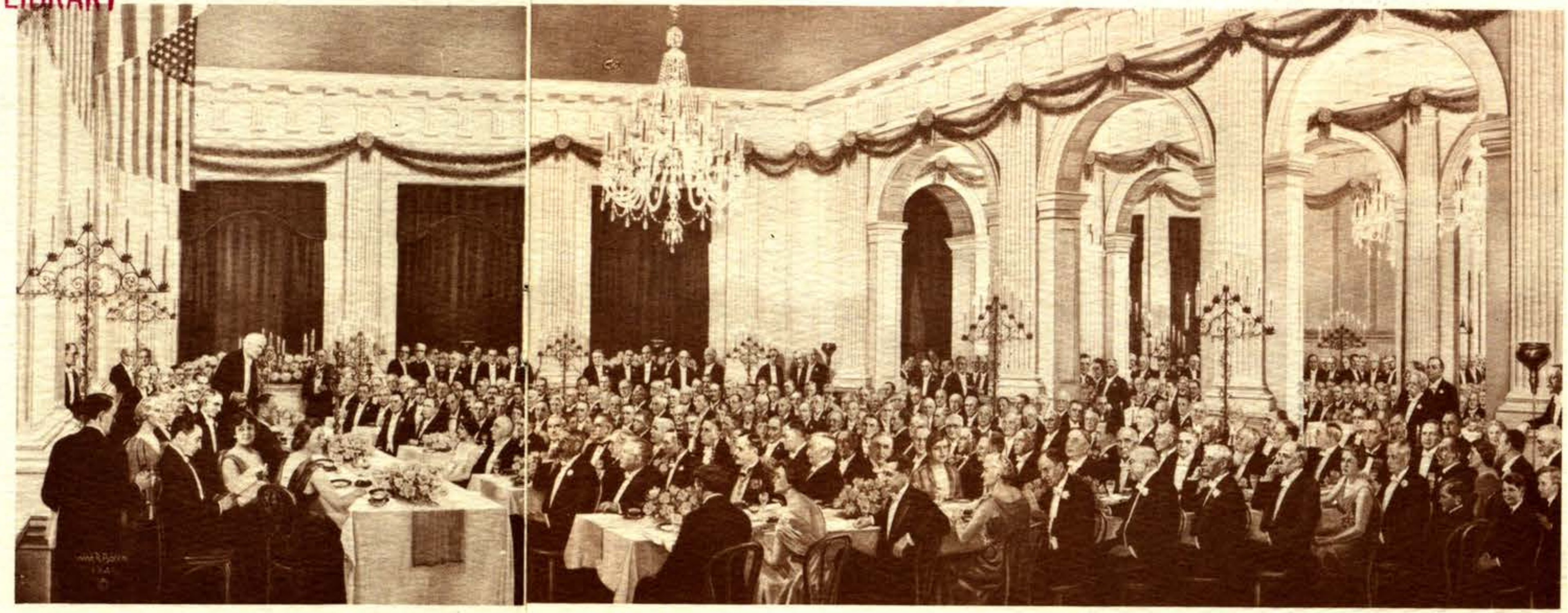


Above: President and Mrs. Herbert Hoover, Mrs. Henry Ford, Mr. and Mrs. Thomas Alva Edison, and Henry Ford arrive at Smiths Creek Station where they joined numerous world dignitaries for the dedication of Greenfield Village and Henry Ford Museum at Dearborn, Michigan, on October 21, 1929.

inal buildings, under Mr. Edison's personal direction, epitomizes the high standards applied by Henry Ford in establishing Greenfield Village.

To assure the accuracy of the restoration, Mr. Ford maintained a close working contact with the inventor and with the Edison Pioneers, former Menlo Park associates who contributed immeasurably to the detailed authenticity of this most important preservation effort. As a lasting gesture to complete the restoration, Mr. Ford was presented with the original Edison Pioneer Collection, an assemblage of over 2,000 historical specimens containing much of the early laboratory apparatus and original inventions used in the development of modern science and technology.

With the Menlo Park Compound in a virtual state of completion, the aging inventor returned to the laboratory on October 21, 1929, to re-enact the invention of the first successful incandescent lamp in the presence of President Herbert Hoover, Henry Ford, and Francis Jehl, his former laboratory assistant. This occasion marked Light's Golden Anniversary and commemorated the founding of The Edison Institute.



Above: Painting by Irving Bacon of the banquet held in the Great Hall (main lobby) of the Henry Ford Museum on October 21, 1929, celebrating the 50th anniversary of Thomas Alva Edison's creation of the first successful incandescent lamp. Today's collection of Edisoniana at the Henry Ford Museum includes numerous items from the banquet, including the microphone, candelabra, indirect wall lighting devices, and the bentwood chairs.

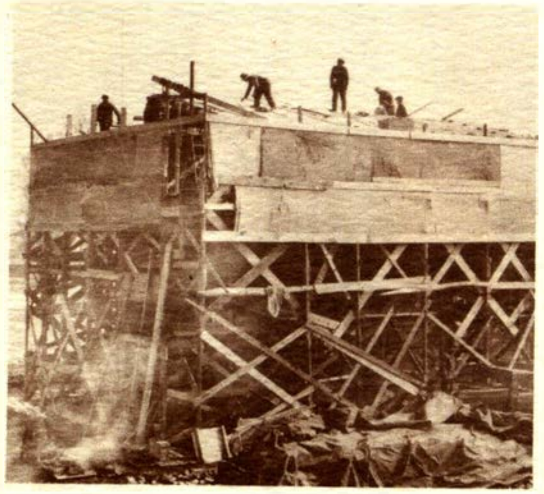
Above: Detail of an oil painting by Irving Bacon illustrating Henry Ford describing his "horseless carriage" to Thomas Edison at the Oriental Hotel, Manhattan Beach, Long Island, August 11, 1896.

Below: Henry Ford and Thomas Edison, his lifelong friend and idol, in whose honor The Edison Institute was named.

Top: Menlo Park Compound, New Jersey, in the summer of 1880 during the second Edison demonstration of incandescent lighting. Left to right: two-story brick office and library, laboratory, carpenter shop, glass house, machine shop.

Left: Thomas Alva Edison and his laboratory staff on the second floor of the Menlo Park laboratory shortly after the installation of Edison's second lamp, February 22, 1880.

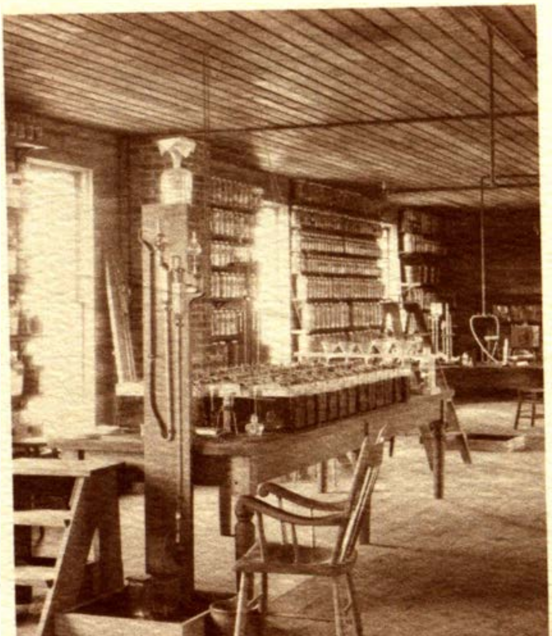
Above: The Menlo Park glass house in post-Edison years when it was used for a time as the residence of Thomas J. McConnell and his family. Mr. McConnell was a chicken farmer and volunteer fireman in the Menlo Park, New Jersey, Hook & Ladder Company.



Left: Careful preservation of the Edison office and laboratory began at Greenfield Village in the fall of 1928.

Above: In the spring of 1929, the preservation of the office and laboratory was nearly complete.

Below: The Menlo Park Compound as it appears today at Greenfield Village. Left to right: office and library, laboratory, carpenter shop, glass house, machine shop. To complete the preservation, Mr. Ford's staff faithfully planted the same species of trees, relocated the original dump pit, and re-erected the buildings on New Jersey red clay moved from the Menlo Park site during the excavations. The only additions to this Compound not original to the site are the two glass display cases in the foreground, one containing the stump of a hickory tree that stood outside of the laboratory; the other housing numerous relics of glass, metal, wood, and pottery exhumed in archeological digs at Menlo Park, New Jersey. Not shown in this photograph is the glass-enclosed train shed housing the original Edison experimental electric locomotive of 1880.

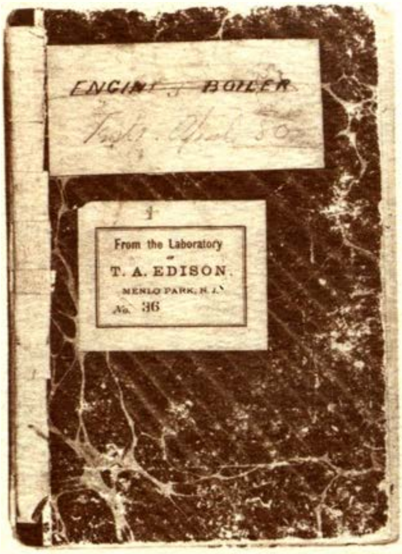


Above: The Edison laboratory was used by Thomas Alva Edison during his "golden years" between 1876 and 1886 when more than 400 inventions originated there. The bronze statue of Mr. Edison was executed by James Earle Fraser, one of America's most distinguished sculptors. Although the work was commissioned by Henry Ford in 1930, World War II and the ensuing shortage of bronze delayed completion until 1949.

Left: The second floor of the laboratory where Mr. Edison developed the incandescent lamp, phonograph, carbon telephone transmitter, and numerous other significant inventions.

Top, center: The Edison laboratory notebook, dated April, 1880, documents boiler tests and is typical of many kept by the Edison laboratory staff which are now in the Greenfield Village collection.

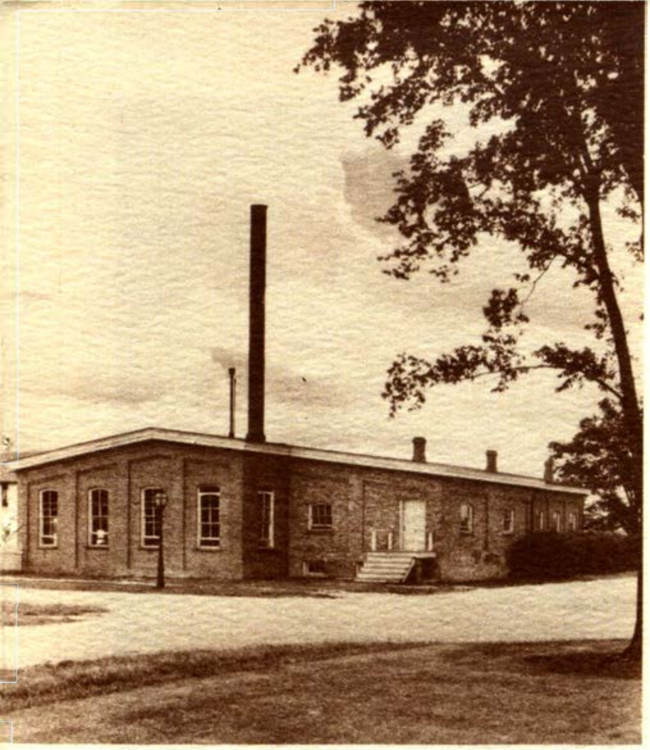
Top, right: The handsome two-story brick office and library housed the Edison business records. The second floor contains the original comprehensive technical library used by Mr. Edison's staff and administered by his laboratory assistant, Dr. Otto Moses.



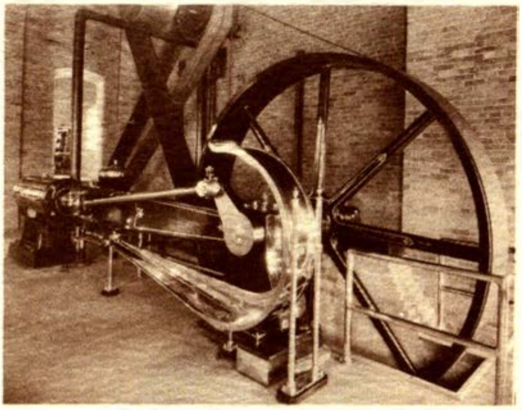
Below: The Menlo Park Compound as seen from the Sarah Jordan Boarding house at Greenfield Village.

Above: Photographic studio and glass house. Ludwig Boehm, Mr. Edison's chief glassblower, created the glass parts for early experimental incandescent lamps in this building.

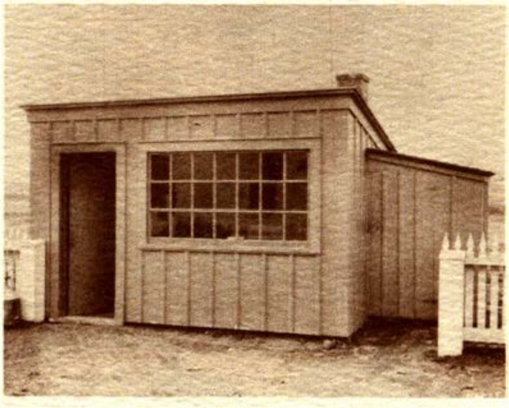
Below: A portion of the Menlo Park Compound viewed from the second floor of Mr. Edison's office and library. Left to right: two-story laboratory, headquarters of the operation; carpenter shop; machine shop; combined glass house and photographic studio. In the center foreground is Mr. Ford's re-creation of the dump pit from which many of the original relics were taken. Mr. Edison's office and library commanded a handsome panorama of the Compound and one-time hilly terrain common to northern New Jersey. After seeing the Compound on the first occasion following its completed preservation, Mr. Edison was amazed and remarked to Mr. Ford, "You have made the place so true that I could not have done better; it is 99.9 per cent perfect." When asked about the 1/10th per cent, he replied, "Our floor was never so clean."



Left: Side view of the machine shop and boiler room. A rear addition was made in 1880 to house the Edison central station which produced the current used for a second electrical demonstration that year. This exhibition achieved fame because it was the first successful use of a system of subterranean wiring which transmitted power from a central station to a consumer.

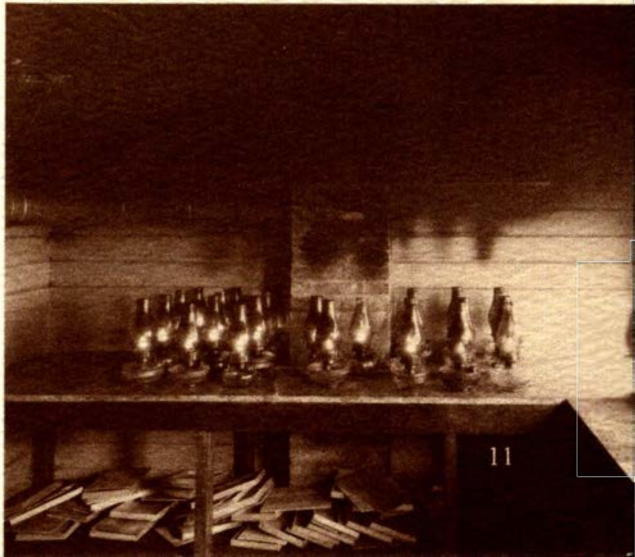


Right: The 1878 Brown 75-horsepower steam engine in the machine shop. As well as operating the overhead line shaft in the machine shop, this engine supplied the power for the three Edison bi-polar dynamos which generated the electricity for the first Menlo Park demonstration on New Year's Eve of 1879.

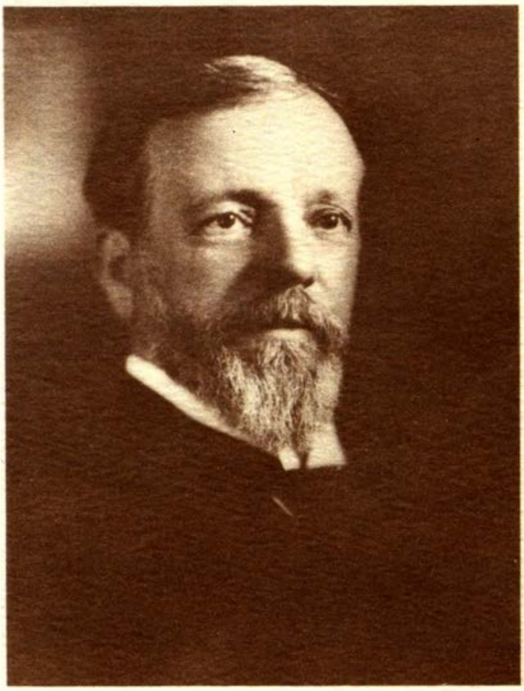


Above: Carbon shed. Alfred Swanson, Edison's night watchman, removed carbon from the chimneys of kerosene lamps for use in a variety of electrical experiments. Among the patented inventions utilizing carbon in their construction are Edison's telephone transmitter, microphone, and filaments for incandescent lamps.

Below: Interior of the carbon shed. Many of the original kerosene lamps used at Menlo Park are ranged on the storage shelves. The boxes under the bench were used to pack carbon buttons for shipment to the Western Union Telegraph Company in New York City during the promotion of their telephone interests in the late 1870's.



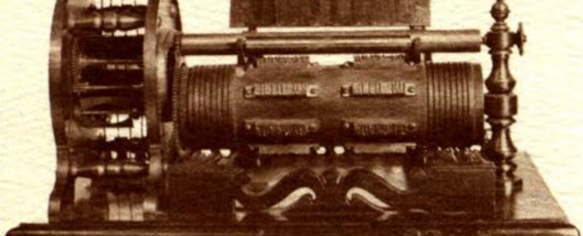
Above: Francis R. Upton (1852-1921). Edison's chief mathematical physicist.

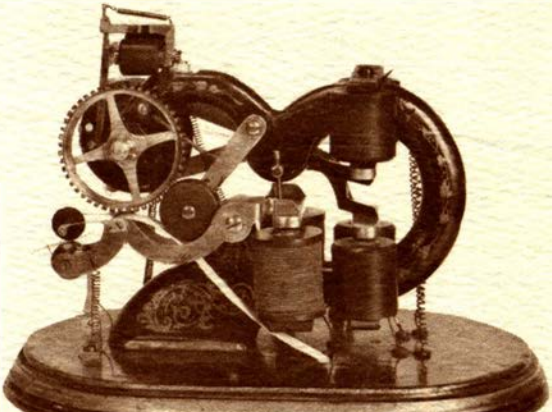


Above: Charles Batchelor (1845-1910). One of Edison's chief mechanicians.

Left: Electrographic vote recorder. 1868. Edison's first patented invention, perfected at the age of 21. It was intended for use in Congress, but was not a financial success because of little public demand.

Below: Printing telegraph or stock ticker. 1869. In 1870, Edison sold the patent rights to this invention to Laws Gold Reporting Telegraph Company, Wall Street, New York City, for $40,000.



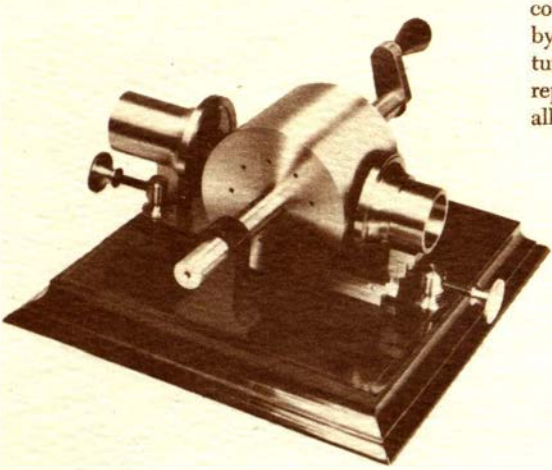


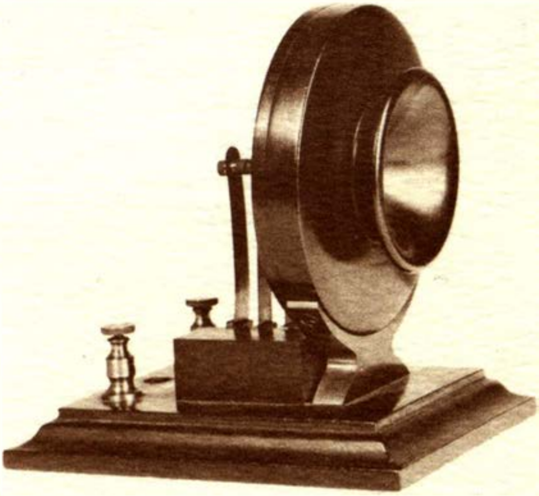
Above: John Kruesi (1845-1899). Chief precision instrument maker and foreman of the Edison machine shop.

Below: Edison commercial stock ticker. Early 1870's. This invention was produced at Edison's factory at 10-12 Ward Street, Newark, New Jersey. It is an improvement over the 1869 patent model. While at Newark, Edison manufactured the improved stock ticker under three different names, Edison and Murray, Edison and Unger, and Edison-Gold & Stock for use in the New York Stock Exchanges. Originals are on display at the Menlo Park laboratory and in the Mechanical Arts Hall at nearby Henry Ford Museum.

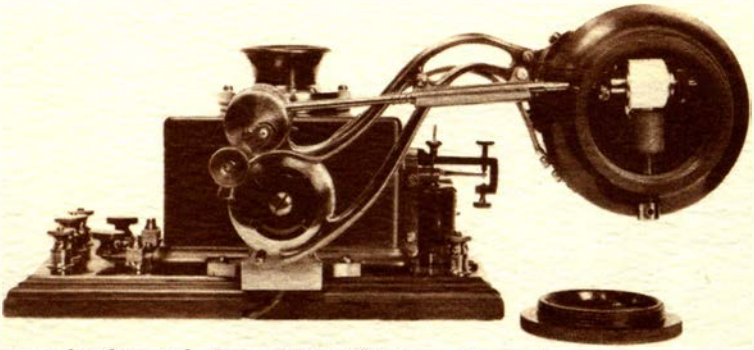
Left: Electric pen. 1876. The first industry promoted at Menlo Park was the production of Edison's newly perfected electric pen. Designed to perforate innumerable holes in paraffin paper by the action of a cam-operated stylus, the pen was driven by a small electric motor powered by a pair of wet cell batteries. When the stencil was spanned in a hand press and an ink roller passed over its surface, ink was forced through the perforations onto a clean sheet below, creating a duplicate of the original. From three to five thousand copies could be produced with careful use of one stencil. The original invention is housed in the Edison laboratory.

Left: Replica of Edison's first phonograph. 1877. The recording surface, a tinfoil-wrapped cylinder, was embossed by the action of a needle when the crank was manually turned and the mouthpiece spoken into. The voice was reproduced by rewinding the threaded cylinder and allowing the needle to retrace the recorded surface.



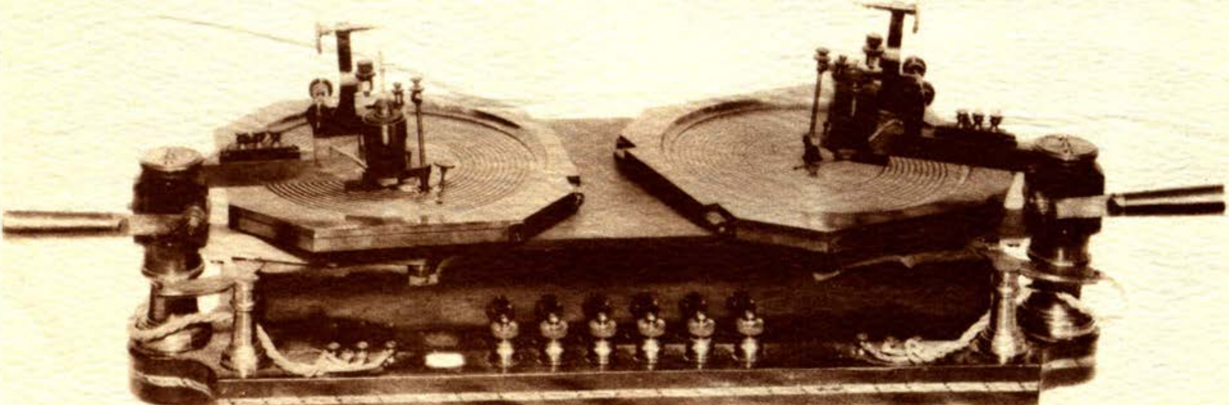


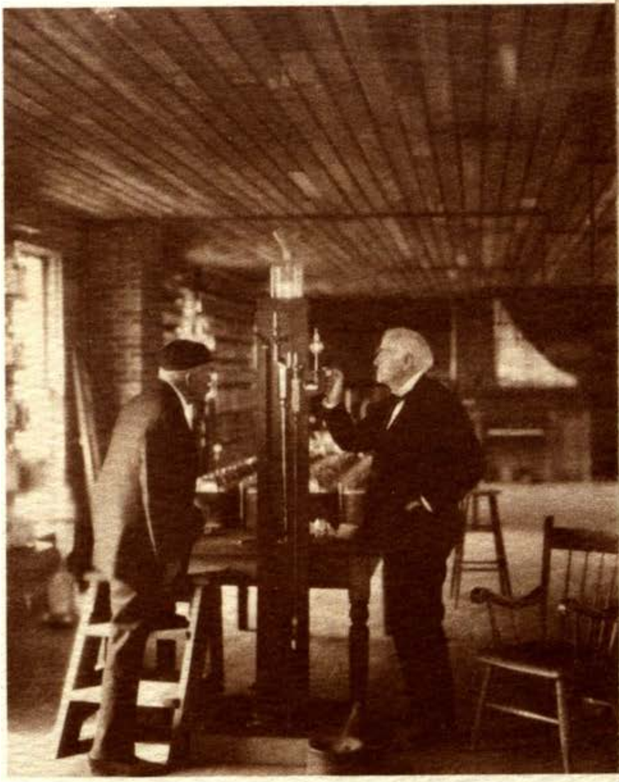
Above: Microphone transmitter. 1877. This was the first carbon microphone.



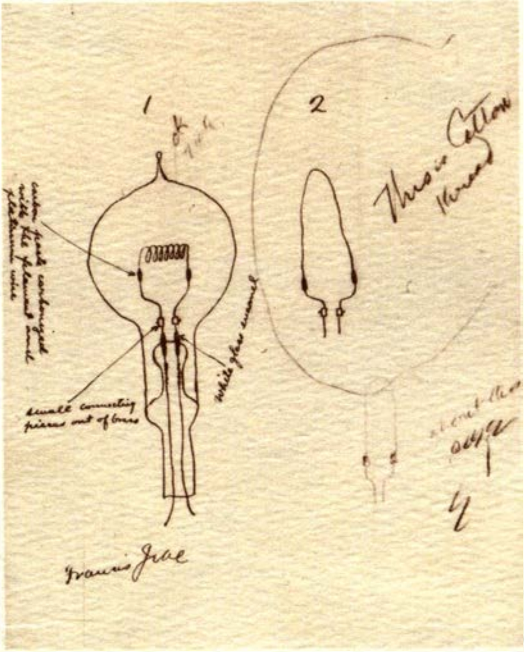
Above: First commercial Edison telephone. 1879. This invention made use of a carbon transmitter and chalk loudspeaking receiver.

Below: Edison embossing telegraph. 1877. Mr. Edison called this invention "the father of the phonograph."

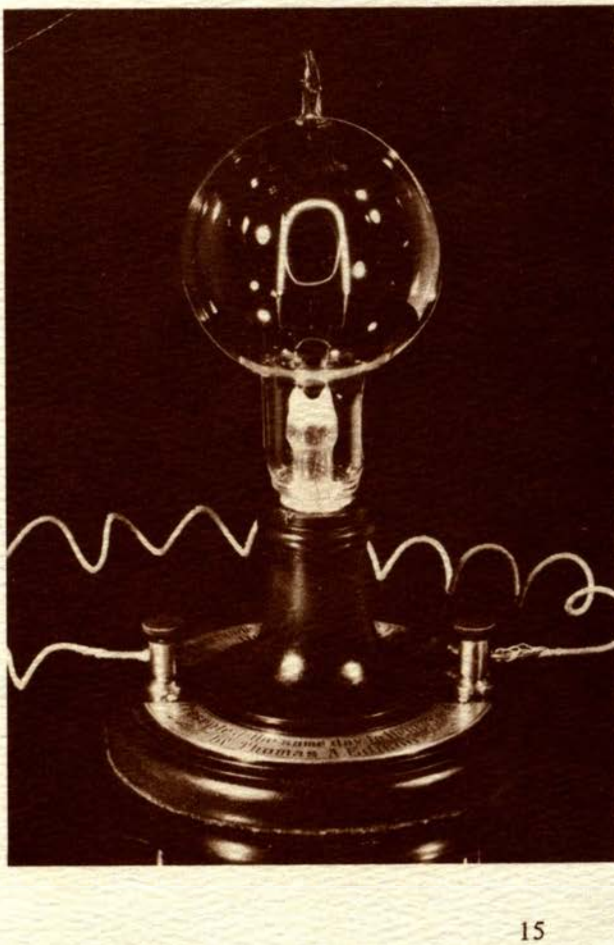




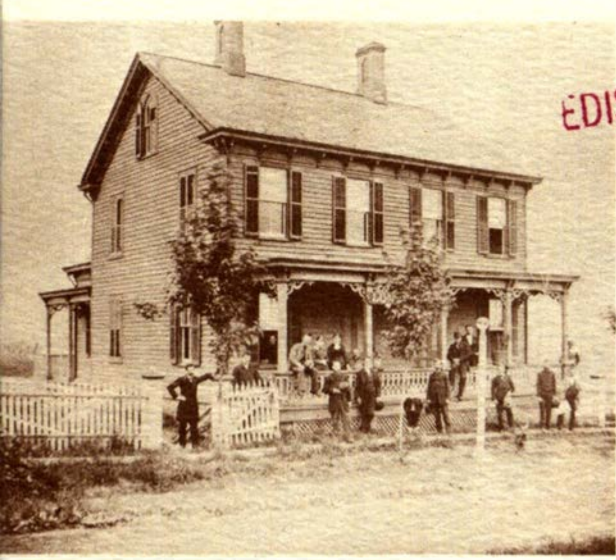
Right: Re-enactment of the creation of Edison's first successful incandescent lamp. October 21, 1929. Greenfield Village, Michigan. Mr. Edison is driving out the occluded gases while his assistant, Francis Jehl, operates the mercury vacuum pump.



Above: Drawing executed by Thomas Edison and Francis Jehl. October, 1879. From this notebook entry came the creation of the first successful incandescent lamp experiment of October 19-21, 1879. It is typical of numerous drawings of dies and component parts that passed from the laboratory to the machine shop and glass house for production.



Right: First lamp made at Dearborn, Michigan, by Thomas Alva Edison and presented to Mr. Ford on October 19, 1929. It uses a carbonized cotton sewing thread filament.

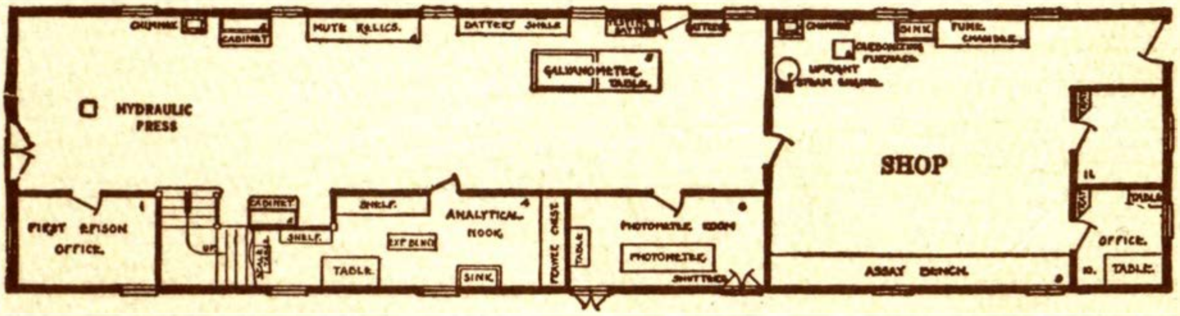


Right: Dining room of Mrs. Jordan's Boarding House. This residence achieved recognition as the first home in the world to be lighted by Edison's newly perfected electrical system for the New Year's Eve demonstration at Menlo Park, New Jersey, on December 31, 1879. An electrified kerosene chandelier is attached to the exposed wiring. It represents the first of many typical conveniences which the advent of practical electricity was to bring into the American home.

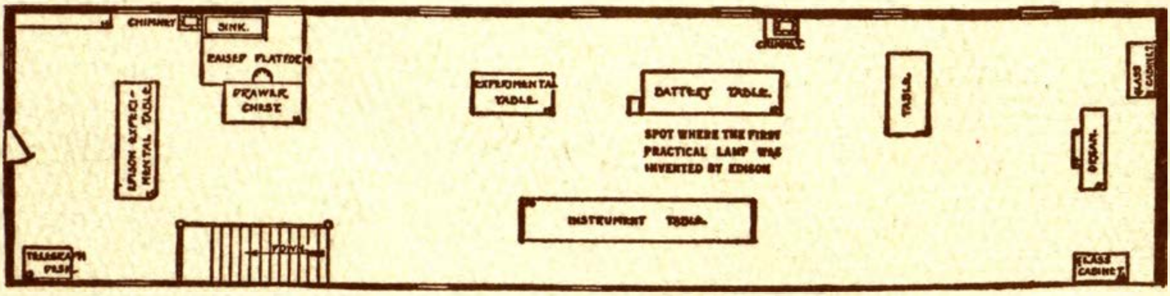
Above: Sarah Jordan Boarding House. Menlo Park, New Jersey. Summer of 1880. Mrs. Jordan, third from the left on the porch, and some of her boarders pose for the photographer in this early photograph.

Above: Sarah Jordan Boarding House, relocated at Greenfield Village. The house is furnished with many original pieces belonging to the Jordan family and given to Mr. Ford by Mrs. Ida Jordan Day, daughter of Sarah Jordan. Mrs. Day carefully arranged the pieces according to the way she remembered them as a teenager at Menlo Park.

Floor Plan, Ground Floor, Edison Laboratory, Menlo Park



Floor Plan, Second Floor, Edison Laboratory, Menlo Park

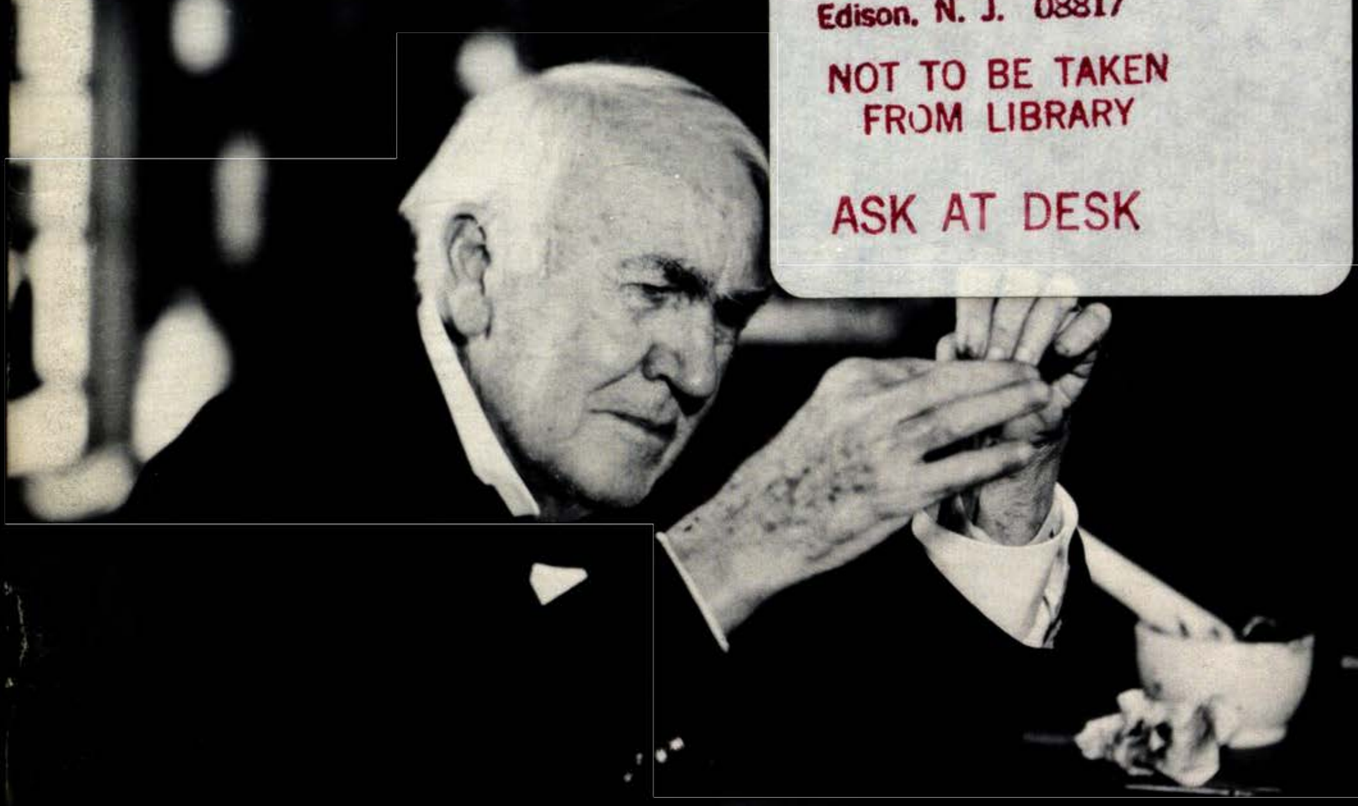


Thomas Alva Edison, the "Wizard of Menlo Park," once told his associate, Dr. George Beard of Columbia University, that it was his aspiration to produce within the Menlo Park Compound one major invention every six months and one minor item every ten days. The inventor more than fulfilled his desire, for of the 1,093 patents achieved within his lifetime, 420 were the direct result of his labors at the Compound.

Although the most significant contribution that Edison and his staff made at Menlo Park was the development of a complete system of electrical engineering, it is often said that the greatest single invention was one which was never patented – the development of *organized technical research* in a modern laboratory. Each member of Edison's team of research assistants was a specialist in his chosen field, directing individual "trial and error" efforts toward the development of practical inventions at the Menlo Park Laboratory.

The Beginning of the Incandescent Lamp and Lighting System

An Autobiographical Account
by
Thomas Alva Edison



Greenfield Village & Henry Ford Museum
Dearborn, Michigan

Thomas Alva Edison and his laboratory staff on the second floor of the Menlo Park laboratory shortly after the installation of Edison's second lamp, February 22, 1880. Left to right: Ludwig K. Boehm, glassblower; Charles L. Clarke, electrical technician; Charles Batchelor, chief laboratory assistant; William Carman, bookkeeper; Samuel D. Mott, patent draughtsman; George Dean, mechanic; Thomas A. Edison; Charles T. Hughes, purchasing agent; George Hill, assistant.

The Beginning of the Incandescent Lamp and Lighting System

An Autobiographical Account

by

Thomas Alva Edison

Foreword
by
Theodore M. Edison

Introduction
by
Robert G. Koolakian

seemed foolish to throw away great quantities of heat in the generator, so he (supported by his mathematical assistant, Mr. Francis R. Upton) simply reduced the loss there by lowering the generator's internal resistance - to disrupt the old 50%-efficiency-limit theory. I think this is a shining example of the way in which entrenched habits of thought can make specialists resist the introduction of radically new ideas.

For laboratory work, he often chose assistants who had little technical training because he said that experts knew too many ways in which things wouldn't work. On the other hand, he *did* employ experts, and he himself read what he could find on subjects under study. He has been called an empiricist, rather than a scientist, but I think that a lot of his "cut-and-try" procedures were far from unguided. In chemical research, he would set up all kinds of wild combinations in a search for clues, but I feel sure that the "wildness" itself was not achieved entirely by accident. He kept constant watch for anything that might look the least bit promising, and once a clue turned up, he would bunch experiments around it.

When late in life he started his work on trying to develop a source of natural rubber that could be used by the United States in the event that normal supplies were cut off by war, he did not turn to the usual trees, because they would take too long to grow. Instead, he sought plants that could be grown and reaped as a crop in many parts of the country. He became quite a botanist and tested thousands of plants - taking into consideration the fact that concentrations of chemicals vary in different parts of plants at different seasons of the year. Eventually he selected goldenrod as being most promising and adopted Burbank's method of selective breeding to increase the yield of rubber. I believe that when he started, he was able to get only about a 4% to 5% yield, but that in a very few years he had succeeded in raising plants that could be counted upon to yield more than 12%. He died before completing this project.

Even a brief discussion of Mr. Edison's work would not be complete without some mention of his contact with patents. He obtained a record number himself, and in the course of getting them I feel sure that he must have picked up a great deal of useful information. I think it is too bad that the formal legal language used in patents is so hard to understand, because patents contain a wealth of information that may never reach the ordinary technical publications. A lot of patents describe results obtained by so-called practical men who may have had very little formal education, but who nevertheless may have developed valuable ideas. For example, Father once invented a method of concentrating ore that consisted of crushing the rock containing the desired mineral and letting the powdered material drop onto a slanting plate. One component, which was elastic, would bounce from the plate into one bin, while another inelastic component would merely slide down the plate into another bin. As I recall it, Mr. Edison's patent application on this process was rejected because the idea had already been patented for use in separating cranberries: berries with sound, healthy skins would bounce into one bin, whereas injured berries would simply slide into the discard.

Thomas Edison pioneered in establishing organized research as a business, and through his knowledge of business and production, he was able to carry his inventions far beyond the laboratory stage. Many people who admire him as the "inventor of the electric light" fail to realize that the light he invented was only a small part of a great system that had to be developed. Switches, meters, generators, distribution systems, fuses, conduits, sockets, and a host of other items all had to be devised or perfected and coordinated for production, and when all was ready, politicians had to be persuaded to permit installation of power lines in city streets. Financial problems were also ever present, and a great deal of work had to be done in the face of opposition from those whose huge vested interests might be disturbed by the new inventions.

It is truly remarkable to see what can be done by a man who didn't even get through grade school!

President Herbert Hoover, Henry Ford, and Thomas Alva Edison, in the Menlo Park Laboratory during the re-creation of the incandescent lamp at Light's Golden Jubilee, Greenfield Village, Dearborn, Michigan, October 21, 1929.

Jerome:
Please put on
my desk - You will
remember there
was a previous
letter on this subject.
With this letter there was a
photostat of page from the
Electrical World - Did I ask you
to have Transcribing Dept.
make a copy? If not,
please do so & have it
double spaced if not
already spaced.
WHM

Henry Ford
Dearborn, Mich.

August
18th
1926

Mr William H Meadowcroft
Laboratory of Thomas A Edison
Orange New Jersey

Dear Mr Meadowcroft:

Thank you for your letter and the assurance about the original article from Mr Edison. Mr Ford was very much pleased. September will do O. K.

Faithfully yours

H M CORDELL

Office of HENRY FORD

HMC:S

Above: Letter from H.M. Cordell, a member of Henry Ford's secretarial staff, to William H. Meadowcroft, assistant to Thomas A. Edison, dated August 18, 1926, regarding Mr. Edison's article on the incandescent lamp.

Introduction

by

Robert G. Koolakian,
Curator, Edisoniana

The Beginning of the Incandescent Lamp and Lighting System represents a unique approach to the recognition of an unforgettable milestone in the history of civilization. It was prepared by Thomas Alva Edison in 1926 at the request of Henry Ford and remains the only complete autobiographical work written by Mr. Edison in story form. For an individual whose life had been characterized by unceasing toil and inventive achievement, it was extraordinary indeed for Mr. Edison to take time to become his own historian. One might say it is a tribute to the lifelong friendship between the two captains of industry.

It is ironic that Thomas Edison could claim but three months of formal education yet, through tireless efforts, within his lifetime he transformed a world of candlelight, oil, and kerosene into one of reliable electric illumination. He introduced an age of recorded sound and motion pictures, and became a key figure in the development of the Industrial Revolution by fostering a common and practical system of electrical technology.

In the history of man's progress, Thomas Edison is a modern figure of undisputed perception. In this year of our nation's Bicentennial we are also observing the hundredth anniversary of Mr. Edison's epoch-making move to the Laboratory at Menlo Park, New Jersey. Here, the inventor and his staff of pioneers achieved the monumental goal of "sub-dividing" electricity into heat, light, power, and advanced communication. The far-reaching effects of this transformation within the economic, industrial, and social institutions of society have been most profound.

It is often said of Edison that in his development of a practical electrical technology he not only answered a great and urgent problem confronting the world of his day, he also opened men's minds to the possibilities of far greater and more infinite accomplishments in the future. Recognition of this great legacy impelled the late Charles F. Kettering to say, "Every citizen is as much a beneficiary of Mr. Edison as if he had been mentioned in his will. The comparatively small sum of money he may have received for his inventions is microscopic in comparison with the public's benefits - yours and mine."

Mr. Edison possessed one of the most remarkable of human amenities. No matter how much he learned, he never considered his education to be a completed process. For him success was not simply a matter of obtaining an "official" degree, but an ongoing educational experience. With little formal education, Edison was very easily branded by the "experts" an "imposter," an unfounded "tinkerer" who could not possibly achieve the "unattainable," yet through systematic research he succeeded in the practical subdivision of electricity. More than 6,000 separate experiments were conducted before Edison found a suitable material to be employed as a filamentary conductor in the first commercial carbonized bamboo lamp of 1880. When we consider that so many other developments, including fuses, switches, sockets, meters, subterranean conduits, junctions, feeders, mains, dynamos, and electric motors had to be perfected before the system could be proven, the extensive Menlo Park industrial research scheme looms large indeed!

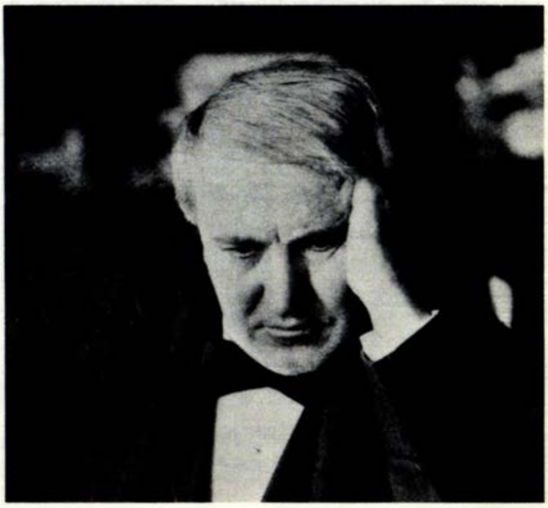
Many exceedingly well-trained technicians were drawn to the Edison staff in the 1876 to 1882 period. Several previously untrained people, under Edison's tutelage, also achieved great reputations in the creation of many diversified industries. No single individual could have humanly achieved this vast undertaking. Edison's ongoing experience was the brainchild behind the Menlo Park dream and his associates served to implement countless details of his research, rendering a broad and fundamental technology. The dream of electricity, of course, was not new with Edison. It is the product of the increasing experience of men, each contributing a part over many generations. We may never know all of the contributors, but Henry Ford felt that each has silently expressed himself in the achievements of this great man.

Mr. Ford asked during the celebration of Light's Golden Anniversary, "What is the name of him who first invented printing? Who was the original metallurgist who first compounded tin and copper? It is unlikely we shall ever know. But the man who gave the world incandescent electric light, his name is known and it is not likely it will be forgotten . . . The name of Edison will live because he is recognized by the people of the world not as a great individualist who has climbed high upon the aching shoulders of a multitude, but as one of the people themselves . . . one of the common people . . . who lifted a light to guide us out of darkness."

It was in his capacity as chief engineer of the Edison Illuminating Company of Detroit that young Henry Ford had his first personal encounter with the inventor on August 11, 1896. It was occasioned by an annual convention of the Association of Edison Illuminating Companies held at the Oriental Hotel, Manhattan Beach, New York. The young engineer had been working for some weeks on the development of his first self-contained gasoline carriage; and, after a detailed explanation, Mr. Edison gave him positive encouragement.

Mr. Ford, almost from the beginning of that association, began collecting Edisoniana, and there is evidence in Edison Institute records that the inventor shipped to him items of technological significance as early as 1905. After years of close friendship, the unceasing memory of that experience impelled Mr. Ford to search out and faithfully reassemble the seven original Menlo Park Compound buildings as the central theme for his museum of Americana at Greenfield Village. Henry Ford reasoned that history ought to be examined not necessarily in terms of succeeding wars and political dynasties, but as it reflected the efforts of the great masses of people and their achievements in coping with everyday life. It was out of great dedication to this objective that he founded The Edison Institute as a lasting symbol of the common man.

Mr. Edison was much too involved in his work even at an advanced age to actively become the main driving force behind the preservation of arts and artifacts that were being dispelled by the effects of a swiftly passing era. He was such an intensely practical man that preservation because of sentiment or historic significance probably would not have occurred to him were it not for the combined efforts of Mr. Ford and Mr. Edison's closest working associates, the Edison Pioneers. Henry Ford was awarded Associate Edison Pioneer status, January 24, 1924, by the Association of Edison Illuminating Companies. He was also a member of the American Institute of Electrical Engineers founded by the Association (now the Institute of Electrical and Electronics Engineers). It is ironic that two individuals who had done much to irrevocably alter the mainstream of human development should unite their efforts in the preservation of the passing culture. Had Mr. Henry Ford accomplished nothing more within his life space, his contribution of The Edison Institute and its dedication to the preservation of the arts and sciences alone would have marked him a great humanitarian.



Cable Address "Edison, New York"

From the Laboratory of Thomas A. Edison, Orange, N.J.

RECEIVED
Henry Ford
NOV 1 1926

October 28, 1926.

Mr. H. M. Cordell,
Office of Mr. Henry Ford,
Dearborn, Michigan.

My dear Mr. Cordell:

I am afraid your patience has been tried in waiting for Mr. Edison's article giving the story of the invention of the incandescent lamp and system of light, heat and power. However, here it is, at last.

You will see that this story is quite different from the one of which you sent me a photostat, which was probably written by some one who had only partial knowledge of the facts, and who signed Mr. Edison's name to it without proper authority.

Will you kindly say to Mr. Ford that Mr. Edison has made an exception in his favor by furnishing an autobiographical story. He understands, however, that Mr. Ford only desires to use it in a pamphlet such as the one you wrote on the evolution of artificial light. Mr. Edison is very glad to let Mr. Ford have the present article.

Yours very truly,

Wm H. Meadowcroft
Assistant to Mr. Edison.

WHM:O

Above: Letter from William H. Meadowcroft to H.M. Cordell, dated October 28, 1926, forwarding Mr. Edison's autobiographical story.

Left: Thomas A. Edison in his laboratory library at West Orange, New Jersey, in 1897 at age 50. Photograph by the Edison National Phonography Company. (From the Edison Pioneer Recording Artist files)

Mr. Ford's most comprehensive preservation effort culminated in the moving of Mr. Edison's laboratory compound from Menlo Park, New Jersey, to Greenfield Village at Dearborn, Michigan. The buildings were faithfully restored to the period of *The Beginning of the Incandescent Lamp and Lighting System*. Thomas Alva Edison returned to the newly restored laboratory on October 21, 1929, the 50th anniversary of the creation of the incandescent lamp, to re-enact that epochal invention, with the help of his laboratory assistant, Francis Jehl. This ceremony not only marked the anniversary of that history-making event but also celebrated the dedication of The Edison Institute, named in his honor.

More than three hundred world dignitaries and leaders gathered at Dearborn, Michigan, to pay tribute to the great American. Here, surrounded by his family and many lifelong associates, Mr. Edison dined with President Hoover, Henry and Edsel Ford, Orville Wright, Madame Curie, Harvey Firestone, Will Rogers, John D. Rockefeller, George Eastman, Charles Dana Gibson, Henry Morgenthau and others in a most auspicious banquet held in the main lobby of the Museum. Many, including the Prince of Wales, President von Hindenberg, Guglielmo Marconi, Commander Byrd, and Albert Einstein, wired congratulatory words.

It was uncommon for Mr. Edison to give formal public addresses for he was shy of the microphone, which he had invented in 1877. Greatly touched with emotion, the aging inventor delivered his lasting expression of gratitude,

"Mr. President, Ladies and Gentlemen: I am told that tonight my voice will reach out to the four corners of the world. It is an unusual opportunity for me to express my deep appreciation and thanks to you all for the countless evidences of your good will. I thank you from the bottom of my heart.

"I would be embarrassed at the honors that are being heaped upon me on this unforgettable night, were it not for the fact that in honoring me, you are also honoring that vast army of thinkers and workers of the past and those who will carry on, without whom my work would have gone for nothing.

"If I have spurred men to greater efforts, and if our work has widened the horizon of thousands of men and given even a little measure of happiness in this world, I am content.

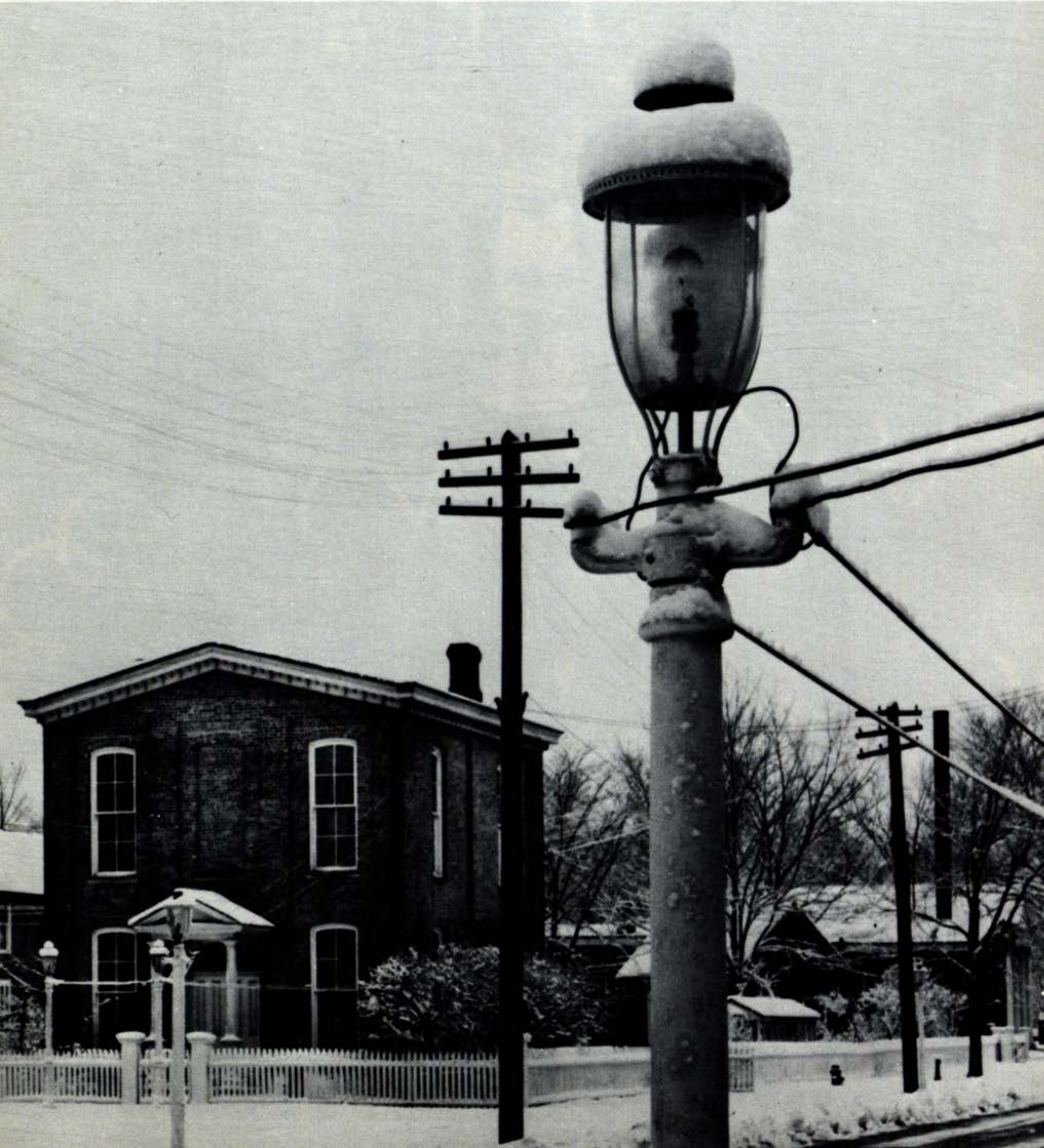
"This experience makes me realize as never before that Americans are sentimental, and this great event, Light's Golden Jubilee, fills me with gratitude. I thank our President and you all, and Mr. Henry Ford, words are

Henry Ford's meticulous, pioneering efforts preserved for future generations at Greenfield Village and Henry Ford Museum Thomas Alva Edison's original Menlo Park Compound.

inadequate to express my feelings. I can only say to you that in the fullest and richest meaning of the term, 'he is my friend' . . . Good night."

To be sure, more people took notice of Mr. Edison on this occasion than during the long concerted laboratory trials of fifty years before. He was one of the few gifted individuals who lived to see his contributions flower in the hands of a grateful civilization.

The Beginning of the Incandescent Lamp and Lighting System records, in Mr. Edison's own words, the story of modern electrical engineering in its embryonic stage. The work of no other single individual has had such a profound effect on our entire concept of life. To Mr. Edison must ever be accorded credit for a thorough mastery of the art of practical invention, an inseparable working force in the ensuing generations.



Above: Menlo Park Laboratory. New Jersey. Built in May 1876 by Mr. Edison's father, this building was the experimental headquarters for Edison's operation during the ten years considered to be his most productive - 1876-1886. Together with the six attendant buildings added between 1876 and 1879, the laboratory constitutes the world's first industrial research complex. Each laboratory assistant was a specialist in his field, directing individual efforts toward the development of practical inventions. From this concerted effort came the incandescent electric light, phonograph, electric pen, carbon telephone transmitter, and the perfection of Edison's complete system of electrical engineering. Among the 1,093 important patents issued to Edison between 1869 and 1933, 421 were the direct result of his work at Menlo Park. The transfer of the seven Menlo Park buildings to Dearborn in 1928-1929, with Mr. Edison's personal collaboration, epitomizes the high standards applied by Henry Ford in establishing his pioneer preservation effort.

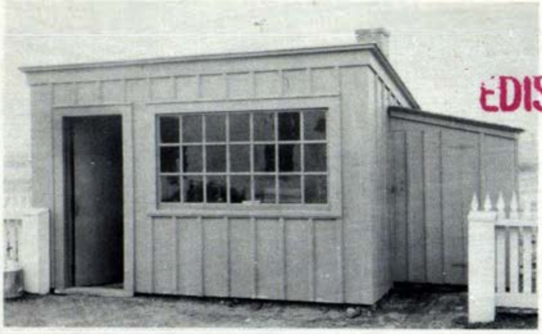
I was inclined to concur in the prevailing opinion as to the easy destructibility of carbon, but, without actually settling the point in my mind, I laid aside temporarily this line of experiment and entered a new field. I had made previously some trials of platinum wire as an incandescent burner for a lamp, but left it for a time in favor of carbon. I now turned to the use of almost infusible metals—such as boron, ruthenium, chromium, etc.—as separators or tiny bridges between two carbon points, the current acting so as to bring these separators to a high degree of incandescence, at which point they would emit a brilliant light. I also placed some of these refractory metals directly in the circuit, bringing them to incandescence, and used silicon in powdered form in silicon mixed with lime or other very infusible non-conductors or semi-conductors. My conclusions as to these substances were that, while in some respects they were within the bounds of possibility for the subdivision of the electric current, they did not reach the ideal that I had in mind for commercial results.

And so the work went on through innumerable experiments along these lines until January, 1878. Then I was obliged to lay aside the experiments for the time being on account of other important business and the great inrush of work following the general excitement caused by my invention and exhibition of the phonograph. This busy period extended into the summer of 1878, when I felt the necessity of taking a vacation trip for a change. I was invited to join a party of astronomers who were going to Rawlins, Wyoming, to observe an eclipse of the sun. The invitation was accepted, as I figured this would also give me an opportunity to test my Tasimeter, a delicate instrument that I had devised for measuring heat transmitted through immense distances of space. I was absent about two months.

After my return from the trip to observe the eclipse of the sun, I went with Professor Barker, Professor of Physics of the University of Pennsylvania, and Doctor Chandler, Professor of Chemistry in Columbia College, New York, to see Mr. Wallace, a large manufacturer of brass in Ansonia, Connecticut. Wallace at this time was experimenting on series arc lighting. Just at that time I wanted to take up something new, and Professor Barker suggested that I go to work and see if I could sub-divide the electric light so it could be got in small units like gas. This was not a new suggestion, because, as already related, I had made a number of experiments on electric lighting a year before this. They had been laid aside for the phonograph. I determined to take up the search again and continue it. On my return home I started

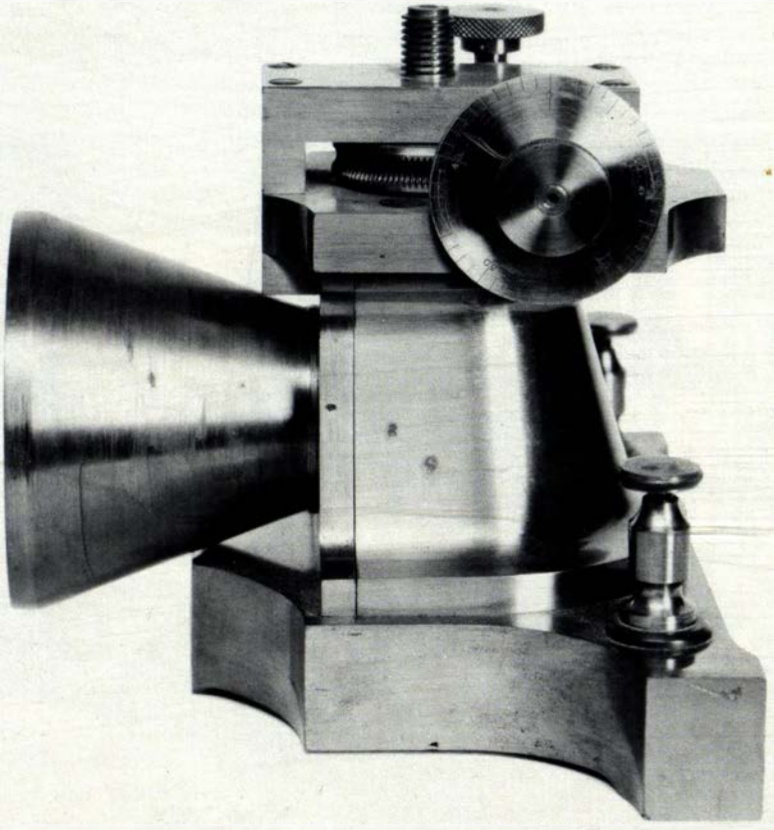
Above: Chest of drawers on which Mr. Edison conducted his carbon experiments between 1876 and 1880.

Below: Experimental table described by Mr. Edison as the scene of the early lamp trials "in vacuo." While undergoing a platinum lamp experiment early in 1879, Mr. Edison and his assistant, Francis Jehl, discovered the phenomenon of "occluded gasses," the method of outgassing the conductor by purging it during evacuation with intermittent and steadily increasing voltages. (U.S. patent 227,229, April 12, 1879)

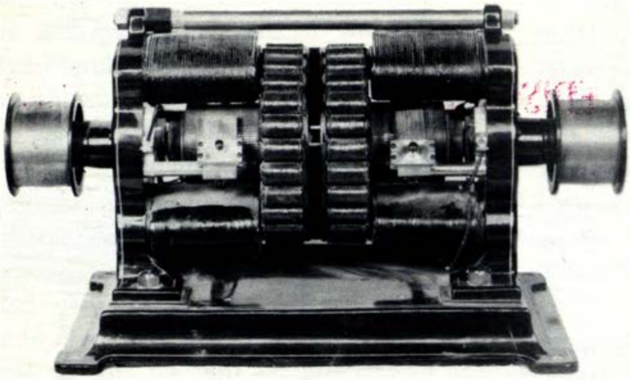


Above: Carbon shed. Alfred Swanson, Edison's night watchman, removed carbon from the chimneys of kerosene lamps for use in a variety of electrical experiments. Among the patented inventions utilizing carbon in their construction are Edison's carbon granule telephone transmitter (1876); dynamic microphone (1877); variable carbon rheostat, the prototype of today's dimmer switch (1877); and carbon filaments for incandescent lamps.

Right: Interior of the carbon shed. Many of the original kerosene lamps used at Menlo Park are ranged on the storage shelves. The boxes under the bench were used to pack carbon buttons for shipment to the Western Union Telegraph Company in New York City during the promotion of their telephone interests in the late 1870s.

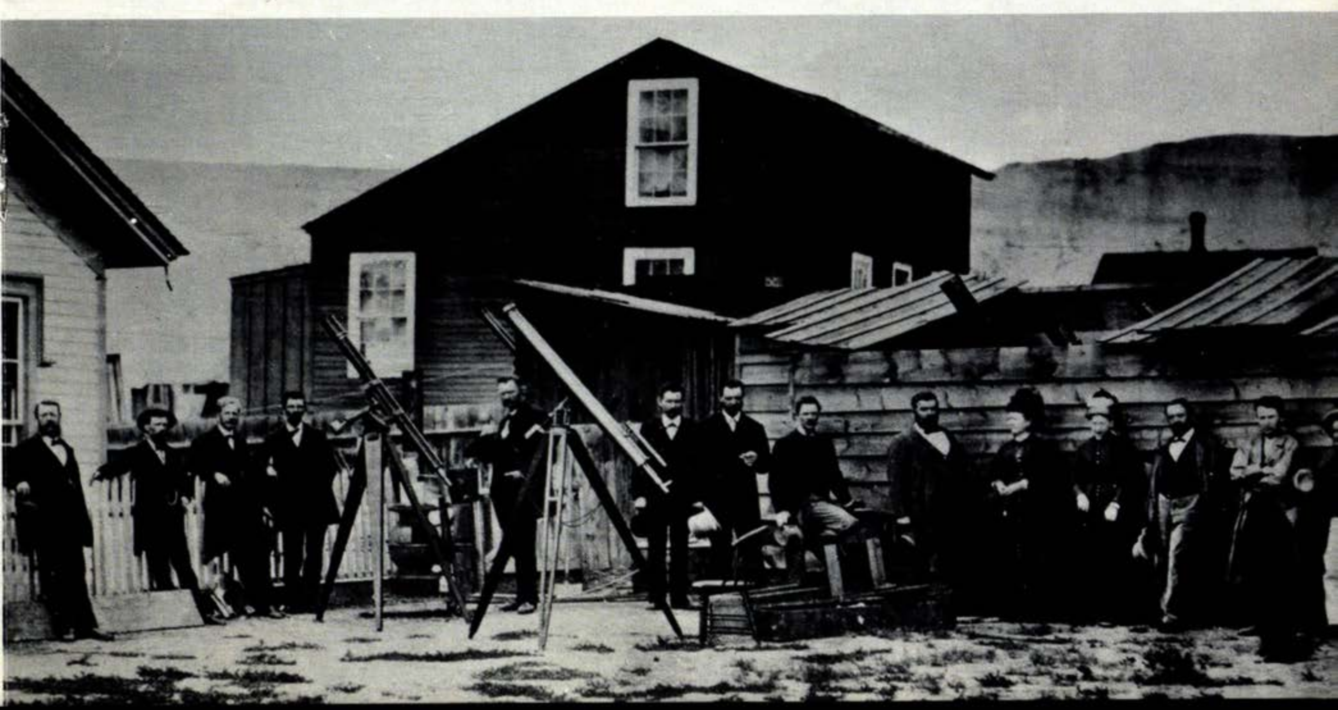


Above: Edison carbon tasimeter. 1878. This device, an aberrant outgrowth of Edison's work with carbon telephony, was used to detect heat transmission through immense distances. Mr. Edison claimed it was capable of measuring temperature change as minute as one-five-hundredth-thousandth of a degree. He took the tasimeter to Rawlins, Wyoming, to measure heat from the sun's corona during the total eclipse of July 1878. *Gift of The Edison Pioneers.*



Above and right: Original Wallace-Farmer arc lamp dynamo, 1878 (above), powered his improved arc lamp (right). Even in the late 1870s electric series connected arc lighting was little employed as a reliable method of illumination in the United States. Its great light intensity and high current consumption rendered it impractical for domestic use except in municipal lighting and illumination of theaters. The intensity of the arc lamp was equal to 4,000 candles. *Gifts of The Edison Pioneers.*

Below: Thomas A. Edison and a group of astronomers gathered at Rawlins, Wyoming, in July 1878 to observe an eclipse of the sun. Left to right: George F. Barker, Dean, University of Pennsylvania; Robert M. Galbraith, master mechanic, Union Pacific Railroad, Rawlins, Wyoming; Dr. Henry Morton, president, Stevens Institute of Technology; Mr. Bloomfield; Professor Myers, Iowa; D.H. Talbot, Sioux City; M.F. Rae; Marshall Fox, reporter, *New York Herald;* Professor James C. Watson, University of Michigan; Mrs. James C. Watson; Mrs. Henry Draper; Dr. Henry Draper, Draper Expedition of New York; Thomas A. Edison; and Sir Joseph Norman Lockyer, astronomer, England.



my usual course of collecting every kind of data, this time it was about gas; I bought all the transactions of the gas-engineering societies, etc., all the back volumes of gas journals, etc. Having obtained all the data, and investigated gas-jet distribution in New York by actual observations, I made up my mind that the problem of the subdivision of the electric current could be solved and made commercial.

I realized that an electric lamp to be commercially practical must of necessity bear a general comparison with a gas jet in at least two points; first, that it must give a moderate illumination, and second, that such a lamp must be so devised that each one could be lighted and extinguished separately and independently of any others. With this basic idea in mind we resumed our experiments at once.

We turned back to the investigation of carbon as a possible illuminant, and during the last few months of 1878 we made a large number of paper carbons from tissue and other kinds of paper and Bristol board. Some of our tissue papers we coated over their surfaces with a mixture of lampblack and tar and we rolled them up into the thin long form of Knitting needles and then carbonized them. These we put into electric circuits and brought them up to incandescence *in vacuo*, but at the best they would last but an hour or two. Besides these experiments with paper carbons, we also tried hard carbon, wood carbons and some made from carbonized broom corn.

We made lamps with these various carbons in the form of strips, and lighted them, but even with the best facilities we had at that time the lamps would give light for only a short while. But their greatest impracticability lay in the fact that they were of low resistance, and in a lighting system the current required to light them in great numbers would necessitate such large copper conductors for mains, etc., that the investment would be prohibitive and absolutely uncommercial. In other words, an apparently remote consideration, (the amount of copper used for conductors), was really the commercial crux of the problem.

The experience gained through my extensive experiments led me to conclude that the only possible solution of the problem of subdividing the electric light was that the lamps must have a high resistance and small radiating surface; also that they must be operated in a multiple arc system,[1] that is to say, independently of each other.

About December 1878 I engaged as my mathematician a young man named Francis R. Upton, who had lately studied in Germany, under Helmholtz. He helped me greatly in the multiple arc problem. Our figures proved that an electric lamp must have at least 100 ohms resistance to compete commercially with gas.

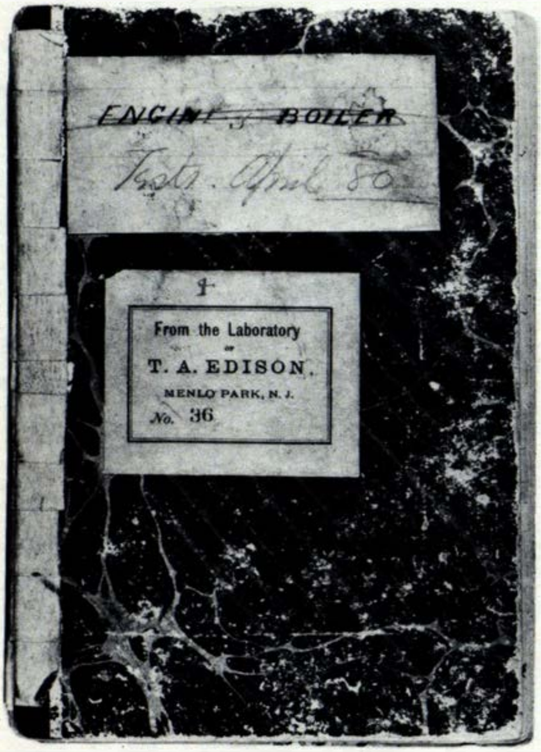
Without losing faith in the latent possibilities of carbon, I realized that it would be useless under the then present conditions to continue further experimenting with low resistance strips of that material as burners in electric lamps. Therefore, I turned my attention to the platinum group of metals and began a series of experiments in which I used chiefly platinum wire, iridium wire, and alloys of refractory metals in the form of wire, as burners for incandescent lamps.

These metals have very high fusing points, and, in addition, were of much higher resistance than the carbon strips I had used. When heated up to incandescence by the electric current these wires were found to last longer than the carbon strips, although under such conditions as we had at hand they were melted by excess of current after they had been lighted a comparatively short time, either in the open air, or in such a vacuum as we could then obtain by means of the ordinary air pump.

Nevertheless, we continued working along this line, making improvements from time to time until about April 1879, when I devised a means whereby platinum wire of a given length, which would melt in the open air when giving light equal to four candles, would emit a light of twenty-five candlepower without fusion. This was accomplished by introducing the platinum wire into an all glass globe, completely sealed and highly exhausted of air, and passing a current through the platinum wire while the vacuum was being made. This was a new and radical invention, and, as proved by subsequent events, was the first real step we had made towards the modern incandescent

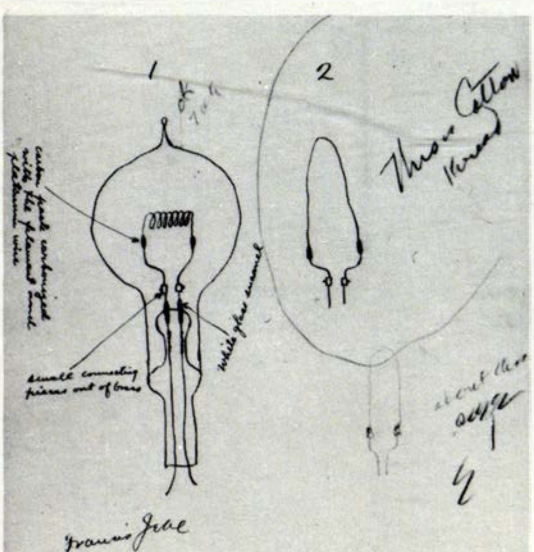
Left: Edison's first lamp patent. April 1879. This lamp used a platinum wire conductor, one of numerous attempts to utilize conductors of high infusible rare metals. Months later, Edison abandoned metals and returned to experiments with carbon. Edison's use of a select and practical "filament" in an incandescent lamp was his key to "sub-dividing" the intensity of illumination, making each lamp capable of emitting a light pleasing to the eye and easily adapted to use in multiple arc on a 110-volt constant potential circuit. (U.S. patent 214636 filed October 14, 1878, awarded April 22, 1879) *Gift of The Edison Pioneers.*

Below: Menlo Park Laboratory main floor. The testing table, which was supported by two brick piers that were separate and independent of the floor, was devised by Mr. Edison for his mathematical physicist, Francis R. Upton. This was the scene of much intensive research in the practical subdivision of electric lighting by parallel distribution. Using the Thomson reflecting galvanometer, Mr. Upton devised the first mathematical table of constants applied to the newly emerging Edison system of electrical engineering.



Above: The Edison laboratory notebook. Dated April 1880. This record book documenting boiler tests is typical of many kept by the Edison laboratory staff that are now in the Greenfield Village collection.

Below: Drawing executed by Thomas A. Edison and Francis Jehl. October 1879. This notebook entry is directly responsible for the creation of the first successful incandescent lamp experiment of October 19-21, 1879. It is typical of many drawings of dies and component parts that passed from the laboratory to the machine shop for production.



lamp. The knowledge I thus obtained that the passing of current through the platinum wire during exhaustion would drive out occluded gases (namely, gases mechanically held in or upon the metal) and increase the infusibility of the platinum, led me to aim at greater perfection in the vacuum pump on the theory that the higher the vacuum obtained the higher would be the infusibility of the platinum burner. I afterwards found this fact was also of the greatest importance when we finally made the successful use of carbon, because, without the subjection of the carbon to the heating effect of the current during the formation of the vacuum, the presence of occluded gases would have been a fatal obstacle.

We followed up this encouraging indication with a long series of experiments to improve our vacuum pumps. About August of 1879 we completed a pump that would produce up to about the one hundred-thousandth part of an atmosphere. As we continued to gain further experience through incessant experiment, it was only about a month afterwards that we succeeded in making a pump by which we obtained a vacuum of the one-millionth part of an atmosphere. It must be remembered that the conditions necessary for *maintaining* this high vacuum were only made possible by my invention of the one-piece all-glass globe in which all the joints were hermetically sealed during its manufacture into a lamp, whereby, a high vacuum could be retained continuously for any length of time.

In obtaining this perfection of vacuum apparatus, together with the concurrent use of an all-glass one piece lamp globe, I realized that I was approaching much nearer to a solution of the problem. In my experiments with the platinum iridium lamp, I had been working all the time towards the proposition of relatively high resistance and small radiating surface; but it was clear to me that the desired economy, simplicity and durability were not to be obtained in a lamp with a metallic burner like platinum.

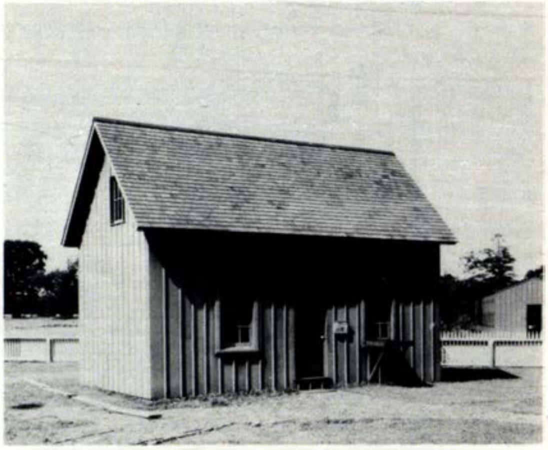
Even after attaining a high degree of perfection with these lamps, I recognized their impracticable character, and my mind reverted to the opinion I had formed in my early experiments two years before —

namely, that carbon had the requisite resistance to permit a very simple conductor to accomplish the object if it could be used in the form of a hair-like "filament,"[2] provided the filament itself could be made sufficiently homogeneous.

I was well acquainted with the properties of carbon and knew that if it could be produced in the form of a hair-like filament, that such a filament would have relatively high resistance, and, of course, small radiating surface. But could such a fragile filament be capable of withstanding mechanical shock and be susceptible of being maintained at a temperature of over 2,000 degrees for 1,000 hours or more before breaking? Again, could this filamentary conductor be supported in a vacuum chamber so perfectly formed and constructed that during all these hours in which it would be subjected to various temperatures, not a particle of air could enter to disintegrate the filament? And not only so, but the lamp, after its design, must not be a mere laboratory possibility, but a practical commercial article capable of being manufactured at low cost and large quantity, and capable of long distance shipment without injury. These and a multitude of minor considerations, — minor, but none the less important, — combined to form a problem of great magnitude.

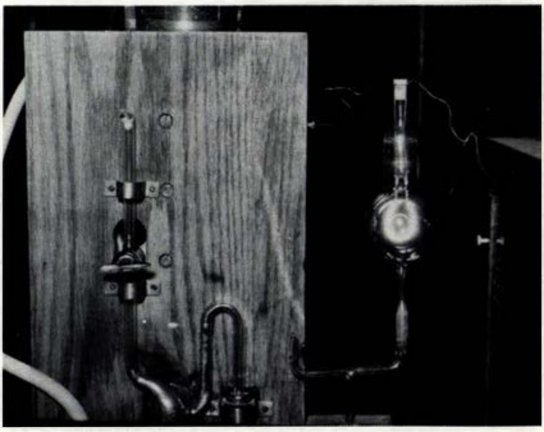
As already stated, I found that I could not use carbon successfully in my earlier experiments, because the rods or strips of carbon I then employed, although much larger than filaments, would not stand, but were consumed in a few minutes under the best conditions that I then had at my command. Now, however, that I had found means of obtaining and maintaining high vacua, I immediately went back to carbon, which from the first I had conceived of as the ideal substance for a burner. My next step proved conclusively the correctness of my former deductions.

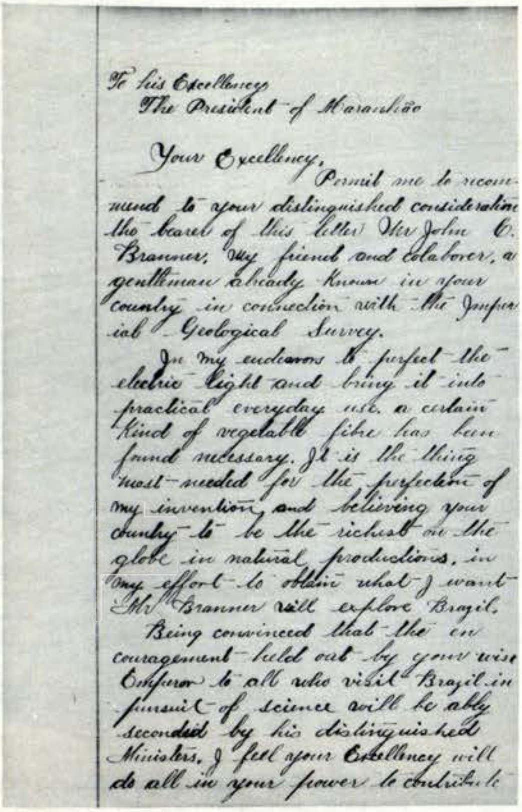
I decided to test out my theory by the use of a filamentary burner and my old laboratory notebooks show that on October 21, 1879, after many heart-breaking trials, we succeeded in carbonizing a piece of cotton sewing thread, bent into horse-shoe shape, and I had it sealed into a glass globe from which I exhausted the air until a vacuum up



Above: Photographic studio and glass house. Ludwig Boehm, Mr. Edison's chief glassblower created the glass parts for early experimental incandescent lamps in this building. Boehm was a student of the celebrated Heinreich Geissler at Bonn, Germany.

Below: The final stage of completing an Edison incandescent lamp. The carbon filament is outgassed by intermittent and steadily increasing voltages while the globe is evacuated on the Sprengel mercury vacuum pump.



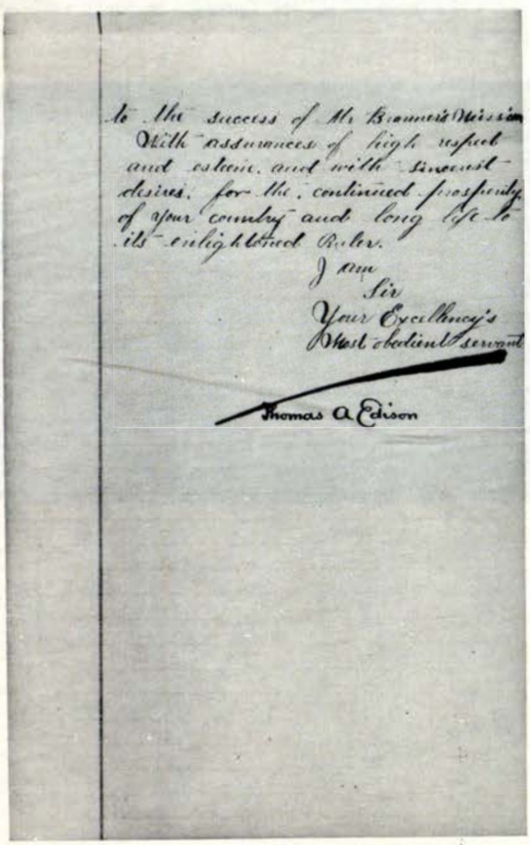


To his Excellency
The President of Maranhão

Your Excellency,
Permit me to recommend to your distinguished consideration the bearer of this letter Mr John C. Branner, my friend and colaborer, a gentleman already known in your country in connection with the Imperial Geological Survey.

In my endeavors to perfect the electric light and bring it into practical everyday use, a certain kind of vegetable fibre has been found necessary. It is the thing most needed for the perfection of my invention, and believing your country to be the richest on the globe in natural productions, in my effort to obtain what I want Mr Branner will explore Brazil.

Being convinced that the encouragement held out by your wise Emperor to all who visit Brazil in pursuit of science will be ably seconded by his distinguished Ministers, I feel your Excellency will do all in your power to contribute



to the success of Mr Branner's Mission.
With assurances of high respect and esteem, and with sincerest desires for the continued prosperity of your country and long life to its enlightened Ruler.

I am
Sir
Your Excellency's
Most obedient servant

Thomas A Edison

to one-millionth of an atmosphere was produced. The lamp was hermetically sealed and then taken off the vacuum pump and put on the electric current. It lighted up and in the first few breathless minutes we measured its resistance quickly and found that it was 275 ohms — all we wanted. Then we sat down and looked at that lamp. We wanted to see how long it would burn. The problem was solved, — if the filament would last. We sat and looked, and the lamp continued to burn. The longer it burned, the more fascinated we were. None of us could go to bed, and there was no sleep for any of us for forty hours. We sat and just watched it with anxiety growing into elation. The lamp lasted about forty-five hours, and I realized that the practical incandescent lamp had been born. I was sure that if this rather crude experimental lamp would burn forty-five hours, I could make a lamp that would burn hundreds of hours, and even up to a thousand.

Up to this time I had spent upwards of $40,000.00 in my electric light experiments, but the result far more than justified the expenditure, for with this lamp I made the discovery that a *filament* of carbon, under the condition of high vacuum, was commercially stable and would stand high temperature without the disintegration and oxidation that took place in all previous attempts that I knew of for making an incandescent burner from carbon. Besides, this lamp possessed the characteristics of high resistance and small radiating surface, permitting economy in the outlay for conductors, and requiring only a small current for each unit of light, — conditions that were absolutely necessary of fulfillment in order to accomplish the subdivision of the electric light current.

So, then, this slender, fragile, tenuous thread of brittle carbon, glowing steadily and continuously with a soft light agreeable to the eye, was the tiny key that opened the door to a world revolutionized as to its interior artificial illumination.

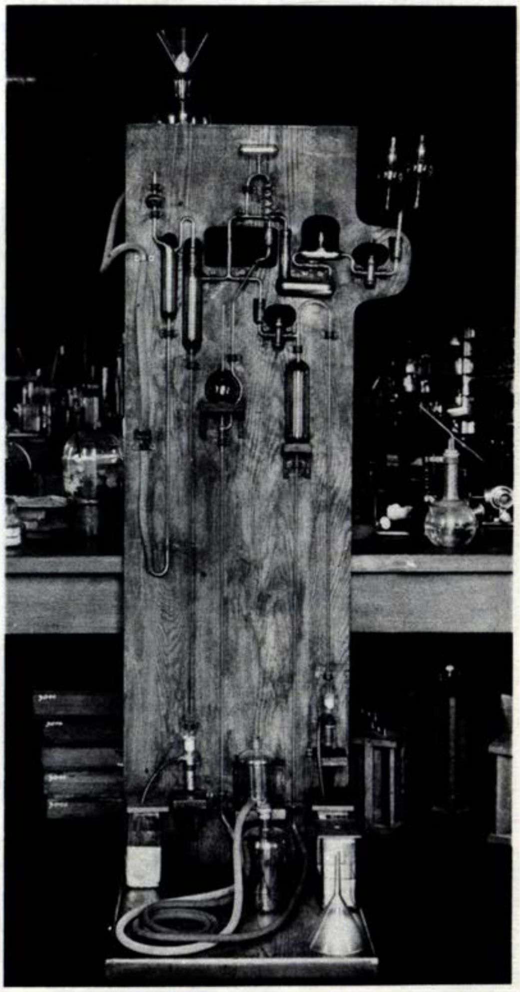
The basic principle of a successful incandescent lamp having thus been established, I began a search for a more suitable filament material. Although we had demonstrated the principle with a carbonized cotton sewing-thread, I knew that this material would not answer commercial requirements because of inherent difficulty in handling. We resorted again to carbonized paper in filamentary form and made a number of successful lamps therewith, but I saw that paper was not by any means ideal for the purpose, and I began to experiment with wood and vegetable fibres. At this time I was investigating everything microscopically and one day I happened to see a palm leaf fan on one of the tables. I picked it up and found that it had on its rim a very long strip of bamboo cut from the outer edge of the cane. We soon had this cut up into filament lengths and carbonized. On putting these filaments into lamps I was gratified to find that these lamps were very much better than any we had previously made. I soon ascertained the reason and sent one of my men off to Japan on a bamboo hunt. I also sent a man up the Amazon and another one to Sumatra. Before I got through I had tested no fewer than 6000 vegetable growths, and had ransacked the world for the most suitable filament material. My man whom I had sent to Japan,[3] found a very fine species of bamboo, and I made a contract with a Japanese farmer to supply this particular species and growth regularly. The use of bamboo for filaments was maintained for many years until other material, such as cellulose, had been perfected.

The invention of a practical, commercial incandescent lamp was only the opening

Above: Iwashimidzu-Hachimangu, a notable Shinto Shrine. Yawata, Kyoto Prefecture, Japan. In the grove by this shrine William H. Moore and his expedition located the finest species of bamboo for the Edison bamboo filament incandescent lamp in 1880.

Far left: Undated letter to His Excellency, The President of Maranhao, from Thomas Alva Edison. 1880. This letter of introduction explains that John C. Branner, Mr. Edison's "colaborer," will explore Brazil searching for a vegetable fiber to be used as a filament for the electric light and requests the President's aid in the success of the mission.

Right: Combination Sprengel-Geissler vacuum pump designed by Thomas A. Edison with assistance of his glassblower Ludwig K. Boehm late in 1879-1880. Sprengel drop-tube suction pump, invented in 1864, is at the left and the Geissler mercury gravitational displacement system, invented in 1855, at the right. Mr. Edison added the spark-gap, McCleod Gauge and phials containing phosphoric anhydride and gold leaf. This pump, which was later simplified, enabled the production of one lamp per hour with continued operation in 1880.



Above and below: The second Menlo Park machine shop, erected in 1878, replaced the small shop once contained on the main floor of the laboratory. It was used to produce a multitude of devices needed in the development of the Edison system of electrical engineering. Among the items perfected in this building were dynamos, motors, fuses, switches, sockets, meters, and electrical insulation. One of the most important investigations made in this facility was the determination of the number of incandescent lamps, each one equal to the intensity of a gas jet, that could be sustained from one horsepower operating in parallel distribution. This shop became the world's first Edison central electric generating station on New Year's Eve, 1879, when the inventor publicly demonstrated his system before 3000 visitors who thronged to the compound to witness this momentous occasion. The historic "Long-legged Mary Ann" Edison dynamos are today located in their original setting where they provided current for the illumination of the Edison Laboratory Compound, Christie Street, and four residences within the hamlet of Menlo Park, New Jersey.

number of my program, for upon my taking up the electric light problem in 1878, my concept was a *complete system* for the distribution of electric light in small units in the same general manner as gas. And now that the key-stone was provided, it became necessary to prepare the other part of the structure, (including the distribution of electric current for heat and power also.) Some idea of the task may be gained from a perusal of the following partial program which confronted me:

First — To conceive a broad and fundamentally correct method of distributing the current, satisfactorily in a scientific sense and practical commercially in its efficiency and economy. This meant, a comprehensive plan, analogous to illumination by gas, covering a network of conductors, all connected together, so that in any given city area the lights could be fed with electricity from several directions, thus eliminating any interruption due to disturbance on any particular section.

Second — To devise an electric lamp that would give about the same amount of light as a gas jet, which custom had proven to be a suitable and useful unit. This lamp must possess the quality of requiring only a small investment in the copper conductors reaching it. Each lamp must be independent of every other lamp. Each and all the lights must be produced and operated with sufficient economy to compete on a commercial basis with gas. The lamp must be durable, capable of being easily and safely handled by the public, and one that would remain capable of burning at full incandescence and candle-power a great length of time.

Third — To devise means whereby the amount of electrical energy furnished to each and every customer could be determined, as in the case of gas, and so that this could be done cheaply and reliably by a meter at the customer's premises.

Fourth — To elaborate a system or network of conductors capable of being placed underground or overhead, which would allow of being tapped at any intervals, so that service wires could be run from the main conductors in the street into each building. Where these mains go below the surface of the thoroughfare, as in large cities, there must be protective conduit or pipe for the copper conductors, and these pipes must allow of being tapped wherever necessary. With these conductors and pipes must also be furnished manholes, junction-boxes, connections, and a host of varied paraphernalia, insuring perfect general distribution.

Fifth — To devise means for maintaining at all points in an extended area of distribution a practically even pressure of current, so that all the lamps, wherever located, near or far away from the central station, should give an equal light at all times, independent of the number that might be turned on; and safeguarding the lamps against rupture by sudden and violent fluctuations of current. There must also be means for thus regulating at the point where the current was generated the quality of pressure of the current throughout the whole lighting area, with devices for indicating what such pressure might actually be at various points in the area.

Sixth — To design efficient dynamos, such not being in existence at the time, that would convert economically the steam-power of high-speed engines into electrical energy, together with means for connecting and disconnecting them with the exterior consumption circuits; means for regulating, equalizing their loads, and adjusting the number of dynamos to be used according to the fluctuating demands on the central station. Also the arrangement of complete stations with steam and electric apparatus and auxiliary devices for insuring their efficient and continuous operation.

Seventh — To invent safety devices that would prevent the current from becoming excessive upon any conductors, causing fire or other injury; also to invent switches for turning the current on and off; lampholders, (sockets) fixtures, and the like; also means and methods for establishing the interior circuits that were to carry current to chandeliers and fixtures in buildings.

Eighth — To design commercially efficient motors to operate elevators, printing presses, lathes, fans, blowers, etc., etc., by the current generated in central stations and distributed through the network of main conductors installed in the city streets. Motors of this kind were unknown when I

Above: Front entrance to the Menlo Park laboratory as preserved in Greenfield Village. The historic street lamps house Thomas Alva Edison's second lamp development and the first type of experimental socket developed at the laboratory in the fall of 1879. It is typical of those in use during late 1879 and early 1880.

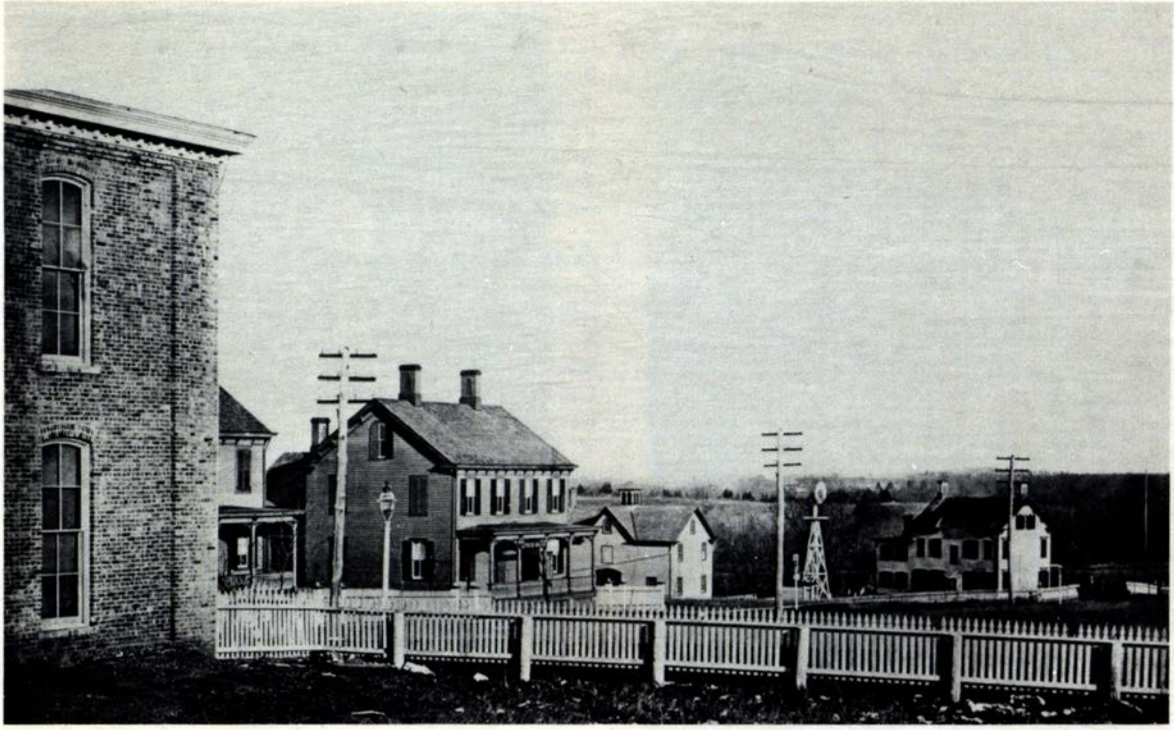
formulated my plans.

From a perusal of the foregoing programme it will be seen that with the invention of a practical incandescent lamp I had merely stepped over the threshold of a complete system. While we kept up a constant series of experiments for the greater perfection of the lamp, I busied myself in devising the other essential parts of the system I had conceived. There was no precedent for such a thing, and nowhere in the world could we purchase these parts. It was necessary to invent everything: dynamos, regulators, meters, switches, fuses, fixtures, underground conductors with their necessary connecting boxes, and a host of other detail parts, even down to insulating tape. Everything was new and unique. The only relevant item in the world at this time was copper wire, and even that was not properly insulated.

My laboratory was a scene of feverish activity, and we worked incessantly, regardless of day, night, Sunday or holiday. I had quite a large force and they were a loyal lot of men as a whole, and worked with vim and enthusiasm. We accomplished a great deal in a short space of time, and before Christmas of 1879 I had already lighted up my laboratory and office, my house and several other houses about one-fifth of a mile from the dynamo plant, and some twenty street lights. The current for these was fed through underground conductors made and insulated for the purpose. It is interesting to note, parenthetically, that in 1926 (47 years afterward) some of these conductors were dug up and found to be in first class condition.

Meanwhile, the newspapers voluntarily gave a great deal of publicity to my work, and on New Year's Eve of 1879, the Pennsylvania Railroad ran special trains from New York, bringing a crowd of over 3,000 people to see the new light. This was followed by a sensational drop in gas stocks and a tremendous increase in price of the stock of the Edison Electric Light Co.

The prices of stocks, however, did not disturb my thoughts, which were given over entirely to my work of devising and reducing to commercial practicability the essential



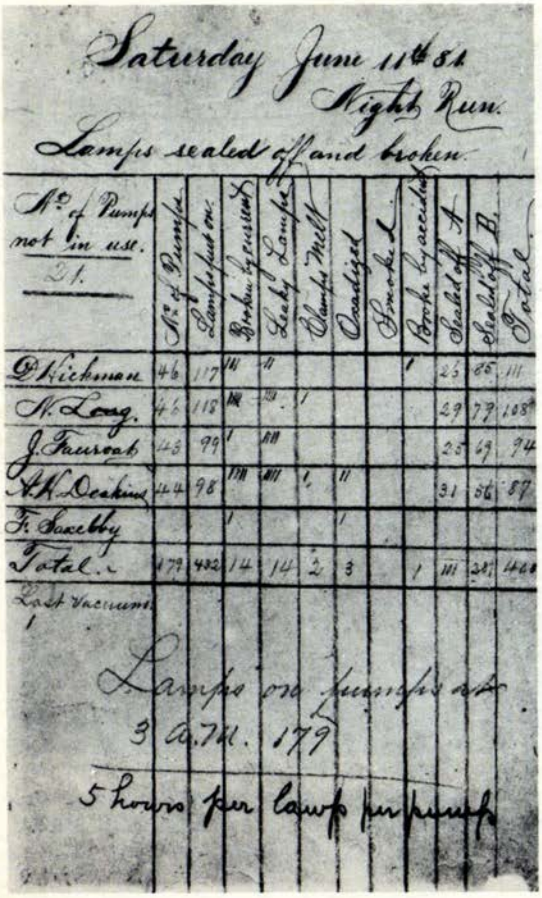
Above: View of lower Christie Street as seen from the Edison Laboratory, Menlo Park, New Jersey, in 1880. This was the first street to be electrically illuminated by the Edison system in 1879. Left to right: two story brick Edison Laboratory library, Sarah Jordan Boarding House, Edison stable, windmill, and homestead.

mechanisms and items that were required to carry my projected system of general distribution into effect. During 1880 I filed about 70 applications for patents on these various devices and by the end of that year had progressed far enough to feel that we were ready to commence real business. Early in 1881 we leased the old Bishop mansion at 65 Fifth Avenue, New York, for our general headquarters, and installed an engine and dynamo in the basement, having wired the house and fitted it up with fixtures made specially for the purpose.

But we had run squarely up against a great difficulty. My agreement with the capitalists who had furnished the money for the experimental work did not provide for the furnishing of money to manufacture the lamps, dynamos and other essential parts for carrying the inventions into effect. When I asked them to furnish capital for the manufacturing shops, they were sorry, (Wall Street sorry), but "could not see their way clear," as this was an untried business, etc.

As the Company held my patents, I was "up against it" for the time being, but not

Above: Edison Homestead, Menlo Park, New Jersey. This was one of four homes first illuminated for the historic 1879 New Year's Eve demonstration. Thomas A. Edison, Jr., (on tricycle), William L. Edison, and the Edison family nurse are standing beside one of Edison's street lamps.



Saturday June 11th 81
Night Run.
Lamps sealed off and broken.

No. of Pumps not in use. 21.	No. of Pumps	Lamps put on	Broken by [illegible]	Leaky Lamps	Clamps Melt	Oxidized	Smoked	Broke by accident	Sealed off A	Sealed off B	Total
D. Hickman	46	117	IIII	II				1	25	85	111
N. Long.	46	118	IIII	IIII	1				29	79	108
J. Faurot	43	99	I	IIII					25	69	94
A. H. Deakin	44	98	IIII	IIII	1	II			31	56	87
F. Saxelby			1			1					
Total.	179	432	14	14	2	3		1	111	28[illegible]	4[illegible]
Last Vacuum 1											

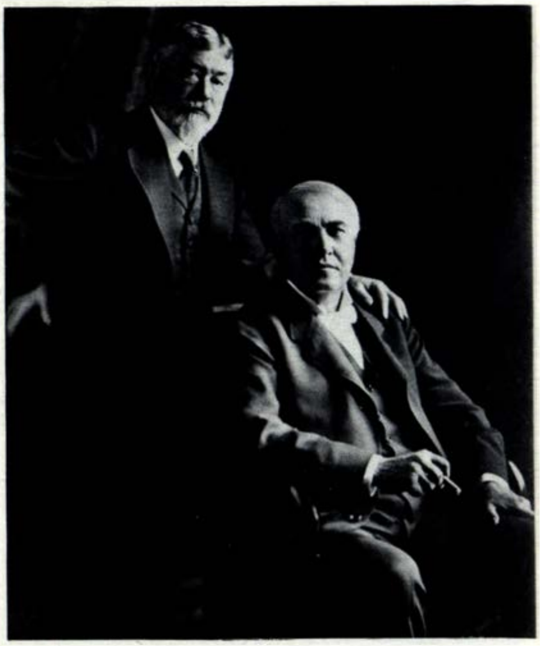
Lamps on pumps at 3 a.m. 179

5 hours per lamp per pump

Left: Page from a notebook recording experiments at the first Edison Lamp Works at Menlo Park, New Jersey, dated June 11, 1881. While lamps were already being commercially produced, experiments continued toward increased production at lower cost per unit. Lamps were first distributed at considerable loss to the company in order to promote the firm establishment of the Edison electric system throughout Europe and America.

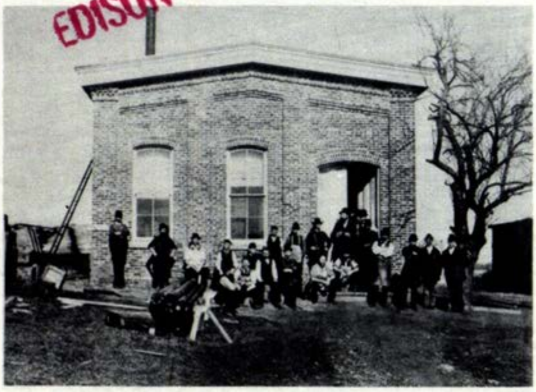
Right: Thomas A. Edison and Sigmund Bergmann, Berlin, Germany, 1911. Originally associated with Thomas A. Edison in 1870 at his telegraph instrument works at Newark, New Jersey, Bergmann moved to New York City and established a machine shop when Edison built the Menlo Park Laboratory in 1876. At his Wooster Street shops, Bergmann was entrusted by Edison with the commercial manufacture of several of his inventions including the first tin-foil phonographs, Edison telephone receivers and transmitters, etc. In 1881 Bergmann & Company was reorganized and soon taken into the Edison Electric Light Company and commissioned to manufacture early commercial Edison electrical apparatus - wall brackets, sockets, switches, fuses, meters, plugs, ceiling blocks, regulators, underground conducters, and many early domestic applicances. After his interests were absorbed into the General Electric Company in 1892, Bergmann began to reorganize his European manufacturing establishments into the Bergmann Electric Motor and Dynamo Company in Berlin. In 1900 he reconsolidated his German factories under the name, "Bergmann Electrical Works," eventually employing more than 30,000 workmen. No individual was more loyal to Edison and influential in establishing the Edison system throughout the European mainland.

Below: The first Edison Lamp Factory was established at Menlo Park in 1880 in this building about a quarter of a mile from the Edison Laboratory. The first commercial Edison bamboo lamps for public distribution were produced here.



Below: The brownstone at 65 Fifth Avenue, New York City, superseded the 1878 Edison Laboratory Library as the legal headquarters of the Edison Electric Light Company in 1881. Left to right: Thomas A. Edison, Charles Batchelor, and Major S. B. Eaton.

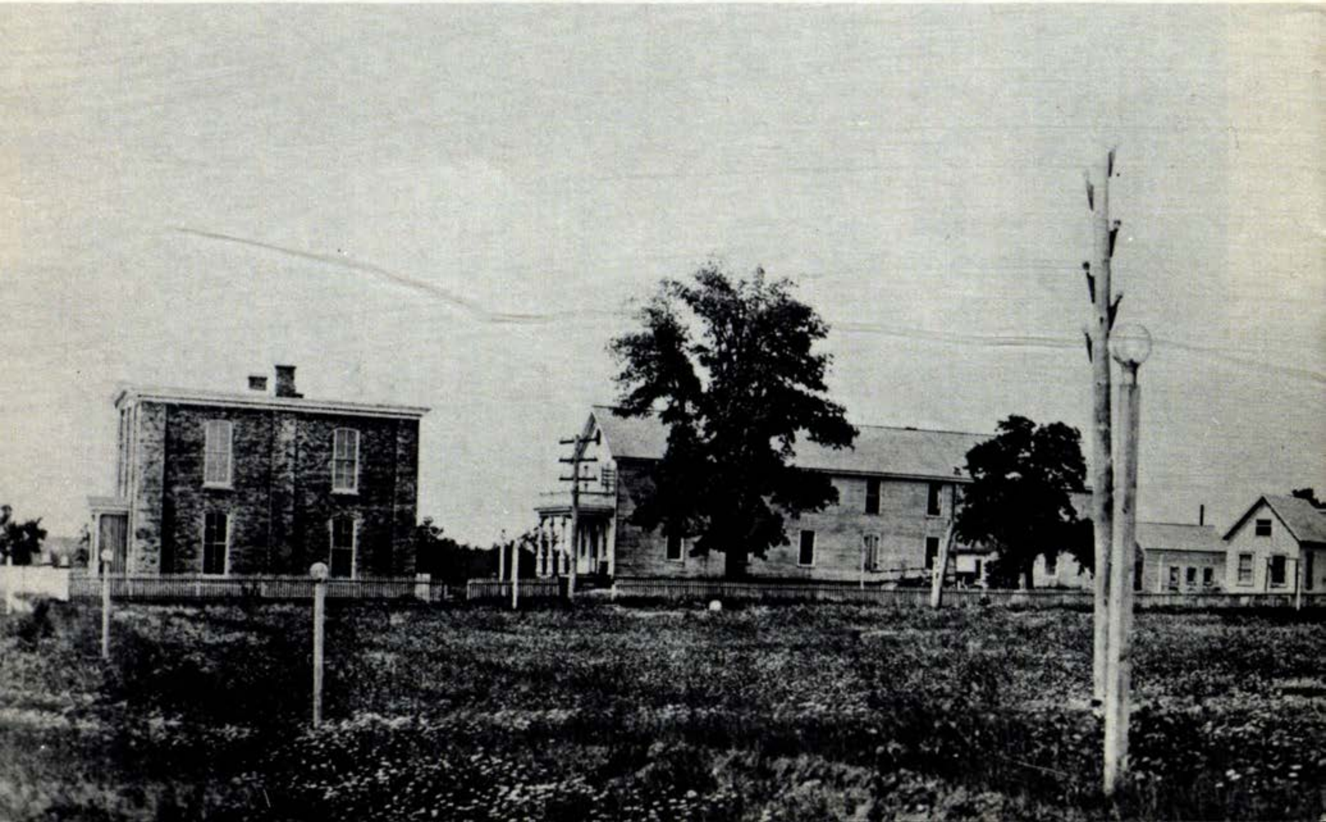
Below: The site of the old Aetna Iron Works, 104 Goerck Street, New York City, became the Edison Machine Works in 1881, the manufactory where Edison dynamos and motors were produced and tested. The Edison Machine Works remained at this site until it was removed to Schenectady, New York, in 1886. The Schenectady works became the headquarters of General Electric during the last merger of the Edison Electric Light Company in April, 1892.

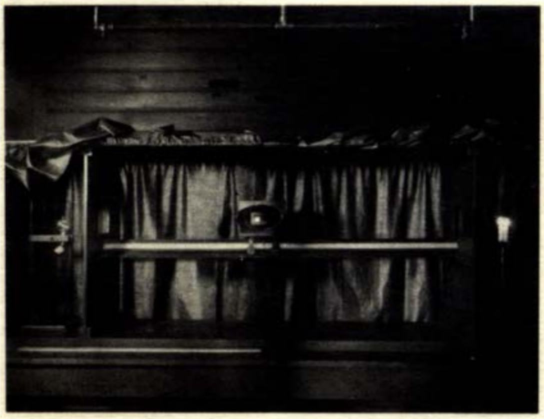


Above: The Edison Machine Shop and its crew, 1880.

Above right: Early Elias A. Howe treadle sewing machine. It was first electrically driven for the public demonstration conducted by Mr. Edison and his staff, New Year's Eve, 1879. Mr. Edison's objective was to demonstrate the fact that the same electrical system which provided illumination could conveniently be transformed into mechanical power, heat, and communication. Mr. Edison's first improvement in a large electric motor appears behind the sewing machine. The first exposed two-wire electrical connections were direct in 1879, interrupted only by simple two-pole sliding telegraph switches, mounted on the side wall. The removable two-pronged insulated wall plug was invented and added to the Edison system in 1881-1882 as were screw-based lamps, sockets and safety fuses.

Below: Menlo Park Compound, New Jersey, in the summer of 1880 during the second Edison demonstration of incandescent lighting. Left to right: two-story brick office and library, laboratory, carpenter shop, glass house, machine shop.





Above: Bunsen disc photometer, invented by the German scientist Robert Wilhelm Bunsen (1811-1899). This device was modified by Mr. Edison and his mathematical physicist Francis R. Upton with a sliding scale for determining candle power of incandescent lamps.

Right: Copper calorimeter made by Eimer and Amend and used by the Edison Laboratory staff in 1879 and 1880 for determining electrical energy consumed by early experimental incandescent lamps. Lacking a universally accepted application of voltage, ohms, and amperes in electrical technology, energy consumption was reliably measured by the length of time required to heat a given quantity of water one degree Farenheit and subsequent conversion into foot-pounds.

for long. I had unbounded faith in the future of the business and fortunately my personal credit was good. So I pawned my future and, with a little assistance from two or three of my associates, organized and established the necessary shops to manufacture the essential devices that would enable us to go ahead with the business. These shops comprised the Edison Lamp Co. which made the lamps; The Edison Machine Works where the dynamos, large motors, etc., were made; The Edison Tube Co., for manufacturing the underground tubes and their accessories; and Bergmann & Co., the works where sockets, switches, cutouts, meters, small motors, fixtures and other accessories were manufactured. These shops entered actively into their respective functions in the early part of 1881, and thereupon the Edison electric light was launched upon the sea of business. The remainder of the story belongs to the annals of commerce.

Footnotes:

1. Parallel wiring
2. U.S. patents 214636 and 223898.
3. Mr. H. Moore of the 1880 Moore Expedition to Japan.

General view, northeast wall, second floor of the Edison Laboratory showing experimental table containing original artifacts and documents used at Menlo Park, 1876-1882. The Edison Institute's vast Edison Historical Collection constitutes the world's most comprehensive preservation of scientific and applied technology of the 19th and early 20th centuries. Most of the artifacts were presented to Henry Ford by Thomas A. Edison and the Edison Pioneers and relocated, with their personal assistance, for Light's Golden Anniversary, October 21, 1929. The comprehensive collection of elements, minerals, and chemicals was provided in original containers by Mr. Edison and Mr. August Eimer of Eimer and Amend, New York City. Mr. Eimer was Mr. Edison's original scientific supplier at Menlo Park, New Jersey.