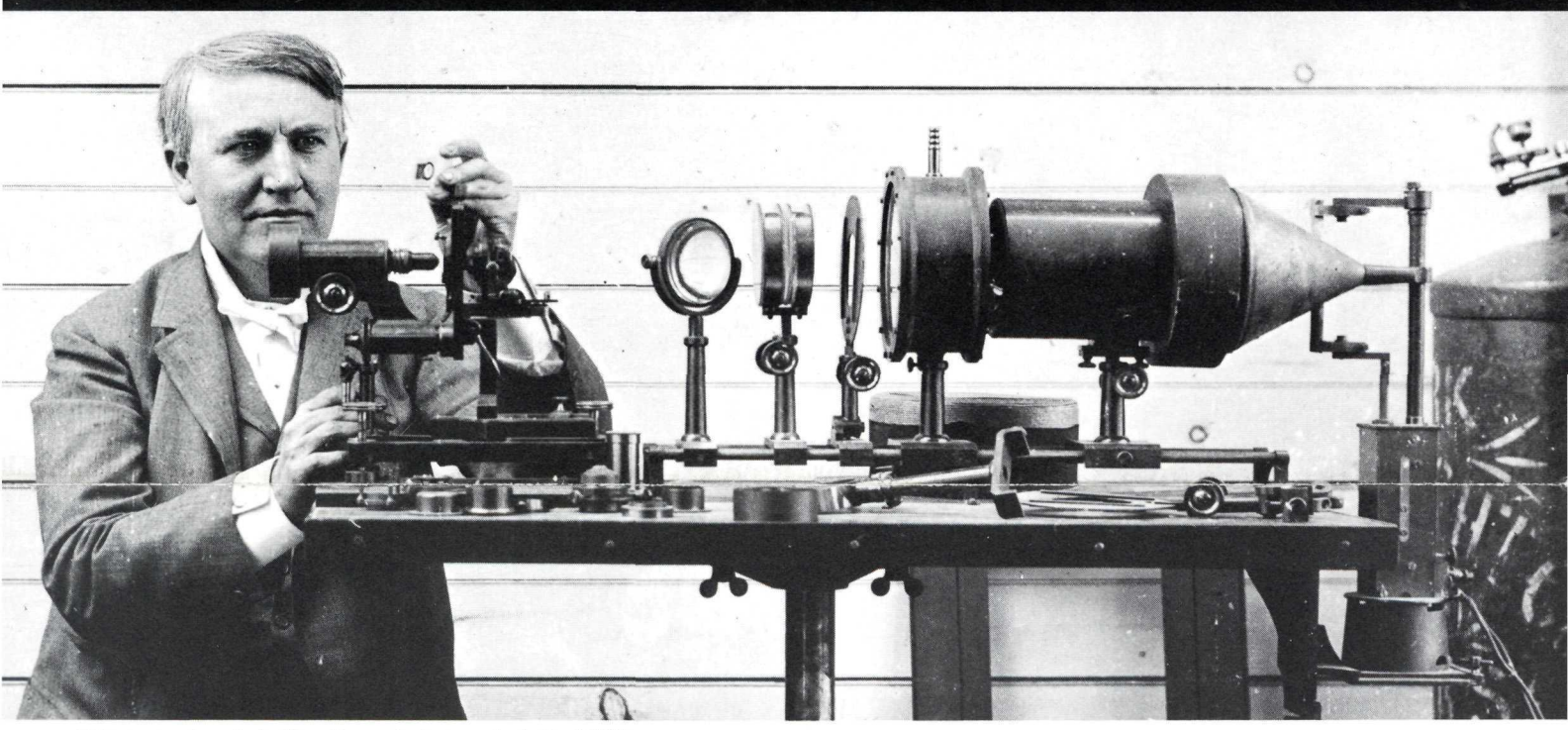
Edison

National Historic Site
New Jersey

National Park Service
U.S. Department of the Interior



Edison experimented with optics and micrography in the 1890's.

A business for translating pure technology into commercial products—that was how Thomas Edison thought of the laboratory he built at West Orange, N.J., in 1887. He was already famous for his work at the Menlo Park lab, where he had invented the phonograph, the first practical incandescent lamp, and its accompanying electrical distribution system. Now he wanted the ultimate research laboratory, a place devoted to the "rapid and cheap development of inventions." It would allow him to literally invent to order "useful things that every man, woman, and child wants. . . . at a price they can afford to pay." Edison liked to boast that the West Orange lab could build anything from a "lady's wristwatch to a locomotive." The manufacturing arm of the operation wasn't formed to accumulate wealth, although Edison certainly did that. "I always invent to obtain money to go on inventing," he said.

At the new lab he expanded his staff to about 60 workers, some of whom had been with him since his earliest inventing days. Though he often spoke against "academics," the team included scientists with training in chemistry, physics, and mathematics. But to Edison, all his workers were "muckers," and he was the "Chief Mucker." Though less educated than many of his staff, Edison remained the guiding force behind all projects at West Orange, walking daily through the labs to check the progress of his workers, supplying a "constant flow of ideas," according to Francis Upton, a mathematical physicist who worked with Edison for many years. Upton later remarked that he was frequently surprised by the accuracy of Edison's "guesses," usually borne out afterwards by mathematics and experiment.

To Edison, no problem was unsolvable, even when the leading theoreticians of the day said otherwise. It was simply a matter of intense application until he could "bring out the secrets of nature and apply them for the happiness of man." A combination of patient empirical work, his own inspired guesses, and the important contributions of his scientists and technicians resulted in the astonishing success of Edison's labs. Out of West Orange alone came the practical phonograph, the movie camera, the improved storage battery, the fluoroscope, and rubber from the goldenrod plant, among other projects.

Despite the personal control that Edison kept at West Orange, he gave his teams a free hand in the way they chose to approach a project. When asked by a new employee about rules, he shot back, "Hell, there ain't no rules around here. We're trying to accomplish something." Still, the atmosphere at West Orange was different from that at Menlo Park. There, a much smaller group, in legendary all-night sessions, threw themselves into problems until they were solved. A feeling of camaraderie and a sense of uniqueness helped focus their efforts. While the excitement and drive to succeed stayed alive at West Orange, the operation was so much larger (ten times), with so many things going at once, that it was necessarily more organized, projects were more secretive, and Edison found more of his time taken up with administrative chores.

He had a lot to manage. In the main lab, three stories high and 250 feet long, there were machine shops, an engine room, glass blowing and pumping rooms, chemical and photographic departments, rooms for electrical testing, stock rooms, and a library with 10,000 volumes. Four one-story labs were set at right angles to the main building. Edison stocked the labs with every conceivable substance his workers might need in their research, from horse hair to silk, or as Edison joked, "Everything from an elephant's hide to the eyeballs of a United States Senator," and with the latest machinery and finest instruments. A spectacular fire in 1914, fed by the enormous stores of chemicals, gutted most of the factory buildings, although the main lab was untouched. Edison reacted with characteristic calm, saying, "I am sixty-seven, but I'm not too old to make a fresh start." In fact, in a month most of his staff were back at work, and production was back to full speed.

The West Orange labs, which remained in operation until Edison's death in 1931, became the model for the modern private research and development lab, linking business and technology. The Bell and Westinghouse labs, two of the world's largest, were modeled on Edison's organization. The Edison lab, though, kept its preeminence in the field well into the 20th century, retaining its flexibility and a spirit of general research the others lacked. The modern industrial research lab is one of Edison's greatest inventions.

A Guide to the Site

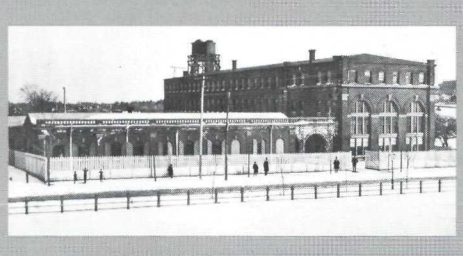
The Laboratory A busy urban area has grown up around the West Orange labs, and all but one of the poured-concrete factory buildings (an Edison innovation) that surrounded them are gone, but the old complex remains a quiet enclave where it is easy to feel the spirit of new ideas, the excitement of new technology, that drove Edison and his staff. The interiors of some of the buildings, especially the chemistry lab, recall the look of Edison's time, and many original inventions are on display, such as the tinfoil phonograph of 1877, the 1889 Strip Kinetograph and other motion picture apparatus, and early electric light and power equipment. A showing of one of Edison's early movies is a highlight of the tour. The only major addition to the complex is the underground vault built in 1942 to protect the huge collection of Edison's papers and rare examples of his early inventions.

Glenmont Edison bought Glenmont in 1886, soon after marrying Mina Miller, the 19-year-old daughter of a wealthy midwestern manufacturer. The 23-room red brick and wood mansion had been built 6 years earlier by a New York executive who had spared no expense (including funds embezzled from his firm) to furnish it in opulent Victorian style. There are wide staircases and a vestibule leading into grand rooms graced with stained glass windows, rich chandeliers, elaborately carved wood paneling, and frescoed ceilings. Most of the original furnishings are in place: damask-covered furniture, animal skin rugs, imported statuary and paintings, and gifts from around the world.

While the interior reflected the tastes of the day, the architecture was in the simpler Queen Anne style. Without Victorian turrets and ornamentation, the house's clean gables and balconies gave it a modern look. Expansive grounds, greenhouses, and stables made it the complete country estate, which Mina Edison managed with a large staff. If Edison ruled the labs down the hill, this was Mina's domain, and the house reflects her tastes and personality. Edison was most comfortable in the airy upstairs sitting room, where he and Mina each had a desk. Mina and Thomas are buried side by side in a simple plot behind their home.

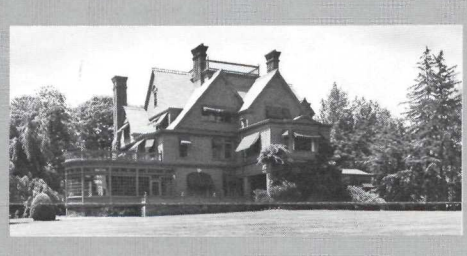
Administration Edison National Historic Site is administered by the National Park Service, U.S. Department of the Interior. A Park Superintendent, whose address is: Main Street at Lakeside Avenue, West Orange, NJ 07052, is in charge.

For Your Safety Use caution on steps and ramps. Watch children carefully in Chemistry Laboratory, Machine Shop, and Library. Use crosswalk at Lakeside Avenue to cross Main Street.



Left **The West Orange laboratory complex. 1893**

Center **Mina Edison 1886**



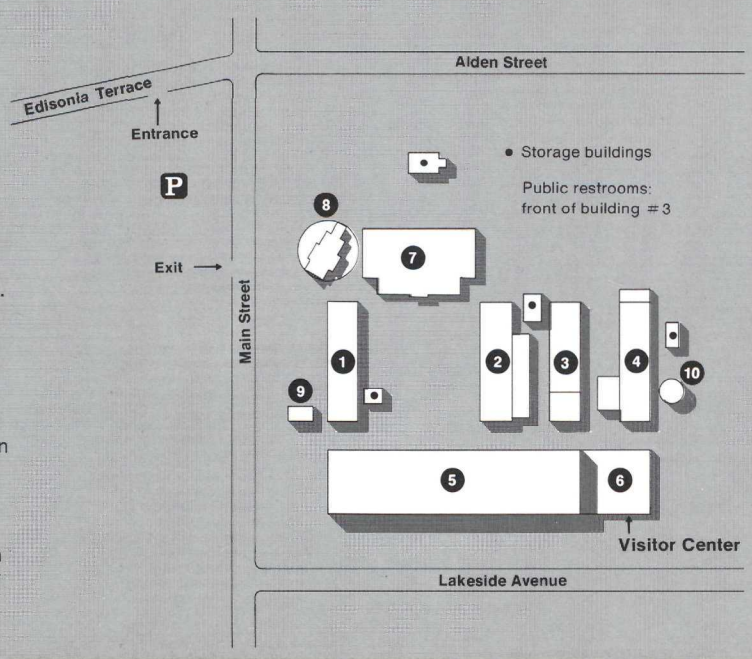
Right **"Glenmont," Edison's West Orange estate near the labs.**

Touring the Park

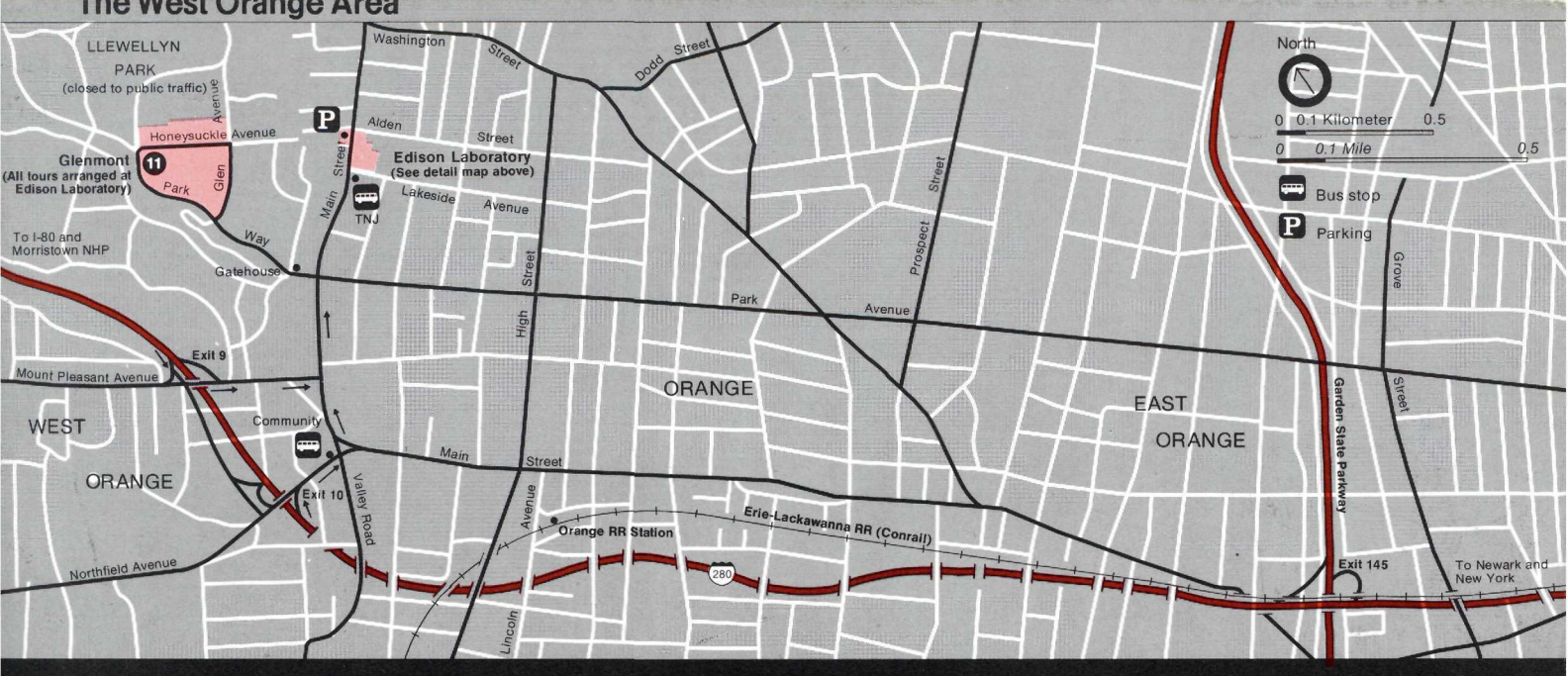
1. **Physics Laboratory** Now contains display rooms and park offices.
2. **Chemistry Laboratory** Has changed little since Edison's death in 1931.
3. **Chemical Storage and Pattern Shop** Now contains visitor restrooms and storage.
4. **Metallurgical Laboratory** Currently serves as curatorial workspace and storage.
5. **The Main Laboratory Building** Still contains 1887 **Machine Shops, Stock Rooms, Offices,** and Edison's double-tiered **Library/Office.**
6. **Laboratory Complex Powerhouse** Now a Museum and Visitor Center.
7. **Main Storage Vault** Holds most of the Edison archives and artifact collection (researchers only).
8. **Black Maria** (1954 Replica) World's first motion picture studio. Stood near the water-tower 1893-1903.
9. **Original Gatehouse** to the laboratory complex.
10. The 1922 Edison complex **Water Tower.**
11. **Glenmont** (See area map.) All visitors must make arrangements for Glenmont tours at Visitor Center in building no. 6.

Public restrooms are in building no. 3.

About Your Visit The Edison National Historic Site is located on Main Street and Lakeside Avenue in West Orange, New Jersey, 2 miles west of Garden State Parkway and half a mile north of Interstate 280. The only way to see Edison's Laboratory buildings or his home, "Glenmont," is by guided tour. Edison's Laboratory is open 7 days a week, 9:00 a.m. to 5:00 p.m. Guided tours are offered from 9:30 a.m. until 4:30 p.m. daily. The last complete tour begins at 3:00 p.m. All non-family groups require reservations. Call (201) 736-1515. Glenmont is open Wednesday through Sunday afternoons. Glenmont tour size is limited and arrangements must be made at the laboratory on the day of your visit. For updated tour information call (201) 736-5050.



The West Orange Area



Edison's Inventions

Thomas Edison was awarded 1,093 patents in his lifetime—the most ever granted to one person. His first was in 1869 for his electric vote recorder, when he was 22. He was still experimenting with rubber from goldenrod when he died at 84. The inventions ranged from subtle refinements of existing technology to major new concepts, such as the phonograph, which profoundly altered our culture. Though not a theoretical scientist, as he was the first to admit—even proudly—Edison contributed more to technological progress in America than any other person, and in some areas added significantly to the store of purely scientific knowledge. He helped lead America from the age of steam into the age of electricity.

He was also a transitional figure in the way technological research was conducted. Before him, invention was a haphazard process, by and large a matter of practical tinkering. Edison himself began this way, working alone, making small improvements in the telegraphic apparatus by which he made his living. But his obvious talent convinced him that he could invent full time. As soon as he had the money, he opened his first small workshop in Newark, N.J.

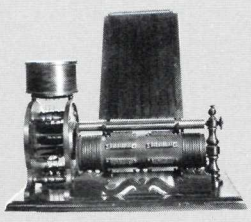
Edison was only 29 when he built his famous laboratory in Menlo Park, the world's first private research and development lab open to all areas of inquiry. He chose for his "invention factory" a pastoral setting in rural New Jersey that he hoped would be conducive to intensive experimentation, and assembled there a team of skilled and loyal assistants who had at their fingertips an enormous stock of materials and chemicals with which to develop Edison's ideas.

After the death of his first wife, Edison wanted to break with the past, including Menlo Park, which at any rate had been virtually abandoned while he stayed in New York City to supervise the installation of his electric power system. He also wanted a lab even bigger and better than Menlo Park, where he could have the facilities to invent anything to which he set his mind. He moved to the West Orange lab and worked there until his death in 1931.

While the popular image of Edison is the eccentric genius, working in isolation, he in fact believed completely in a systematic team approach, although he remained the creative force behind the work at all his labs, was always alert for serendipitous discoveries, and he certainly could be eccentric. Ironically, the modern research lab he invented helped hasten the demise of the solitary inventor.

Early Years 1863-70

As an itinerant telegrapher, Edison often tinkered with his equipment to improve its performance, although his experiments cost him several jobs. After moving to Boston and later to New York, he became a full-time inventor.



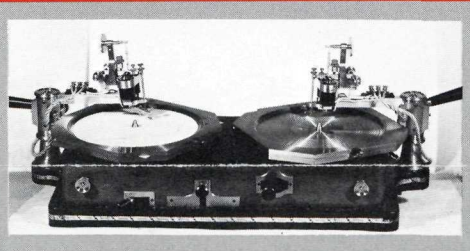
Vote Recorder 1869 Edison's first patented invention was a device that electrically recorded legislative votes. Although it was a forerunner of present-day voting machines, politicians of the day wouldn't accept it. Edison then vowed to invent only products that would be in "commercial demand."

Universal Stock Printer 1870 Stock market printers, or "tickers," of Edison's day tended to run out of control. Edison's device immediately brought tickers in outside brokers' offices back into alignment with the central transmitter, eliminating the need to send out runners to reset them by hand. The sale of this invention was Edison's first big break, and allowed him to open his own shop.

Newark 1870-76

The Newark years were characterized by a tangle of telegraphy patents and partnerships, but Edison also found time to invent the electric pen and discover the "etheric force," actually electromagnetic waves.

Automatic Repeating Telegraph 1872-77 George Little's automatic telegraph, which used perforated tape to transmit, wasn't practical until Edison made it print faster, more clearly, and in Roman letters. His own automatic repeater used paper discs to receive and repeat messages at 200 words per minute. Edison said that voice-like noise from the device played at high speed was his inspiration for the phonograph.

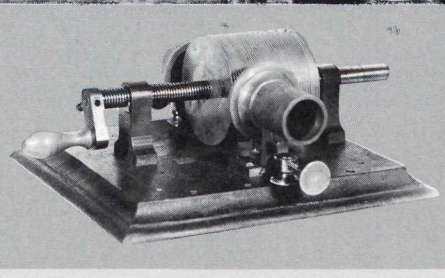


Quadraplex Telegraph 1874 By developing a system where four messages could be sent simultaneously over a single wire, Edison expanded the capacity of the Nation's telegraphic system and reduced the amount of wire needed. He said it was the most difficult project he had ever undertaken. It was also the first to bring him a wide reputation.

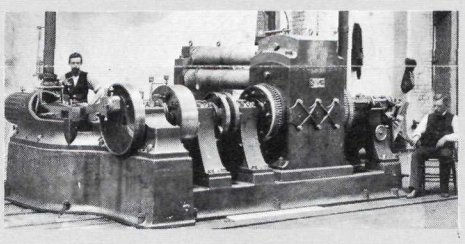
Menlo Park and New York City 1876-87

The period at Menlo Park was the peak of Edison's creative life. The combination of inspired leadership, exceptional staff, and opportunity was unique. (Edison is at left center in cap.)

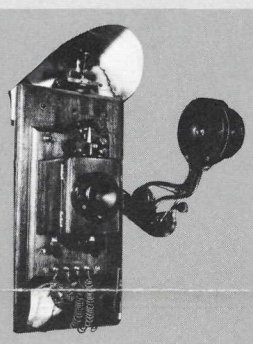
The Phonograph 1877 The phonograph was Edison's most original invention, the one that made him "The Wizard of Menlo Park." He hadn't been trying to invent a phonograph, but he recalled that his mind had been "filled with theories of sound vibrations and their transmissions by diaphragms." He was working on a device for recording messages over the telephone, and had already noticed a "light, musical, rhythmical sound" emanating from his repeater telegraph when the stylus read the impressions at high speed. It occurred to him that, rather than converting the vibrations of the diaphragm into electricity and back again, as in the telephone, he could simply record the vibrations, to be converted back into sound later. Both Edison and his staff were awed when they heard the world's first recorded words: "Mary had a little lamb." He said "I was always afraid of things that worked the first time."



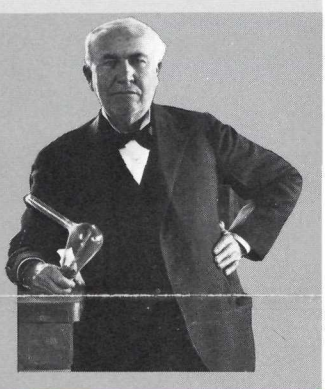
Incandescent Lamp 1879 Edison didn't "invent the light bulb"; his achievement was to bring an old idea to life. For 50 years scientists had been trying and failing to produce a reliable source of light by sending electric current through a material inside a vacuum, causing it to glow. Edison challenged the accepted use of high current and a low-resistance material. He saw that a very small filament of a highly-resistant material would glow with a lower current and last longer. His first platinum wire lamp burned an hour or two, but it wasn't until he greatly improved the vacuum inside the globe and turned to carbonized filaments that he was successful. One lamp burned for 13½ hours, inaugurating the age of electric light. There was still a problem, though—the bulb was useless outside the laboratory. For people to benefit, he would have to incorporate a new system of electric power distribution into established urban areas. Edison's solution to the problem was as great an achievement as the lamp itself. Fighting gaslight interests and indifferent politicians, he developed a model system which he placed in the financial district of New York City. For this Pearl Street station he developed a new and more powerful **dynamo** *above*, which he combined with a steam engine into one unit. Then he had to design a whole array of original devices: insulated conduits, mains, underground junction boxes, relay circuits, and switchboards. For users he developed meters, fuses and fuse boxes, and sockets for the lamps. In all, he devoted 4 years to the electric lamp and distribution system.



Telephone Transmitter 1877 The voice-driven transmitter/receiver in Bell's telephone sent a weak signal. Edison improved it by combining a battery current with a carbon microphone. Bell's receiver and Edison's transmitter were the basis for today's telephone. Also, Edison's work with sound was a major step toward the phonograph.



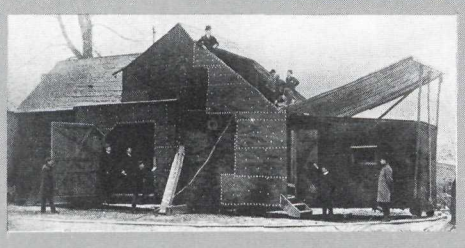
Edison Effect 1883 Edison sped the progress of electronics with his discovery of the "Edison Effect." Trying to correct carbon build-up in his lamps, he produced a globe in which electrons passed from one electrode to another—the first vacuum tube, or diode. He didn't realize its potential, and it was 20 years before someone else used it in the radio.



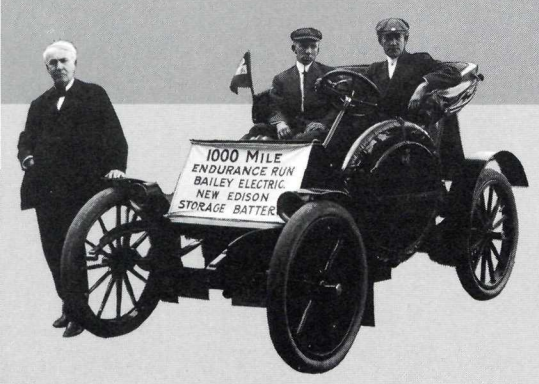
West Orange 1887-1931

The hub of Edison's manufacturing operations, the West Orange lab was the most productive of all in sheer quantity: more than half of his 1,093 U.S. patents were for inventions developed here. West Orange set the standard for all industrial research labs.

Improved Phonograph 1888 After letting his phonograph lay dormant for 10 years, Edison was spurred to improve it when Bell was awarded a patent for his "graphaphone." The machine was very similar to Edison's, with an improved stylus and a wax rather than tin recording surface. Edison borrowed and refined Bell's improvements, and developed a small electric motor to turn the cylinder at a constant speed. But progress came slowly, and Edison remained dissatisfied, so he reverted to his old methods. He locked himself and his staff in the lab, emerging after 72 straight hours with the improved phonograph. Although he envisioned it as a business machine, it eventually brought music into the homes of millions.



Motion Pictures 1889 Edison's work in motion pictures was inspired by Muybridge's analysis of motion. His first device resembled his phonograph, with a spiral arrangement of 1/16" photographs made on a cylinder. Viewed with a microscope, these motion pictures were crude and difficult to focus. Working with W.K.L. Dickson, Edison then developed the **1889 Strip Kinetograph,** which used Eastman's improved celluloid film. Cut into continuous strips and perforated, the film was moved by sprockets in a stop-and-go motion behind the shutter. In the first movie studio, the "**Black Maria**" **1893** *far left, Edison recorded* everything from ballet to boxing. These minute-long films could be viewed in commercial parlors by one person at a time on his **1889 Kinetoscope** *left.* When Edison combined his camera with Thomas Armat's projector in 1896, film moved into the theater as a major new form of popular entertainment. Although Edison had experimented with sound for movies since 1905, and by 1913 offered it in all his theaters, the industry stayed with silent movies until 1927.



Storage Battery 1910 Edison, believing the future lay with electric cars, decided to build a better battery. The old lead-acid batteries were heavy, self-destructive, and difficult to recharge. This project proved to be one of Edison's most difficult problems. It took him a decade to come up with a workable nickel-iron-alkaline battery, after trying hundreds of combinations and recalling all of the first batteries he produced because they leaked and lost power. After all his efforts, electric cars went out of vogue, and his battery wasn't powerful enough to start gasoline engines. But it became the standard in mining, railroad, marine, and military applications.

Hundreds of other inventions flowed from Edison's fertile mind: He devised a technique for **poured concrete buildings.** He extracted **rubber from the goldenrod plant.** He built a **fluoroscope** used in the first x-ray operation in America.

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