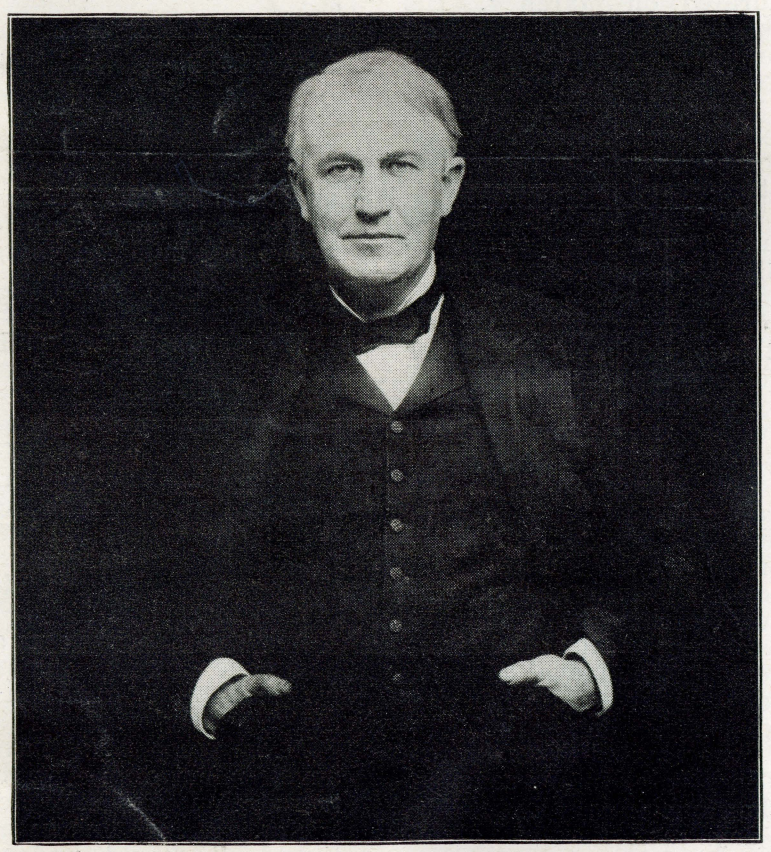
WORLD'S FAIR SERIES Bulletin No. 4

A CENTURY OF PROGRESS
IN
ELECTRICITY, TRANSPORTATION and COMMUNICATION

By Alfred H. Kirkland



THOMAS ALVA EDISON

Published by
A Century of Progress International Exposition
Burnham Park Chicago, Illinois

A CENTURY OF PROGRESS IN TRANSPORTATION, COMMUNICATION AND ELECTRICITY

WE HAVE already considered, in our study of a wonderful Century of Progress, some of the changes in our ways of living, the important discoveries of science, and the development of agriculture from a somewhat haphazard method of tilling the soil to a scientific business.

Now we take up, in the final booklet of this series, three of the principal influences on our present civilization. The United States as we know it would hardly be possible without the modern wonders of electricity, and the transportation and communication agencies in which it plays so important a part.

President Roosevelt is the last of our presidents to be inaugurated on March 4. His successors will take their oaths of office on January 20, by the provisions of the most recent amendment to the Constitution of the United States. In this change we see one of the significant effects of the better transportation and communication that have been developed in the last century.

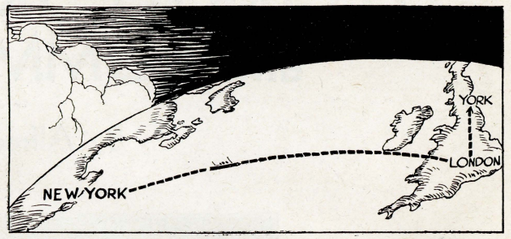
When March 4 was fixed as the inauguration date, more than 100 years ago, our country was much smaller than it is today. But if we measure distance by time, it was much larger. If anything important happens anywhere in the world we read about it either in today's or in tomorrow's newspaper. If we decide today we must go to New York at once, we reach New York tomorrow by train, or late tonight, by airplane. Men have flown 3000 miles across the United States in the light of a single day.

Our great-grandfathers elected their presidents in November, as we do, but they did not have them take office until four months later. This was to give them time to write letters all over the country to select the members of their Cabinets, and to give all of them, and the members of Congress and other officials, time to get to Washington for the ceremonies. The mail was carried by men on horseback, or in easy-going stage-coaches. Officials traveled the same way.

In those earlier days men were out of instant touch with one another as soon as they passed beyond earshot. To send a letter from Illinois to New England and receive a reply took many weeks.

Today we pick up the telephone and in a few seconds our friend in New York answers. In a few minutes we can talk to London. We can telegraph half-way round the world and have a reply in less than an hour. A message is broadcast by radio in Chicago and it is heard in New Zealand, on the other side of the earth.

Because electricity is so important to our travel, transportation, and communication,



Science has brought New York nearer to London than York was in coaching days

and touches our daily lives in so many other ways, let us consider briefly its development in the last hundred years.

Electricity, The Wonder Worker

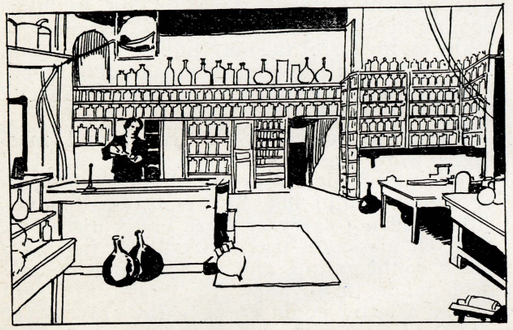
We push a button and the home is illuminated as by the midday sun; an electric vacuum cleaner banishes dirt and dust; an electric washing machine and electric iron help with the housework; a fan gives cooling breezes and an electric heater radiates warmth; an electric range cooks the family meal; an electric refrigerator preserves the food and makes ice; and many other familiar labor-saving or convenient appliances are placed in action.

Yet less than 50 years ago the richest kings had none of the commonplace conveniences which are found today in the homes of all but the extremely poor.

Many great minds have contributed to the development of the present-day electric central station systems which provide our electricity. If only one name were to be mentioned, it would undoubtedly be that of Thomas A. Edison. But before Edison, with his hundreds of marvelous inventions, and contemporary with him, were a host of other electrical scientists and inventors who contributed their part.

Such men as Dr. William Gilbert, Benjamin Franklin, Luigi Galvani, Alessandro Volta, Sir Humphrey Davy, H. C. Oersted, A. M. Ampere, G. S. Ohm, Charles Wheatstone, Michael Faraday, Joseph Henry, Z. T. Gramme, J. C. Maxwell, A. Pacinotti and Lord Kelvin did very important work before Edison. Since Edison's first important inventions many others, notable among them Dr. Charles P. Steinmetz, added achievements of value.

Back in 1600 Dr. Gilbert, an English physician, conducted numerous experiments and



Michael Faraday, the founder of Modern Electrical Science, at work in his laboratory

made many important discoveries, but it was nearly a century and a half later before any great progress was made by others. Benjamin Franklin's demonstration, by his famous kite experiment in 1752, that lightning is an electrical phenomenon, is well known. About 1790 Galvani discovered a current of electricity. Up to that time electricity had been developed only by friction. Volta developed the electric battery in 1800. Oersted of Copenhagen in 1820 discovered the magnetic effect of electric current. This paved the way for the later development of electrical machinery. Michael Faraday of England in 1831 discovered the basic principles on which dynamo electric machines are designed.

But it remained for an American, Samuel F. B. Morse, to perfect the first electrical invention to find an immediate and common use—the telegraph. This was in 1837, four years after the beginning of our Century of Progress, and was the first great communication development. It will be discussed more in detail later in this pamphlet.

Industry Only Fifty Years Old

The development of the modern electrical industry, however, dates from September 4, 1882, when the first central electric generating station was started in New York City and furnished energy for lighting a small area in downtown Manhattan. Three years before this Edison had invented the incandescent electric lamp, but it had been regarded as an impractical curiosity until the first station, known as the Pearl Street station, was opened. With this start, a new epoch in electricity began, for the basic principles of this plant were the same as those used today by electric light and power companies.

At the central station the coal is handled by mechanical conveyors and crushers, themselves operated by electricity, and is delivered to the automatic stokers of the furnace without being touched by human hands. The other raw material required is water. This is delivered to the boilers, where the heat of the burning coal converts it into steam. The steam is piped to the turbines, where the impact of its expansive force and its momentum rotate the shafts of the electric generators.

The energy produced by the steam turbine is mechanical energy, but in the electric generator a transformation takes place. The generator converts the mechanical energy of the turbine into electrical energy, which is transmitted on wires.

In spite of the enormous power produced by a modern generator, the principle of its work is based on simple laws. Nothing of importance has been added, except elaboration of machinery, since Faraday in 1831 worked out the laws. Faraday used a coil of wire and a magnet. Each time the magnet was thrust into the coil its magnetism was found to cause a flow of electricity in the coil, as indicated by a compass placed near the coil. The same phenomenon takes place when a generator rotates. It contains magnets and coils of wire which are, of course, much stronger than those used by Faraday. So long as the magnet rotates inside the coil, electricity is generated.

Many Uses for Electricity

Electricity has made America machine-land. There are no less than 3,000 uses for it. Most of them are in industry, and the use of electricity for power, as well as for lighting and heating in the home, is growing steadily.

Although the use of electrical energy for driving motors is its most common employment in industry, aside from illumination, it is being used more and more for generating heat and bringing about chemical reactions in many manufacturing processes.

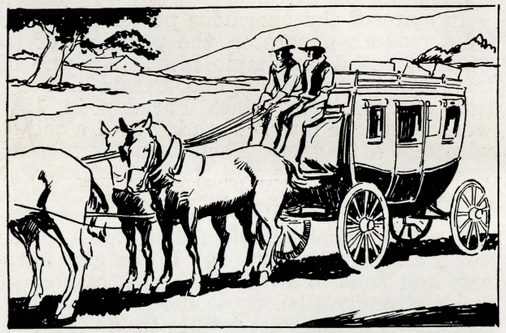
In the latter field electricity has a wide use in electro-chemistry, a department of industrial endeavor with which most people are not familiar. In electro-chemistry, electricity is used to break down, build up, cover, uncover, separate and blend. Some remarkable accomplishments result.

Making of "electric steel" is a fast-growing industry. By using electricity, vanadium and chrome—new kinds of steel—are produced.

One of the great developments of the future will be the more general electrification of the steam railroads, as the experimental

stage of this use of electricity seems to be passed. In several cities in the United States the railroad terminals have been electrified; and through Montana, Idaho and Washington one large steam railroad has electrified its tracks for 600 miles over mountains. Four-thousand ton trains go up and down steep mountains under perfect control at speeds never attained under steam operation, and with a regularity that leaves no doubt as to the practicability of electrification. All railroads leading into New York City are electrified within the city limits. The Pennsylvania Railroad has electrified its tracks between Philadelphia and New York City.

In and near Chicago, the Illinois Central Railroad has electrified its tracks for suburban service, and is working on a general electrification plan for its entire terminal facilities.



A western stage-coach, carrying passengers, mail and express in the early days

Electric light and power companies are devoting much time and effort to the electrification of farms. In 1924 175,000 farms had central station electric light and power service, and now the total is about 700,000.

The Electrical Building at A Century of Progress Exposition is one of the largest and most important structures on the grounds. One of the largest working models, called a diorama, ever made will show how electricity is made, distributed and used, and other exhibits will show in graphic fashion the hundreds of electric appliances and the many new ways in which they are used.

The Development of Communication

The United States mail is so regular and so prompt, and the telephone, the telegraph and the radio so nearly instantaneous, that it is difficult to realize that the means of communication our great-grandfathers had 100 years ago were almost as crude as those of the time of Christ.

The American Indians could send brief messages many miles in a comparatively short space of time, by means of smoke signals. The savages of the jungle could send out certain warnings by means of their hollow log drums. Napoleon in his Russian campaign communicated with Paris on clear days by a continuous system of semaphore signals. The semaphore system of communication was called the "telegraph," was developed to a considerable degree throughout France and to a lesser degree in England and Germany. The ancient Chinese were known to have communicated over considerable distances at night by means of flashing lights. The signal flashed to Paul Revere by means of lanterns hung in the tower of "the old North Church" is familiar to us all.

But these devices were crude, and messages were easily misunderstood. In bad weather conditions—especially in fog—lights or signals could not be seen, and sounds either did not carry or were badly distorted. Written messages traveled only as fast as a horse could gallop, and unless provision had been made in advance for relays of fresh horses a letter could go in a day only as far as the horse could go.

The coming of the railroad, about the beginning of our Century of Progress, was destined to speed up the mail. But the first great improvement in communication, already referred to, was the invention of the electric telegraph by Morse in 1837.

Morse profited by numerous experiments extending over more than a century. The fact that an electric current could be sent over a wire of considerable length was first demonstrated by Stephen Gray in 1729, but it apparently did not occur to him that his discovery furnished the means for the rapid transmission of signals.

While the first battery was constructed by Volta in 1800, a battery of sufficient strength for telegraph purposes was not invented until 1836. In the early part of the nineteenth century various inventors suggested electric telegraphs which required only two connecting wires, a marked improvement over the previous systems.

Oersted's Important Discovery

The discovery of electromagnetism by Oersted in 1820 may be said to have been the culminating episode in the development of the telegraph. While it was known that electric impulses could be sent over a wire, no satisfactory way had been found to recognize these impulses at the receiving end of the line.

Oersted discovered that a magnetic needle placed near a wire would be deflected when a current was sent through the wire. Ampere at once suggested that the deflection of a magnetic needle might be utilized for the reception of electric signals, but a practical needle telegraph was not devised until 1837, notably by Wheatstone and Cook in England.

Joseph Henry, while a professor at Princeton University, made important contributions to the knowledge of electro-magnetism between 1828 and 1831. He demonstrated that the magnetic effect of an electric current could be magnified many times by winding a coil of wire on some soft iron.

Apparently Morse's investigations, and his subsequent success, were largely the result of a chance conversation between him and Dr. Charles T. Jackson on an ocean voyage in 1832. When Morse was required to defend his patents before the Supreme Court in 1850, Dr. Jackson claimed that he had suggested most of the elements of the invention to Mr. Morse during this conversation. Professor Henry also testified that the principles of Morse's invention had been common knowledge before the patent was filed. The captain and fellow passengers on the ship refuted Dr. Jackson's testimony, however, and the court upheld the validity of Morse's patent.

Morse undoubtedly made use of the work of others, but he kept at the job until he was successful. His first line was built between Baltimore and Washington in 1844, Congress having appropriated the necessary funds.

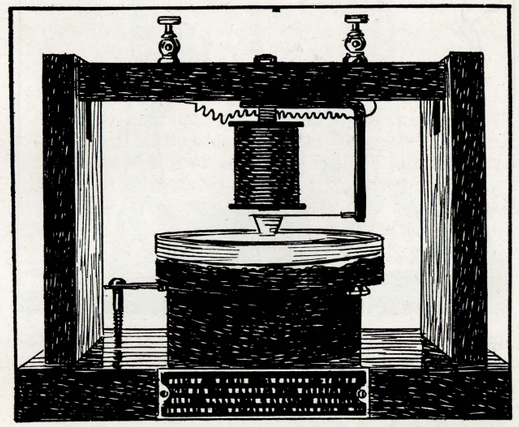
Edison An Early Telegrapher

His basic principles are still the basic principles of the telegraph, although many improvements have been added. Many were invented by Edison, who was one of the most expert telegraphers in the country before he came of age. Edison's studies in electricity, and his marvelous inventive genius, resulted in inventions that not only increased the speed at which messages could be sent, but also made it possible to send several messages over the same wire at the same time.

Telegraph messages are sent in a code, in which the different letters of the alphabet are represented by different combinations of dots and dashes. At first these were printed on a ribbon of paper at the receiving end, but operators soon became so expert that they could recognize the letters by the sound of the receiving instrument, and they wrote out the messages by hand as they received them. Now they write them on the typewriter, and there are also automatic receiving instruments which operate typewriters and write out long messages without an error. The transmission of many thousands of words each day to newspapers is handled by these automatic printers.

Several other important cities were linked by telegraph wires in the four years after the first line was built. By 1848 the country had become so enthusiastic that lines were being built in every direction. Railroads began using it for controlling the movements of trains. Its principles are used in many other ways, as in stock tickers, fire alarm systems, railroad signal systems and clock systems, in which individual clocks are corrected every twenty-four hours by signals sent from a master clock, sometimes many miles away. If all telegraph systems should be suddenly paralyzed the business of the world today would come to a sudden halt.

A submarine cable was laid between Eng-



Model of Prof. Bell's first telephone, through which speech sounds were first transmitted electrically in 1875

land and France in 1846, and a telegraph line was successfully operated over it. This was the beginning of experiments that attracted the attention of Cyrus W. Field, an American who had been so successful in business that he retired with a fortune at the age of 33 years. In 1856 he organized a company for the purpose of laying a cable under the Atlantic Ocean. The following year, using an English and an American warship, the company attempted to stretch a cable between Ireland and Newfoundland, but the cable parted a little more than 300 miles from the Irish coast. In August, 1858, a similar attempt was successful, but the cable failed in less than a month, and the company suffered a heavy loss. The efforts were continued, however, and in the next ten years, after repeated failures, four cables were in operation and now all the important countries of the world are connected by telegraph lines laid on the bed of the oceans.

The Coming of the Telephone

Alexander Graham Bell was the inventor of the telephone, and spoke the first words over it in March, 1876. Like most successful inventors, he had the benefit of much work previously done by others.

Bell's success may perhaps be attributed to

SWEDISH AMERICAN MUSEUM

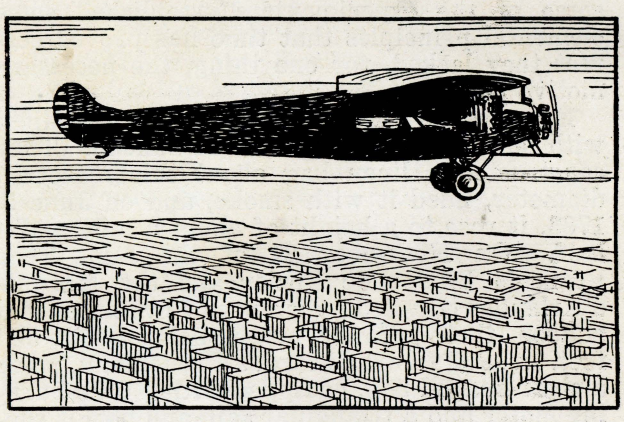
This archival record has been partially scanned, including covers and initial pages for each issue. For more information about a particular issue of this publication, please contact the Swedish American Museum Curator.

many basic principles. The internal combustion engine was ready with the motive power, and the one big problem left to solve was that of balance. It remained for two young bicycle mechanics, Wilbur and Orville Wright of Dayton, Ohio, who began their studies in 1896, to solve it.

Heavier-Than-Air Flight

Samuel P. Langley, an American scientist once head of the Smithsonian Institution, began experimenting in 1887, and in 1896 he built a machine like a kite, propelled by a steam engine and twin-screw propellers. He called it an aerodrome. It flew for three-quarters of a mile but without a passenger. In 1903 he built another machine designed to carry a man, but it would not fly, and failing to find more money to continue his efforts, he died in 1906, a greatly disappointed man. Later his machine was taken from the Smithsonian Institution, equipped with a modern engine, and successfully flown.

The first successful flight was made by the Wright brothers at Kitty Hawk, North Carolina, on December 17, 1903, just nine days after Langley's last sad failure. They had worked at Kitty Hawk, where high winds prevailed, three years before with a glider, and discovered some basic faults in their machine. With the help of Octave Chanute, another pioneer in aviation, they corrected these faults and made



The United States Army's "Question Mark" in flight at beginning of endurance record run

more than a thousand successful short flights. They built a light motor, after several automobile engine manufacturers had declined to aid them, and installed it in their glider. On December 14 the machine rose a few feet, with Wilbur in the pilot's seat, and settled down heavily, breaking several parts. These were quickly repaired, and three days later, with Orville at the controls, the machine rose and stayed in the air for twelve seconds. It was the first successful flight in a heavier-than-air machine, and is now so recognized, although it was disputed for some years by partisans of Langley.

The Wrights made three more successful flights that day. They returned to Dayton and spent the winter constructing another machine, but it failed in a test in the spring of 1904. In 1905, however, they made a flight of twenty-four miles. On May 14, 1908, they returned to Kitty Hawk and Orville flew with a mechanic, marking the first two-passenger flight in history.

The Wright experiments had attracted attention in other countries, notably France. Chanute had gone to France, and had described the Wright planes in detail. Louis Bleriot, Henry Farman and Leon Delagrange were performing sensational stunts in planes of their own construction. The Wright family fortunes were almost exhausted, and the brothers were seeking a contract from the French government. On September 21, 1908, Wilbur smashed all distance records by covering 60.85 miles in an hour and thirty-one minutes. He immediately got his contract, cabled several thousand dollars home, and many other countries pressed invitations upon him. From this time on the Wrights and others were able to get adequate funds from governments and private individuals, and the science made rapid progress. The World War brought the airplane to a high state of development, and trained thousands of men as flyers.

In 1919 three trans-Atlantic flights were made. Commander A. C. Read and a crew of five men flew from Newfoundland to Lisbon, Portugal, after two stops at the Azores. Hawker and Mackenzie-Grieve landed in the ocean, near a ship, 1200 miles out from Newfoundland. On June 14, Captain John Alcock of Great Britain and Lieutenant Arthur W. Brown of the United States flew from St. Johns, Newfoundland, to Clifton, Ireland, a distance of 1,890 miles, in sixteen hours. This was the first non-stop flight.

Commander Richard E. Byrd astounded the world in 1926 by flying over the North Pole, from Spitzbergen, Norway, and return, 1,545 miles in 15 hours and 52 minutes. At the beginning of 1927 there were 2,000 privately owned airplanes, 200 aerial service operators and probably 200 airports in the United States. Then in May, 1927, came Colonel Charles A. Lindbergh with his sensational non-stop flight from New York to Paris, the first man to fly the Atlantic Ocean alone, in thirty-three hours and twenty-nine minutes.

Today aviation is an established transportation medium, with well-organized companies carrying passengers and the United States mail on regular schedules, uninterrupted except by the most unfavorable weather conditions, principally fog.

One of the most interesting features at A Century of Progress Exposition will be a daily pageant of transportation, showing how man has moved himself and his articles of commerce in all ages, from before the discovery of the wheel to the modern airplane.