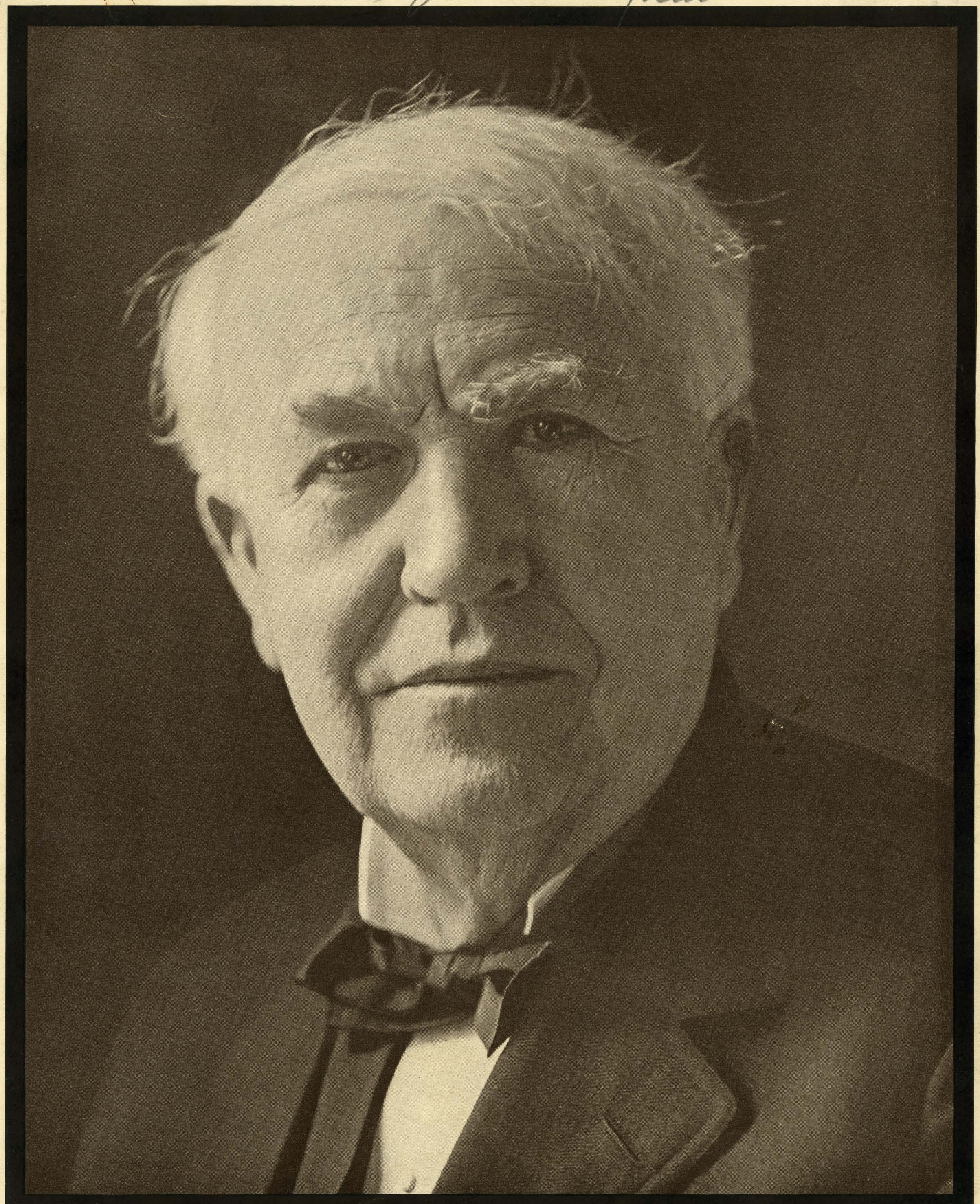
~~G. R. HENNINGER~~ – Edison folder –



The MOTOR

Memorial Edition

Thomas Alva Edison

February 11, 1847—October 18, 1931

"The light once lit shall never dim,
But through all time shall honor him."
—R. R. Bowker

In memory of Thomas Alva Edison, and as a tribute to him and his works, this edition of The CEICO Motor is published by The Cleveland Electric Illuminating Company.

By Robert Lindsay, President

It is impossible for anyone to visualize, let alone to express, the tremendous impress that Mr. Edison made on human life. He advanced progress by a century, or even more, excelling all men of all time in the number of constructive ideas he conceived and carried forward to completion.

Not only did Mr. Edison create many great inventions, but he devised ways and means to extend their use throughout the world.

Because of his supreme ability to transmute theories into accomplishments, he established himself as the world's greatest inventor.

We are only beginning to realize the vast benefits of his genius and labors. In countless ways we are utilizing his inventions and discoveries. Their applications are extending and multiplying constantly.

To those who had the privilege of close association with Mr. Edison, he endeared himself by his friendliness and human qualities. He inspired respect, confidence, loyalty and an appreciation of the value of hard work. He imbued his own spirit of service not only in his associates and organization, but in the entire electrical industry.

The CEICO MOTOR

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Thomas Alva Edison, Immortal

Today the world mourns the passing of Thomas Alva Edison.

Tomorrow, and through all the tomorrows to come, the world will rejoice that Thomas Alva Edison lived.

In any well-considered list of the ten greatest men of all times, Edison's name must be included.

"The greatest of all the giants who have made the modern world," he was called by Charles Proteus Steinmetz.

Genius has been given to many men.

None has exceeded Edison in the will with which he used his genius for the benefit of mankind.

His philosophy of life was work.

"An indefatigable worker, with the imagination of a poet, preaching the gospel of the joy of work, a man of the simplest tastes, an untiring searcher after truth, an altogether charming personality, patient, affable, always optimistic, a great benefactor of the human race," he was described by John W. Lieb.

To "bringing out the secrets of Nature and applying them for the happiness of Man," was Edison's own statement of his life's purpose.

From his early boyhood in Milan, Ohio, where he was born on February 11, 1847, until the fatal sickness which terminated October 18, 1931, Edison was a worker and a thinker.

"The trouble with most people is that they will not try to bring out the enormous capacity of the brain," he once wrote.

"There is no expedient to which a man will not go to avoid the real labor of thinking," he remarked on another occasion.

Genius he defined as "one per cent inspiration and 99 per cent perspiration."

Time he regarded as the most precious of possessions.

By combining genius and work, by making the most of every minute of his long lifetime, Edison produced hundreds of inventions of incalculable value to mankind. He was successful in the fields of mechanics, electricity, physics and business.

Past 70 when the United States entered the World War, Edison enlisted in the service of his country, and by a series of important discoveries and inventions, contributed vastly to the winning of the war.

But for 50 years before the war, Edison had been contributing invention after invention to the pursuits of peace and the progress of civilization.

He was barely 21 when he made his first patented invention, the electrical vote recorder. In the years that followed, he received nearly 1,200 patents from the United States Patent Office.

Most pleasing to him of all his inventions was the phonograph.

Most important to the world was the incandescent lamp, which together with other inventions for the generation, distribution and use of electricity, laid the foundation of the electrical industry.

Among his many inventions were the multiplex telegraph, the motion picture camera and projector, the carbon telephone transmitter which made telephony commercially practical, the first life-size electric railway, the dictating machine, the telescribe combining the telephone and dictating machine, the alkaline storage battery and Portland cement processes.

He assisted many other inventors, notably Bell in perfecting the telephone and Sholes in perfecting the typewriter.

Edison had only three interests in life; his work, his family, and his friendships.

He was deeply interested in the progress of men of ability who became associated with him. Some of these men, who worked with him in the early days, have an organization, the Edison Pioneers—formed *"to bring together in friendly intercourse the men who have been associated with Mr. Thomas Alva Edison and his interests in the United States of America or abroad, who desire to pay tribute to his transcendent genius, to bear testimony to his achievements, to acknowledge the affection and esteem in which they hold him, and as far as lies within their power to do good deeds in his name."*

Kings and kingdoms, presidents and republics, universities and scientific societies, and the peoples of many nations found ways of expressing to Edison, while he lived, their appreciation of his service to all mankind.

His body rests in an honored grave, but his genius is a living force. Edison is immortal!

Edison—the Boy, the Man

By Ernest Greenwood

EIGHTY-FOUR years ago—on February 11, 1847, to be exact—a boy was born in the little village of Milan, Ohio. In those days there were no electric lights, no telephones, no radios, no automobiles, no electric railways. Folks still went about in covered wagons or on horseback, for the steam railroads were advancing very slowly.

Seven years before, Morse had taken out his patents on the electric telegraph, but even after seven years telegraphy had been accepted by the people as hardly anything more than an experiment. Gas, for lighting purposes, was known only in the larger cities.

The boy was named Thomas Alva Edison. His father was well-to-do and his mother was a woman of great culture and education. He was named Thomas in honor of his great-grandfather who, as a bank official, signed Continental currency in 1778, and was named Alva after Captain Alva Bradley of Cleveland, a celebrated shipowner on the Great Lakes and an old friend of Edison's father.

During the first years of his life, the young Edison gave no promise of future greatness. He had an abnormally large head, and the local doctors thought he might have "brain trouble." Because of his seeming delicacy he was not allowed to go to school for some years, and when he did his teacher told a school inspector that she thought he was "addled." Fortunately, his mother was not only well informed but had had long experience as a teacher, and she gave him an education far better than he could have secured in the local public schools of the day.

When he was about six he noticed a goose sitting on her eggs, and the result. Soon after he was missing and his father, after a frantic search, found him sitting in a nest he had made in the barn, filled with goose and hen's eggs he had collected, trying to hatch them.

The boyhood experiences of young Edison were not so very different from the experiences of any average American boy in a small town. He fell into the canal and was nearly drowned. He fell into a pile of wheat in a grain elevator and was almost smothered. While holding the end of a skate strap for another boy to shorten it with an axe, he lost the end of a finger. He built a fire in a barn which resulted in its complete destruction, and was publicly whipped in the village square as a warning to other boys. He induced a lad in the employ of the family to swallow a large quantity of Seidlitz powders on the theory that the gases generated would enable him to fly, but only succeeded in making him extremely ill, and Edison received a sound thrashing from his mother.

Edison in boyhood

In 1854, when Edison was seven years old, the family moved from Milan, Ohio, to Port Huron, Michigan. His father purchased a well-stocked farm, became a dealer in grain and feed, and was extremely active in the lumber industry.

At Port Huron Edison attended the public schools for exactly three months—the only regular scholastic instruction he ever received.

However, before he had reached the age of 12 the young Edison, with the help of his mother, had read Gibbon's "Decline and Fall of the Roman Empire," Hume's "History of England," Sear's "History of the World," Burton's "Anatomy of Melancholy" and The "Dictionary of Sciences." He had attempted to struggle through Newton's "Principia" but the mathematics were beyond both teacher and pupil.

At that time all his interests were centered in chemistry. It was at his home in Port Huron that he had his first laboratory, and he began experimenting at about 10 or 11 years of age.

Having obtained a copy of Parker's "School Philosophy," an elementary book on physics, he tried almost every experiment in it. He collected in the cellar no fewer than 200 bottles which he gathered from various parts of the town and carefully labeled all of them "Poison" so that no one else would touch them. These he filled with all sorts of chemicals, and his greatest diversion was to test statements made in the various scientific books he read.

Edison's mother soon tired of the mess in her cellar, so she told him to clear everything out and restore order. This caused so much distress that she relented. It was his experimenting in this crude laboratory that gave him his early familiarity with electric batteries and the use of electric current from them.

About this time he had his first commercial experience. His father laid out a large market garden on the ten acres around the house and he, together with his chum Michael Oates of the flying experience, was entrusted with a horse and wagon. Every morning in season they would load up with onions, lettuce, peas, etc., and peddle them through the town, making as much as $600 in one year from this source.

EDISON didn't like agriculture. As he frequently said: "I tired of this work, as hoeing corn in the hot sun is unattractive, and I did not wonder that it had built up cities." About 1861 the Grand Trunk Railroad extended its lines from Port Huron to Detroit and after a great deal of persistence he persuaded his mother to let him go on a local train as a newsboy.

After working on the train for several months, the 14 year old boy started two stores in Port Huron and hired two other boys to take care of them. One was for periodicals and the other for vegetables, butter and berries in season. The periodical store was soon closed, but the vegetable store was kept open for nearly a year. Edison would buy two large baskets of vegetables in the Detroit markets and send them to Port Huron on an express train on which he had received permission to put a boy in his employ.

Edison at the age of 33

But Edison could not keep away from his favorite hobby, chemical experimentation, for long. He had a little compartment in the baggage car where he kept his papers and stock of goods, and he soon had it equipped with an extraordinary variety of apparatus.

At the outbreak of the Civil War he noticed a great increase in the demand for newspapers and decided to become a newspaper owner and publisher. Buying a small press and some type in Detroit, he set up a printing shop on the train, doing the composing while on his run, and thus came into existence the "Weekly Herald," of which he was compositor, pressman, editor, publisher and news-dealer.

It sold for three cents a copy, or eighty cents a month to regular subscribers, and he soon had a circulation of more than four hundred copies. This paper was noted by the London *Times* as the first newspaper in the world to be printed on a train while in motion. The youthful proprietor often cleared as much as twenty or

Edison's birthplace at Milan, Ohio

thirty dollars a month from the enterprise.

Edison's "laboratory on wheels" soon became crowded with equipment and eventually met with disaster. Due to a sudden lurch of the train one day a stick of phosphorus was jarred from its shelf, fell to the floor, and burst into flame. The car took fire and when the next station was reached Edison and his entire outfit, laboratory, printing plant, and all, were promptly ejected by the conductor.

It has often been told that this incident was the original cause of Mr. Edison's deafness, but this is not true. The real cause is as follows, in his own words: "My train was standing by the platform at Smith's Creek Station. I was trying to climb into the freight car with both arms full of papers when the conductor took me by the ears and lifted me. I felt something snap inside my head, and my deafness started from that time and has ever since progressed."

Not discouraged, Edison put his laboratory and printing office together again in his home, but not without some protest from his family. He changed the name of the "Weekly Herald" to "Paul Pry" and enlarged it. It became more and more personal in its character until one day he printed an item about a local citizen who became exceedingly indignant. Soon after this the paper was abandoned.

While still a newsboy on the train Edison became very much interested in telegraphy. He and his chum built a line between their homes which consisted of stove-pipe wire with bottles, set on nails driven into the trees, for insulators.

With the idea of securing current cheaply, Edison experimented in static electricity and at one time actually attempted to use cats as frictional machines until they protested so vigorously that he had to abandon the attempt. The line was made to work, however, and the boys interchanged many messages.

One August morning in 1862, while Edison was still working as a newsboy, the little son of the station agent at Mount Clemens was playing with the gravel on the main track along which a car without a brakeman was rapidly approaching.

Edison dropped his papers and made a dash for the child, lifting him to safety without a second to spare. The child's father was so grateful that he offered to teach young Edison the art of train telegraphy and to make an operator of him; the offer was gratefully accepted.

Even at this time, however, the newsboy had mastered the Morse code and was able to take to the station a neat little set of instruments he had made with his own hands in a gun shop in Detroit.

LATER he applied for a job on the Grand Trunk Railroad and became night operator at Stratford Junction, Canada.

The one thing that bothered him at this time was the fact that no one seemed to be able to explain to him how the telegraph worked. The best explanation he got was from an old Scotch line repairer who told him that if he had a dog like a dachshund, long enough to reach from Edinburgh to London, and if you pulled his tail in Edinburgh he would bark in London. As Mr. Edison later said, "I could understand that, but I never could get it through me what went through the dog or over the wire."

It was while he had the job at Stratford, that young Edison first showed signs of his real inventive genius. He was on duty from 7 P. M. until 7 A. M. and from 9 P. M. on he was supposed to send in the signal "6" every hour to the train dispatcher's office.

Edison, feeling that he needed sleep at night just as much as anyone else, rigged up a small wheel with notches on the rim, and attached it to his clock in such a manner that at each hour the wheel revolved and sent in accurately the dots required

for "6." The invention was a success, but was soon discovered and ruled out.

Returning to Port Huron during the winter of 1863-64 Edison began a period of roaming and drifting which, during the next five years, took him all over the Middle States. During these days there was a great scarcity of telegraph operators and he was able to gratify a taste for travel without running any risk of privation. He could always get a job and he might almost be said to have been what was called a "tramp operator." Throughout this period, however, he never ceased to study, explore and experiment.

IN 1868, after having paid a visit to his parents, Edison found his way to Boston, where he secured a job with the Western Union Telegraph Company with the help of Milton Adams, who was then working in the office of the Franklin Telegraph Company. His arrival might almost be said to parallel that of Benjamin Franklin's arrival in Philadelphia. He had travelled on a pass and had spent four nights and days on the journey, being cold and hungry most of the time; but it took him only five minutes to get the job after he arrived.

There are many interesting stories about Edison's experiences in Boston. It was here that he took out the patent for his first invention—a vote recorder. The purpose of this device was to take a vote in the House of Representatives in a minute or so. It was exhibited in Washington and worked perfectly, but Congress was not interested in it.

He also constructed a device for the electrocution of cockroaches. The office where he worked was literally alive with them. He pasted two strips of tin foil on the wall at his desk. He connected one piece to the positive pole of the big battery supplying current to the wires and the negative pole to the other strip. The cockroaches moving up the wall would pass over the strips and the moment they got their legs across both strips there was a flash of light with the result that they went up in gas.

It was in Boston that Edison invented the first stock ticker and also built the first duplex telegraph for sending two messages over a single wire at the same time.

Going to New York in 1868 with his early stock ticker, which he was unsuccessful in selling, he applied for a position as an operator with the Western Union. At that time stockbrokers were receiving quotations

Edison at about the age of 38

from the floor of the New York Stock Exchange by means of a very complicated telegraph system. Something went wrong with this system and Edison was able to fix it almost immediately. As a result he was offered a job at $300 a month. An ill-clad, unkempt, half-starved boy, 21 years old, who had so little money that he would eat apple dumplings because they were filling, suddenly found himself in a position of responsibility with an income that seemed to him almost princely.

About this time General Lefferts, President of the Gold & Stock Telegraph Company, asked Edison to go to work on improving this system which had then become known as the "stock-ticker." This resulted in a great many inventions on which he took out patents and finally the general decided he wanted to close the matter up. He called Edison into his office and asked him what he thought he should receive for his work. The result of that interview is best told in Mr. Edison's own words.

"I had made up my mind that taking into consideration the time and killing pace I was working at, I should be entitled to $5,000, but

could get along with $3,000. When the psychological moment arrived, I hadn't the nerve to name such a large sum, so I said: 'Well, General, suppose you make me an offer.' Then he said: 'How would $40,000 strike you?' This caused me to come as near fainting as I ever got."

Edison signed the contract without reading it, and received a check for $40,000, which he cashed.

Thinking to play a practical joke on him the teller gave him the whole $40,000 in small bills. These Edison gravely stowed away in his overcoat pockets and in all his other pockets and went to Newark, where he sat up all night with the money, fearing that it would be stolen. The next morning he called on the general again, who arranged for him to deposit the currency and open a bank account.

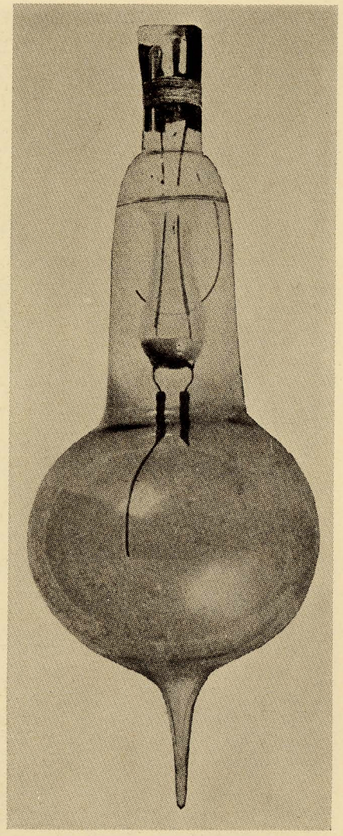
WITH the money he received from General Lefferts Edison rented a shop in Newark, bought machinery and went to work.

He quickly moved to a larger shop and secured many orders from General Lefferts to build stock tickers. Soon he was employing fifty men and as business increased he put on a night force, acting as foreman of both day and night shifts himself.

Work of various kinds poured in on the young manufacturer, and during 1870-1871 he started no fewer than three shops in Newark. During this period, an Englishman named George Little had brought to this country a system of automatic telegraph which worked well on short lines but was a failure when put on longer circuits. Edison was recommended as a man who might find out what the difficulties were and correct them. He went to work on it and solved the problem to such an extent that he succeeded in transmitting and recording 1,000 words per minute between New York and Washington and 3,500 words per minute between New York and Philadelphia.

About this time a Mr. Sholes came to New York from Milwaukee with the wooden model of a machine which he called a typewriter. It was put into Edison's hands to perfect. The typewriter which he eventually evolved as a commercial machine is known as the Remington.

In 1875, Alexander Graham Bell made his first pair of magneto telephones and in 1876 he applied for a patent which was issued. Mr. Bell is credited with inventing the first telephone, which consisted of the present receiver used both as a transmitter and receiver, but when an attempt was made to introduce it commercially it failed on account of the faintness of sound transmitted.



Edison's original lamp

Mr. Orton, of the Western Union Telegraph asked Edison to take hold of it and make it commercial. He started in and soon produced the carbon transmitter which is now universally used. He decided to ask Orton for $25,000 for this invention, but, as in the case of his work for General Lefferts, he suggested to Mr. Orton that he be made an offer. Orton promptly said that he would give him $100,000.

This Edison accepted on the condition that it was not to be given to him all at once, but at the rate of $6,000 a year for seventeen years—the life of a patent.

The deal was closed and, as Mr. Edison said: "I saved seventeen years of worry by this stroke."

Edison began his experiments with the incandescent lamp in 1877. By this time the arc light was well established and gas lighting was in use on the streets and in some houses. But artificial lighting had always depended on the consumption of some material in the open air and Edison dismissed the idea of using arc lights for general indoor illumination, deciding that an electric lamp giving light by incandescence was the solution to the problem of an electric substitute for gas lighting. The whole scientific world pronounced such an idea impossible.

There has been a great deal of misunderstanding as to exactly what Edison did invent when he was able to announce that he had devised a practical incandescent lamp suitable for use in large numbers.

He was not the first man to make an incandescent lamp, as the principle had been established and demonstrated by several experimenters—some of them before Edison was born. What he did do was to invent a lamp with a carbon filament enclosed in a glass globe, in which he created a vacuum, with platinum wires imbedded in the glass to carry the electric current to the filament.

It was the first "practical" incandescent lamp which could be used in homes, stores, factories or on the streets. His patent covered a particular kind of incandescent lamp—which combined four things—(1) a filament of carbon which had a high resistance to electric current, in (2) a chamber made entirely of glass and closed at all points in which (3) the air had been exhausted, and through which (4) platinum wires passed to carry the current to the filament. It was a patent on a combination of four old things which produced a new thing.

THE story of the work and experimenting which Edison went through before he succeeded in producing this incandescent lamp is entirely too long to tell here. When he finally decided that it would have to be made of some carbonized material enclosed in a glass vacuum, he first had to devise a pump by means of which he could create such a vacuum.

He experimented with literally hundreds of materials in order to secure a carbon filament, until he finally hit on common sewing thread.

He cut several pieces of this and packed them, with a lot of carbon, in an earthenware crucible in "U" shaped form. This crucible he put into a furnace and heated it to a high temperature for several hours.

After many patient trials he obtained an unbroken carbonized thread, or "filament" as he called it, which then had to be fastened to a pair of platinum wires. This filament was inserted in a glass bulb and the neck of the bulb sealed. He then had a lamp which he connected with a mercury pump and exhausted the air.

The time had now come to try the lamp out. The workmen in Edison's factory were skeptical and made bets that it would last but a few minutes. But it burned steadily for nearly two days.

The Edison incandescent lamp became a fact October 21, 1879.

The problem then became one of finding a better filament. He finally discovered that carbonized paper (bristol board) would give his lamp several hundred hours of life and decided to announce his invention and demonstrate it to the public.

This demonstration consisted of about 60 lamps mounted on poles lighting the grounds around his laboratory and the country roads in the neighborhood. Wires were also run to several houses, and lamps installed in them. Crowds came to see them during the next few days and the Pennsylvania Railroad had to run special trains to accommodate them. All of this happened only 52 years ago.

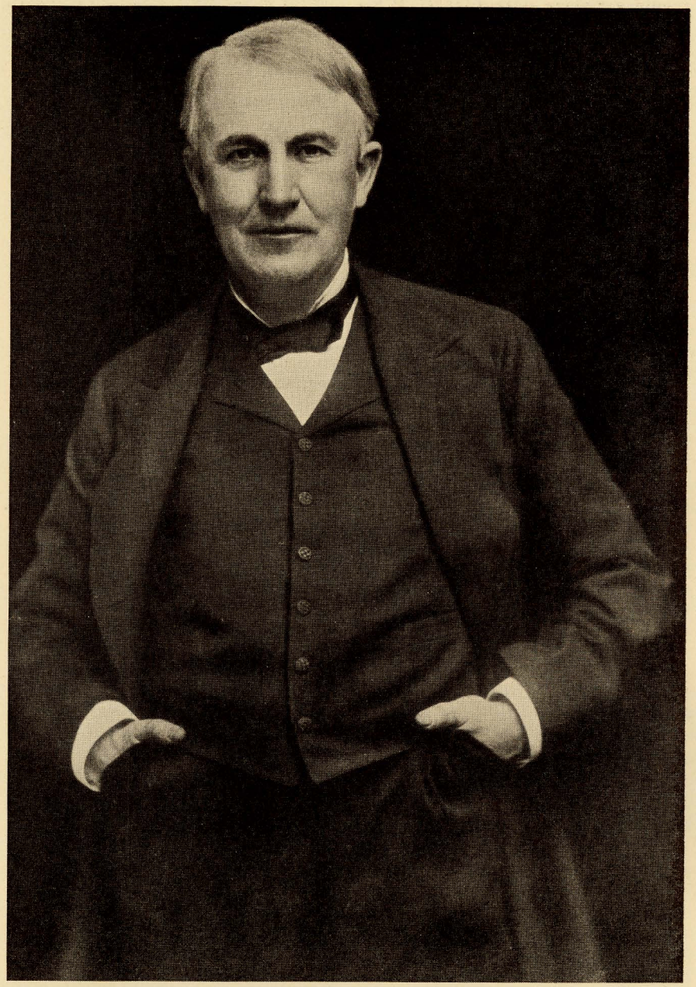
BUT Edison was not satisfied with paper carbon, so he began to carbonize everything in nature he could lay his hands on.

Finally one day he noticed on a table in his laboratory an ordinary palm leaf fan. He picked it up and, looking it over, saw that it had a binding rim made of bamboo, cut from the outer edge of a bamboo cane; a very long strip. He gave it to one of his assistants, telling him to cut it up and get out of it all the filaments he could, carbonize them, and try them in lamps.

This material proved to be far better than anything he had used and shortly afterward he sent a man to Japan to secure supplies of bamboo.

But Mr. Edison had to invent many things other than a practical incandescent lamp before he could claim to have produced a commercially practicable system of lighting with electricity.

First, he had to conceive and devise a satisfactory method of distributing electric current to houses, stores and factories. Then he had to invent his lamp. Following this he had to devise a meter so that the company furnishing the electricity could tell just how much current each customer had used. Then he had to devise a means of maintaining an even "pressure" of current so that the customer farthest away from the plant would receive the same amount of light as the customer near the plant.



Edison in the prime of his life

Following this he had to design efficient dynamos, or generating machines and means for regulating them. Finally he had to invent all sorts of things, such as switches for turning the current on and off, lamp holders, fixtures and the like; also means and methods for wiring houses.

In other words, Edison had to really invent a whole new system of artificial lighting, from the means of generating and distributing the current to the actual lamp and means for controlling it. Without all of these things, even his successful incandescent lamp would have been little more than an interesting experiment.

While Edison was laying the foundation for the light and power industry as we know it today, furnishing us with comforts and conviences which have become so commonplace that we scarcely notice them, he was also busy with many other things. Not the least of these was the invention of the phonograph in 1877. Until that happened the human race had no means of passing on to future generations (except in pictured, manuscript, or printed form) the things which had been said by its great men or, in fact, any other sound, such as music.

There is a popular story that the invention of the phonograph was due to a chance discovery by Edison that a point attached to a telephone diaphragm would, under the effect of sound waves, vibrate with sufficient force to prick his finger. This story is interesting but is not true. The fact is that the invention of the phonograph was the result of pure reason.

He had been experimenting on an automatic method of recording telegraph messages, using a disk of paper on a revolving plate; exactly the same as the disk of a talking machine today.

If an embossing point or needle connected to an arm, traveled over this disk and electrical signals were given through magnets, they were embossed on the paper disk. If it was then put in a similar machine, the embossed record would cause the signals to be repeated over another wire. Edison concluded that in some way he could cause the sound of the human voice to be recorded and then reproduced in the same way.

Instead of a disk, he designed a cylinder provided with grooves around the surface. Over this was to be placed tinfoil. He made a sketch and marked "$18" on it. It was his habit to mark the price he would pay on each sketch. If the workman who was to make the model lost, he still got his regular wages. If he made more than his wages he was allowed to keep it.

The workman who got this sketch was John Kruesi. He made the model and brought it to Edison, asking him what it was for. He was told that it was to record talking and then have the machine talk back. Kruesi thought this was absurd, but the tin foil was put on, the machine started, and Edison shouted into it the poem, "Mary Had a Little Lamb." He then adjusted the reproducer and it reproduced surprisingly well.

Edison started immediately to make several larger and better machines. He worked for five days and nights, at one spell, without sleep and with little food.

Once more the Pennsylvania Railroad had to run special trains to accommodate the crowds who wanted to see it. He took one to Washington and was invited by President Hayes to bring it to the White House. This he did, staying there until 3:30 in the morning. It is interesting to know that the principle of the phonograph has changed but little in the years which have passed since 1877-78. It has simply been refined in a mechanical way.

It was not until 1882 that Edison was able to establish the first "central station" for the generation and distribution of electricity for incandescent lighting. Two years before this, The Edison Electric Illuminating Company of New York had been organized.

This Pearl Street station, which was the grandfather of the New York Edison Company, started in business on September 4th, 1882. Two steam engines were turned on and immediately thirty little balloon shaped globes, ranged at intervals on either side of the long room containing the machinery, glowed with incandescent horseshoes. All of the customers which the new enterprise had succeeded in obtaining were notified that the new light was ready for use.

"I have accomplished all that I promised," Mr. Edison told a reporter for the New York *Sun*. "It was not without some fear that I started the machinery this evening. I half expected that some new phenomena would interfere with the working of the light. But it has been quite successful."

The light and power industry, the cornerstone of which was laid on that night of September 4, 1882, now has more than 24,000,000 customers.

But the men who had invested about one million dollars in the original enterprise soon lost courage and refused to advance any more money. Mr. Edison had to risk his entire personal fortune in the development of manufacturing establishments to produce the apparatus necessary to the system and finance the operations to the extent of several hundred thousand dollars until the Pearl Street plant had progressed to a point where it was evident that it would be profitable.

Edison was the inventor of an electric motor before he perfected his incandescent lamp and he was one of the earliest pioneers in the development of the use of electricity for street railways.

Early in 1880 he constructed a stretch of track close to his laboratory and at the same time built an electric locomotive to operate over it. As in the case of the incandescent lamp, however, he was not the first to think of an electric railway.

The trouble with all prior experiments was that chemical batteries had to be depended on for current. The machines hauled the batteries along with themselves.

In the face of much criticism Edison developed the essentials of a satisfactory dynamo for the generation of current and it was with this that he operated the electric railway around his laboratory.

In the spring of 1883 the Electric Railway Company of America was organized to develop the patents and inventions of Edison and Stephen D. Field. In June of the same year an exhibit was made at the Chicago Railway Exposition in Chicago. A track and locomotive were constructed for the company by Mr. Field and put in service in the main gallery of the main exhibition building. During the exposition this tiny road operated for over 118 hours, the train traveling 446 miles and carrying 26,805 passengers. This was immediately followed by an outburst of excitement over electric railways.

It has been said that Mr. Edison was as much the creator of the art of motion pictures as he was of the phonographic art. When he first tackled the problem, the idea of animated pictures was not new. This, as we have seen, was also the case with the phonograph, the telephone and the electric light.

In the year 1887 the idea occurred to Mr. Edison that it would be possible to make an instrument which would do for the eye what the phonograph did for the ear and that by combining the two, all motion and sound could be recorded and produced simultaneously.

The "talking movies," as we call them today, prove that he was right, although it took many years to bring them to their present state of perfection.

During the period in which he was experimenting with this idea, which covered almost two years, the camera film was being developed by George Eastman, and Edison saw in this film the solution of the problem on which he was working.

Finally securing the right kind of a film, he went to work on the production of a kodak or camera which would take from 20 to 40 pictures a second. This was finally accomplished and in the summer of 1889 the first modern motion picture camera was made.

From that day to this the Edison camera has been the accepted standard for securing pictures of objects in motion, and such changes as have been made in it have been in the nature of improvements of the mechanism.

When the first storage battery was made in about 1880, Edison's attitude toward it was one of skepticism. In fact, he remarked contemptuously that the best storage battery he knew was a ton of coal.

He watched its development closely for about 15 years and finally came to the conclusion that if a storage battery of some other and better type could be brought out, it would fulfill all of the hopes of the first inventors. In 1900 he undertook to solve some of the problems involved, saying, "I don't think Nature would be so unkind as to withhold the secret of a *good* storage battery if a real earnest hunt for it is made. I'm going to hunt."

Of all his inventions, it is doubtful whether any one of them called forth more original thought, work, perseverance, ingenuity and monumental patience than the Edison storage battery.

It has been estimated that Edison made no less than 50,000 experiments in the development of his storage battery.

After Edison had made several thousand experiments in his "hunt" for a *good* storage battery, he was talking with an engineer one day who deplored the fact that he had done so much work without any tangible results. "Results," replied Edison; "I have accomplished all sorts of results. I know of several thousand things that won't work!"

Edison was always greatly interested in cement. He used to say: "Wood will rot, stone will chip and crumble, brick disintegrate, but a cement and iron structure is apparently indestructible. Look at some of the old Roman baths. They are as solid as when they were built."

Having finally decided to go into the business of cement manufacturing, he introduced some bold and revolutionary methods and devices with the result that in five years he raised his plant from the position of an outsider to the rank of the fifth largest producer in the United States.

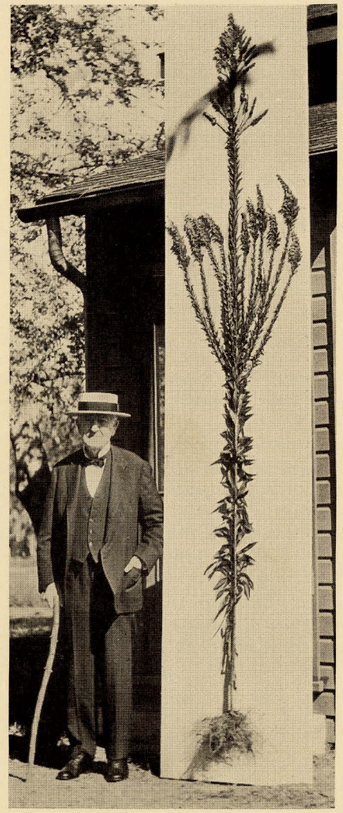
The kilns which were in use for burning cement had a capacity of about 200 barrels of cement clinker every twenty-four hours. Edison decided he could construct a kiln with a capacity of 1,000 barrels.

When the plant was started up the new type of kiln produced about 400 barrels a day and Edison was greatly disappointed. "Try again," he said.

Finally the output was raised to 500 barrels a day and then to 650 barrels a day, but still Edison was disappointed. Eventually his kiln was made to produce more than 1,100 barrels a day, realizing the prediction made by Edison even before the plans for it were drawn.

Today more than one-half of the Portland Cement produced in this country is made in kilns of the Edison type.

When Mr. Edison was about 80 Henry Ford said to him: "Edison, why don't you make some investigations and see whether it is not possible to produce rubber from plants grown right here in the United States?" To which Edison replied: "That seems good to me. I've been working about 60 years on mechanics, electricity, physics and business, and I would like an entire change. I guess I'll take it up."



Edison standing beside a tall golden rod, raised in his quest for rubber.

Edison set about the work in his usual way. First, he undertook to find out what had been done, if anything, to obtain rubber in commercial quantities from plants grown in the United States. Then young botanists were sent to various parts of the country to collect plants from which rubber might be obtained.

Within a short time he had tested more than 15,000 specimens for their rubber content and had found some hundreds of promising species. Then he set to work growing these selected plants and developing a method of extracting rubber, in the meantime, however, going on with the search for new plants. His experiments with rubber were progressing satisfactorily when his health failed completely.

It was on August 1, 1931, that Mr. Edison collapsed suddenly at his home in West Orange, N. J. His physician said he never again could be "out of danger."

Throughout the long illness which followed, his constant nurse and comforter was Mrs. Edison.

In the early days of October, he began to lose strength rapidly, and finally he fell into a deep sleep from which he never awakened. On Saturday, October 17, his children and grandchildren, and the household servants, gathered and passed by his bedside, looking lovingly on a face peaceful and benign.

Before dawn Sunday morning, Mr. Edison's physician issued this announcement to the press: "Thomas Alva Edison quietly passed away at 24 minutes after 3 a. m., Oct. 18, 1931."

On Monday and Tuesday, his body lay in state in the library of his laboratory in Llewellyn Park. Tens of thousands filed in silent sorrow past his bier. Notable among these was a a group of his former associates and intimates, the Edison Pioneers. Funeral services were held in his home, Wednesday, October 21—the 52nd anniversary of his invention of the incandescent lamp. His body was laid to rest in Rosedale Cemetery, West Orange, N. J.

Events in Edison's Career

1847: Born February 11th, at Milan, Ohio.

1859: Became newsboy and "candy butcher" on trains of Grand Trunk Railway, running between Port Huron and Detroit.

1862: Printed and published a newspaper, "The Weekly Herald," on the train. The first newspaper ever printed on a moving train.

1862: Saved from death young son of J. U. Mackenzie, station agent at Mount Clements, Michigan. In gratitude, the father taught Edison telegraphy.

1868: Made his first patented invention, Electrical Vote Recorder. Application for patent signed October 11, 1868.

1869: Landed in New York City from Boston boat, poor and in debt. Shortly afterward, looking for work, was in operating room of Gold & Stock Telegraph Company when apparatus broke down. No one but Edison could fix it and he was given job as superintendent at $300 a month.

1869: Went into partnership with Franklin L. Pope as electrical engineer. Improved stock tickers and made new inventions, among which was the "Universal" stock ticker, also the Unison Device.

1870: Received first money for inventions, $40,000. Opened manufacturing shop in Newark, where he made tickers, etc.

1871: Assisted Sholes, the inventor of the typewriter, to make the first successful working model.

1872-76: Worked on and completed many inventions, including motograph, automatic telegraph system, duplex, quadruplex, sextuplex, and multiplex telegraph systems; also paraffin paper, carbon rheostat, micro-tasimeter, etc. His invention of the quadruplex system of telegraphy was a great development in the art and saved the investment of many millions of dollars in wires.

1875: Discovered previously unknown and unique electric phenomena, which he called "Etheric Force." Twelve years afterward these phenomena were recognized as due to electric waves in free space, and became the foundation of wireless telegraphy.

1876: Moved from Newark to laboratory at Menlo Park, N. J.

1876-77: Invented the carbon telephone transmitter, which made telephony a commercial art. This invention included the microphone, which makes radio possible.

1877: Invented the phonograph. Patent was issued by United States Patent Office within two months after application, without a single reference.

1879: Invented incandescent electric lamp. The invention was perfected October 21st, 1879, on which day the first lamp embodying the principles of the modern incandescent lamp was put in circuit and maintained its incandescence for over 40 hours.

1879: Invented radical improvements in construction of dynamos, making them suitable for generators for systems of distribution of current for light, heat, and power. Invented systems of distribution, regulation, and measurement of electric current. Invented sockets, switches, etc.

1879: December 31. Gave public demonstration of electric lighting system in streets and buildings at Menlo Park, N. J., using underground mains.

1880: Invented further improvements in systems and details for electric light, heat, and power, and prepared to introduce same commercially.

1881: Established first commercial incandescent lamp factory at Harrison, N. J. Organized and established shops for the manufacture of dynamos, underground conductors, sockets, switches, fixtures, meters, etc.

1880-82: Invented and installed first life-size electric railway for freight and passengers at Menlo Park, N. J.

1882: September 4. Commenced operation of first commercial central station in New York City for distribution of electric current for light, power, and heat.

1883: Discovered a previously unknown phenomenon. He found that an independent wire or plate placed between the legs of the filament of an incandescent lamp acted as a valve to control flow of current. This became known as the "Edison Effect." Patent was issued to him in 1883, No. 307,031. This discovery covers the foundation principle on which every modern radio lamp (or tube) is based.

1881-87: Invented system of wireless telegraphy (by induction), to and from trains in motion, or between moving trains and railway stations. Installed on Lehigh Valley R. R. in 1887, and used several years. Same principle capable of use at sea.

1887-90: Established a very extensive commercial business in the manufacture and sale of phonographs and records, including dictating machine, shavable record, and shaving machine.

1891: Invented the motion picture camera.

1891-1900: These years were spent on the great iron ore concentrating enterprise, in which Edison did some of his most brilliant engineering work. He made many important inventions during this period, among which were those covering the giant rolls for breaking large masses of rock, and the three-high rolls for fine crushing.

1900-10: This period covers the work resulting in the invention of the Edison Alkaline Storage Battery, and its commercial introduction. Today, the Edison Battery is used in nearly two-thirds of all battery motivated units operated in the United States.

1900-09: During these years Edison established a Portland cement mill. He made many important inventions relating to the method and processes in the production of Portland cement. Some of these, such as the long kiln, are of great importance to the industry in general.

1902: Worked on improvements in the Edison Primary Battery.

1905: Introduced new dictating machine, which enabled the dictator to hear repetitions and make paper scale corrections.

1910-14: Worked on improved disk phonograph. This work resulted in the production of an instrument and records which reproduce vocal and instrumental music with absolute fidelity and sweetness.

1912: Introduced the Kinetophone or talking motion picture, after spending much time in its development during a number of years past. He foreshadowed the production of this combined device in 1887.

1914-1915: Developed ways and means of providing American commerce and industry and the American government with many basic chemicals, the supply of which was cut off by wartime embargoes and blockades.

1917-18: Worked on war problems for the United States government developing many ideas and inventions which contributed greatly to the winning of the war.

1919-26: Spent in experimenting on new devices, processes, and improvements; and perfecting many technical processes and mechanisms, getting 40 patents in this period.

1927-31: Devoted much of his energy to investigations and experiments looking toward the production of rubber in the United States.

A Brief Biography

From Who's Who

EDISON, THOMAS ALVA, inventor; born in Milan, Ohio, February 11, 1847; son of Samuel and Nancy E.; received some instruction from his mother; (Honorary Doctor of Philosophy Degree, Union College, 1878; Doctor of Science Degree, Princeton University, 1915; Doctor of Laws Degree, University of the State of New York, 1916); married Mary G. Stilwell, 1873; children—Marion Estelle, Thomas A., William L.; married Mina M. Miller, 1886; children—Madeline, Charles Theodore.

At 12 years of age became newsboy on the Grand Trunk Railway, later learned telegraphy; worked as operator at various places in United States and Canada; invented many telegraphic appliances, including automatic repeater, quadruplex telegraph, printing telegraph, etc.

Established workshop at Newark, N. J., removing to Menlo Park, N. J. Invented machines for quadruplex and sextuplex telegraphic transmission; the electric pen and mimeograph; the carbon telephone transmitter; the microtasimeter for detection of small changes in temperature; the megaphone, to magnify sound; the phonograph; the incandescent lamp and light system; the electric valve, (at first called the "Edison effect"), now fundamentally essential in wireless telegraphy; a system of wireless telegraphy to and from moving railway trains; motion pictures; the telescribe; alkaline storage battery.

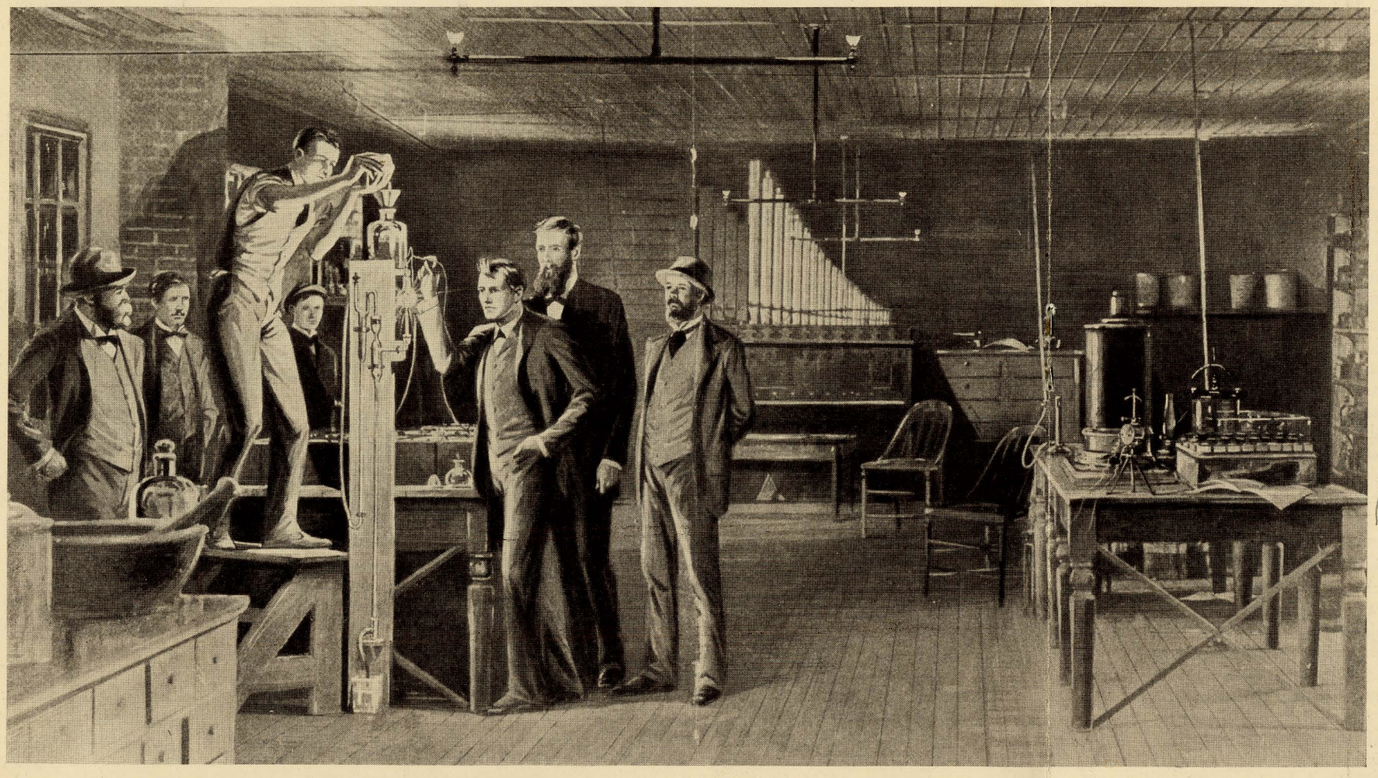
Since commencement of European War, 1914, designed, built and operated successfully several benzol plants; also two carbolic acid plants; also other chemical plants for making myrbane aniline oil, aniline salt, and paraphenylenediamine; has received patents for more than 1,000 inventions.

Was made Chevalier, Officer, and afterward Commander Legion of Honor, by French Government; appointed 1903, Honorary Chief Consulting Engineer, St. Louis Exposition, 1904.

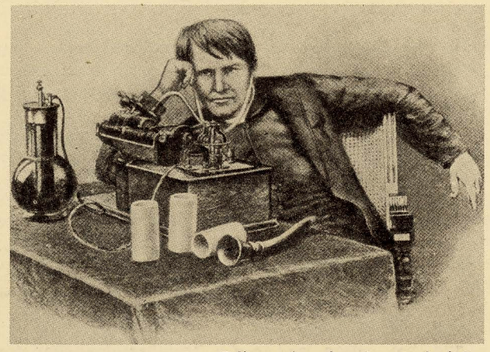
Awarded John Fritz medal, 1908; Rathenau medal (German), American Museum of Safety, 1914. President Naval Consulting Board since July, 1915. Made many war inventions for United States Government. HOME: Llewellyn Park, Orange, N. J. ADDRESS: West Orange, N. J.

Mr. and Mrs. Thomas Alva Edison

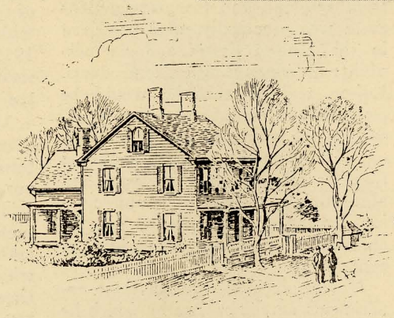
Spanning a Half Century



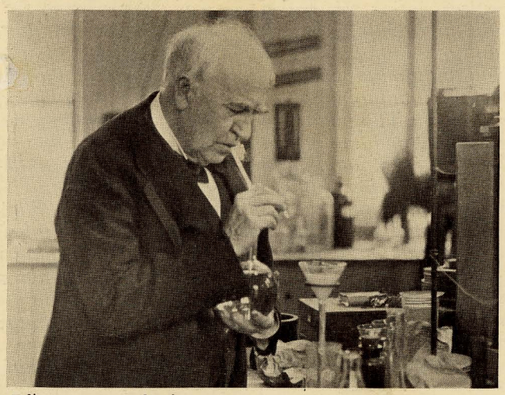
1879 *Edison working on the incandescent lamp in his laboratory at Menlo Park, New Jersey*



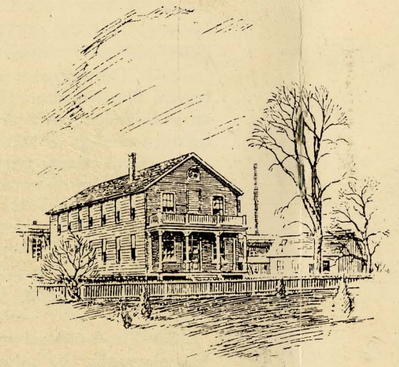
Edison after five days and nights of steady work on his phonograph



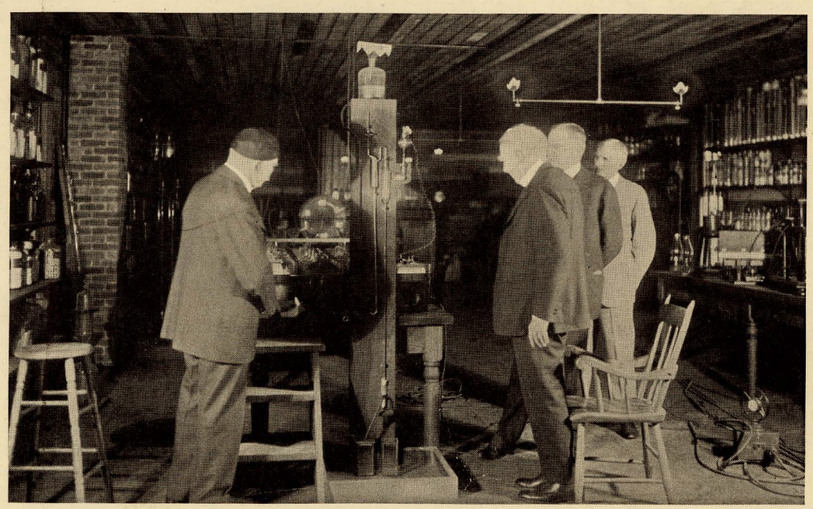
The Jordan home, the first house lighted with electricity



Edison engaged in chemical experiments



Pen sketch of the Edison Laboratory at Menlo Park



1929 *Edison reenacting invention of incandescent lamp at Light's Golden Jubilee Celebration, Dearborn, Michigan*

Edison's Work during the War

By William H. Meadowcroft

Associated with Thomas Alva Edison for 50 years

WITH the shattering of the world's peace by the great conflict which commenced on July 28, 1914, there came a universal disturbance of industrial conditions. The Edison industries were not exempt.

Edison's activities during the years of the war were of the same intensely vigorous and energetic nature so characteristic of him throughout his busy life. His work during this period is divisible into two distinct sections: *first,* the working out of processes and the design and construction of nine chemical and two benzol plants to supply chemicals and materials greatly needed by our country; and, *second,* his war work for the United States government.

For many years before the war America had been a large importer of raw materials and manufactured products from England, Germany, and other European countries. Among these may be mentioned potash, dyes, carbolic acid, aniline oil, and other coal-tar products. After hostilities began, the activities of the Allied fleets prevented all exportations by Germany and the Central Powers. On the other hand, England and her allies placed embargoes on the exportation from their countries of all materials and products which could be used for food or munitions of war.

Thus there suddenly came a great embarrassment to numerous American industries. By reason of our continued importation for many years our country had become dependent upon Europe for supplies of various products and had made practically no provision for the manufacture of these products within our own borders.

Inasmuch as our narrative concerns Edison and his work, we shall not attempt to name all the industries thus affected, we will confine ourselves to a mention of the items relating to his own needs and of those which he promptly took steps to produce for the relief of many industries and for the general good of the country.

These items included carbolic acid, aniline-oil, myrbane, aniline salts, acetanilid, para-nitro-acetanilid, paraphenylenediamine, para-amido-phenol, benzidine, benzol, toluol, xylol, solvent naphtha, and naphthaline flakes.

Edison's principal requirements were potash paraphenylenediamine for use in the manufacture of disc phonograph records. After a great deal of experimenting he found that caustic soda could be used in his storage battery and therefore employed it until new supplies of potash were obtainable.

Carbolic acid and paraphenylenediamine had been previously imported from England and Germany and as there was practically none produced in the United States and no possibility of substituting other products, Edison realized that he would be compelled to manufacture them himself, as the source of supply was cut off. He, therefore, as usual, gathered together all available literature and plunged into a study of manufacturing processes and quickly set his chemists to work on various lines of experiment.

Having decided through these experiments on the process by which he would manufacture carbolic acid synthetically, Edison designed his first plant, gathered the building material and apparatus together and instructed his engineers to rush the construction as fast as possible.

By working gangs of men 24 hours a day the plant was rapidly completed and on the eighteenth day after the work of construction was begun it commenced turning out carbolic acid. Within a month this plant was making more than a ton a day and gradually increased its capacity until, a few months afterward, it reached its maximum of six tons a day.

It soon became publicly known that Edison was manufacturing carbolic acid, and he was overwhelmed with offers to purchase the excess over his own requirments. The demand for carbolic acid became so great that he decided to erect a second plant. This was quickly constructed and its capacity, which was also six tons per day, was contracted for before the plant was fully completed. It is interesting to note that the army and navy departments of the United States were among the first to make long contracts with Edison for his carbolic acid, from which they made explosives that were badly needed.

There had come about a serious shortage of benzol, which is a basic material in the manufacture of synthetic carbolic acid. Benzol is a product derived from the gases arising from the destructive distillation of coal in coke ovens. At the time of which we are writing (beginning of 1915) there was only a comparatively small quantity of benzol produced in the United States.

Mr. Edison realized that without a continuous and liberal supply of benzol he would be unable to carry out his project of producing carbolic acid in large quantities. He had also been approached by various textile manufacturers to make aniline-oil, which was essential to their continuance in business, and of which there was practically no supply in the country. Without it, he could not make paraphenylenediamine. Benzol is also a basic material in making aniline-oil.

Therefore, it became doubly important to arrange for an adequate and continuous supply of benzol. Edison made a study of the methods and processes of producing benzol and then made proposals to various steel companies to the effect that he would, with their permission, erect a benzol plant at their coke ovens, operate the same at his own expense, and pay them a royalty for every gallon of benzol, toluol, xylol, or solvent naphtha taken from their gases. Such arrangements would not only meet his requirements, but at the same time would give the steel companies an income from something which they had been allowing to pass away into the air. He succeeded in making arrangements with two of the companies.

Ordinarily, it requires from nine to ten months to erect a benzol plant, but before making his proposal to the steel companies, Edison had worked out a plan for erecting a practical plant within 60 days, and had laid it out on paper.

The contract for his first benzol plant at Johnstown, Pa., was signed on January 18, 1915, and the actual work was begun an hour after the contract was signed, with the final result that in 45 days afterward the benzol plant was completed and commenced working successfully. The second plant, at Woodward, Alabama, was completed within 60 days after breaking ground, the two weeks difference in time being accounted for by the fact that Woodward was farther away from the base of supplies.

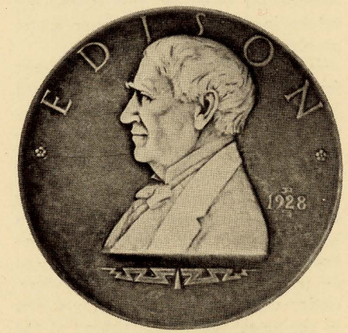
Being sure, through these contracts, of a continuous supply of benzol, Edison designed a plant for making aniline-oil. By working gangs of men day and night, the erection of this plant was completed in 45 days. The capacity of the plant, 4,000 pounds per day, was fully contracted for by anxious manufacturers long before the machinery was in place.

Paraphenylenediamine is a chemical product which is largely used in dyeing furs black. America had imported all her requirements from Germany, but within a few months after the beginning of hostilities the visible supply was exhausted and no more could be expected during wartimes. Fur-dyers were in despair.

This product being also absolutely essential in the manufacture of phonograph records, Edison worked out a process for making it, and as his requirements were very moderate, he established a small manufacturing plant at the Orange laboratory and soon began to produce about 25 pounds a day.

In some way the news reached the ears of many desperate fur-dyers, and Edison was quickly besieged with most urgent requests for such portion of his output as could be spared. Fortunately, a small proportion of the output was available and was distributed daily in accordance with the necessities of those concerned. This small quantity being merely a drop in the bucket, the fur-dyers earnestly besought Edison to establish a larger plant and supply them with greater quantities of paraphenylenediamine, as their business had come almost to a standstill for lack of it. He, therefore, designed and contructed rapidly a larger plant, which, when put into operation, was soon producing 200 to 300 pounds a day, thus saving the situation for the fur-dyers. The capacity of this plant was gradually increased until it turned out upward of a 1,000 pounds a day, of which a goodly proportion was exported to Europe and Japan.

Much could be written about his work on producing myrbane, aniline salts, acetanilid, para-nitro-acetanilid, para-amido-phenol, benzidine, toluol,



Congressional Medal

xylol, solvent naphtha, and naphthaline flakes—how his investigations and experiments on them ran along with the others, team fashion, so to speak, how he brought the same resourcefulness and energy to bear on many problems, and how he eventually surmounted numerous difficulties.

Nor can we make more than a mere passing mention of the assistance he gave to the governments in the quick production of toluol and in furnishing plans and help to construct and

Congressional Medal

operate two toluol plants in Canada. Suffice it to say that his achievements during this episode in his career were fully in accord with the notable successes he had already scored.

It may be noted that in the three years following 1914, others went into the business of manufacturing the above chemicals, and as they installed and operated industries, Edison withdrew and shut down his special plants one after another.

In the late summer of 1915, the Secretary of the Navy, Hon. Josephus Daniels, communicated to Mr. Edison an idea he had conceived of gathering together a body of men preeminent in inventive research to form an advisory board which should come to the aid of our country in an inventive and advisory capacity in relation to war measures.

In this communication Secretary Daniels made an appeal to Edison's patriotism and asked him to devote some of his effort in the service of the country and also to act as chairman of the board. Although he was already working about 18 hours a day, Edison signified his consent. In the fall of 1915, the board was organized and subsequently became known as the Naval Consulting Board of the United States. Mr. Edison was at first chairman and subsequently became president of the board.

In December, 1916, Secretary Daniels expressed a desire that Mr. Edison visit him in Washington for an important conference. At that time it seemed almost inevitable that the United States would be drawn into the conflict with Germany sooner or later, and at the conference Secretary Daniels asked Edison to devote himself to undertaking experiments on a series of problems, a list of which was handed to him.

Edison signified his assent, agreeing to give his whole time to the government without charge, and returned to his laboratory. He immediately put everything else aside, and with characteristic enthusiasm and energy delved into the work he had undertaken.

Inasmuch as Edison's war work for the government occupied his entire time for upward of two years, we must be content to itemize the principal problems upon which he occupied himself and assistants and as to which he reported definite results to Washington. The items are as follows:

1. Locating position of guns by sound-ranging.

2. Detecting submarines by sound from moving vessels.

3. Detecting on moving vessels the discharge of torpedoes by submarines.

4. Quick turning of ships.

5. Strategic plans for saving cargo

boats from attacks by submarines.

6. Collision mats.

7. Taking merchant-ships out of mined harbors.

8. Oleum cloud shells.

9. Camouflaging ships and burning anthracite.

10. More power for torpedoes.

11. Coast patrol by submarine buoys.

12. Destroying periscopes with machine guns.

13. Cartridge for taking soundings.

14. Sailing-lights for convoys.

15. Smudging sky-line.

16. Obstructing torpedoes with nets.

17. Under-water search-lights.

18. High-speed signaling with search-lights.

19. Water-penetrating projectile.

20. Airplane detection.

21. Observing periscopes in silhouette.

22. Steamship decoys.

23. Zigzagging.

24. Reducing rolling of warships.

25. Obtaining nitrogen from the air.

26. Stability of submerged submarines.

27. Hydrogen detector for submarines.

28. Induction balance for submarine detection.

29. Turbine head for projectile.

30. Protecting observers from smoke-stack gas.

31. Mining Zeebrugge harbor.

32. Blinding submarines and periscopes.

33. Mirror-reflection system for warships.

34. Device for look-out men.

35. Extinguishing fires in coal bunkers.

36. Telephone system on ships.

37. Extension ladder for spotting-top.

38. Preserving submarine and other guns from rust.

39. Freeing range-finder from spray.

40. Smudging periscopes.

41. Night glass.

42. Re-acting shell.

It will be seen that Mr. Edison's inventive imagination was permitted a wide scope. He fairly reveled in the opportunity of attacking so many difficult problems and worked through the days and nights with unflagging enthusiasm. He committed his business interests to the care of his associates, and during the two years of his work for the government kept in touch with his great business interests only by means of reports which were condensed to the utmost.

In view of the vast destruction of shipping, perhaps it is not an overstatement to say the most vital problem of the late war was to overcome the menace of the submarine. Undoubtedly there was more universal study and experiment on means and devices for locating and destroying submarines than on any other single problem.

The class of apparatus most favored by investigators comprised various forms of listening devices by means of which it was hoped to detect and locate by sound the movement of an entirely submerged submarine. The difficulties in obtaining accurate results were very great even when the observing vessel was motionless, but were enormously enhanced on using listening devices on a vessel under way, on account of the noises of the vessel itself, the rushing of the water, and so on.

Edison's earliest efforts were confined to the induction balance, but after two months of intensive experimenting on that line he gave it up and entered upon a long series of experiments with listening devices, employing telephones, audions, towing devices, resonators, etc.

The Secretary of the Navy provided Edison with a 200-foot vessel for his experiments, and in the summer and fall of 1917, they had progressed sufficiently to enable him to detect sounds of moving vessels as far distant as 5,000 yards. This, however, was when the observing vessel was at anchor. The results with the vessel under way, at full speed, were not poor.

Having pushed the possibilities along this line to their reasonable limit, Edison was of the opinion that this plan would not be practical and he turned his thoughts to another solution of the problem—namely, to circumvent the destructive operation of the submarine and avoid the loss of ships.

He had discovered in his experimenting that the noise made by a torpedo in its swift passage through the water was very marked and easily distinguishable from any other sound.

With this fact as a basis, Edison, therefore, evolved a new plan, which had two parts: *first,* to provide merchant-ships with a listening apparatus that would enable them, while going at full speed, to hear the sound of a torpedo as soon as it was launched from a submarine; and, *second,* to provide the merchant-ships with means for quickly changing their course to another course at right angles. Thus, the torpedo would miss its mark and the merchant-ship would be saved. If another torpedo should be launched, the same tactics could be repeated.

His further investigations were conducted along this line. After much experimenting, he developed a listening device in the form of an outrigger suspended from the bowsprit. This device was so arranged that it hung partly in the water and would always be from 10 to 20 feet ahead of the vessel, but could be swung inboard at any time. The device was about 20 feet long and about 16 inches in width and was made of brass and rubber. It contained brass tubes, with a phonograph diaphragm at the end which hung in the water. The listening apparatus was placed in a small room in the bow of the vessel. There were no batteries used.

With this listening apparatus, and while the vessel was going full speed, moving boats 1,000 yards away could be easily heard in rough seas. This meant that torpedoes could be heard 3,000 yards away, as they are by far the noisiest craft that "sail" the ocean.

The second step in Edison's plan—namely, the quick changing of a ship's course, was accomplished with the "sea anchor." This device consists of a strong canvas bag, which is attached to a ship by long ropes. When thrown overboard the bag opens, fills with water, and acts as a drag on a ship under way. Edison's plan was to use four or more sea anchors simultaneously.

In a trial made with a steamship 325 feet long, draught 19 feet 6 inches, laden with 4,200 tons of coal, by the use of four sea anchors, the vessel going at full speed, was turned at right angles to her previous course with an advance of only 200 feet, or less than her own length.

This means that if an enemy submarine had launched a torpedo against the ship while she was on her original course it would have passed by without harming her, thus making submarine torpedo attack of no avail. It may be noted parenthetically that this apparatus has its uses in the merchant-marine in peace-times.

Honors Conferred on Edison

DURING his lifetime Thomas Alva Edison was the recipient of many honors conferred by a grateful world. Poets and scientists, educators and statesmen, societies and universities, expositions and governments expressed to him admiration and appreciation.

1878

In 1878, when Edison was only 31, his fame had become world-wide. In that year, Union College conferred upon him the degree of Doctor of Philosophy and he was made a Chevalier of the French Legion of Honeur. The American Institute (of the City of New York) awarded him a Medal of Superiority for an electrical pen, and a Medal of Superiority for a multiplying press. A character sketch of Edison was included in "The American Portrait Gallery," a collection of biographical essays and portraits of prominent Americans.

1879

In 1879 The American Institute awarded Edison two Medals of Excellence, one for his chemical telephone and the other for his carbon telephone.

1881

In 1881 Edison exhibited a complete system of electric lighting at the International Exhibition of Electricity in Paris. He was awarded the Diploma of Honor, the General Congress having "nothing higher to give." In that year, His Majesty King Kalahaua of Hawaii visited New York City, and called on Edison at his office on Fifth Avenue.

1882

At the Electrical Exhibition, which was held at the Crystal Palace in London, in 1882, Edison's exhibit of his lighting system was most prominent. Among those who attended were the Prince and Princess of Wales, grandparents of the present Prince of Wales.

1889

When Edison was in Paris, in August, 1889, a special envoy of King Humbert of Italy presented him with the "insignia of a Grand Officer of the Crown of Italy." Edison thus became a Count and his wife a Countess.

1892

The British Society of Arts awarded the Albert Medal to Edison in 1892. The letter notifying Edison of the award was signed by the Prince of Wales Albert Edward, as President of the Society. The Prince later became King Edward VII. In his letter to Edison, the Prince said: "This Medal was instituted thirty years ago in Memorial of His Royal Highness the Prince Consort, who was for eighteen years the President of the Society of Arts, and since that time it has been awarded, as you are aware, to men of the very highest scientific distinction in all countries of the World. It is a source of satisfaction to me that the last name on this distinguished list should be that of one who has done so much for the advancement of science as yourself."

1904

The twenty-fifth anniversary of the successful development by Edison of the incandescent lamp fell in 1904. The St. Louis Exposition was held in that year, and Edison was appointed Honorary Chief Consulting Engineer. On his fifty-seventh birthday a memorable dinner was given in his honor, at the Waldorf-Astoria, by the American Institute of Electrical Engineers.

1908

The John Fritz Gold Medal was awarded to Edison in 1908. In the select company to whom this medal has been awarded are Ambrose Swasey, Guglielmo Marconi, Orville Wright, Elihu Thomson, and Alexander Graham Bell.

1913

The American Museum of Safety, in January, 1913, awarded to Edison, the Rathenau Gold Medal, for achievements in electrical devices to make safe the lives of workers in atmospheres charged with combustible gas.

Also, in January of that year, the Independent Magazine held a referendum among its readers on the following question: "Who are the most useful Americans?" Edison's name lead all the rest.

1914

After the fire which partly destroyed Edison's large factory at West Orange, N. J., he, without dismay, began to rebuild, winning new admiration. Hundreds wrote him letters of praise, among them President Woodrow Wilson, who said: "I cannot deny myself the pleasure of sending you a line to say how greatly I admire your action in the matter of your business after the loss of your plant. It is not only very fine, but shows a degree of courage and public spirit which excites my most earnest admiration."

1915

One thousand prominent American scientists were polled by the Technical World Magazine in 1915, for the purpose of ascertaining who, in their opinion, were the most prominent scientists. Edison was chosen among the 12.

On May 6th, 1915, he was presented with the Civic Forum Gold Medal, a medal awarded annually by the Civic Forum for distinguished public service. Inscribed on the Edison medal are the words "Inventor World Benefactor." In presenting the medal, at Carnegie Hall, Nicholas Murray Butler said: "This gold medal is not awarded for any particular achievement, but for distinguished services and great scientific achievements and in recognition of a great career, which has a place in the very highest in the role of human history."

In this year, Edison also was awarded the Medal of the Franklin Institute in recognition of the value of "numerous basic inventions and discoveries, signally contributing to the well being, comfort and pleasure of the human race."

On June 15, 1915, Edison received the Degree of Doctor of Science from Princeton University.

1916

Edison was made Honorary Member of the Illuminating Engineering Society on February 10th, 1916. In introducing Edison, John W. Lieb said: "We are delighted to honor

Some of the many awards conferred on Edison

Thomas Alva Edison, not only as a great scientist and one of the greatest inventive geniuses of all time, but as a modest, unspoiled and unassuming man, with broad sympathies for all sorts and conditions of men; the greatest living American, a great benefactor of the human race!"

The Honorary Degree of Doctor of Laws was conferred on Edison October 20th, 1916, by the University of the State of New York. It was the twentieth honorary degree given by the University since 1792.

1917

On Edison's 70th birthday, he was given a dinner by 1,800 Edison employes. President Woodrow Wilson sent a message, in which he said of Edison: "He seems always to have been in the special confidence of Nature herself. His career already has made an indelible impression on the history of applied science."

On October 18th, 1917, exercises were held at the Electrical Exhibition in the Grand Central Palace, New York City, to dedicate a tablet, subsequently placed on the building at 257 Pearl Street, to mark the site where Edison had established the first central station in New York City.

1920

On November 12th, 1920, Edison was honored by being presented with a Distinguished Service Medal, the only instance where this medal was presented to a civilian by the Navy Department. The citation, made public by Secretary of the Navy Josephus Daniels, said: "For exceptionally meritorious and distinguished service in a position of great responsibility as President of the Naval Consultation Board."

1922

A tablet was unveiled in 1922 over an entrance to the Research Laboratory of the General Electric Company at Schenectady to commemorate Edison's starting the manufacture of electrical machinery at Schenectady in 1886.

In a poll taken by the New York Times, to determine the 12 greatest living American men, Edison's name appeared on virtually every list submitted and led a composite list made up by giving each man a tally each time his name appeared on an individual list.

In November, Edison was voted the greatest man in history by approximately 750,000 young people of the Methodist Episcopal Church. In December, as the result of a poll taken at Bowdoin College, Edison was chosen as the first in a list of six foremost living Americans.

1923

Edison was presented with a silver replica of the Edison Medal, at a luncheon given at the Engineers' Club, in New York, by the Chairman of the Edison Medal Committee of the American Institute of Electrical Engineers. Each year a gold Edison Medal is awarded by this body to a resident of the United States or Canada, "for meritorious achievement in electrical science, electrical engineering or the electrical arts." On June 26th, 1923, Edison was made an Honorary Life Member of the Order of Loyal Knights of the Round Table, being the second man to be thus honored.

1924

M. L. Burton, President of the University of Michigan, undertook to name the four outstanding men of the 20th Century. He chose Theodore Roosevelt, Henry Ford, Orville Wright and Thomas Edison. Said President Burton: "I have made my choice from the angle of constructive civilization."

1925

On May 16th, 1925, the Edison Pioneers unveiled a tablet near the site of Edison's laboratory and workshop at Menlo Park, N. J. The inscription reads: "On this site, 1876-1882, Thomas Alva Edison began his work of service for the world to illumine the path of progress and lighten labor for mankind. This tablet is placed by the Edison Pioneers to attest the gratitude of the industries he did so much to create. Dedicated Menlo Park, N. J., May 16, 1925."

As a state monument, this tablet was formally given into the custody of Governor George S. Silzer, who in accepting it, said: "This is historic ground, for it marks a step in the progress of the world. Here in enduring bronze, is recorded for all time the fact that on this spot Thomas A. Edison, by his genius, industry and ability, made some of the greatest discoveries the world has ever known, and thus helped to make this a better world and a happier place in which to live. It is especially gratifying that this should take place during the lifetime of him whom we honor today, and that the inspiration should have come from those who here labored with him, and shared with him the thrill of discovery and achievement."

The Venezuelan Government conferred on Edison its Medal of Public Instruction in acknowledgment of the great service which he had given the world.

1926

At the annual convention of the National Electric Light Association held at Atlantic City, Secretary of the Treasury Andrew W. Mellon, said in an address: "It seems almost incredible that most of the inventions which have revolutionized our daily life should have been made within the recollection of men now living, and so many of them by the ability and undying effort of one man who is the distinguished guest of this convention. Thomas A. Edison is a living example of what may be accomplished when genius is used in the service of mankind and along lines that are always constructive."

On June 3rd, the Crown Prince of Sweden, Gustaf Adolf, visited Edison and said afterward: "His mental capacity is marvelous. He astounds me. How can a man have such a grasp of so many different things?"

On Edison's 80th birthday, he received a letter of congratulation from President Calvin Coolidge, which said in part: "To your energy, courage, industry and strong will the world owes a debt of gratitude which it is impossible to compute. Your inventions, placing the forces of nature at the service of humanity, have added to our comfort and happiness and are a benefaction to all mankind for generations to come."

In a speech on the occasion of Edison's 80th birthday, George Eastman, notable for his inventions and developments in the field of photography, said: "I regard him as the greatest inventor who ever lived, with nobody else even second. Other men may have made as important single inventions, but nobody has ever made as wide a range of important inventions. His inventions are valuable, too, because they have been of such benefit to humanity and have changed the lives of human beings in many ways."

Edison reading tablet placed in his honor near site of laboratory at Menlo Park, N. J., by the Edison Pioneers

1928

In recognition of Edison's great service to mankind, the Society of Arts and Sciences bestowed on him its gold medal for sciences. This was on May 24th, 1928.

The eve of the 49th anniversary of Edison's invention of the incandescent lamp, October 20th, 1928, the Congressional Gold Medal was presented to him in his laboratory at West Orange, N. J. In attendance were representatives of the United States Government and of the British Sovereign, and leaders in science and the industrial arts. The ceremonies were broadcast throughout the United States.

President Calvin Coolidge delivered a radio address from the White House.

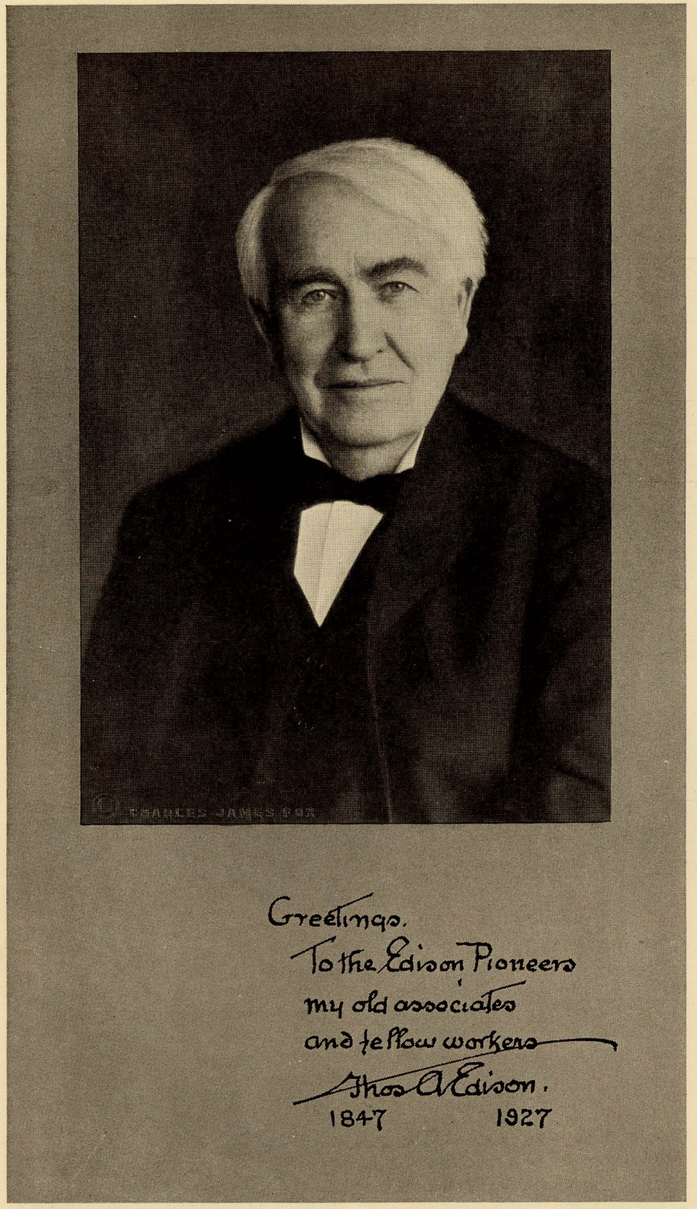
Edison's response, in accepting the medal, was typical of the modesty which characterized his life. He said: "Mr. President, Mr. Secretary and Honored Guests: In accepting the medal which has been awarded to me, I do so with a keen appreciation of the great honor that has been conferred upon me. To my mind there is a profound significance in this token of the esteem and good-will of my fellow countrymen as expressed by their representatives in Congress. This medal will be a source of pride and veneration to my family as well as to myself, and will be preserved in my home with my choicest possessions. Thank you."

On October 26th, 1928, there was a notable gathering of 2,000 people to honor Edison. Addressing the assemblage, Dr. Nicholas Murray Butler, President of Columbia University, said of him: "Native of Ohio, successively newsboy, telegrapher, manifold inventor, whose name has now become sometimes a figure of speech and sometimes an adjective, known the world 'round; whose inventions are too numerous to mention and too important to be underestimated by anyone; whose genial and kindly philosophy of life is a fortunate ornament of America!"

1929

The 50th anniversary of the invention of the incandescent lamp was seized by the world as an opportunity to pay homage to Edison. Never in previous history had so many nations joined to do honor to any man. President Herbert Hoover acted as honorary chairman of the committee sponsoring "Light's Golden Jubilee," as a personal tribute to the genius of a great national benefactor.

At the 52nd convention of the National Electric Light Association, at



Atlantic City, Thursday, June 6th, was celebrated as Edison Day. The convention adopted a resolution which concluded: "And, be it further RESOLVED that the National Electric Light Association express to Mr. EDISON its hearty congratulations and felicitations on this memorable occasion, rejoicing that it can pay him this homage and do him honor while he is still in our midst, with his gracious help-mate ever at his side, and while he is still actively living his full life, so replete with accomplishments, enriched with rewards and enjoying the love and esteem of mankind, all of which constitutes a marvelous contribution to the happiness, convenience and comfort of civilization, in which we are privileged to share. And in this Golden Jubilee celebration we join all the world in heralding the genius and great accomplishments of THOMAS ALVA EDISON."

Ceremonies attending the dedication of the Edison School of Technology and the Ford Museum of Industrial Development, which enshrines Edisonia, and to which Edison's Menlo Park laboratory and workshop have been moved, supplied a climax to the celebration of "Light's Golden Jubilee." This was at Dearborn, Mich., October 21st.

Edison was the guest of honor of Henry Ford, whose admiration and friendship with Edison prompted him to establish these institutions. Among other guests were members of the Edison Pioneers, through whose co-operation much of the Edisonia was provided for the Museum. President Herbert Hoover journeyed to Dearborn to participate in the ceremonies.

Through broadcasting arrangements, the people of the United States and many countries across the oceans, attended the ceremonies.

In many cities, local celebrations were held in honor of "Light's Golden Jubilee." In Cleveland, was dedicated the Moonlighting of the Cleveland Museum of Art, as a permanent memorial in light, commemorating Edison's great achievement.

Association's Message

As president of the Association of Edison Illuminating Companies, Edwin Gruhl sent the following telegram of condolence to Mrs. Edison:

"The saddest and most difficult task which I shall ever have as president of the Association of Edison Illuminating Companies is to endeavor to tell you of the grief and the personal sense of loss which the passing of Mr. Edison has brought to every member of the Association.

"Mr. Edison's personal interest in the Association, whose members represent the electric companies operating under his original licenses, has been an incentive from the earliest days, and we have counted his membership a distinguished honor.

"Many of us were privileged to be his old friends and proteges and pupils, in the great industry which he founded, and to which he gave his genius for the benefit of mankind.

"We join with a grateful people the world over in offering sympathetic thoughts to you and your family. Our deep respect and reverent affection will remain as our memorial to him."

Edison As a Philosopher

"My philosophy of life: Work. Bringing out the secrets of Nature and applying them for the happiness of man. Looking on the bright side of everything."

"Music should be established upon so scientific a basis that anyone who can play at all can play a piece in precisely the time that the composer intended it should be played."

"I am not an individual—I am an aggregate of cells as, for instance, New York City is an aggregate of individuals."

"Everything comes to him who hustles while he waits."

"We don't know one millionth of one per cent about anything! . . . . We are just emerging from the chimpanzee state mentally."

"Reason, Justice and Equity never had weight enough on the face of the earth to govern the councils of men."

"I am working on the theory that our present personality exists after what we call life leaves our present material bodies."

"Genius is one per cent inspiration and ninety-nine per cent perspiration."

"There is no substitute for hard work."

"Let a young man get a job and work so hard at it that he has no time to fall into temptation."

"Education in the United States is more effective through motion pictures than any other medium."

"I am long on ideas, but short on time."

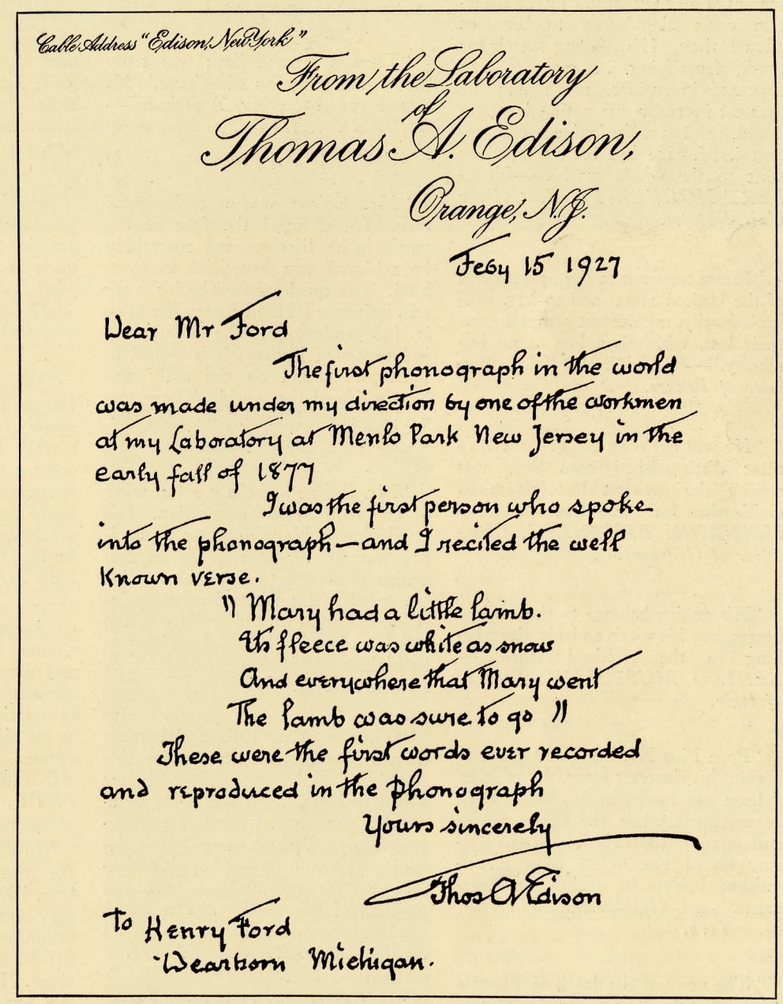
"The capacity of the human brain is tremendous, but people put it to no use. They live sedentary mental lives."

"There is no expedient to which a man will not go to avoid the real labor of thinking."

"Human slavery will not have been fully abolished until every task now accomplished by human hands is turned out by some machine."

"I believe Civilization is advancing."

"The Electrical Age is just starting."


Cable Address "Edison, New York"

From the Laboratory of Thomas A. Edison,
Orange, N.J.
Feby 15 1927

Dear Mr Ford

The first phonograph in the world was made under my direction by one of the workmen at my Laboratory at Menlo Park New Jersey in the early fall of 1877

I was the first person who spoke into the phonograph—and I recited the well known verse.

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

These were the first words ever recorded and reproduced in the phonograph

Yours sincerely

Thos A Edison

To Henry Ford
Dearborn Michigan.

Vertical handwriting developed by Edison for speed and legibility

Tributes to Edison

FROM people throughout the world, announcement of the death of Thomas Alva Edison evoked words of sympathy for his wife and family, and expressions of high tribute to his character, his genius and his achievements. Some of these we quote in part:

"It is given to few men of any age, nation or calling to become benefactors of all humanity. That distinction came abundantly to Thomas Alva Edison. His lifelong search for truth, fructifying in more than a thousand inventions, made him the greatest inventor our nation has produced, and revolutionized civilization itself. He has been a precious asset to the whole world."—*HERBERT HOOVER, President of the United States.*

"Please transmit to the government of the United States and to Mr. Edison's family, my deepest sympathy for their loss, which is a loss to all humanity."—*PIERRE LAVAL, Premier of France.*

"He was not only one of America's most distinguished sons, but was among the greatest benefactors of civilization for the entire world."—*HEINRICH BRUENING, Chancellor of Germany.*

"His genius belongs to the United States, but his work and his glory belong to the civilized world."—*BENITO MUSSOLINI, Premier of Italy.*

"Pope Pius XI, has directed me to present his sincerest sympathy to Mrs. Edison and family in this hour of sad bereavement while the entire world suffers an irreparable loss in the passing on of one of its most distinguished leaders in scientific achievement."—*CARDINAL HAYES, New York.*

"The news of the death of Thomas Alva Edison will be received with profound sorrow all over the world. His life is a great example of what can be accomplished by genius combined with indomitable courage and purpose. He was not only a great genius, but a true man and a noble-hearted American. He will be remembered for the sincerity and uprightness of his character and for his unfailing kindliness of spirit, as well as for his astonishing scientific achievements and his great contributions to human welfare."—*BISHOP WILLIAM T. MANNING, New York.*

"Thomas Alva Edison was truly the 'grand old man of science.' He was loved by every American."—*GEORGE WHITE, Governor of Ohio.*

"Mr. Edison was a truly great man. He changed the face of the world in his lifetime, and everything he achieved was beneficial to mankind. The epoch created by his work will influence all the future. His fame is independent of the fluctuating judgments of history; it is etched in light and sound on the daily and hourly life of the world. There was only one Edison."—*HENRY FORD.*

"Mr. Edison had the greatest mind of any man in our generation. His unselfishness, his willingness to sacrifice himself for others, his natural genius combined to drive him on at top speed in his determination to increase the comfort and welfare of the people and to lift human happiness to its highest standard."—*HARVEY S. FIRESTONE.*

"Thomas Alva Edison did more than any other man to make this world an easier, pleasanter, better world to live in. In him were combined a phenomenal mind, a tremendous energy, and, even up to his declining years, an almost boyish enthusiasm for the successful solving of the problem of the moment. The world has lost one of its greatest men of all time."—*GEORGE EASTMAN.*

"In Edison, one of the great technical inventors to whom we owe the possibility of alleviation and embellishment of our outward life, has departed from us. An inventive spirit has filled his own life and all our existence with bright light. Thankfully we accept his legacy, not only as a gift of his genius, but also as a mission placed in our hands. For to the new generation falls the task of finding the way for the right use of the gift given to us."—*DR. ALBERT EINSTEIN, German scientist.*

"Edison, through his discovery of how to preserve the spoken word, made man and himself immortal. What greater is possible in practical achievement?"—*ROBERT A. MILLIKAN, physicist.*

"His inventive genius and passionate love of science contributed so greatly to the marvelous progress made in the field of research and applied science." — *GUGLIELMO MARCONI, inventor of wireless telegraphy.*

"With the passing of Thomas Alva Edison, humanity has lost its greatest single benefactor. Were all the world's light and power cut off tonight a single hour in reverent commemoration of its debt to Edison, we might perhaps glimpse some faint appreciation of the immeasurable debt we owe to that glorious immortal."—*LEE DE FOREST, inventor.*

"Edison was a member of the Council of National Defense during and after the World War, and his services to the Navy Department and to aviation then were as outstanding as his aid to all humanity during the greater part of his life."—*REAR ADMIRAL WILLIAM A. MOFFETT, Chief of Naval Aeronautics.*

"In Edison the world loses one of the greatest technical geniuses who ever lived. Though Edison himself very often equated genius with application, we know that his successes cannot be accounted for by application alone. In Edison intuitive thought and exact weighing of all technical and economic problems were united

MOONLIGHTING on the Cleveland Museum of Art, a memorial to Thomas Alva Edison. Tablets on the bronze lighting standards read: "In commemoration of the invention of the incandescent lamp by Thomas Alva Edison—October 21, 1879—Erected by The Cleveland Electric Illuminating Company October 21, 1929"

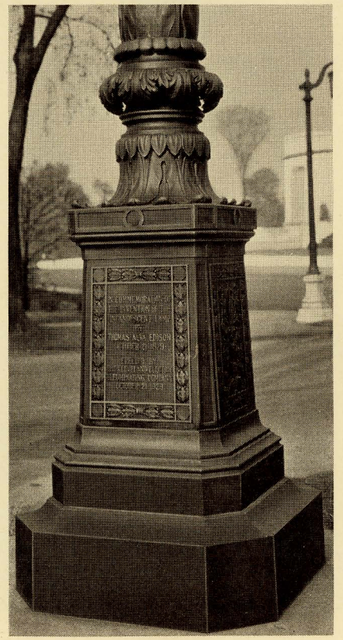
with unparalleled perseverance in pursuit of his problems to such a degree that thereby he became for us the archtype of inventor."—*PROFESSOR AUGUST CAROLUS, of the Physics Institute of Leipzig University.*

"'Be courageous, go forward,' was the last public utterance of Thomas Alva Edison. These words were spoken to a tried and troubled world on June 11, last, and have helped to restore faith to the hearts of men throughout the land."—*W. ALTON JONES, President, the National Electric Light Association.*

"His encouragement of youth has been a tremendous stimulation not only to his own generation but to many generations to come."—*GERARD M. SWOPE, President, the General Electric Company.*

"Edison's wonderful inventions have increased geographical knowledge and revolutionized conditions under which we live as much as did Columbus's discovery of the New World."—*DR. GILBERT GROSVENOR, President, the National Geographic Society.*

"Thomas Alva Edison was one man whose contemporaries called him great. The scientific world and the world at large heaped honors upon him. He was the last of the great pioneers in electrical development who made the present advancement of the art possible."—*ANDREW W. ROBERTSON, Chairman of the Board, Westinghouse Electric and Manufacturing Company.*



"In the death of Mr. Edison we have lost a great man and a great mind. His work and his genius have made an impression upon humanity that will be indelible for all time. The fruits of his inventive faculty will continue to enrich the world for many years to come."—*MATTHEW WOLL, Vice President, American Federation of Labor.*

"Without Edison's genius, how different our lives might be today, and we in Great Britain join in doing homage to one of the great pioneers of electrical science and electrical industry."—*BRIG. GEN. SIR HAROLD HARTLEY, President, chemistry section, British Association for the Advancement of Science.*

"Mr. Edison became a great man by virtue of three moral qualities—indomitable courage, keen intelligence and the will to serve."—*DR. HENRY VAN DYKE, author and diplomat.*

To Thomas Alva Edison

We hail the day which claims the birth
Of one who soared to heights sublime,
Who served the world with steadfast zeal,
Whose name will conquer endless time.

A pioneer through four-score years,
He blazed the trail o'er trackless ways;
Forgetting self,—for others wrought,
And gained earth's everlasting praise.

A mind which sounded depths unknown,
Bid science yield its secrets rare;—
No heights too great to daunt its search,
No goal but found its master there.

A heart whose every sturdy throb
Responded to some noble theme;
Achieved success while others failed;
Made real the product of his dream.

A life from selfish passion free,
Devoted to his brothers' needs;—
The world his sphere of action bound,
While all acclaim his worthy deeds.

—Ed. S. Mansfield

HIS was Thomas Alva Edison's final message to the electrical industry which he founded. This message he sent to the fifty-fourth annual convention of the National Electric Light Association, at Atlantic City, in June, 1931.

My message to you is, be courageous. I have lived a long time. I have seen history repeat itself again and again. I have seen many depressions in business. Always America has come out stronger and more prosperous. Be as brave as your fathers before you. Have faith. Go forward.

THOMAS A. EDISON