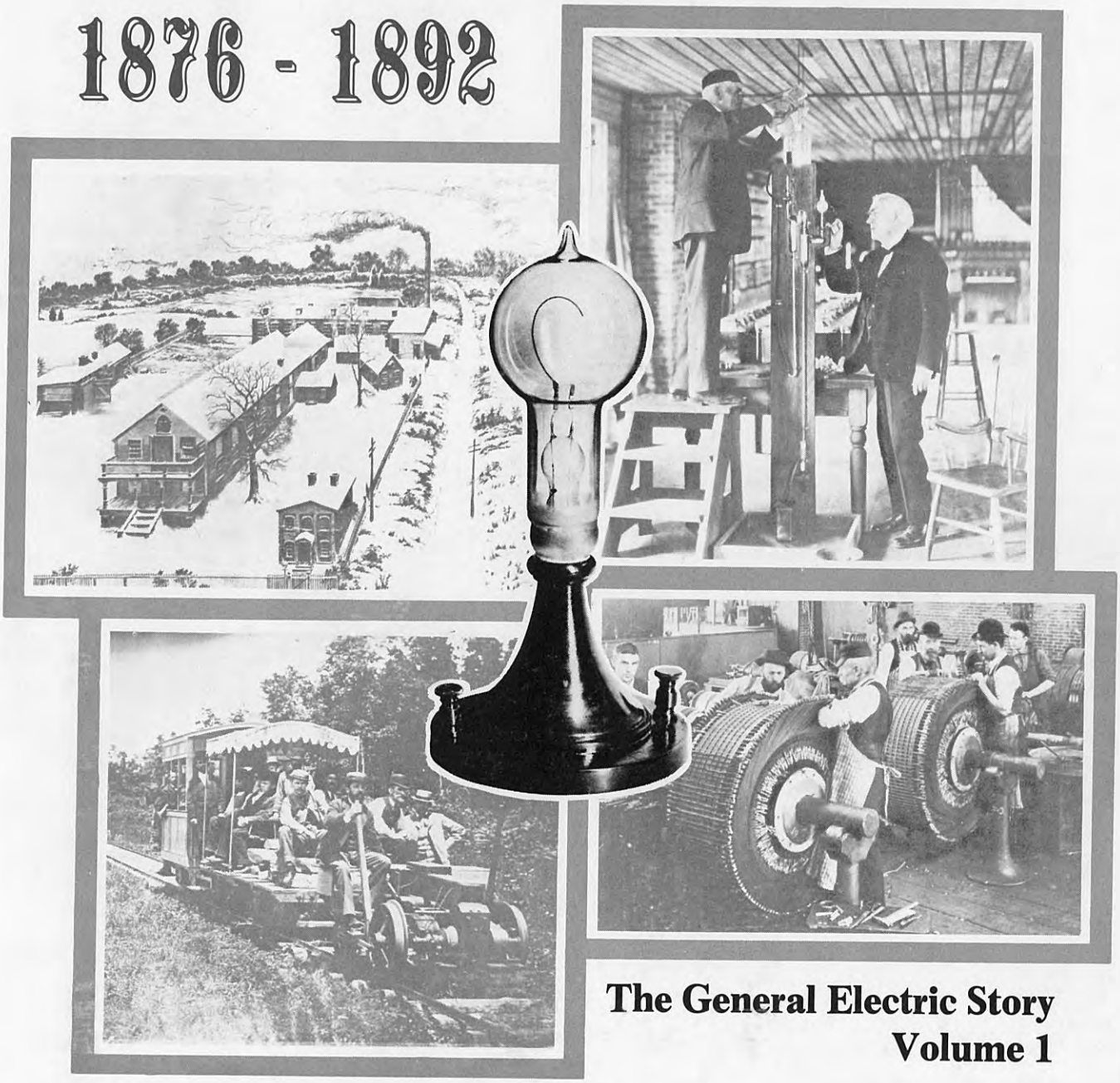
THE EDISON ERA

1876 - 1892



The General Electric Story
Volume 1

An Elfun Hall of History
Publication

A Photo History

"SEMPER PARATUS"

THE ELFUN SOCIETY

An organization of present and retired employees of the General Electric Company, dedicated to the encouragement of cooperation, fraternity, and good fellowship and to the betterment of the community in which they function.

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THE EDISON ERA
1876 — 1892

THE GENERAL ELECTRIC STORY

A Photo History

Volume 1

THE ALGONQUIN CHAPTER
ELFUN SOCIETY
SCHENECTADY, NEW YORK
JULY 1976

CONTENTS

Elihu Thomson

Menlo Park Laboratory

FOREWORD

The "Edison Era" — 1876-1892 is the first of a series of Elfun Society "Hall of History" publications relating the history of the General Electric Company. The "Hall of History", a project initiated by the Algonquin-Schenectady chapter of the Elfun Society, evolved out of a desire by its members to identify, preserve and share with the General Electric family and the public - photographs, documents and artifacts which constitute a portion of the company's one-hundred year old heritage. This is a heritage rich in personalities such as Edison, Steinmetz, Coffin, Langmuir and Coolidge, and rich in scientific and technological achievements which have contributed significantly to the development of our country.

For ease of reference, the narrative is arranged in categories which separate factors associated with company evolution, for example, from other related business and technological events of the time. The heroes of our story are, of course, those whose achievements were instrumental in the birth and growth of the General Electric Company. But, in many ways these achievements were stimulated by the work of others who had made or were making major contributions in the same and related fields. In the context of history, they, too, are recognized here.

Thomas A. Edison

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EDITOR & ART DIRECTOR

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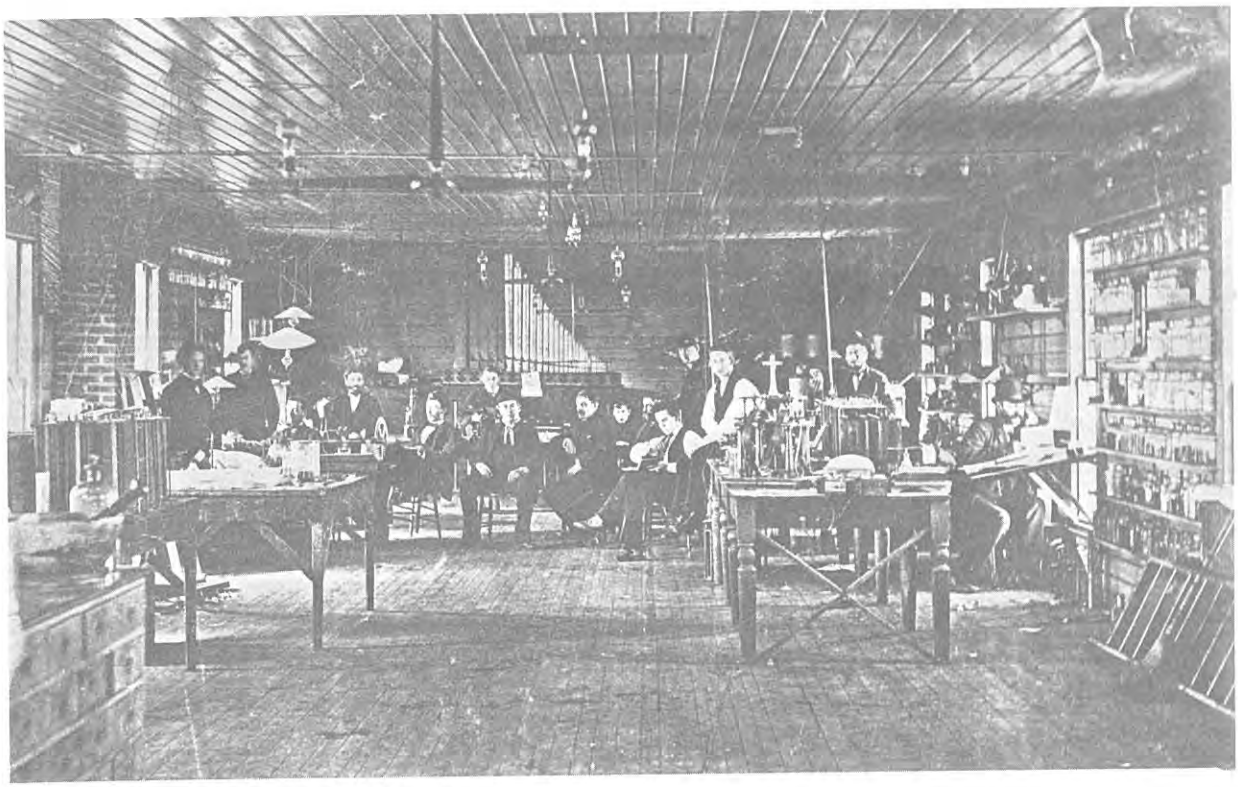
INTRODUCTION

The year 1876 marked America's centennial. For most Americans it was a time for looking backward with pride. American industry, non-existent in 1776, had reached the heights in a mere century.

No moment better symbolized that ascent than the opening of the Centennial Exposition at Philadelphia, in May of 1876. President Ulysses S. Grant pushed the button which started the mighty 2500 horsepower Corliss engine that powered the Fair. Novelist William Dean Howells, looking on, was inspired to write:

> "... the mighty walking beams plunge their pistons downward, the enormous fly-wheel revolves with a hoarded power that makes all tremble, the hundred life-like details do their office with unerring intelligence ... Yes, it is still in these things of iron and steel that the national genius most freely speaks."

Compared with the "hoarded power" of the Corliss engine, the electrical exhibits at the Exposition were mere sputtering sparks. An unknown Bostonian, named Alexander Graham Bell, demonstrated his new devices for "voice telegraphy and telephony." A Belgian "electrician", named Zenobe Theopile Gramme, sent, from his Paris workshop, a machine called a dynamo. Its main use was to supply electric current for electroplating. To attract attention, it was sometimes hooked up to a brilliant, but expensive, light source called an arc lamp.



Edison & his Menlo Park staff, 1880

Yet the portent of the spark was to be greater than that of the mighty engine. For, across America, young and ambitious men sought new targets for invention. And, increasingly, the common denominator for their efforts became electricity.

THOMAS ALVA EDISON won a medal at the Philadelphia Centennial for his quadruplex telegraph -- an ingenious means for sending four messages simultaneously over a single telegraph circuit. Later in 1876, he moved into a new and better equipped laboratory at Menlo Park, New Jersey, where he could more effectively explore and develop his many new innovations.

ELIHU THOMSON, a Philadelphia high-school teacher, was a frequent visitor to the Centennial's electrical exhibits. He noted that the Gramme dynamo was little better than the crude experimental models he himself had made. The comparison set the scholarly "professor" thinking along commercial lines.

CHARLES FRANCIS BRUSH, a graduate of the university of Michigan, also built a dynamo of his own design in Cleveland, Ohio, in that year of 1876. He next sought to convince his employer, a manufacturer of telegraphic equipment, that tomorrow's profits lay in electric lighting, not in telegraphy.

FRANK JULIAN SPRAGUE was a midshipman at the Naval Academy, where exposure to scientific studies was awakening in his mind a new idea. Electric street railways, rather than horsecars, might be the answer to the need for better urban transportation.

CHARLES VAN DE POELE, a Belgian-born woodcarver, was looking around for a new world to conquer. He was to focus his inventive talents on the same field that Sprague was to choose — electric transportation.

JAMES J. WOOD, born in Ireland, had been a working mechanic since the age of eleven. Now completing a night school education in Brooklyn, he was already an accomplished inventor of steam machinery. His thoughts turned to new ways of transmitting and using the power of steam.

The pioneering efforts of these men, and many more like them, make up the story of the "Edison Era." It took great courage to abandon secure occupations -- telegrapher, teacher, naval officer, woodcarver, mechanic -- for the risks of an untried field. Yet courage was the common possession of these men, which they had in full measure together with their ingenuity.

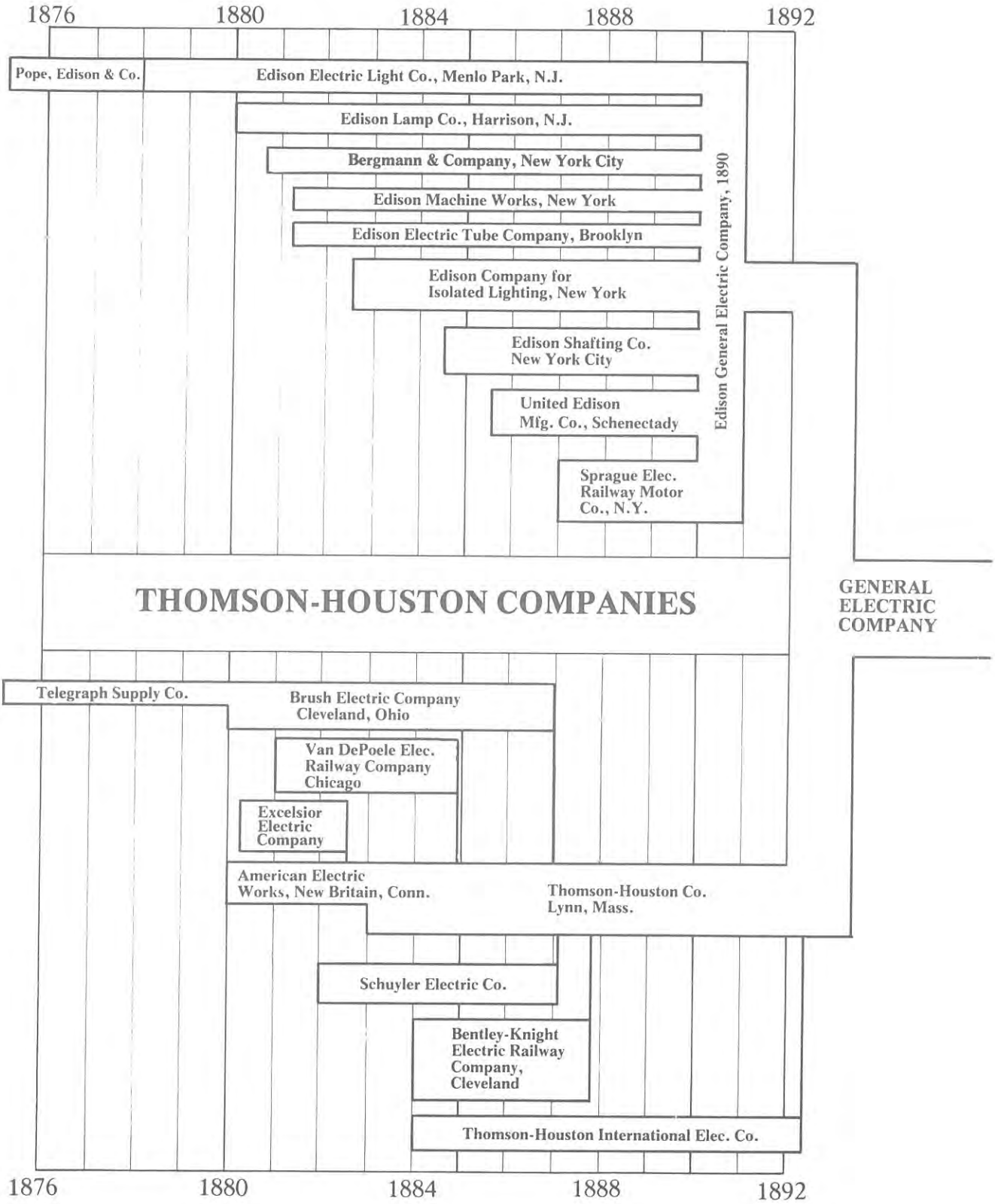
So it is not merely the inventions and installations of the Edison Era that this book commemorates. More important -- since they made those inventions and installations possible -- are the skill and courage of the men who made them.

THE PREDECESSORS of the GENERAL ELECTRIC COMPANY

The chart on the following page illustrates the evolution of the company and the rapid growth of the electrical industry during the last twenty years of the nineteenth century. The various companies and their founders intended to promote the particular inventions they felt would revolutionize their fields. Edison's incandescent lighting systems; Brush's arc lamps and dynamos; Wood's "spark-free dynamos" and electric regulating systems; Thomson's and Houston's arc lamps, dynamos, motors, generators, transformers, and alternating-current power systems; and Sprague and Van Depoele's electric street railway systems were all developed by their own companies.

By 1890, Edison had organized his various businesses into the Edison General Electric Company. The Thomson-Houston Company and the various companies that had merged it were led by Charles A. Coffin, a former shoe manufacturer from Lynn, Massachusetts. These mergers with competitors and the patent rights owned by each company put them into a dominant position in the electrical industry. As businesses expanded, it had become increasingly difficult for either company to produce complete electrical installations relying solely on their own technology. In 1892, these two major companies combined to form General Electric.

EDISON COMPANIES

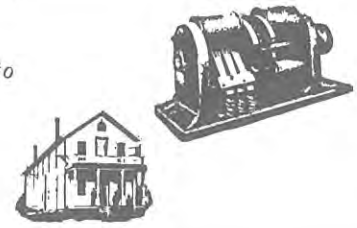


THE MILESTONES

1876

Brush constructs Dynamo.

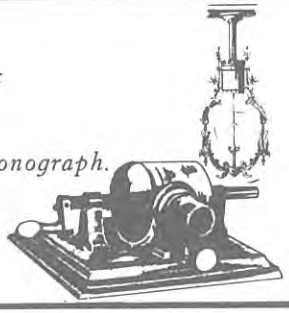
Edison moves to Menlo Park.



1877

Brush is granted patent for Carbon Arc Lamp.

Edison invents the phonograph.



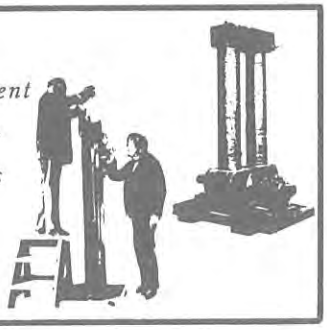
1878

Grosvenor P. Lowrey and others give financial support to Edison for incandescent lamp research.

1879

Edison makes first successful incandescent lamp demonstration.

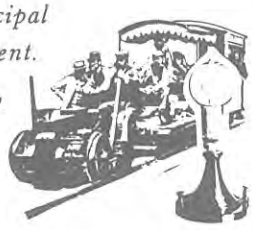
Edison constructs his first dynamo.



1880

Edison is granted principal incandescent lamp patent.

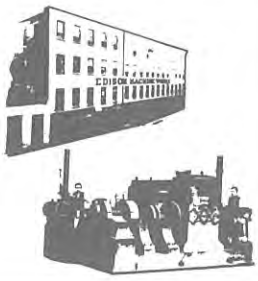
Edison electric railway trial run is made at Menlo Park, N.J.



1881

Edison's "Jumbo" dynamo built in New York City.

Edison Machine Works is established at New York City.



1882

Sprague develops under-running street railway trolley.

Pearl Street Station, New York City, begins operation.

1883

Thomson-Houston Company is formed from American Electric Co.

1884

Bentley-Knight Railway Co. begins in Cleveland.

OF GENERAL ELECTRIC

1876-1892

1885

Thomson sets up experimental a.c. system.

1886

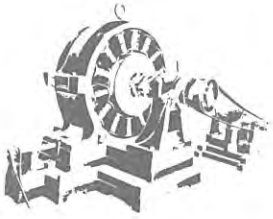
Edison moves Machine Works to Schenectady.

Thomson patents electrical welding equipment.

William Stanley perfects electrical transformer.

1887

Thomson builds first repulsion induction motor and ships his first alternator.



1888

Charles J. Van Depoele invents carbon brushes for the electric railway motor.

1889

Edison General Electric is formed.

Thomson-Houston Co. buys Brush Electric Co. and merges with Bentley-Knight Electric Railway Co. Steinmetz arrives in USA.

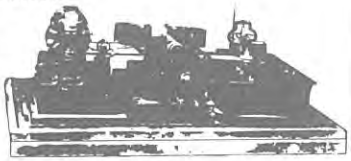
1890

Charles A. Coffin, of Thomson-Houston, organizes United Electric Securities Co. for financing purposes.

1891

Edison wins key patent suit on incandescent lamp.

Edison invents motion picture camera.



1892

General Electric Co. formed by merger of Edison General Electric Co. and Thomson-Houston Company.

1876

Company Evolution

Thomas A. Edison moves into his new laboratory at Menlo Park, New Jersey. A year earlier he had decided to give up his telegraphic machine manufacturing interests and devote all of his time to invention in a peaceful setting away from the bustle of the city (Newark, New Jersey).

Power Generation

Charles F. Brush constructs his second hand-built dynamo. He successfully demonstrates the development to his employer and sponsor, George W. Stockly, Manager of the Cleveland Telegraph and Supply Company, founded in 1872. The Brush dynamo was one of the first to show that electric power could be put to practical use.

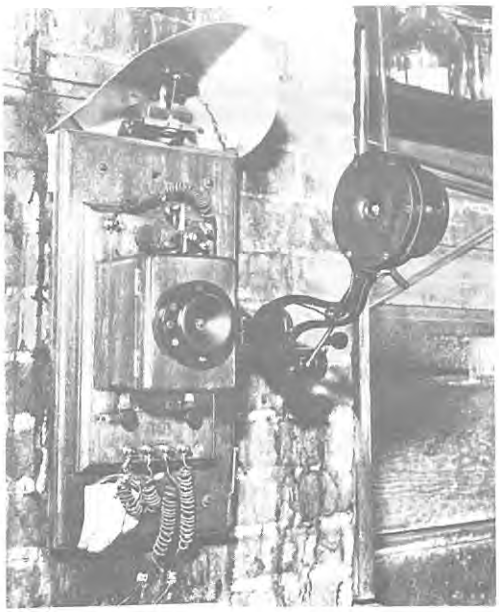
Communications

Alexander Graham Bell demonstrates his telephone at the Philadelphia Centennial.

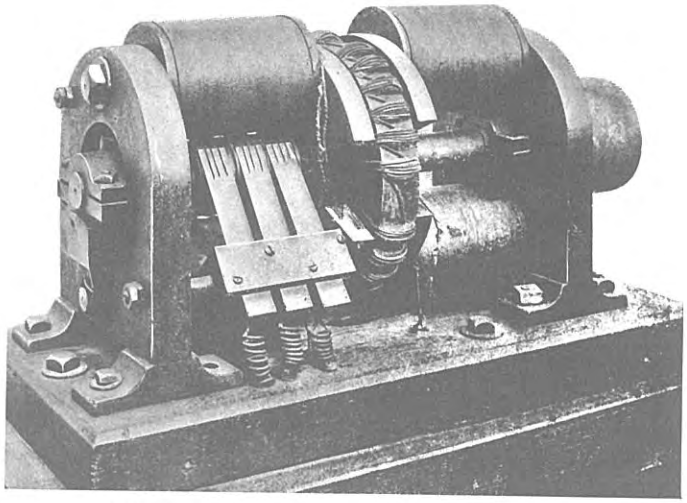
Edison invents the carbon telephone transmitter improving on Bell's earlier telephone which had limited transmission ability. Patent rights to the Edison transmitter were purchased by the American Speaking Telephone Company, a subsidiary of the Western Union Telegraph Company.

Edison patents his mimeograph machine. It consisted of an electric pen that made 8,000 punctures per minute on a sheet of waxed paper which served as the stencil. An inked felt roller transferred the ink supply through the perforated sheet onto the blank sheet below.

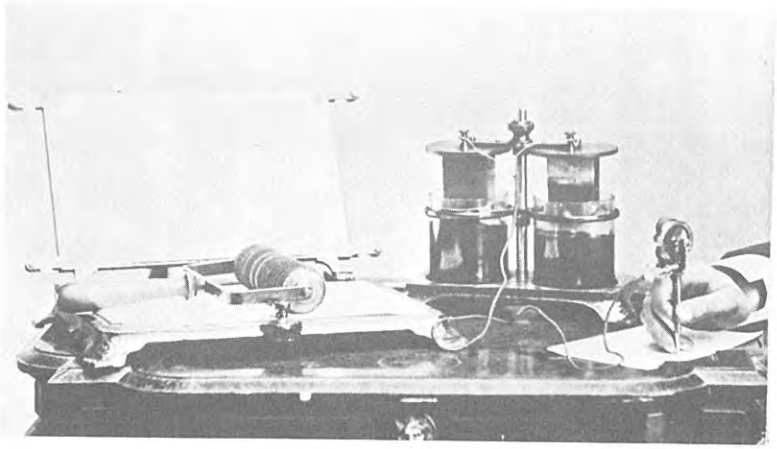
The Western Union Telegraph Company completes installation of the Edison quadruplex telegraph system on its lines. The system, which permitted four messages to be sent simultaneously over a single circuit, doubled the capacity of existing wires and revolutionized the telegraphic communications industry.



Edison's carbon transmitter telephone — more practical than Bell's early models because of the improved transmitter and induction coil it employed.

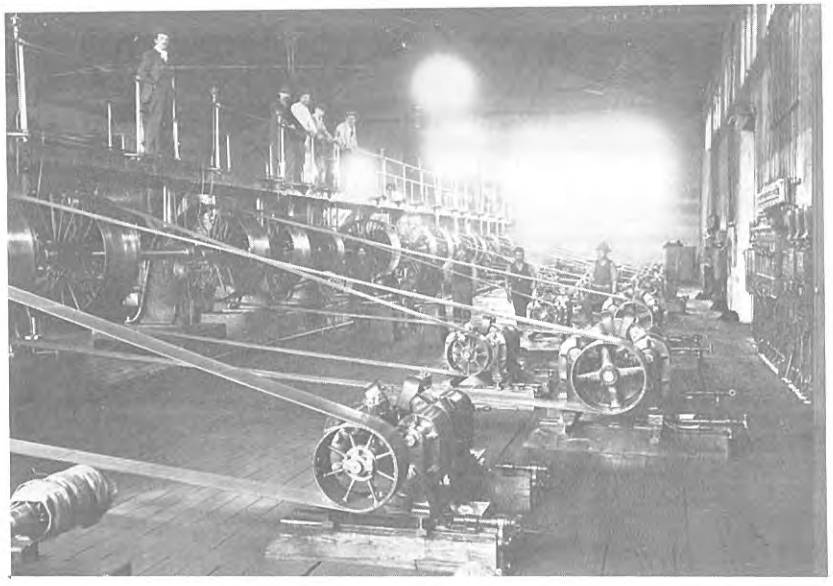


Charles F. Brush and his dynamo — the first dynamo to support theories that electrical power could be put to practical use.



Edison's electric pen — the forerunner of the mimeograph.

A Brush arc lamp and arc lamps in the Brill Brothers Store in New York City.



A Brush dynamo room in South America

1877

Lighting

Edison increases his Menlo Park staff and begins his incandescent lamp experiments. At the same time, he starts development of what he envisions as a complete electric lighting system.

Brush is granted patents on his copper-coated carbons for arc lamps and the first open-coil arc dynamo.

The Cleveland Telegraph Supply Company receives the sole right to manufacture Brush's dynamos and arc lamps. After several months of testing, the Franklin Institute of Philadelphia decides to purchase a Brush dynamo, citing it as one of the most efficient and the best engineered of its type.

Electricity

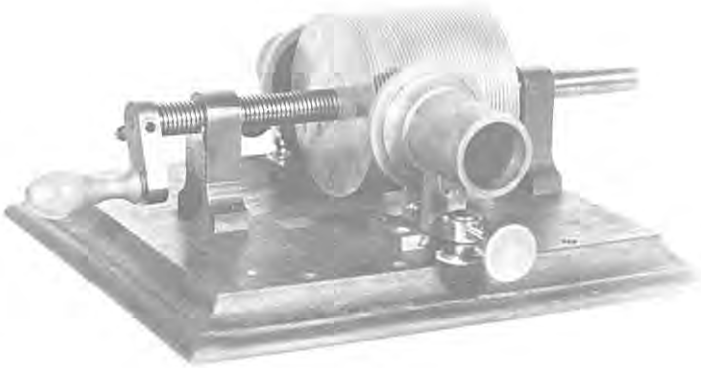
Elihu Thomson, Assistant Professor of Chemistry at the Central High School in Philadelphia, demonstrates that by passing sufficient current through a coil of German silver it can be used as a heating element. Two years earlier, he demonstrated the production of "electric waves" and the ability to detect them. In 1887, Heinrich Hertz demonstrated electromagnetic waves, and in 1895, Marconi put them to practical use in the first wireless transmission of messages.

Communications

Edison invents the phonograph. A grooved cylinder, covered with tin foil, was turned by hand with a stylus attached to a diaphragm resting against it on either side. The tin foil recorded the vibrations of the diaphragm which were caused by the voice. When the stylus was returned to its original position and the cylinder was rotated again, the original vibrations were reproduced with the sound playing through the diaphragm on the other side.

Edison's original tin foil phonograph played the first recorded words of its inventor:

Mary had a little lamb,
Its fleece was white as snow,
And everywhere that Mary went
The lamb was sure to go.



1878

Company Evolution

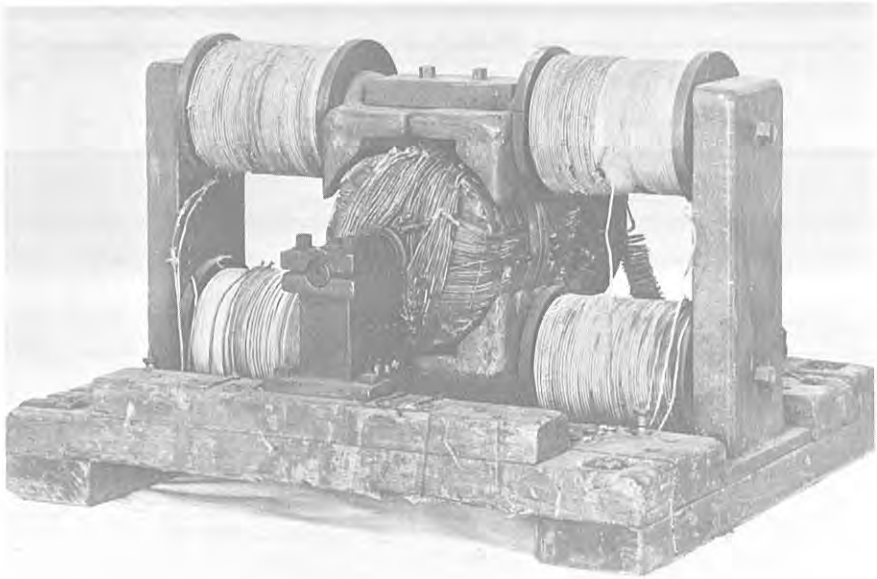
The Edison Electric Light Company is founded to support Edison's lighting research. Organizational and financial backing for the company was provided by Grosvenor P. Lowrey, Edison's patent attorney; J.P. Morgan, financier; and others. The founding of this company marked the beginning of the General Electric Company lineage.

Lighting

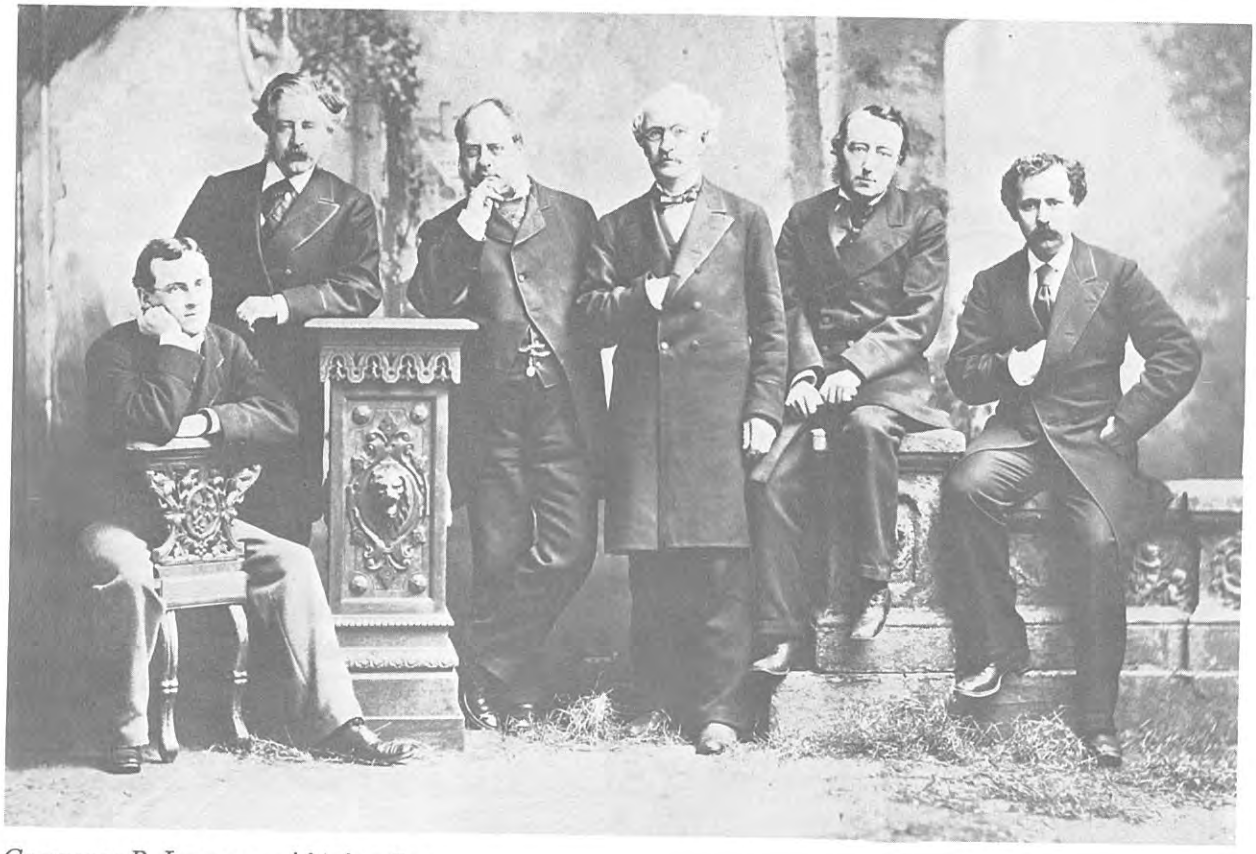
Brush is granted a patent on the first series arc lamp, marking the beginning of the arc lighting industry.

Five Brush dynamos power twenty arc lamps in the front windows of Wanamaker's Philadelphia store.

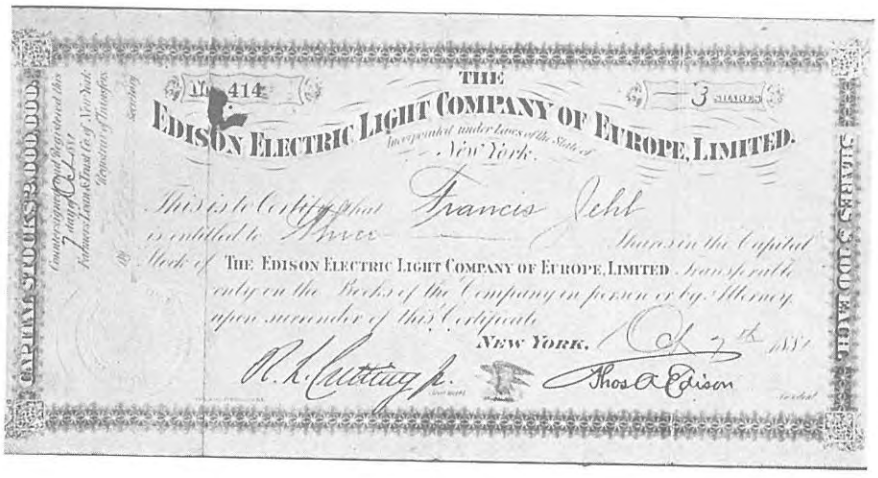
Thomson demonstrates his alternating-current dynamo and transformers at the Franklin Institute. He and Edwin J. Houston devise a vibrating arc lamp powered by the Thomson dynamo.



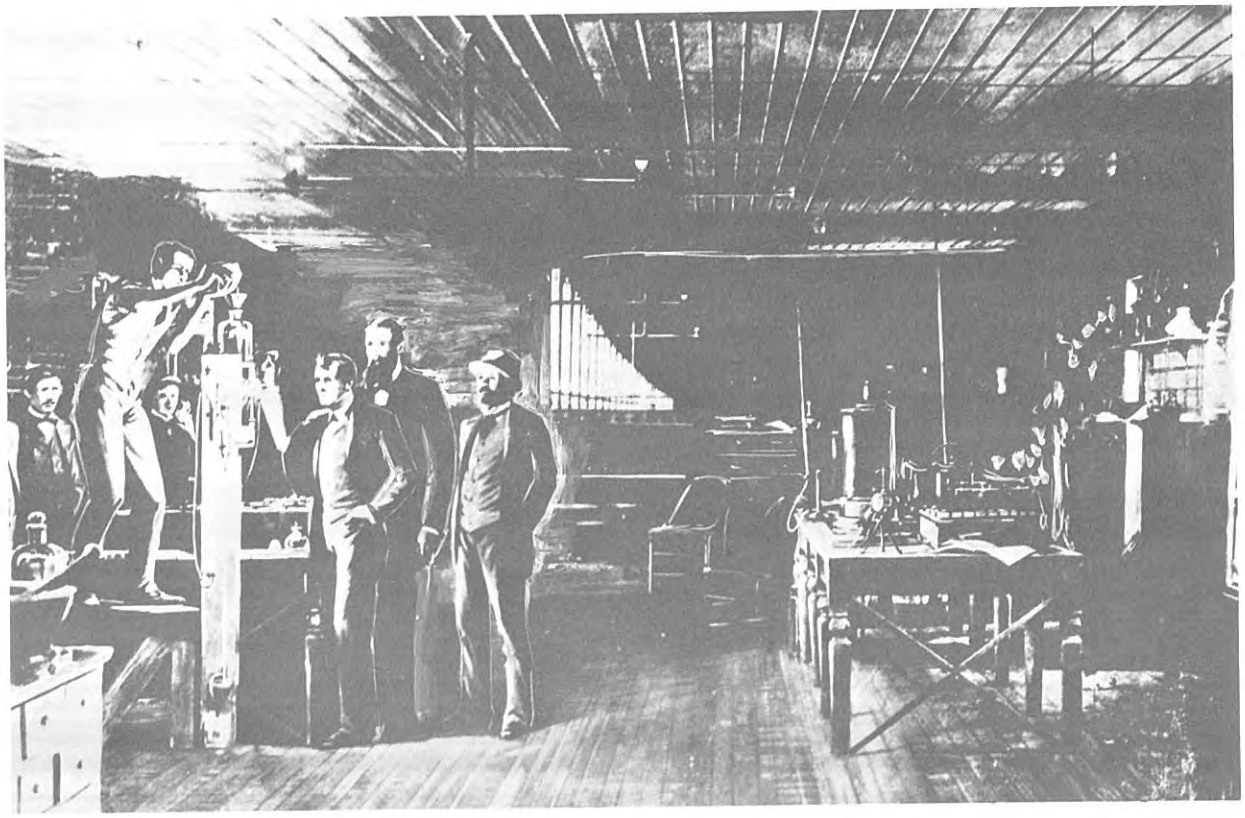
Thomson's first dynamo — built for a demonstration at the Franklin Institute, Philadelphia.



Grosvenor P. Lowrey and his law firm associates (Lowrey is third from left.)



A stock certificate for the Edison Electric Light Company of Europe — signed to Edison's associate, Francis Jehl.



Edison and Francis Jehl demonstrating the electric incandescent lamp to their associates in the main Menlo Park lab.

James J. Wood

1879

Lighting

Edison invents the carbon filament incandescent lamp. On October 21, the first commercially practical incandescent lamp completes a 40 hour duration test at the Menlo Park Laboratory.

On December 31, Edison gives the first public demonstration of his electric lighting system in the streets and buildings at Menlo Park. The entire system was interconnected using underground mains.

Edison installs a small dynamo for lighting on the "Jeanette", the James Gordon Bennett arctic exploration ship. Although the lighting system was a success, the exploration was not, and the ship was lost in the Arctic.

Brush promotes the formation of the California Electric Light Company of San Francisco, the first electric central station for arc lighting in the world.

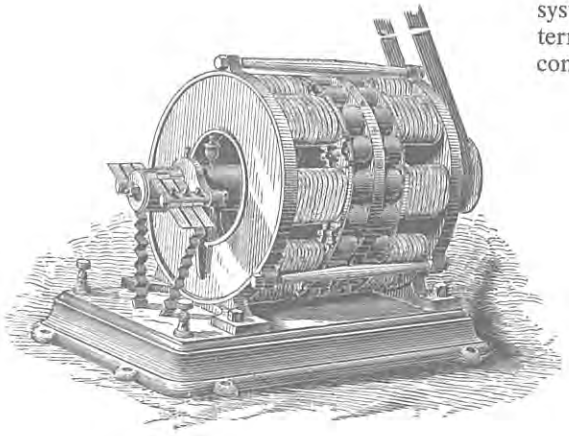
Brush receives patents on compound wiring and secondary distribution systems for arc lighting.

The first large-scale installation of arc lighting is made in Monumental Park, Cleveland using Brush lights on a 250-foot mast.

Niagara Falls is illuminated for the first time on July 4th, using 16 Brush arc lamps powered by a Brush dynamo.

James J. Wood constructs a spark-free dynamo and arc lamp. His employer, James Brady, owner of the Brady Manufacturing Company, agrees to build the dynamos in return for a half interest in the patent.

Thomson and Houston install their first commercial arc lighting system in Fuller's Bakery in Philadelphia. The three-phase alternating current winding used in the dynamo was later to become fundamental to the design of electric power systems.



Wood's spark-free dynamo.

1880

Company Evolution

Sigmund Bergmann, a good friend of Edison's, organizes Bergmann & Co. in New York for the manufacture of light fixtures, meters, junction boxes, and other accessories to complete the production of Edison's lighting systems.

Brush Electric Company of Cleveland is formed from the Telegraph Supply Company to continue the production of Brush's dynamos and arc lights.

Lighting

Edison is granted his main lamp patent, no. 223,898, on January 27, covering the fundamental features of the carbon filament lamp. Edison adopts carbonized bamboo filaments for his lamps and increases their rated life to 600 hours.

Edison establishes the first incandescent lamp factory at Menlo Park, New Jersey.

The first commercial installation of incandescent lights in the world is completed by Edison on the Steamship "S.S. Columbia".

The first municipally owned electric light plant is put into service at Wabash, Indiana, using four Brush arc lamps above the courthouse. An installation of Brush arc lamps is also made on Broadway, New York City.

Brush receives a patent on his automatic cutout for arc lamps.

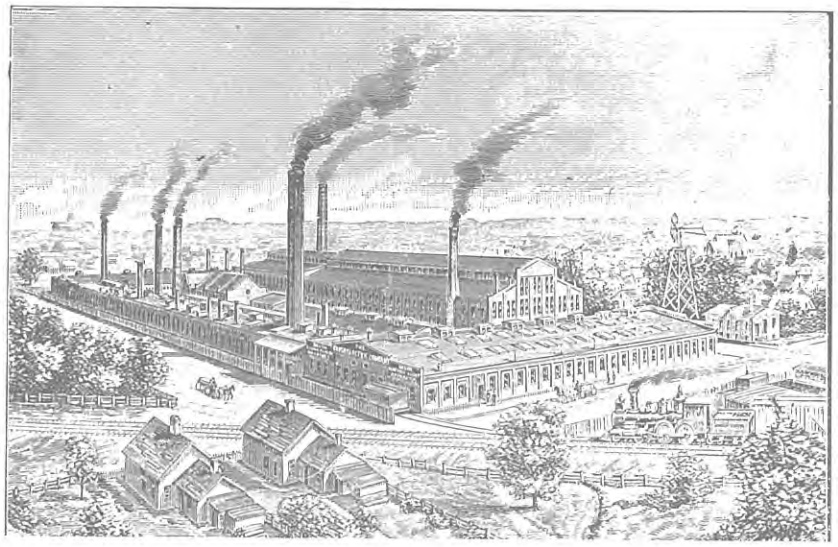
Edison files his first patent for a large-scale public electric distribution system. (The patent was not issued until 1887.)

The Thomson-Houston arc dynamo is patented. Its manufacture, along with a line of arc lights, is begun by the American Electric Company, New Britain, Connecticut.

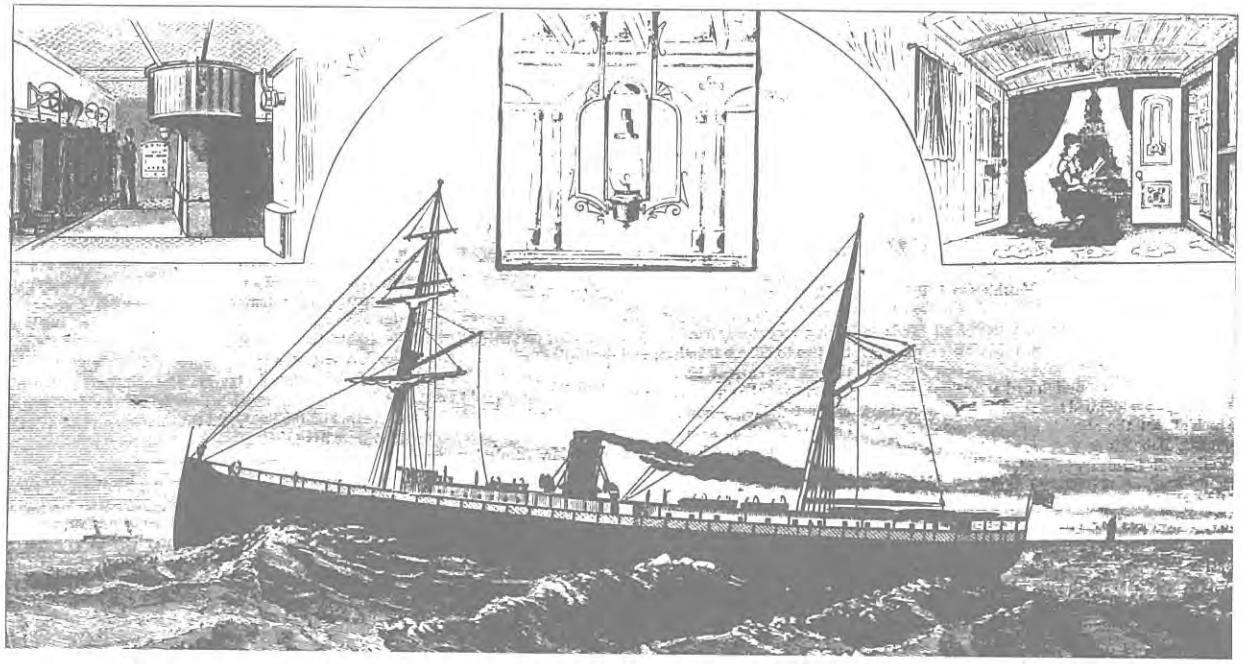
Transportation

Edison's electric railway undergoes trials at Menlo Park. It uses many of his new inventions for drive and braking systems.

Edison's electric railway on a trial run at the Menlo Park laboratories.

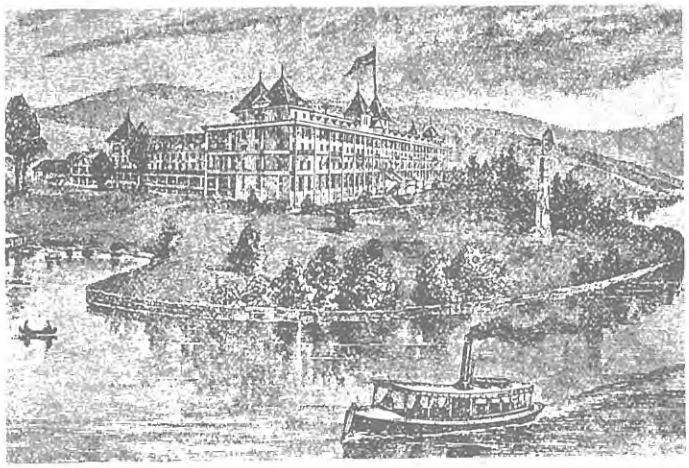


The Brush Electric Company — formed from the Cleveland Telegraph Supply Company to manufacture Brush dynamos and arc lights.



The "S.S. Columbia" — the first commercial installation of the Edison lighting system.

The Edison Machine Works, Goerck Street, New York City.



Prospect House, Blue Mountain Lake in the Adirondacks, New York.

Office of the Edison Electric Light Company, 65 Fifth Avenue, New York City. (Edison is at the extreme left.)

1881

Company Evolution

The Edison Machine Works is established on Goerck Street, New York City. Later, it was moved upstate to become the Schenectady Works of the General Electric Company.

Edison opens business offices at 65 Fifth Avenue, New York City, to exploit his electric lighting systems.

The Fort Wayne Electric Light Company is formed by Ronald T. McDonald, a clothing manufacturer, to produce the James Jenney System of arc lighting.

The Edison Lamp Company of Menlo Park, the Edison Tube Company of New York, and the Edison Shafting Company of New York are formed.

Lighting

Edison receives patents on his current regulator for dynamos, apparatus for producing high vacuum, and a method of treating carbon for use in electric lamps. All of these patents are related to his new system of incandescent electric lighting.

The Edison"Jumbo", the largest dynamo ever built, with a 1200 light capacity is exhibited at the Paris Exposition.

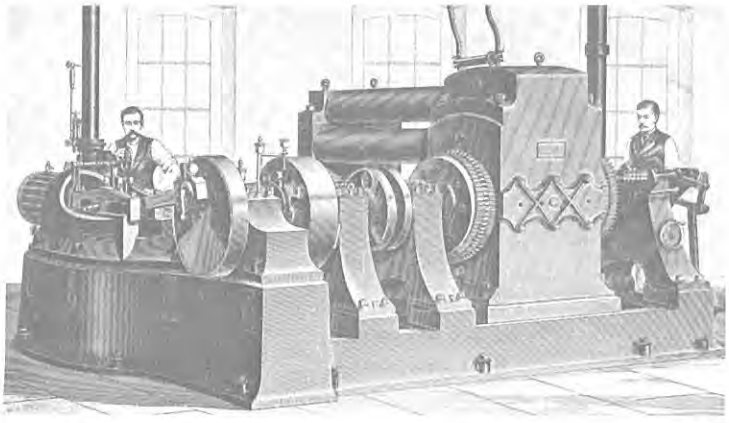
The first commercial incandescent light installation on land is installed at the lithography shop of Hinds, Ketchum & Company, New York City.

Prospect House at Blue Mountain Lake in the Adirondacks of New York becomes the first hotel lighted by electricity.

Electricity

Elihu Thomson develops the constant-current regulator.

The first generating plant in a mill is installed at James Harrison's woolen factory in Newburgh, New York.



Edison's "Jumbo" dynamo — built at the Edison Machine Works, Goerck Street, New York.

1882

Company Evolution

The Edison Company for Isolated Lighting is formed in Harrison, New Jersey. Its purpose is to make direct installations on the premises of commercial and industrial firms, providing complete systems from dynamos to lamps. By the end of the year there are 150 such installations with 30,000 lamps. Within five years the totals increase to 700 installations and more than 180,000 lamps.

The Schuyler Electric Light Company is incorporated for the manufacture of arc lighting systems.

Lighting

Edison applies for a patent on the three-wire electric distribution system. This development, resulting in an almost two-thirds reduction in the amount of copper used in wiring systems, is an important factor in making incandescent lighting and central stations economically feasible.

Electricity

The world's first hydroelectric plant is placed in operation at Appleton, Wisconsin, using an Edison bipolar generator.

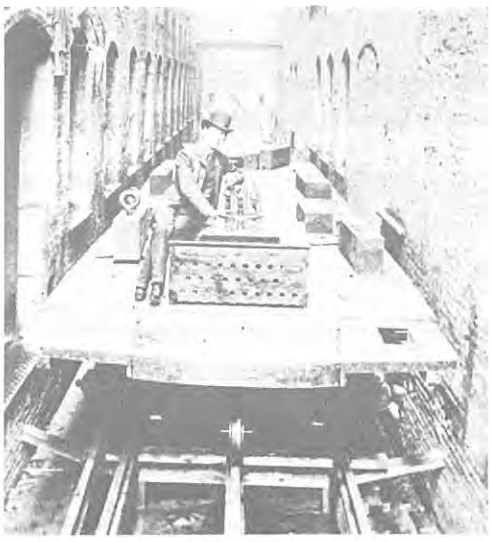
Two Edison "Jumbo" dynamos are installed in the central station at Holburn Viaduct, London.

The first incandescent lamp central station in the United States, the Pearl Street Station, built by Edison and staff, begins operation in New York on September 4. Employing six "Jumbo" dynamos, the installation supplies 7,200 16-candlepower lamps over an area of one-sixth of a square mile. All power lines are laid in underground mains.

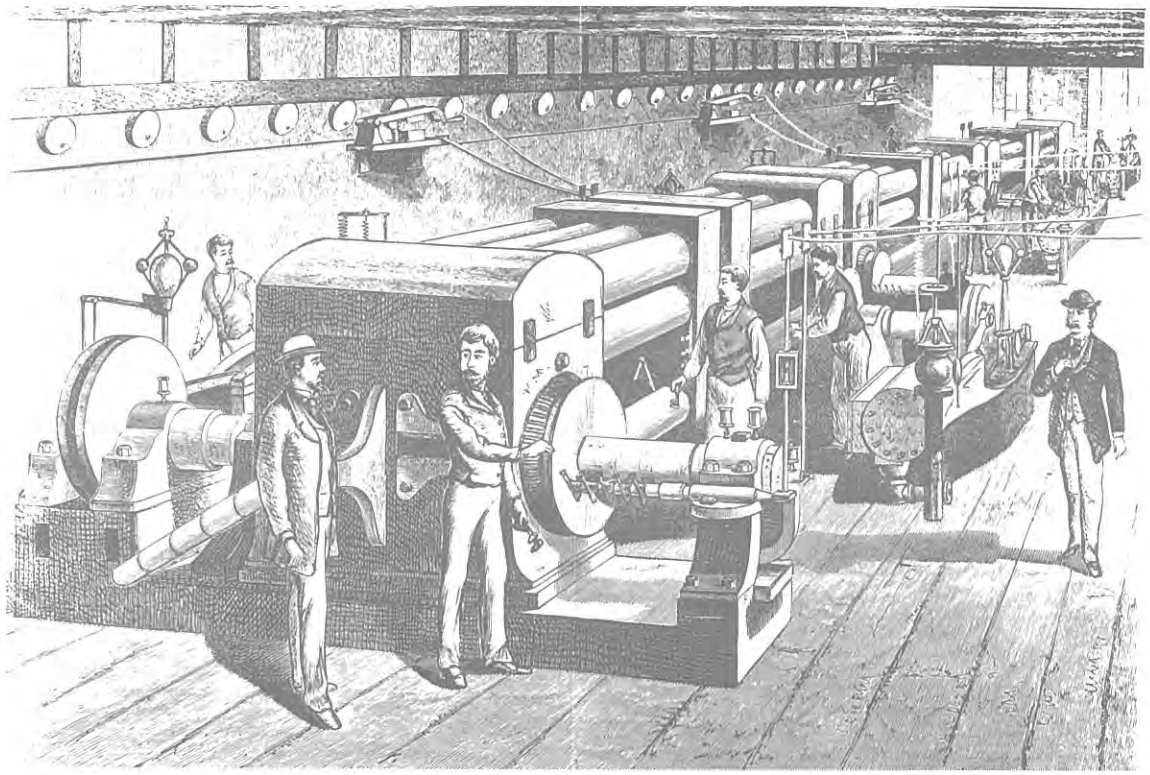
Thomson develops the air blast arc arrester for the protection of high current switching components.

Transportation

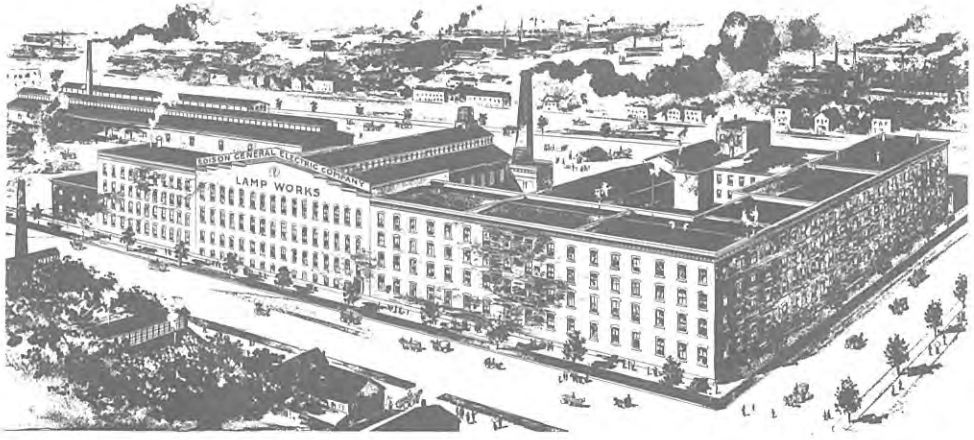
Frank J. Sprague develops the underrunning trolley for street railways. Sprague conceived the idea of using an overhead conductor cable and an upward pressing contact arm mounted on the roof of the car to transmit electricity to a motor-drive system underneath the car.



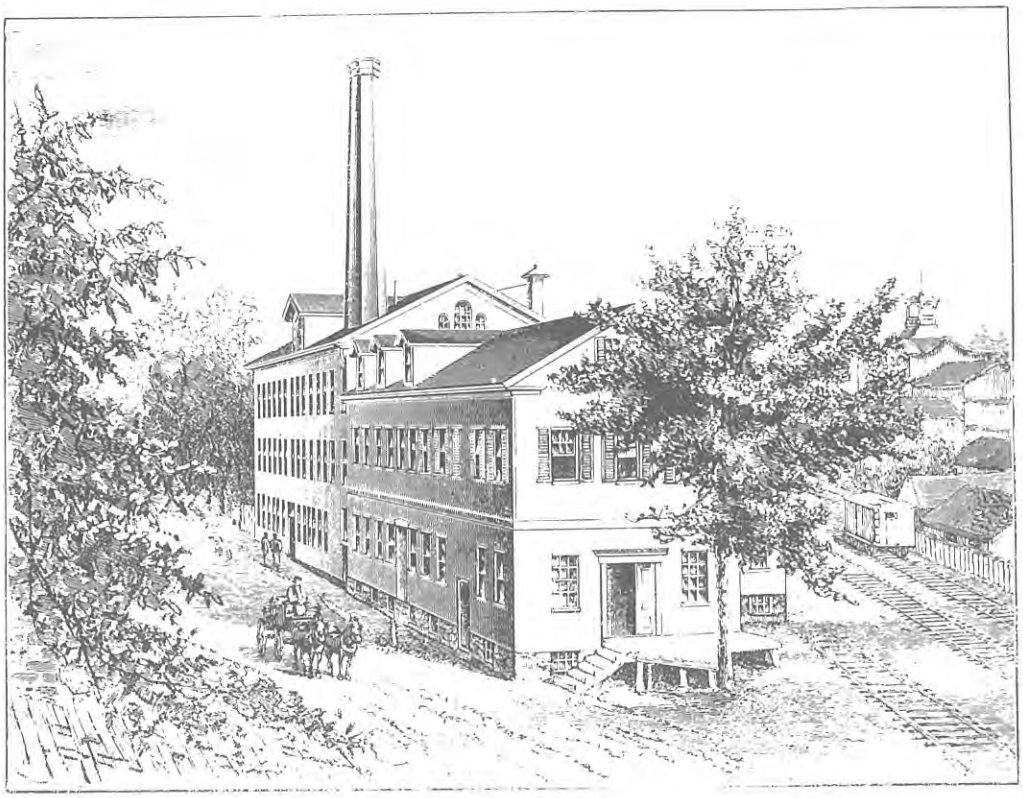
Frank Sprague with his underrunning trolley in New York City.



Drawing of Edison's Pearl Street Station in New York City.



Edison's lamp manufacturing factory in Harrison, New Jersey.



American Electric Company, New Britain, Connecticut — forerunner of the Thomson-Houston Company.

Walter H. Knight and Edward M. Bentley — pioneers in the development of electric railways and public transportation.

1883

Company Evolution

The Thomson-Houston Company, a reorganization of the American Electric Company, is formed by a group of Massachusetts shoe manufacturers headed by Charles A. Coffin. Its operations are later moved to Lynn, Massachusetts.

The Bentley-Knight Electric Railway Company is formed through the aid of the Brush Electric Company in Cleveland, Ohio.

Lighting

Thomson patents the magnetic blowout for the protection of arc lighting circuits from current surges.

San Francisco makes its first use of electric street lighting with the Brush system.

The first night baseball game is played in Fort Wayne, Indiana, using seventeen arc lights of 4,000 candlepower each.

The first photograph ever made using incandescent lamps is taken at Menlo Park, New Jersey.

Electricity

Edison discovers that electric current can flow through an evacuated space from a filament to a plate in an incandescent bulb. This phenomenon, later called the "Edison Effect", was patented by him and became the forerunner of electronics.

The first central station to use Edison's three-wire system begins operation at Sunbury, Pennsylvania. The Edison Electric Light Company inaugurates the first underground three-wire system at Brockton, Massachusetts.

Transportation

The first elevated electric railway in the United States is operated at the Chicago Railway Exposition by the Electric Railway Company.

Edison's exhibit of a third-rail trolley line is opened to the public in Chicago, Illinois.

The first incandescent lamp photo, Menlo Park.

1884

Company Evolution

Edison's lamp manufacturing business at Harrison, New Jersey becomes the Edison Lamp Company.

Frank Sprague demonstrates his invention of a DC motor. He forms the Sprague Electric Railway and Motor Company to exploit this and his other inventions.

Transportation

The Bentley-Knight Company demonstrates the first electric street railway in Cleveland, Ohio, using an early form of the third-rail system with Brush dynamos and motors.

The first electric submarine in America, "The Peacemaker", is built by the Delameter Iron Works of New York City. The vessel used Brush storage batteries and a Brush 12-hp motor for propulsion.

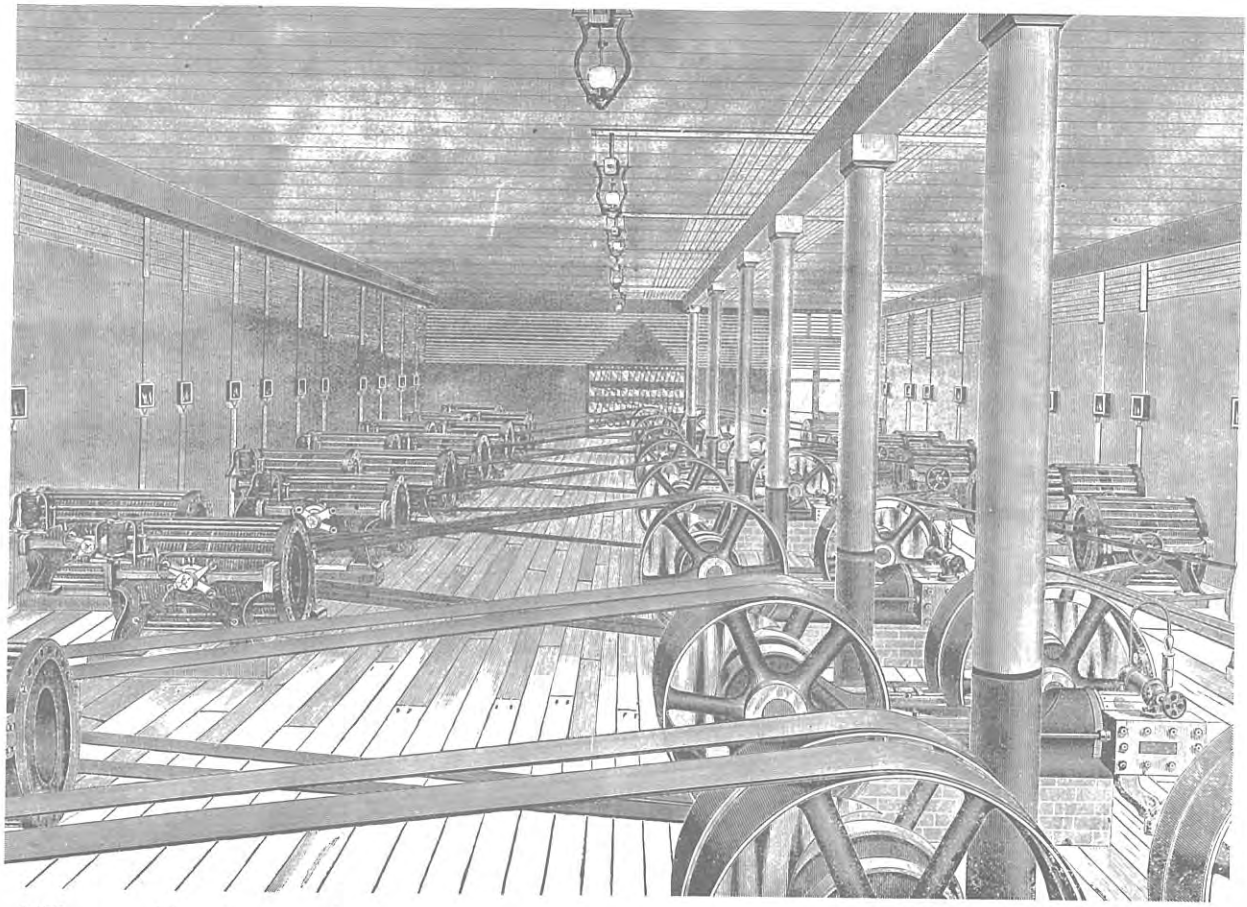
Electricity

George Westinghouse forms the Westinghouse Electric and Manufacturing Company in Pittsburgh, Pennsylvania, after purchasing William Stanley's incandescent lamp and DC dynamo patents from the Swan Incandescent Electric Light Company.

Industrial Products

Alfred and Eugene Cowles produce the first electric industrial furnace using a Brush dynamo for current. With this furnace, they produced the first alloy of aluminum; and later, synthetic rubies and sapphires.

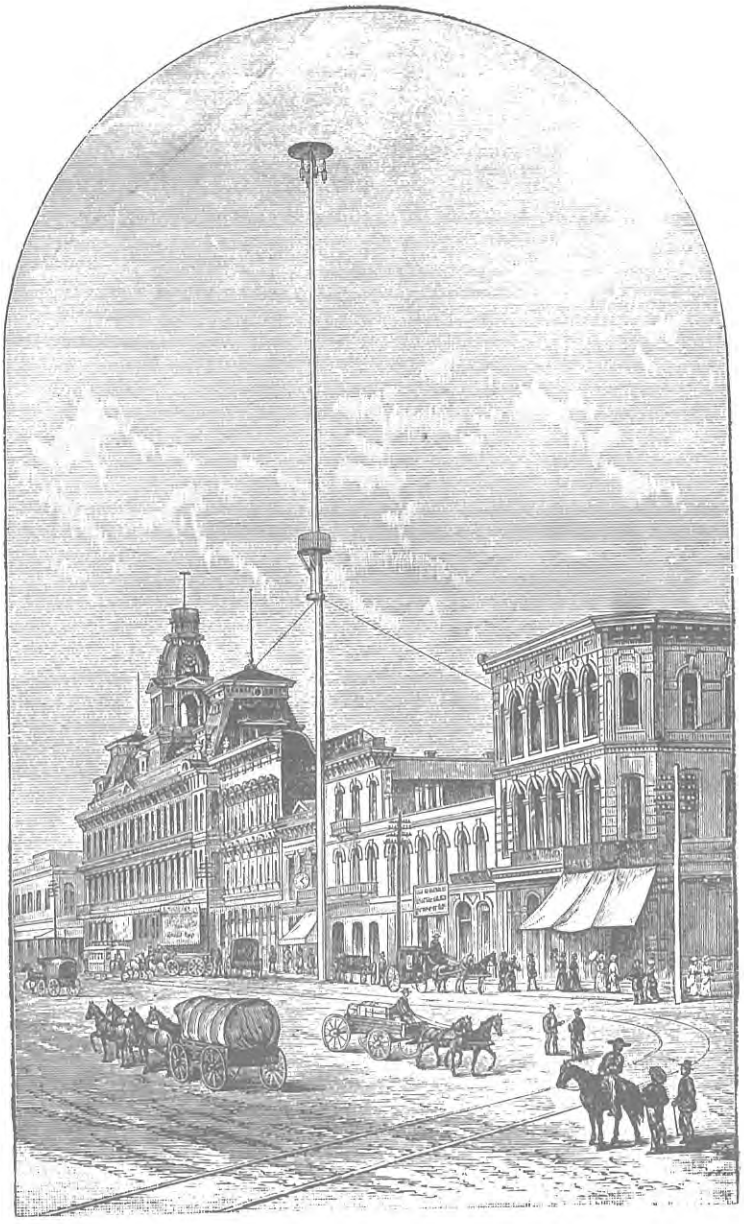
A Bentley-Knight trolley, powered by contact with an electric conduit between the tracks.



A Thomson-Houston central station in Boston, Massachusetts.

George Westinghouse

Elihu Thomson.



The Brush Electric Company arc lighting system for the Los Angeles, California light tower.

1885

Company Evolution

The Van Depoele Electric Light Company is merged into the Van Depoele Electric Manufacturing Company.

Lighting

Thomson devises the use of the grounded secondary for transformers. This development provided a means for coping with the possibly dangerous effects of insulation breakdown in a transformer and, in so doing, gave impetus to the use of AC distribution systems.

Thomson develops a DC dynamo for incandescent lamps.

Thomson adopts the magnetic blowout as a lightning arrester for the protection of arc lighting and other circuits. The principle of the magnetic blowout has since been employed in the design of modern high-current switching devices.

The Statue of Liberty is floodlighted by the use of arc lights from the Fort Wayne Electric Company.

The Thomson-Houston Company begins to manufacture incandescent lamps at Lynn, Massachusetts.

Dr. Edward Weston develops the hydrocarbon flashing process for making uniform carbon lamp filaments.

Industrial Products

Weston patents a magnetic drag-type speedometer — an early automobile speedometer.

An electric drill is invented by Charles J. Van Depoele, and its manufacture is begun by the Thomson-Van Depoele Electric Mining Company, a subsidiary of Thomson-Houston for the production of mining equipment.

The Thomson-Houston Company's manufacturing machine shop at Lynn, Massachusetts.

1886

Company Evolution

The Edison Machine Works moves to Schenectady, New York, following a strike in New York City. In December, the two unoccupied buildings erected by the McQueen Locomotive Company are purchased for $45,000. Of this sum, Edison paid $37,500, and $7,500 was supplied by a group of Schenectady citizens and businesses interested in attracting his company to the city. These buildings, Shop 10 and part of Shop 12, formed the nucleus around which the present extensive Schenectady Works has grown.

The Edison Tube Company and the Edison Shafting Company merge with the Machine Works. John Kruesi, General Manager of the Machine Works, was later to become Chief Mechanical Engineer of the General Electric Company.

The Edison Electric Light Company absorbs all the business previously handled by the Edison Company for Isolated Lighting.

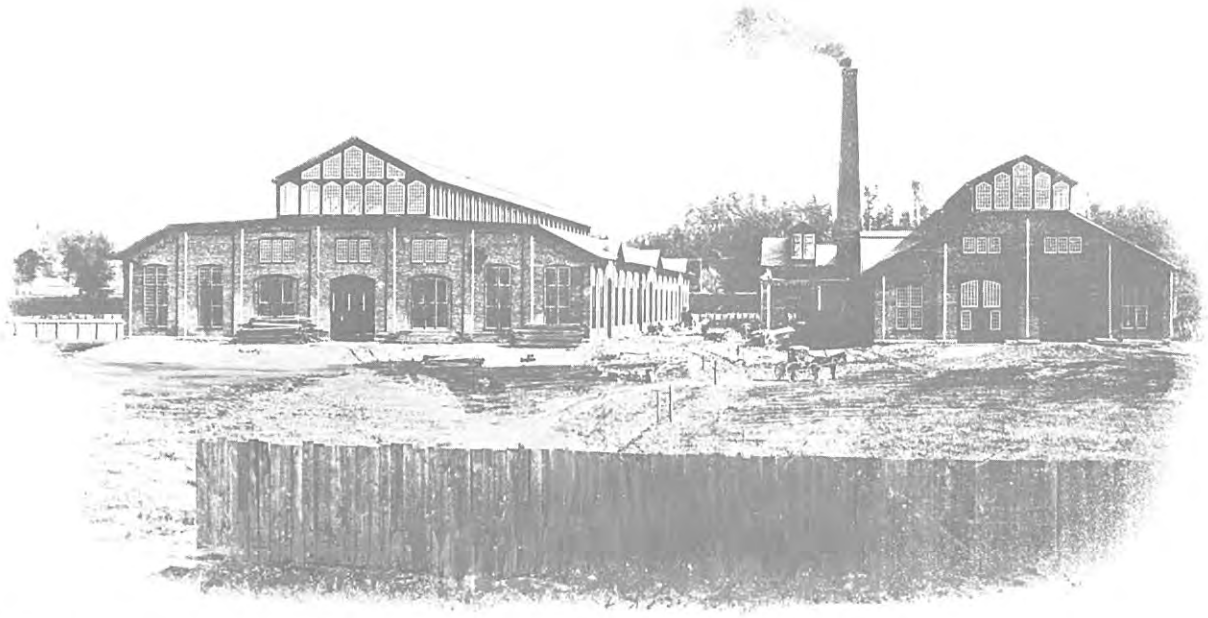
Electricity

Thomson receives patents for the first electrical resistance welder and welding transformer.

William Stanley develops a commercially practical transformer that he uses in the first AC lighting installation in the United States at Great Barrington, Massachusetts. The overall distance spanned by the system was 4,000 feet. Stanley also demonstrated that transformers could be connected in parallel and designed as self-regulating.

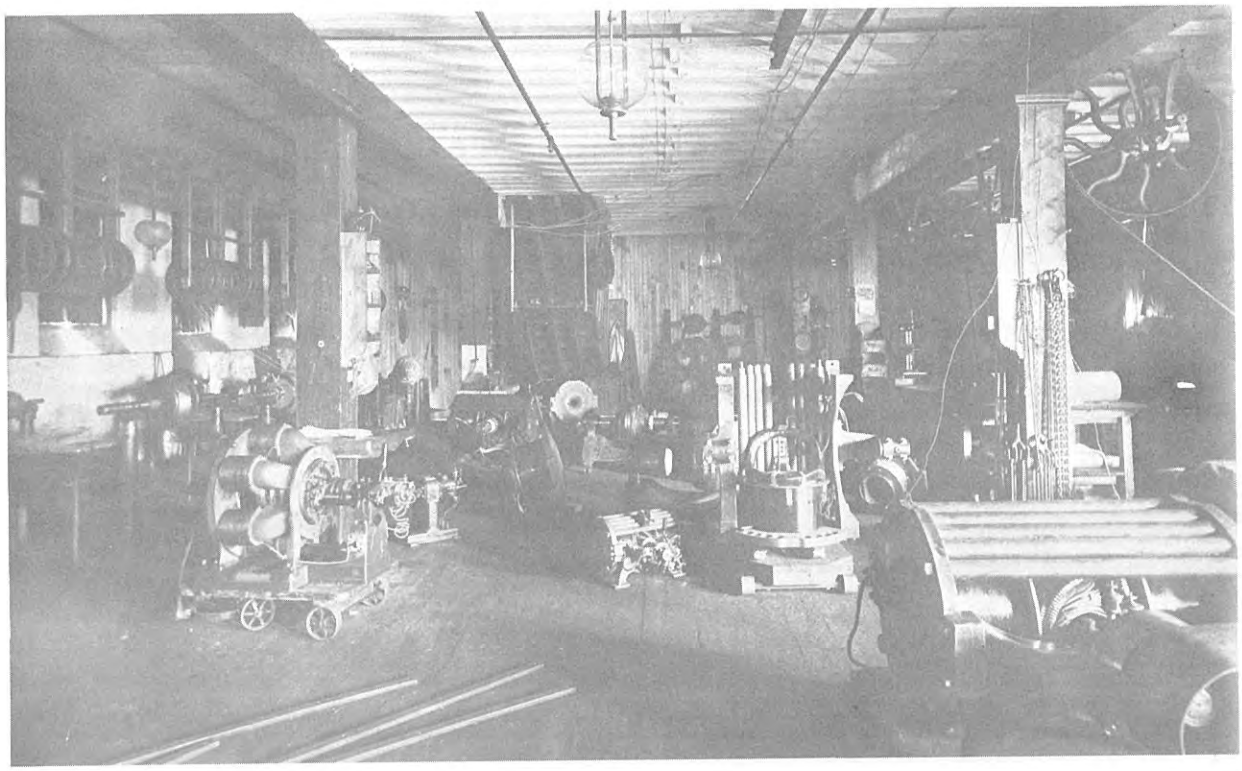
The Westinghouse Electric and Manufacturing Company builds the first commercially successful AC generating station at Buffalo, New York.

John Kruesi, General Manager of Edison's Schenectady Machine Works.



Buildings 10 & 12, Schenectady, New York.

William Stanley and his transformer — an important step in the establishment of AC power systems.



The basement of Factory A of the Thomson-Houston Company's plant at Lynn, Massachusetts... In the left foreground — the first alternator ever shipped by the company...

The first talking doll — produced by Edison in his West Orange, New Jersey factories

1887

Company Evolution

The Schuyler Electric Manufacturing Company, which went into receivership in 1886 after great financial difficulty, becomes the Schuyler Electric Company and is acquired by Thomson-Houston.

Edison moves his residence from Menlo Park to West Orange, New Jersey, where he reestablishes his laboratory. The new laboratory was ten times the size of Menlo Park, with 60,000 square feet of floor space and a staff of 45 to 60. It was considered the largest industrial research facility in the world.

Industrial Products

Elihu Thomson builds the first repulsion-induction motor. The first Thomson alternator is shipped by the Thomson-Houston Company to the Lynn Electric Company.

Power Transmission

Thomson receives a patent on the use of oil to insulate and cool transformers.

The Bentley-Knight Electric Railway Company starts operation of the Woonsocket Electric Railway, the first in New England. Tracks for an electric railway are laid on Fulton Street, New York City.

Communications

Edison inventions improve his wax cylinder phonograph. Between 1887 and 1890 he received more than eighty phonograph-related patents and established an extensive commercial business in the manufacture and sale of phonographs and records.

Lighting

Thomson-Houston begins production and sale of an AC incandescent lighting system.

Thomas A. Edison on July 16, 1889 after 72 continuous hours of research on the wax cylinder phonograph

1888

Company Evolution

The Edison Machine Works begins to expand its operations in Schenectady.

The Weston Electrical Instrument Company is formed by Edward Weston. During the '70s, Weston had developed highly efficient dynamos and arc lighting systems.

To commercialize the transformer for electric resistance welding which he developed in 1885, Elihu Thomson organizes the Thomson Welding Company.

Lighting

Edison's lamp factory at Harrison, New Jersey, improves his filament by coating it with asphalt.

Transportation

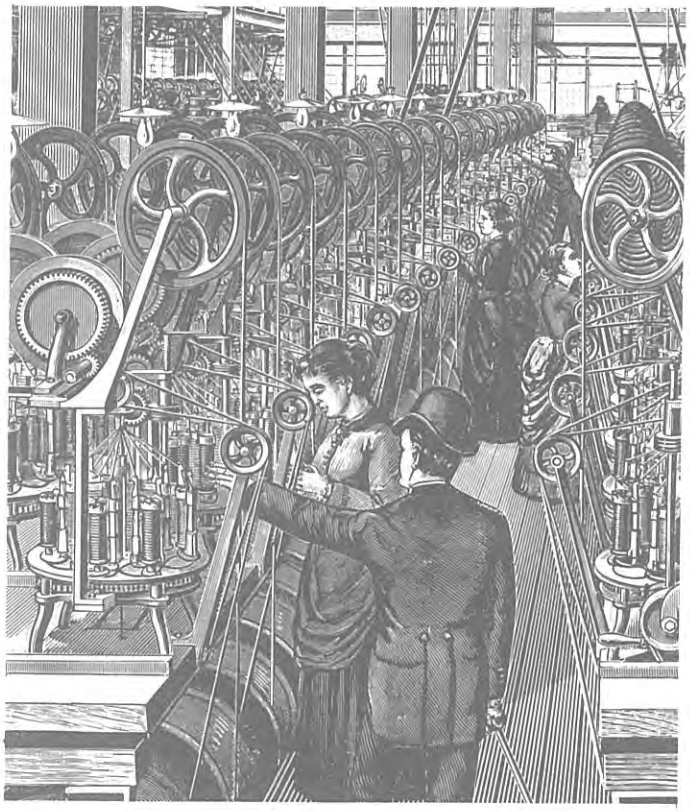
In January, the Thomson-Houston Company installs the first industrial electric locomotive at the Tremont & Suffolk Mills, Lowell, Massachusetts.

The Thomson-Houston Company enters the electric railway field by acquiring the Bentley-Knight, Van Depoele, and Sprague patents, which give the company control of virtually all important patents in this field. By the end of 1888, it had on order or had constructed 16 complete street railway installations.

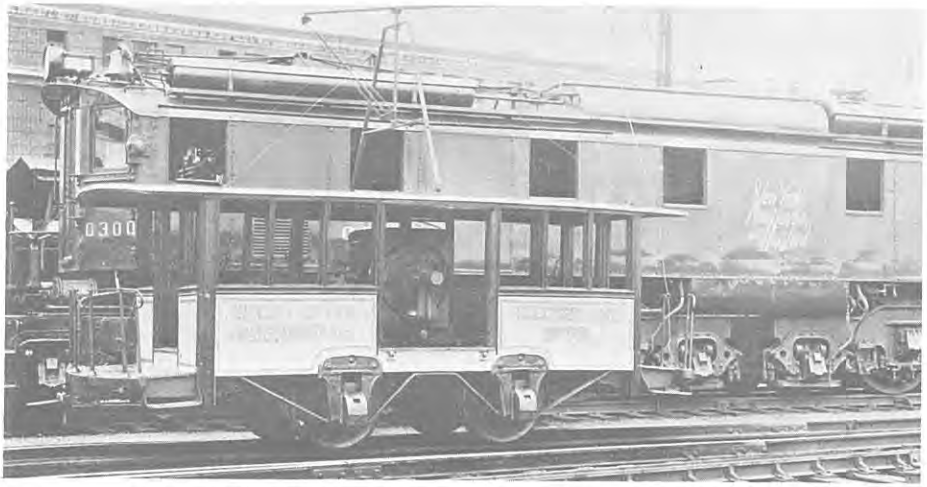
Charles J. Van Depoele invents carbon brushes for the electric railway motor. One of the most important inventions in the electric railway field, his carbon brushes also had much to do with the success of the direct-current motor.

Charles J. VanDepoele, a pioneer in electric transportation.

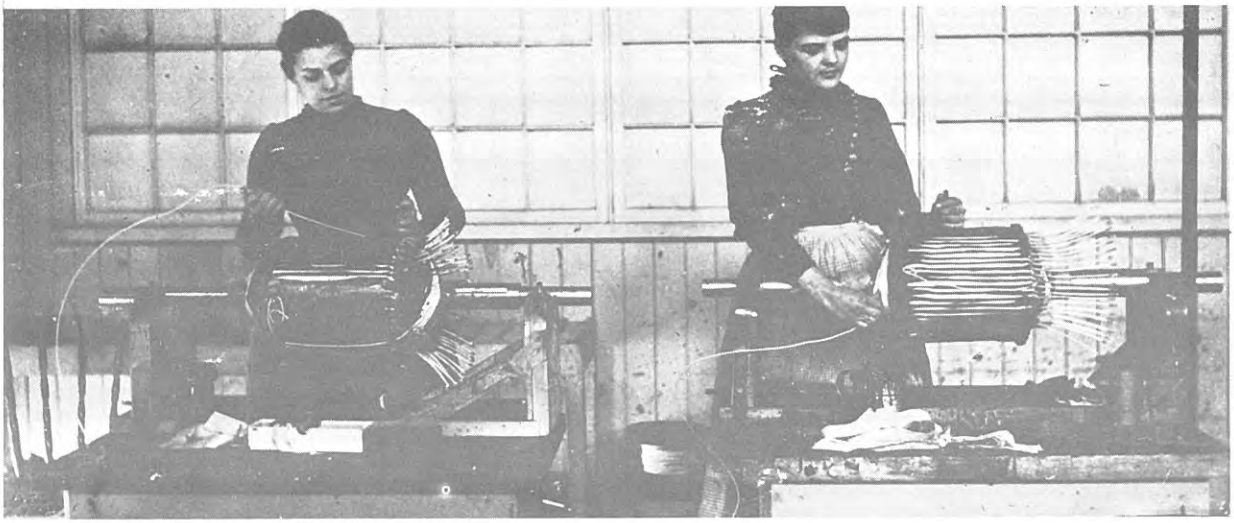
Railway streetcar scene on the Ansonia, Derby & Birmingham line.



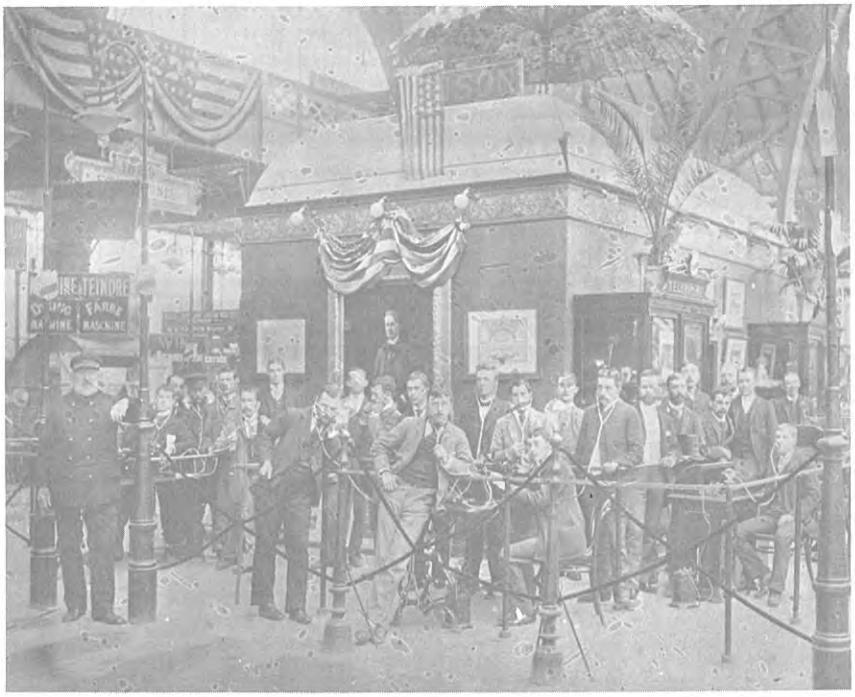
A view of the wire insulating department at Schenectady, Shop 1, Building 10.



Ansonia, Derby & Birmingham Railway Company electric locomotive by Charles J. Van Depoele



Streetcar armature winders at the Schenectady Works, late 1880's.



A display of Edison telephones and phonographs attracted over 30,000 people at the Paris Exposition this year.

1889

Company Evolution

The Edison General Electric Company is formed by consolidating the Edison Electric Light Company, the Edison Lamp Company, the Edison Machine Works and Bergmann & Company.

The Edison United Manufacturing Company becomes the United Edison Manufacturing Company and is acquired by the Edison General Electric Company.

The Sprague Electric Railway and Motor Company is absorbed by the Edison General Electric Company.

The Thomson-Houston Company buys the Brush Electric Company, although the Brush Company continues as a separate organization.

The Bentley-Knight Electric Railway Company merges with the Thomson-Houston Company.

Charles Proteus Steinmetz (1865-1923) of Germany arrives in the United States and starts work in Yonkers, New York, as a $12-a-week electrical draftsman for Eickemeyer and Osterheld.

Charles P. Steinmetz — in Yonkers, New York after his arrival in the United States.

Transportation

The first official commercial run of an electrified street railway is made on the Beacon Street-Brookline Division in Boston along 13 miles of track powered by the Sprague Company.

Lighting

The Paris Exposition is the first to be kept open successfully during the evening with the extended use of electric lighting. More than 10,000 incandescent lamps, ranging from 4 to 50 candlepower, were used for lighting purposes.

Power Transmission

The first alternating-current power transmission system to be installed in the United States is placed in operation between Portland and Willamette Falls, Oregon — a distance of 13 miles.

Electricity

Thomson invents the integrating wattmeter. This meter was the forerunner of the watt-hour meter used almost universally for the automatic measurement of power utilization by electric utility consumers.

1890

Company Evolution

The Edison Electric Company sets up a district sales organization of seven zones across the United States.

Charles A. Coffin of Thomson-Houston organizes the United Electric Securities Company in an effort to combat the effects of the nation's faltering economy.

Charles A. Coffin and Henry Villard, President of the Edison General Electric Company, conduct negotiations aimed at a possible merger of their two companies.

The Stanley Electric Manufacturing Company of Pittsfield, Massachusetts is formed by William Stanley, after leaving the Westinghouse Company. He begins the manufacture of a polyphase motor for AC power systems. Later this company was to become the Pittsfield Works of General Electric.

Industrial Products

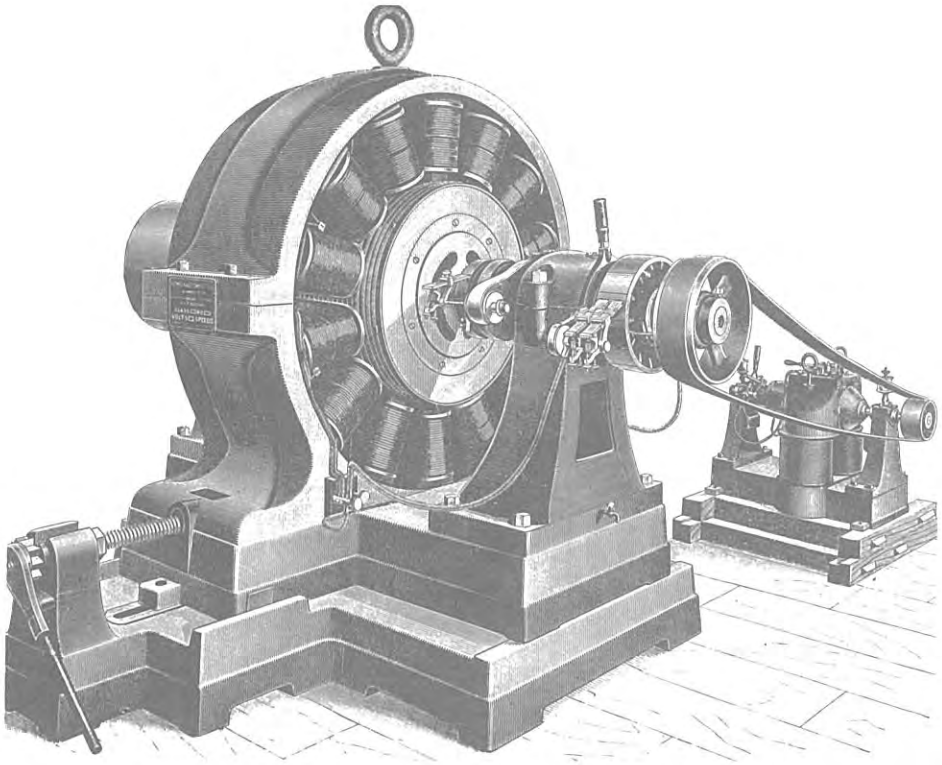
Edison builds a large plant near Ogdensburg, New Jersey for the magnetic concentration of low grade iron ore. With the formation of the Edison General Electric Company the previous year, Edison had received a large sum of money. He decided that the best use for this money was the financing of an independent venture into the field of ore production. In spite of his numerous technological innovations, the project was a financial disaster because of a sharp drop in the price of ore concentrations newly discovered in the West.

Thomson receives several patents covering devices and processes for electric soldering and pipe welding.

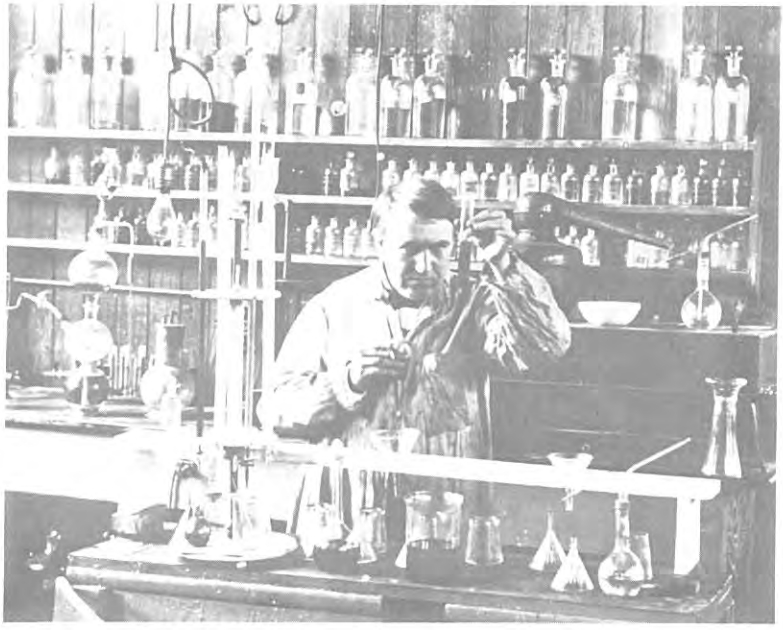
Electricity

The first electrocution of a prisoner takes place at Auburn Prison, New York. Alternating current at 2,000 volts was employed for the execution, and Edison, who opposed the development of AC, used this event to support his arguments about the dangers of the system.

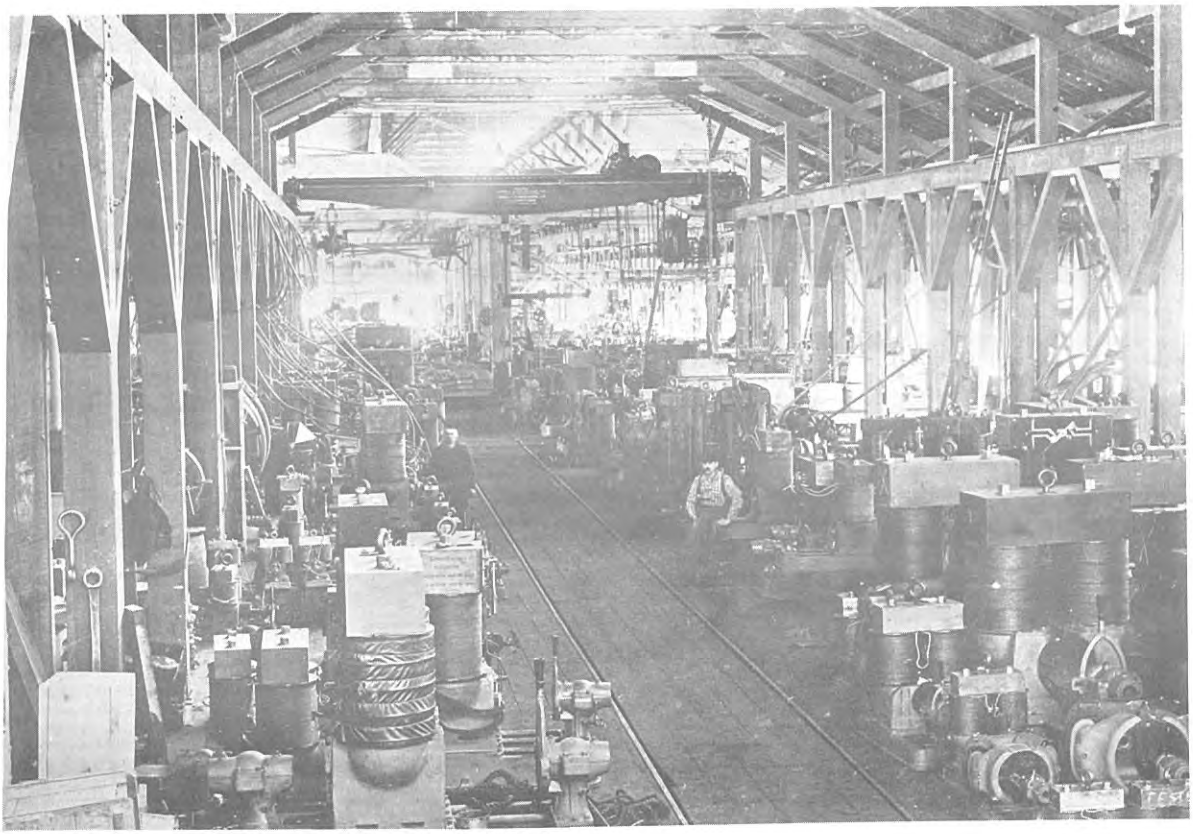
Charles A. Coffin, Thomson-Houston Company executive and the first President of the General Electric Company.



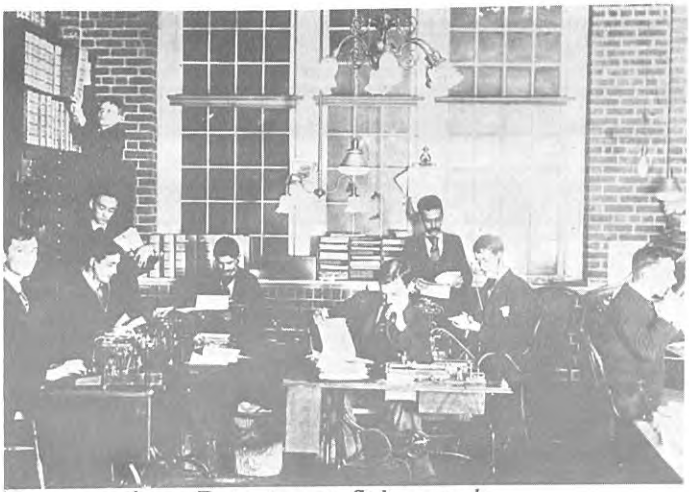
The earliest type of AC generator — constructed by the Thomson-Houston Company.



Edison in his West Orange chemistry laboratory.



General view of Building 12, Schenectady Works.



Correspondence Department, Schenectady Works in early 1890's.

1891

Lighting

Edison wins a court victory — gaining all patent rights on the incandescent lamp.

The manufacture of incandescent lamps in Europe is begun in Eindhoven, Holland, by the Philips Holland Company.

Communications

Edison invents the motion picture camera. With the continuous tape-like film that he originated for this mechanism, it became possible to take and reproduce motion pictures.

Transportation

Edison invents a number of devices for use in electric railway overhead-wire systems. Such systems were used in areas where third rails could not be conveniently installed.

Industrial Products

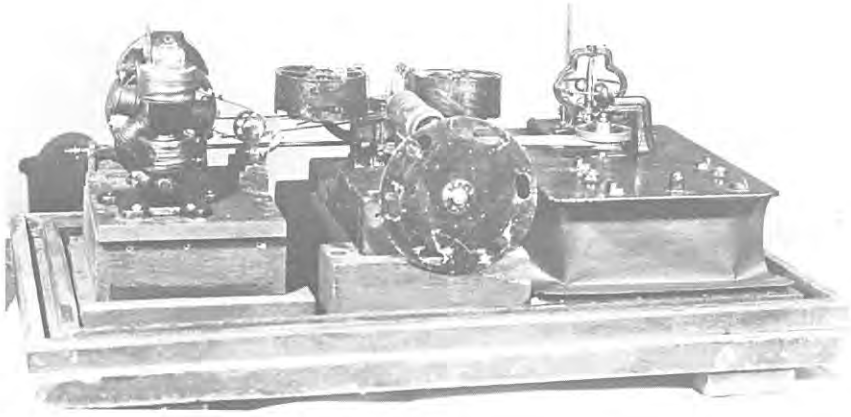
The Westinghouse Electric and Manufacturing Company installs the first electric equipment for steel mills in the Edgar Thompson Works of the Carnegie Steel Company, Bessemer, Pennsylvania.

Power Transmission

Westinghouse introduces the 60-cycle frequency, which later saw almost universal use in the United States.

The first alternating-current power transmission installation in the United States for industrial use is made at Telluride, Colorado, by the Westinghouse Electric and Manufacturing Company.

Steinmetz publishes his first paper on hysteresis while working for Eickemeyer & Osterheld in Yonkers, New York.



The world's first motion picture camera — strip kinetograph by Thomas Edison.

1892

Company Evolution

The General Electric Company is formed by merging the Edison General Electric Company and the Thomson-Houston Company on April 15. The Edison Company contributed to the new company such major assets as the fundamental incandescent lamp patents, the Edison system of distributing electrical energy, and a growing electric traction business. Thomson-Houston contributed its profitable arc lighting business and valuable developments in alternating-current systems. Together, they accounted for about $20 million in gross sales and employed about 10,000 people.

The General Electric Tube Works in Schenectady is destroyed by a fire.

Eickemeyer & Osterheld is acquired by the General Electric Company. In this acquisition the prize was Charles Proteus Steinmetz, who now goes to work for General Electric at Lynn, Massachusetts.

Lighting

Machine-molded bulbs replace the old hand-blown type.

Thomson-Houston Company begins experiments with the squirted cellulose filament in an effort to improve the productivity and properties of its carbonized filament lamps.

Industrial Products

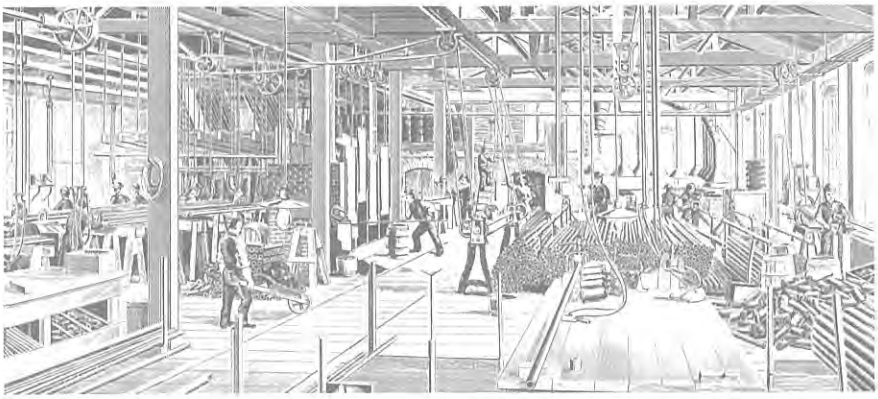
The first automatic push-button controlled elevators are installed in the Postal Telegraph Building in New York using six Sprague-Pratt passenger elevators.

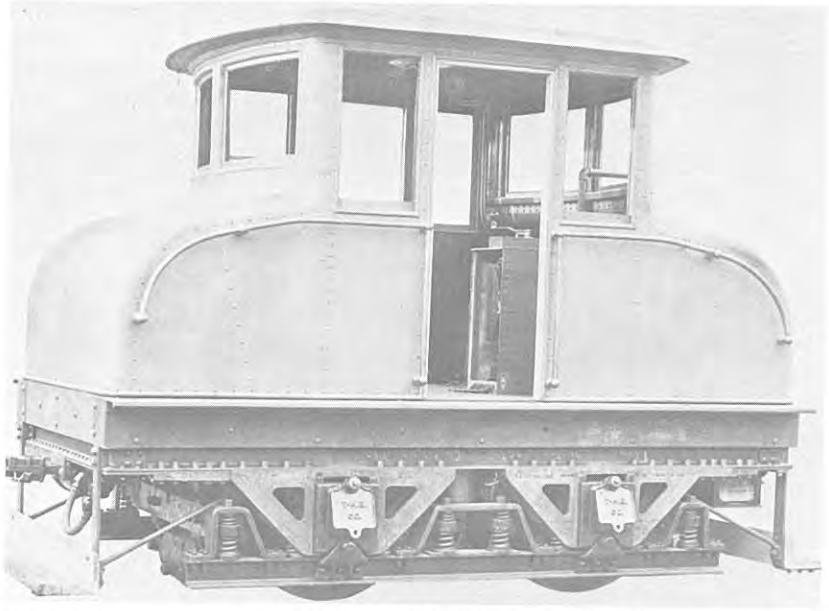
Thomson-Houston Company develops the waterproof motor.

Transportation

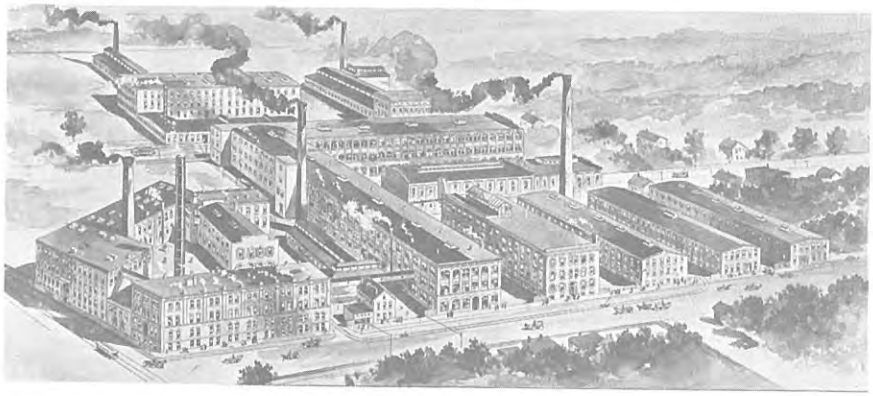
The Baltimore & Ohio Railroad becomes the first steam railway in the United States to use electric locomotives and power equipment.

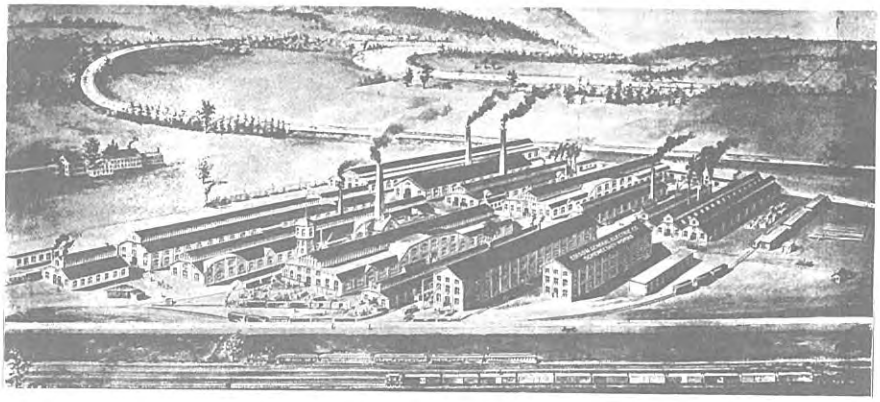
Schenectady Tube Works destroyed by fire in 1892 (litho 1888)



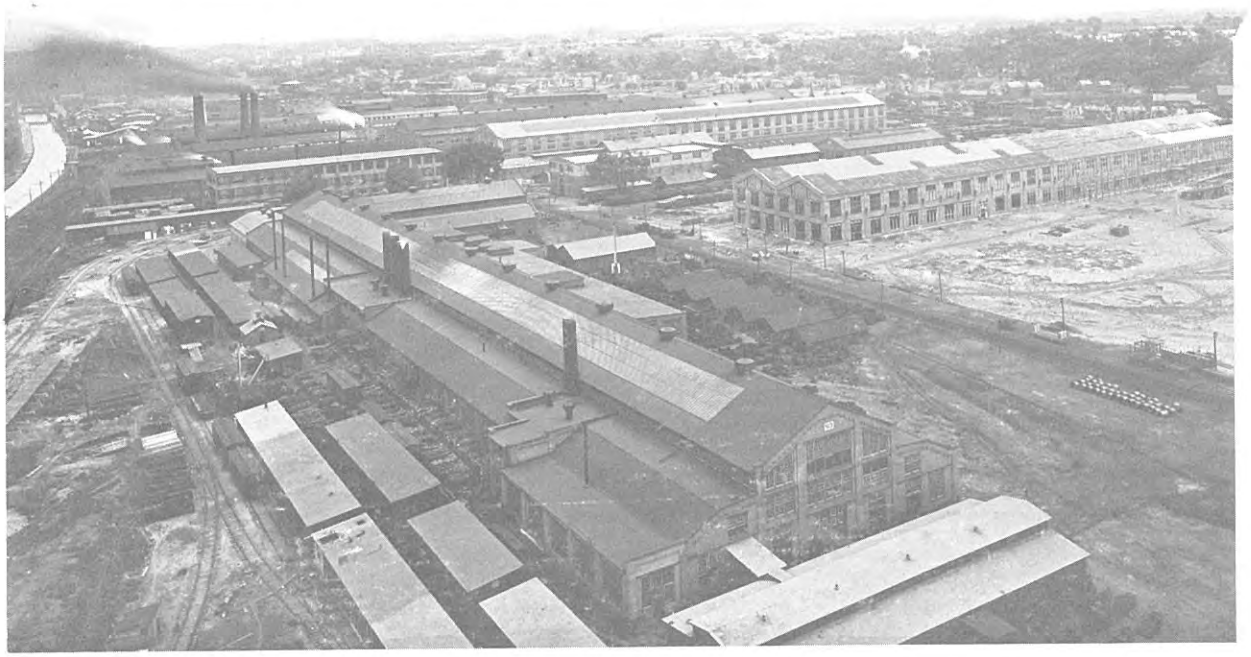


Electric locomotive from Thomson-Houston for railyard switching.





The Edison General Electric Company, Schenectady in 1891 (left) and the Thomson-Houston Plant at Lynn in 1892 (above).



Views of Main Plant, Schenectady, N.Y. Circa. 1900.

EPILOGUE

The formation of the General Electric Company by the consolidation of the Edison General Electric Company and the Thomson-Houston Company on April 15, 1892 brought together many of the most inventive minds in the electrical industry - Edison, Thomson, Van Depoele, and Wood; and it provided the new company with the outstanding administrative capabilities of Charles A. Coffin, who had been so successful in building the Thomson-Houston Company. Coffin was elected President of General Electric, with Eugene Griffin, an expert salesman and former Thomson-Houston man, as Executive Vice-President. Edwin W. Rice, Jr., Thomson's assistant after his departure from Central High School and later general superintendent of Thomson-Houston operations, was named Vice-President and Technical Director.

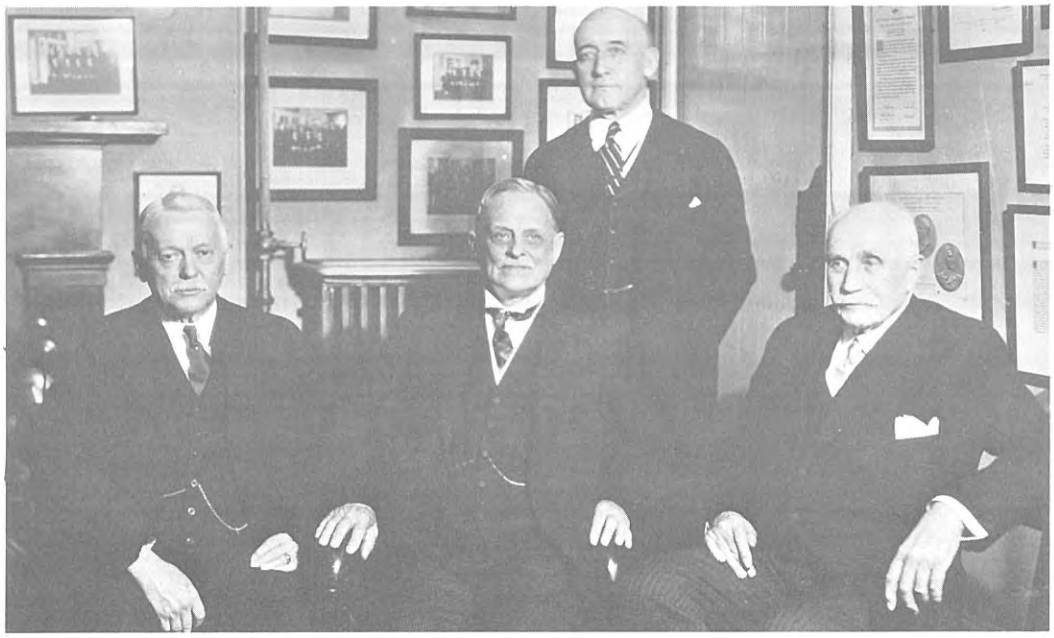
Thomson, more interested in research than in the day-to-day operations of the company, chose to continue his work at the Engineering Laboratory at Lynn, Massachusetts. During his career he was to receive a total of nearly 700 patents, the first granted in 1876 and the last in 1932 - five years before his death.

Edison, who initially opposed the merger, joined the General Electric Board of Directors but became more involved with independent ventures. He turned his attentions to such things as his mining projects, motion pictures, the perfection of his phonograph, and even the development of new types of cement and a system for the construction of poured concrete homes which could be mass-produced and assembled in less than three days. He was to receive a total of some 1,300 patents in the course of his lifetime, and leave in the pages of history a name which has become synonomous not only with elecricity but with inventive genius.

At the end of its first seven months of operation - from June 1 to December 31, 1892 - the General Electric Company had earned nearly $3 million. But within months the country was faced with a severe economic depression which would continue for five years. Many companies failed and the young electrical industry was hard pressed for survival. Coffin would subsequently prove that he could provide the leadership to meet the challenge; and the innovators who had created the products and ideas which were the foundation of the company would be joined by Charles P. Steinmetz, William Stanley, Willis R. Whitney and numerous others who would make their contributions to its growth. Their stories will be the subject of succeeding volumes of the "General Electric Story".

View of Mohawk Valley in 1900. Waterways subsequently rerouted for plant expansion.

Thomas A. Edison and his son, Charles, at the Edison Laboratories in New Jersey making a radio broadcast to Schenectady in 1928.



Mr. Henry Howson, Professor Elihu Thomson, Dr. Howard McClenahan, and Charles F. Brush at the Franklin Institute, Philadelphia, Pennsyvania, 1928.

SELECTED QUOTATIONS

"Genius is one percent inspiration and nine-nine percent perspiration." ***Edison***

"Remember, nothing that's good works by itself, just to please you; you've got to make the damn thing work." ***Edison***

"I will have the best equipped and largest Laboratory extant, and the facilities incomparably superior to any other for rapid and cheap development of an invention and working it up into Commercial shape with models patterns and special machining. In fact there is no similar institution in Existence. We do our own castings, forgings and can build anything from a lady's watch to a locomotive ... Inventions that formerly took months and cost large sums can now be done 2 or 3 days with very small expense, as I carry a stock of almost every conceivable material." ***Edison (from his notebook)***

"My electric light inventions have brought me no profits, only forty years of litigation." ***Edison***

"I've tried everything. I have not failed. I've just found 10,000 ways that won't work." ***Edison***

"There will one day spring from the brain of science a machine or force so fearful in its potentialities, so absolutely terrifying, that even man, the fighter who will dare torture and death in order to inflict torture and death, will be appalled, and so will abandon war forever..." ***Edison***

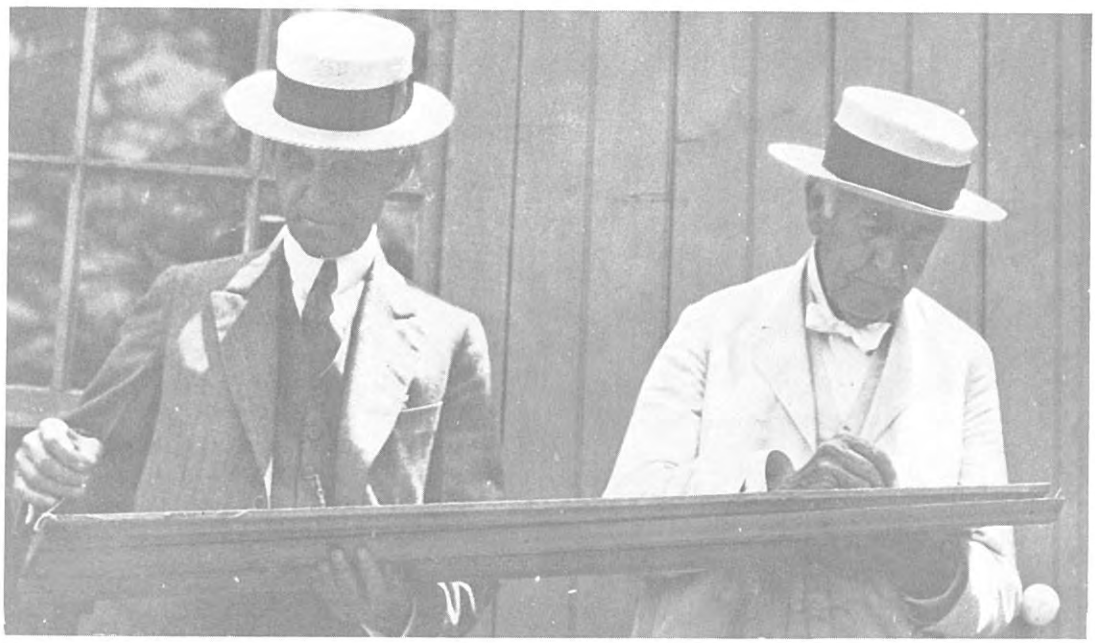
"Scientific facts are of little value in themselves. Their significance has a bearing upon other facts, enabling us to generalize and to discover principles, just as the accurate measurements of the position of a star may be without value in itself, but in relation to other similar measurements of other stars may become the means of discovering their proper motion." ***Elihu Thomson***

"We refine our instruments, we render more trustworthy our means of observation, we extend our range of experimental inquiry and thus lay the foundation for future work with the full knowledge that although our researches cannot extend beyond certain limits, the field itself is even within those limits inexhaustible." ***Thomson***

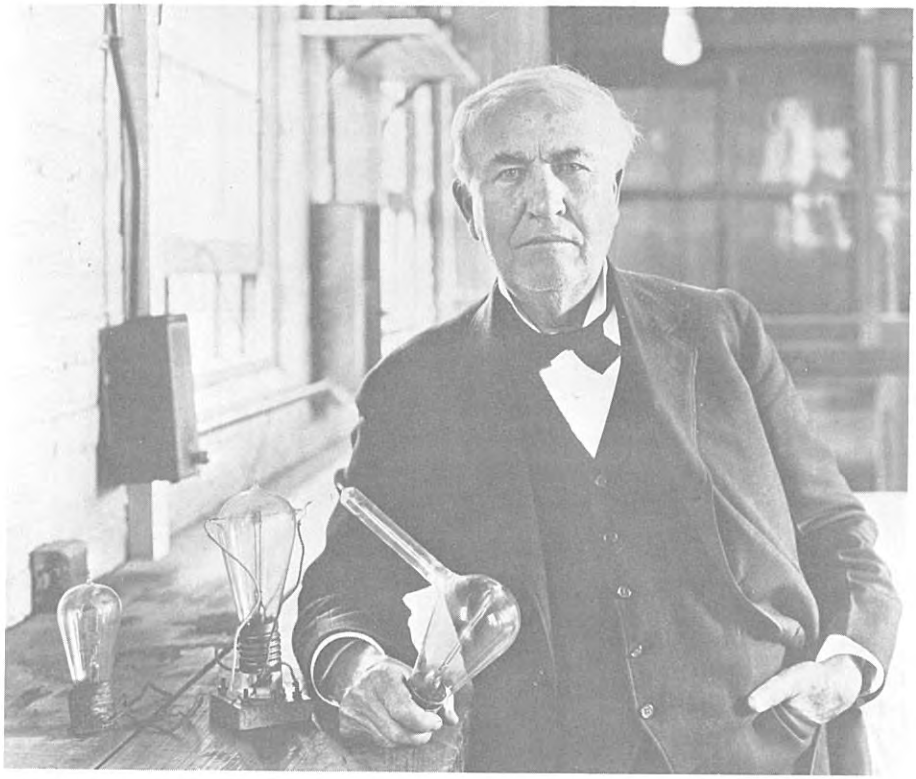
EDISON'S LATER YEARS

Thomas A. Edison seated in his library.

Edison in the New York Edison Company office.



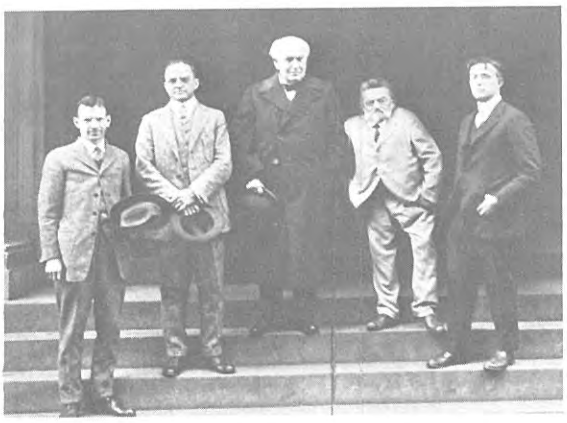
Presentation of Edison's "Glass House" to Henry Ford, June 1929. Edison and Ford autographing board from building.



Edison with his "Edison Effect" lamps.

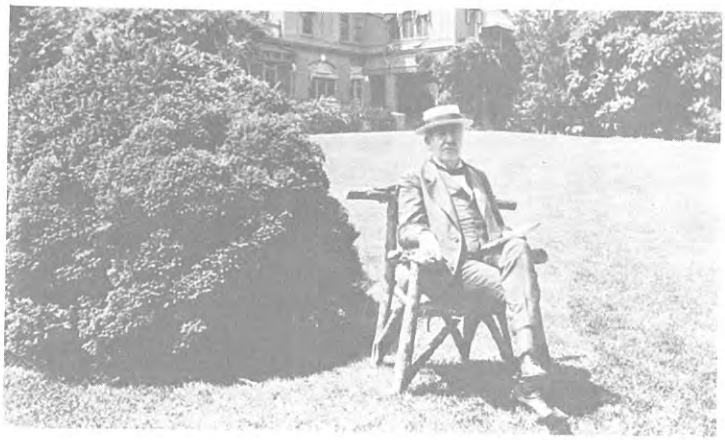
Edison Day window display 1915 at Rikers Drug Store 200 Broadway, New York City.

Thomas A. Edison on tour of the Schenectady plant in 1922.

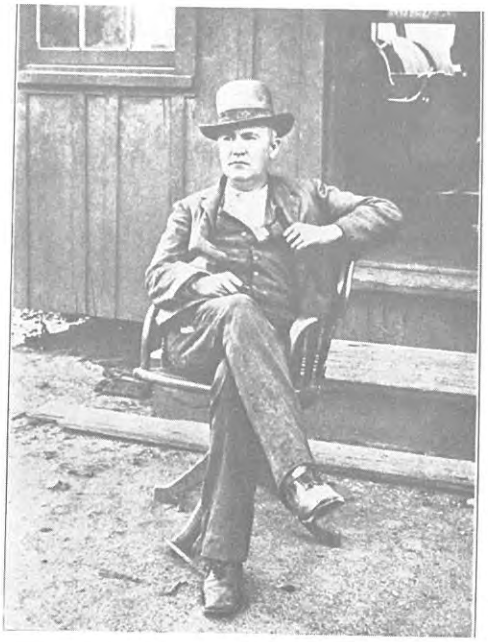


Dr. W.D. Coolidge, Dr. W.R. Whitney, Thomas A. Edison, Dr. Charles P. Steinmetz and Dr. Irving Langmuir on the steps of the Research Laboratory, General Electric Company, Schenectady, N.Y., October 18, 1922.

Edison and Steinmetz before lightning generator.



Edison in front of his home at Orange, N.J.



Edison at the office of the ore-concentrating plant at Edison, New Jersey, in the nineties.

EDISON HISTORIC SITES

HENRY FORD MUSEUM AND GREENFIELD VILLAGE
DEARBORN, MICHIGAN

History Museum; Art Museum; Industrial Museum; Science Museum (14-acre museum, with exhibits covering 300 years of Americana arranged in decorative arts galleries; street of twenty-two early American shops; 8-acre mechanical arts hall. Facade of buildings includes architectural reproductions of Independence Hall, Congress Hall, and Old City Hall of Philadelphia. Decorative arts galleries contain furniture, silver, pewter, glass, pottery, porcelain, folk painting, textiles, clocks and watches; mechanical arts hall includes seven major divisions: agriculture, crafts and domestic arts, industrial machinery, steam and electric power, communications, lighting and transportation; exhibits range from 17th cent. hand tools to 600-ton steam locomotive; objects associated with Washington, Lincoln, Edison, McCormick, Admiral Byrd, Lindbergh); Preservation Project (Greenfield Village: nearly 100 historic buildings moved from many parts of America and from England; typical village green; historic houses showing architectural development; working crafts shops and industrial buildings; homes and workshops of famous Americans, including Edison's Menlo Park compound, West Orange Laboratory and Fort Myers Laboratory).

Daily, 9-5 Admission charge.

EDISON NATIONAL HISTORIC SITE
WEST ORANGE, NEW JERSEY

Park Museum; Science Museum; Historic Buildings (6 original laboratory buildings built by Thomas A. Edison in 1887; original and models of his electrical, chemical and mechanical inventions; research notebooks, personal and business papers; first phonograph ever made; phonograph records, both cyclinder and disc); Historic House (Glenmont in Llewellyn Park, 1880; H. Hudson Holly, architect; home of Thomas A. Edison; house furnishings including books, objects of art, portraits, photographs, prints and other Edison family personal memorabilia).

Activities: guided tours, films; formally organized education programs for children; loans to museums; radio and TV programs. Publications. Governing Authority: Federal (National Park Service)

Laboratory Unit: Tues.-Sun., 9:30-4:30
Glenmont Unit: Tues.-Sat., 10-4
Admission charge.

EDISON MEMORIAL TOWER AND STATE PARK
MENLO PARK, NEW JERSEY

Electricity Museum (site where Edison invented the light bulb in 1879; contains model of his laboratory; generator, 1905 phonograph and related material).

Activities: guided tours. Administered by: State (Forest and Parks Section, Dept. of Conservation and Economic Development).

Tues.-Sat., 10-12, 1-5; Sun., holidays, 2-5.
Admission charge.

EDISON BIRTHPLACE MUSEUM
MILAN, OHIO

Historic House (built 1840 by Samuel Edison, Thomas Edison's father); Historical Society Museum (Edisonia; documents, photographs, personal mementos, examples of many of his inventions).

Activities: guided tours. Publications. Governing Authority: Non-profit Corp. (The Edison Birthplace Association, Inc.).

Tues.-Sat., holidays, 9-5; Sun., 1-5 (Feb.-Nov.)
Admission charge.

EDISON HOME
FORT MYERS, FLORIDA

Historic House (1885; first pre-fabricated home, built in Maine, brought to Florida by boat); Science Museum (Edison Laboratory; coll. of his inventions); Botanical Garden.

Activities: guided tours; lectures.

Daily, 8-4.
Admission charge.

EDISON'S BUTCHER TOWN HOUSE
LOUISVILLE, KENTUCKY

Historic House: house where Edison lived for one year 1866-1867 to work for the Western Union Company as a telegrapher. House restored to 1866 period containing inventions, artifacts and items relevant to Edison's stay.

Activities: Bus tours — House being restored — unopened yet.

from: the Museum Directories of the United States and Canada, published by the American Association of Museum and the Smithsonian Institution - 1965.

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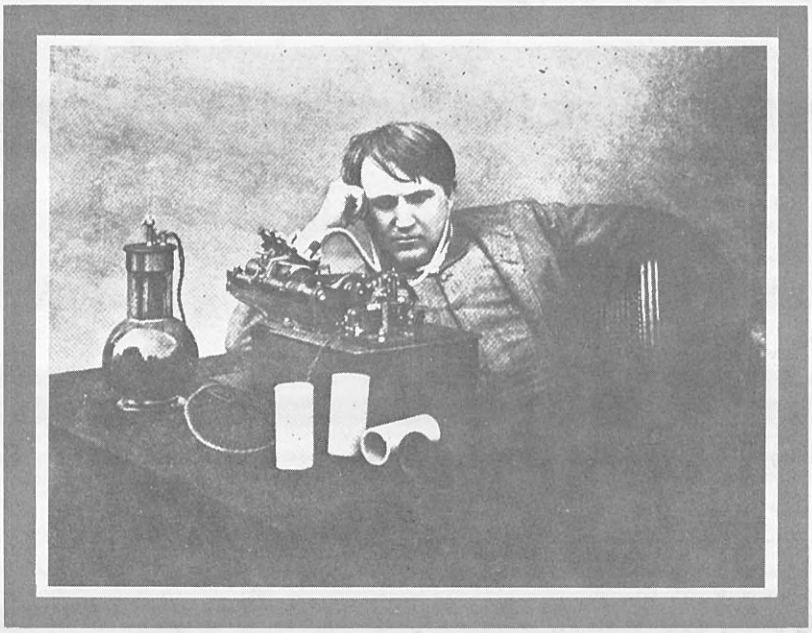

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