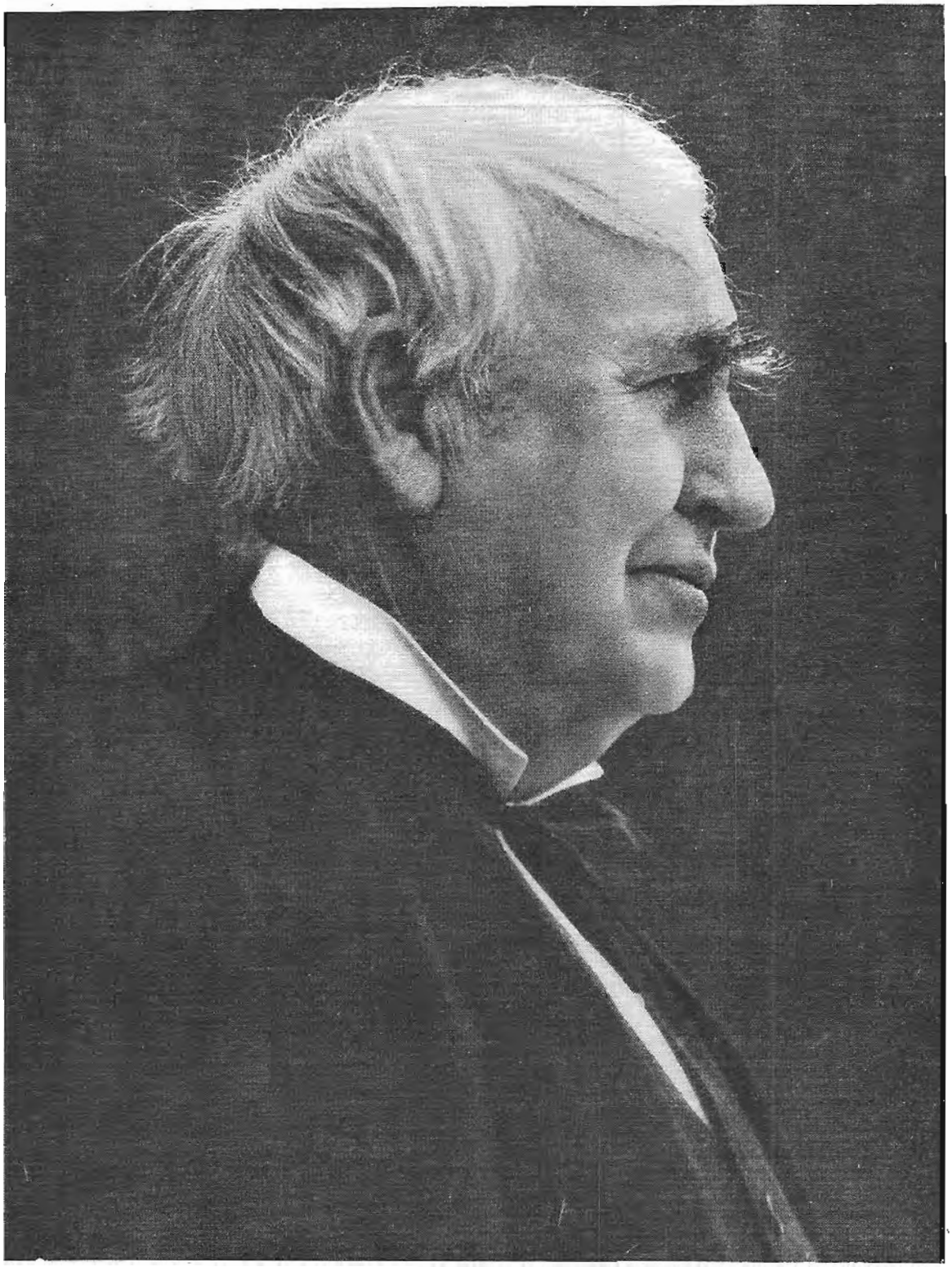


PHOTOGRAPH BY JOHN S. GARABRANT

Thomas Alva Edison

The "Grand Old Man" of the electrical industry whose surpassing vision and inventive genius have made the whole world forever his debtor

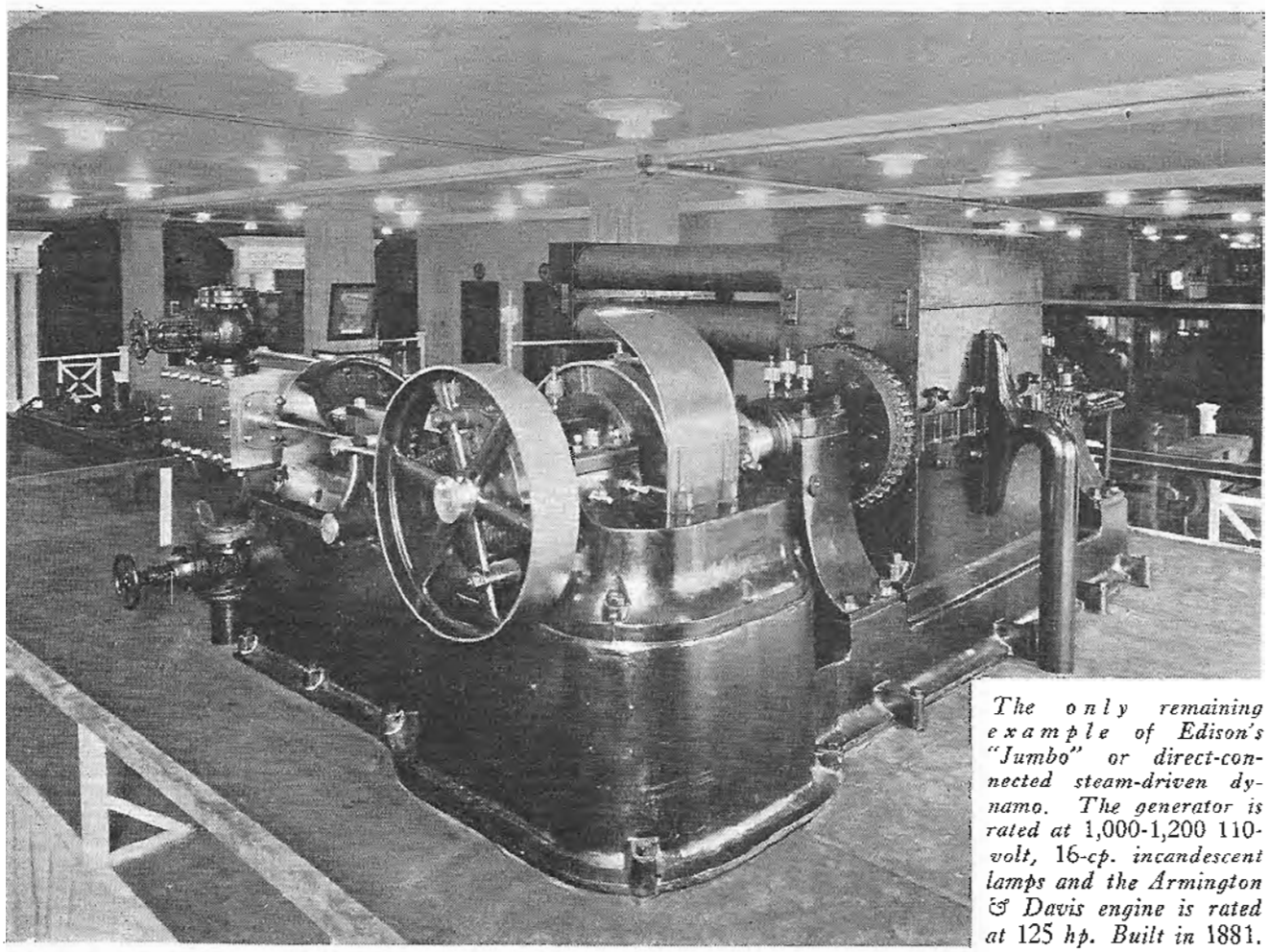
The Edison of 1879

Retrospective glance at the days when the invention that was to revolutionize the material world was being slowly brought to perfection at Menlo Park

By Francis Jehl
Edison Pioneer

REMINISCENCES of the surviving pioneers of electric lighting have much of the fascination of a romance by Jules Verne, for Edison's conceptions seemed superimaginative at first. When they turned out true and practical it was to the embarrassing astonishment of scholastic men who thought that they alone had the knowledge necessary to solve the difficult scientific problems of those days. Edison's genius and manner of research work created a new epoch, the Edisonian age. The history of modern electric lighting and distribution dates from 1878, when he formulated the essential requirements for an electric central station. His ideas were met with incredulity. Sylvanus P. Thompson was speaking for many scientists besides himself when he asked: "When we spend heat and motive power to produce our electric currents (and know of no cheaper way of producing them) do you imagine that we shall get out of our electricity more heat or motive power than we put into it?"

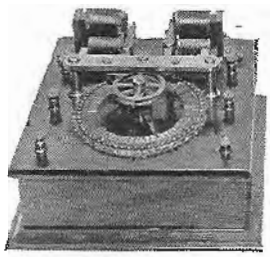
There was one man who knew better, and he was the self-tutored electrician Thomas A. Edison, who had studied in the hard-boiled "university of life" and who with his indomitable will and spirit had pledged himself to solve the great problem that a host of investigators before him had failed to solve. At Menlo Park he began a methodical study first of the rare and high fusible metals, and in many arduous weeks of day and night toil he succeeded in producing a metal lamp that was more durable and gave more intensity in light than had ever been produced before. However, Edison was con-



The only remaining example of Edison's "Jumbo" or direct-connected steam-driven dynamo. The generator is rated at 1,000-1,200 110-*volt,* 16-*cp. incandescent lamps and the Armington & Davis engine is rated at* 125 *hp. Built in* 1881.

vinced that with the metals then at his command he could not make a practical lamp. It was in the early part of 1879 that he exhibited the results of his researches on platinum and iridium lamps for the benefit of his financial backers. In his machine shop he installed six or eight such lamps supplied with current from a Gramme dynamo machine.

His work on platinum and iridium was productive of a great discovery, for he found that metals as well as other substances were packed with gases. If such a metal



Edison Automatic Voltage Regulator. The Relays Operate Pawls and Ratchet Wheels, Cutting Resistance In and Out of the Shunt Field

or other substance be placed in a vacuum and then be subjected to the action of an electric current, the heat expels the gases, which in turn create air washings that are with the gases doubly detrimental to the hot conductor. Edison found that the occluded gases could all be driven out by an intermittent process of heating and evacuating. This discovery was one of the things that led to the creation of his incandescent carbon-filament lamp of high resistance.

Experimenting with Carbon

When Edison began to take up carbon again as the material from which he intended to construct a practical lamp he found that in order to conduct his experiments properly he would need an artificer who could manipulate glass. One was engaged, Sprengel and Geissler vacuum pumps were made, and Edison began again his experiments in electric light, which were all conducted on the upper floor of the laboratory. There the inventor could be seen day and night working with three or four assistants. The work was generally carried on at the sink and in front of a long, low wooden case that contained the battery salts and other dry chemicals, its top being used as a table. Here hundreds of hydrocarbon compounds were mixed and made into putty of various grades and then rolled out into threads between two small flat boards. Edison himself would take them downstairs and carbonize them in furnaces procured for that special purpose, trusting no person but himself to carry out this work.

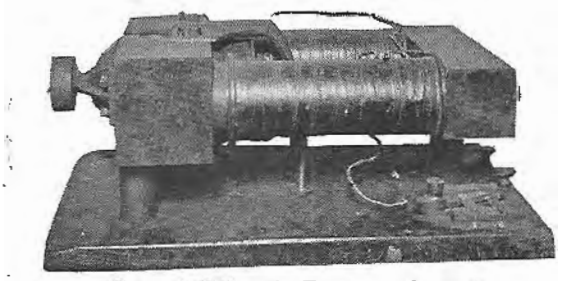
The first carbon filament that Edison made broke when it was attempted to connect it to the leading-in wires. The first few trials were made by forcing the ends of the platinum leading-in wires of the glass stem into tiny carbon cups and by inserting the carbon filament in the cavity, which was then plugged up with powdered carbon or paste. The first lamp finished in this manner was evacuated on a Sprengel pump after having been treated for about eight hours in order to expel all the occluded gases. This lamp had a short life, and it was noticed that a sort of sparking occurred sometimes at the legs of the filament, due to bad contact. In addition to Edison and the young man who operated the vacuum pump, there were only two other assistants present to witness the first carbon-filament lamp experiment in 1879. After Edison had tried several lamps constructed in this manner he made some that had a spiral-formed filament and carbonized them together with small pieces of platinum wires that were held at the ends of their legs by binding them with a carbon paste. These spiral filaments were then connected to the leading-in wires by means of small brass connection pieces that held both the leading-in wires as well as the short platinum ones connected to the filament by the carbonized paste joints.

Early Lamps Burn Twenty Hours

Some of these lamps, which all had a high resistance and small radiating surface, had a life of more than twenty hours. It is a pity that none of them was ever preserved. After they gave out they were broken up and the platinum was retrieved. Edison then tried numerous other experiments with all manner of materials, even using human hair taken from the red whiskers of a visitor. He tried all kinds of vegetable fibers, papers and threads, many of his experiments giving promising results. It was while using different kinds of silk and cotton threads that the thought struck him that perhaps the Clark thread mills at Newark might furnish him with a special brand that would give better results. This was in October, 1879, and a few days afterward he procured a package from the Clark mills containing a pound of white thread. New experiments were carried out, and about the middle of October Edison was satisfied that he had reached a point at which his carbon filaments could be considered stable and that the practical and commercial incandescent lamp was born. Not long after he made his successful Bristol cardboard lamps and used platinum clamps for holding the filament. He gave his famous public demonstration in December, 1879, during which some of the dwellings at Menlo Park were lighted up, receiving their current from the machine shop by means of overhead wires.

Regenerating the Dynamo

During the period that Edison was conducting his epoch-making researches in connection with the incandescent lamp he also regenerated the art of dynamo construction. He knew that the Franklin Institute had tested some of the well-known dynamos of that period



One of Edison's Earliest 100-Volt Shunt-Wound Motors

and had found that the best of them all had given an efficiency of only 40 per cent. He was well aware that with such a loss in the conversion of power his conceptions regarding the commercial distribution of electricity might prove impracticable. He procured the two dynamos that offered the lowest and highest results and made a thorough examination and study of them and was not long in discovering their principal defects and where most of the power was wasted.

He then, with his mathematician, laid out a series of long and exhaustive experiments in order to determine certain electrical and magnetic data that had never before been investigated. It must not be forgotten that at this period electricity was in its infancy and that what was done with it in a practical way was effected mainly by practical men. It is true that there were many long and conflicting methematical treatises on the subject that were hardly understood by the writers themselves, but the sublime law of George Simon Ohm was not appreciated and little was understood regarding its application to electric lighting. Even the Foucault experiment that was demonstrated in almost every college was hardly ever noticed by the dynamo constructors and their scientific advisers in those days, and numerous documentary evidences plainly verify the lack of scientific judgment employed in the construction of most of the dynamos prior to Edison's machine.

Many of those early machines had only solid-iron cores in their rotating parts, and even as late as 1881 one well-known designer constructed his drum armature with a hollow cast-iron piece through which, by means of a hole bored into the shaft, he led water for cooling purposes. The detrimental effect of bad magnetic contact, insufficient cross-section and injudicious winding of the armature, as well as the field magnets, was not even noticed, and thus Edison found it necessary to probe into unwritten laws and obtain by experiment the facts upon which he built his dynamo machine, which when finished gave an efficiency of 90 per cent against 40 per cent.

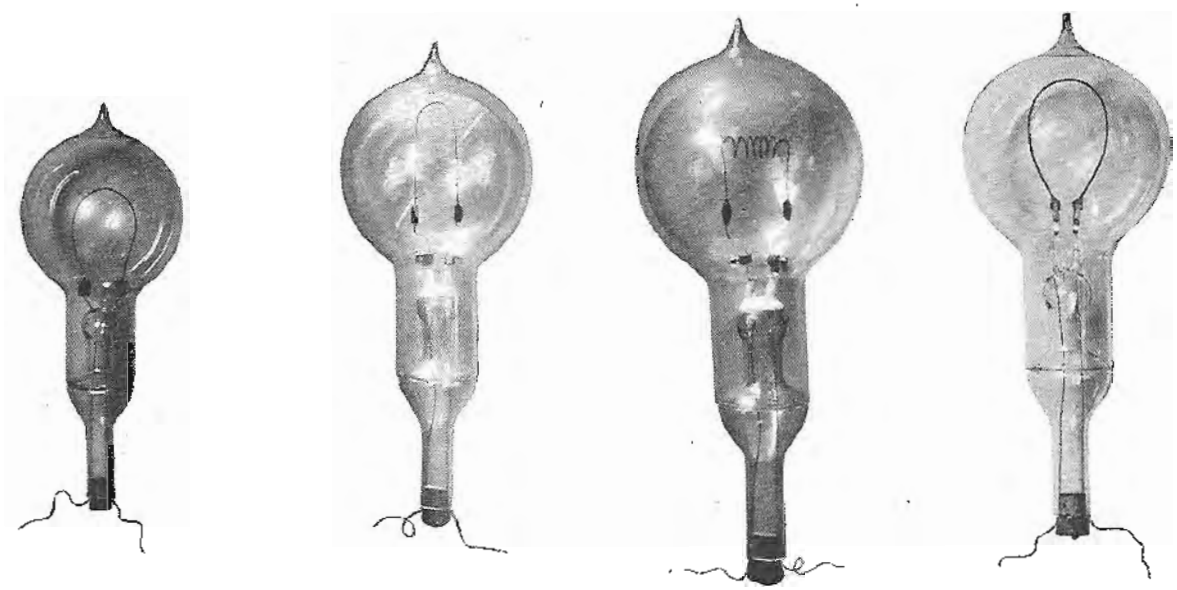
The great importance of this achievement can never be overestimated, for it established salient principles that later on furnished many theorists with ample material and data from which they filled the books and journals of those days. The same may be said concerning the method of ratio which Edison's common sense dictated when he wound his armature with a resistance as low as it was possible to obtain and that was compatible with the generation of pressure. Here, too, scientists began to decry Edison, accusing him of understanding nothing of electrical laws; but he had outwitted them all by discovering primary facts that could never have been attained by slinging Bessel's functions about. Edison never worked with suppositions; he always dug down to the rock bottom and there built his foundations.

In 1879 Edison's foresight also devised that simple and ingenious appliance known as the safety fuse, which is still in use in every part of the world where electricity is generated. No other device has yet been able to supplant that safeguard of life and property and canonized pet of the underwriters. In the same year he constructed his first electrolytic meter, containing the essentials of the one that was used by the Edison companies for over a decade before the efforts of others could replace it by a reliable electromechanical one.

Edison Had No Prompter

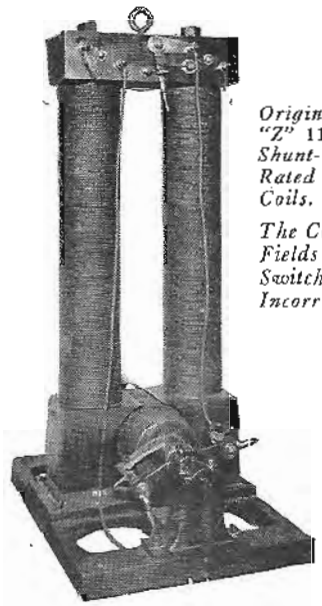
In summing up what Edison did when he created a system of electric lighting, one might simply quote what Preece said in reference to the Edison exhibit in Paris in 1881: "Nothing seems to have been forgotten, no detail missed." Many entertain the most erroneous impression that Edison was surrounded at the time when he invented the incandescent lamp and the high-efficiency dynamo by a large staff of well-drilled assistants and that some of them played the rôle of prompter. In the gigantic problems before him he naturally required help—help similar to that which the architect needs when he has finished the plans of his building and begins its erection. Who built the building—the architect or the men who piled the material according to his plans?

When Edison conducted those epoch-making researches which revolutionized the world he had six laboratory assistants who carried out the experiments under his direction and supervision. Each of these men had a laboratory notebook in which he noted the progress of the work to which he was assigned. When contrivances or apparatus were needed in the course of experimenting, they were made and furnished by the men of the machine shop, among whom were some clever mechanicians, who carried out their orders under the control of the master mechanician, one of the six above-mentioned assistants. The men at the laboratory were paid a fixed salary; in



The Hydrocarbon Paste, Vegetable Fiber, Spiral Thread and Famous Paper or Cardboard Filament Incandescent Lamps of Edison

the machine shop overtime was paid. Edison had, besides, two men who worked upon other things, principally testing the grade of ore from California. Toward the end of 1879 some men were engaged to familiarize themselves with the Edison motograph telephone before they were sent to England to introduce it there. At the office there were four men and a draftsman who attended to



Original Edison "Z" 110-Volt Bi-Polar Shunt-Wound Dynamo Rated at 16-Cp. Lamp Coils.

The Cord Winding on the Fields Is Modern and the Switch Contacts Are Incorrect.

the business transactions and the making of the patent drawings. Such was the small group that aided the great master in his work of 1879 with all the enthusiasm and devotion possible. From him alone came the initiative and impulse.*

Edison's Famous Graduates

The Edison laboratories at Newark and Menlo Park, together with the first office of the Edison Electric Light Company at 65 Fifth Avenue, New York, and the Edison Machine Works at Goerck Street in the same city, were not only the starting place but the Alma Mater of many successful Edison pioneers. When the great master sent them out into the world the knowledge that he had imparted to them was the baton that they carried in their knapsacks. They all did their tasks to the best of their abilities, some being more and others less endowed with those intensive traits that characterize the "live-wire" man. A few have attained extraordinary prominence as directors of the largest electrical concerns of the world; some are still and others have been the prime movers in their profession—the field marshals of applied electricity.

Taken collectively, these young pioneers were men of great potentialties, talented, super-energetic and endowed with intellectual powers that enabled them to progress rapidly to positions of eminence where they became the guardians of enormous capital investments. They possessed the same qualities of initiative that characterize all leaders and were broad-minded, far-visioned and ever ready in emergencies, while at the same time they became master experts in all the phases of administration as well as of operation. As organizers they became in the economic world revolutionists of the first order and have built up temples of production the magnitude and utility of which are far beyond any dreams they themselves ever had when they first entered the ranks as soldiers in the Edisonian army.

The healthy, vigorous and progressive mentality of these men of the old Edison corps needs no further comment. Their names suffice. They have all been self-made men who have reaped the legitimate reward of their supernormal qualifications. A list of seven men who from Edison's workshop rose to high places in the industrial engineering world comprises:

SIGMUND BERGMANN
President Bergmann Electrical Works, Berlin.

SIGMUND SCHUCKERT
of the Siemens-Schuckert Works, Berlin, Vienna and Budapest.

LOUIS RAU
of the French Edison Company, Paris.

EMIL RATHENAU
of the German Edison Company, now the Allgemeine Elektricitäts-Gesellschaft, Berlin.

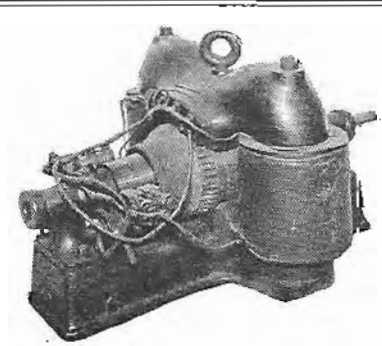
JOHN W. LIEB
Vice-President New York Edison Company.

SAMUEL INSULL
President Commonwealth Edison Company, Chicago.

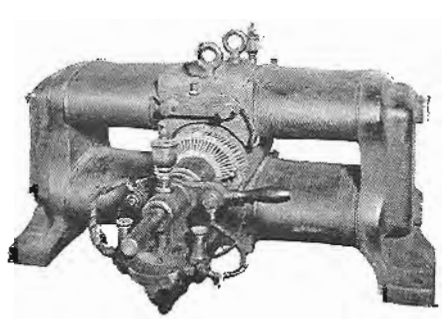
CHARLES L. EDGAR
President Edison Illuminating Company of Boston.

Schuckert, Rau and Rathenau are dead. Sigmund Bergmann and the three Americans still live, and each of them has been constantly "on the same job" ever since applied electricity obtained its footing. Today they are more active than ever. Thousands upon thousands depend upon their guidance, and their productive work has contributed tremendously to the welfare of the public.

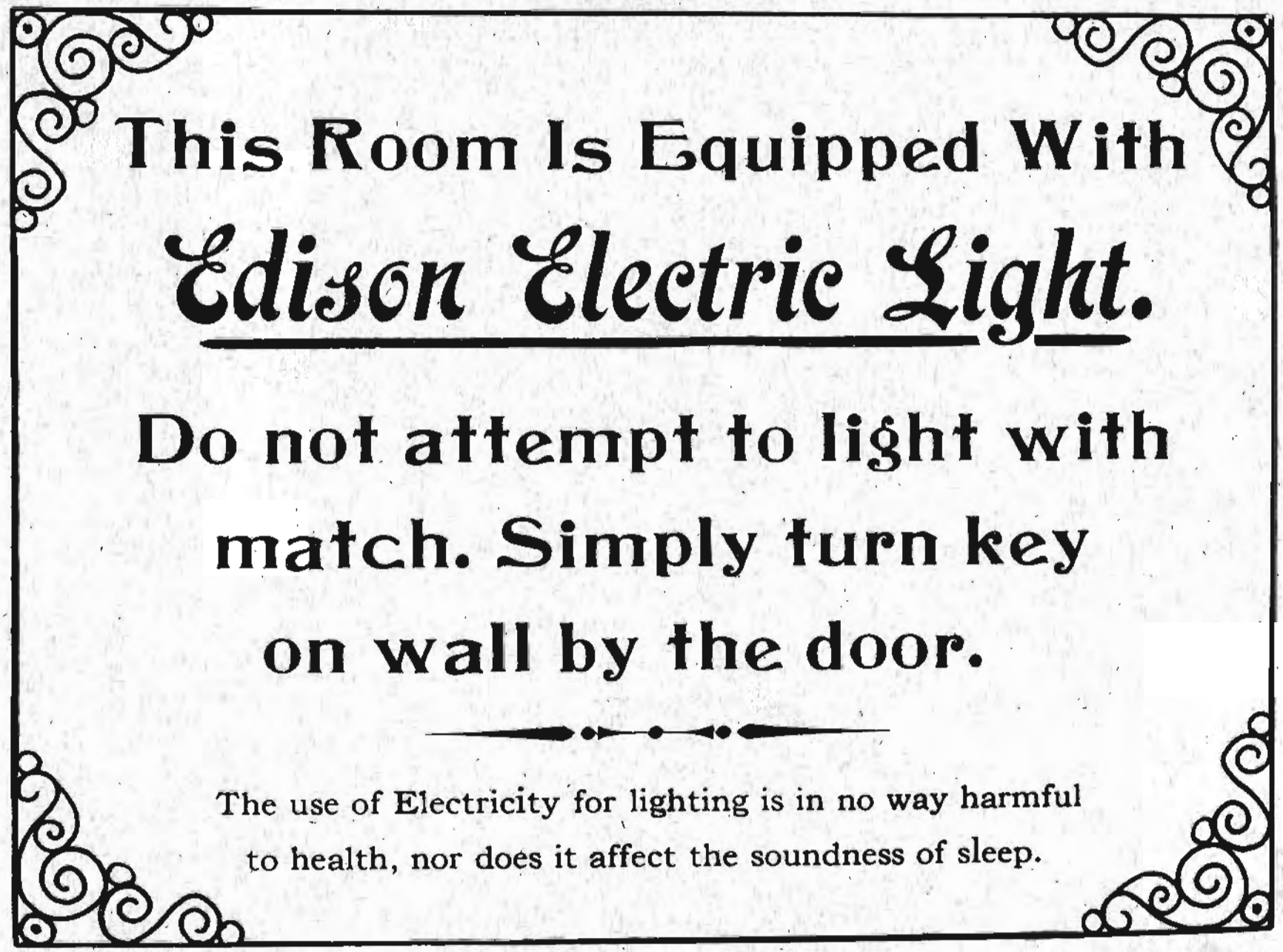
*Recently the writer spoke with a gentleman who was commissioned by the United States government to study the organization of the Edison industries at West Orange, N. J. He relates that when he spoke to Edison upon the subject, the latter inquired "What organization? I am the organization." That's the same Edison of 1879.



Original "Sprague" 5-Hp., 220-Volt Compound-Wound Direct-Current Motor



"Weston" 5-Kw., 110-Volt Direct-Current Shunt-Wound Dynamo of 1885



Reproduction of a 19th century sign distributed by Edison Electric Light Co.