IMPRESSIONS OF AMERICAN INVENTORS.—I.
THOMAS A. EDISON.

As an inventor, Edison's chief characteristic is his pertinacity. "Genius is two per cent inspiration and ninety-eight per cent perspiration," is an epigram of his, which has been worn threadbare by much newspaper use, but which contains the whole story of his intensely active career. Edison is a utilitarian to his finger tips. He never yet invented a machine that could not be employed in everyday life. Long ago he made a brief excursion into the field of aerial navigation, and although his experiments were full of promise, he abandoned the investigation, largely because there was no immediate prospect of applying the flying machine to the needs of this world. Even his conversation is that of a man whose interests are essentially practical. He would never ramble off, for example, into a metaphysical discussion on man's place in the universe. He is a glorified Yankee inventor, a mechanic of real genius who, by dint of rare patience and indomitable energy, has raised himself to an enviable position among the most distinguished scientists of his time. Despite the exceedingly practical bent of his faculties, he is a man of large ideas with a wonderful gift of what may be termed scientific penetration. Few engineers and physicists can grasp with anything like his swiftness of perception the meaning of simple phenomena, often accidental in their origin. The phonograph, for example, which, although not his greatest invention, is probably the most marvelous in the eyes of the public, was suggested by experiments made with the telephone and automatic recording telegraph. He was working on a machine provided with a disk of paper, similar to the present disk talking machine. On the traveling arm was a magnet which had an embossing point which embossed or indented dots and dashes on the paper, the platen having a grooved volute spiral on its surface. After recording Morse signals a contact point swept over the record, and the indentations gave movement to the make and break and reproduced the signals on another line. When run at high speed, it would give a humming sound. He knew from the telephone about the movements of the diaphragm, and had caused his voice to work a ratchet wheel and toy figure. Then he conceived the idea of indenting by the voice, and reproducing the sound by means of the indentations. The machine was made, but in cylinder form. Then he decided to make a talking machine—with what success every one knows. When the first operative machine was produced, he packed up the instrument and came to the office of the SCIENTIFIC AMERICAN. Without ceremony he placed the machine on the Editor's desk and turned the crank. The machine literally spoke for itself. "Good morning," it said. "How do you do? How do you like the phonograph?" And thus the Editors of the SCIENTIFIC AMERICAN constituted the first public audience that ever listened to the phonograph.

If ever an Edison invention was the product of unflagging pertinacity it was the electric incandescent lamp. Strange to narrate, he began with the metallic filaments, which now threaten to supplant the carbon filament that he finally adopted. He abandoned the metallic filament, not because he failed to see its immense possibilities, but because the proper metals could not be obtained cheaply enough until a few years ago. Indeed, some of them were mere laboratory rarities when he commenced his epoch-making researches. Before he began, he studied everything that had been done before him, so that he could take up the work where his predecessors had ceased. When he finally decided that the filament must be made of carbon, he began a search for the proper raw material which may well be considered a quest for a scientific Holy Grail. Men were dispatched to all quarters of the globe to search for fibers having the requisite properties. One of these scientific crusaders ransacked the Amazon jungles and tasted no meat for a hundred and sixteen days. The eighty varieties of bamboo and three thousand specimens of fibers brought back by these emissaries were tested in Edison's laboratory, and all but three or four rejected. Night after night he and his assistants slept in the laboratory with resistance-boxes for pillows and work benches and tables for beds. Food was passed in to them through the windows. Doggedness such as this was bound to bring success.

The same story could be told of every one of the hundreds of inventions that Edison has patented. The method of procedure (an object lesson to every inventor) is always the same. He invariably begins his investigations by a thorough course of reading, fully conscious that he is not the first in the field and that he must know where others failed. After a thorough review of the subject he begins actual work—an expert, who carefully avoids covering ground which has already been explored and who begins where others abandoned investigation. Experiments are made by the hundred and thousand. Model after model is built. Failure succeeds failure, until further efforts seem hopeless. For all that more experiments are made, and more models built. At last an experiment is conducted or a model constructed that seems faintly encouraging. A less experienced inventor would be elated. Edison, however, regards the favorable result with suspicion. Not until the partial success has been confirmed by many repetitions of the experiment is he convinced that something has been achieved.

THE MONEY VALUE OF EDISON'S INVENTIONS.*

The activities of Mr. Edison have been of such great range, and his conquests in the domains of practical arts so extensive and varied, that it is somewhat difficult to estimate with any satisfactory degree of accuracy the money value of his inventions to the world.

First of all, let us mention the incandescent electric light and systems of distribution of electric light, heat, and power, which may justly be considered as the crowning inventions of Mr. Edison's life. To-day there are in the United States more than 41,000,000 of these lamps, connected to existing central station circuits, in active operation. At the present time there are over 5,000 central stations in this country for the distribution of electric current for light, heat, and power, with capital obligations amounting to not less than $1,000,000,000. Besides the above-named 41,000,000 incandescent lamps connected to their mains, there are about 500,000 arc lamps and 150,000 motors, using 750,000 horse-power, besides countless fan motors and heating and cooking appliances. The gross earnings of these central stations approximate the sum of $225,000,000 yearly.

In addition to central stations there are upward of 100,000 isolated or private plants in mills, factories, steamships, hotels, theaters, etc., owned by the persons or concerns who operate them. These plants represent an approximate investment of $500,000,000, and the connection of not less than 25,000,000 incandescent lamps, or their equivalent.

Then there are the factories where these incandescent lamps are made, about forty in number, representing a total investment that may be approximated at $25,000,000.

The reader will naturally be disposed to ask whether it is intended to claim that Mr. Edison has brought about all this magnificent and wonderful growth of the electric lighting art. The answer to this is decidedly in the negative, for the fact is that he laid the foundation and erected a building thereon, and in the natural progressive order of things other inventors of more or less fame have added a wing here and a story there until the resultant great structure has attained such magnificent proportions as to evoke the wonder and amazement of the beholder; but the old foundation and the fundamental building still remain to support the other parts.

Edison was the first man to devise, construct, and operate from a central station a practicable, life-size electric railroad, which was capable of transporting and did transport passengers and freight at variable speeds over varying grades, and under complete control of the operator. While Mr. Edison's original broad ideas are embodied in present practice, the perfection of the modern electric railway is also greatly due to the labors and inventions of a large number of other well-known inventors.

The statistics of 1908 for American street and elevated railways show that within twenty-five years the electric railway industry has grown to embrace 38,812 miles of track on streets and for elevated railways, operated under the ownership of 1,238 separate companies, whose total capitalization amounts to the enormous sum of $4,123,834,598 in 1908. In the equipments owned by such companies there are included 68,636 electric cars and 17,568 trailers and others, making a total of 86,204 of such vehicles. These cars and equipments earned over $425,000,000 in 1907, in giving the public transportation, at a cost, including transfers, of a little over 3 cents per passenger, for whom a 15-mile ride would be possible. No cheaper transportation is given in the world.

Some mention should also be made of the great electrical works of the country, in which the dynamos, motors, and other varied paraphernalia are made for electric lighting, electric railway and other purposes. The productions of the General Electric Company alone, as shown by average annual sales of over $50,000,000, are of themselves a colossal item, but they do not comprise the total of the country's manufactures in these lines, which amount to five times as much again.

To Alexander Graham Bell is due the broad idea of transmission of speech by means of an electrical circuit. Mr. Edison invented and brought out the carbon transmitter, which is universally acknowledged to have been the needed device that made the telephone a commercial possibility, and has since led to its phenomenally rapid adoption and world-wide use. His inventions may be found in every one of the 7,000,000 telephones employed in the country at the present day. On a conservative estimate at this writing the investment has been not less than $800,000,000 in now existing telephone systems, and no fewer than 10,500,000,000 talks over the lines during the year 1908. These figures relate only to telephone systems, and do not include any details regarding the great manufacturing establishments engaged in the construction of telephone apparatus, of which there is an annual production amounting to at least $15,000,000 per annum.

There is no way in which any definite computation can be made of the value of Mr. Edison's contributions in the art of telegraphy except, perhaps, in the case of his quadruplex telegraph, through which alone it is estimated that there has been saved from $15,000,000 to $20,000,000 in the cost of line construction in this country.

At Orange, N. J., may be found the National Phonograph Company, the Edison Business Phonograph Company, the Edison Phonograph Works, the Edison Manufacturing Company, the Edison Storage Battery Company, and the Bates Manufacturing Company. The importance of these industries will be apparent when it is stated that there are upward of 3,600 people employed, and an annual payroll of about $2,250,000.

There have been upward of 1,310,000 phonographs sold during the last twenty years, with and for which there have been made and sold no less than 97,845,000 records of a musical or other character. Phonographic records are now being manufactured at Orange at the rate of 75,000 a day, the annual sale of phonographs and records being approximately $7,000,000, including business phonographs. The figures given represent only about one-half of the entire business of the country in phonographs, records, cylinders, and supplies.

Taking next his inventions that pertain to "moving pictures," we find that from the inception of the moving-picture business to the present time Edison has made upward of 13,100 projecting machines and many million feet of film carrying small photographs of moving objects. Although the moving-picture business is still in its youth, it calls for the annual production of thousands of machines and many million feet of films in Mr. Edison's shops, having a sale value of not less than $750,000. The annual product of the Edison Manufacturing Company in this line is only a fractional part of the total that is absorbed by the 10,000 or so moving-picture theaters and exhibitions which are in operation in the United States at the present time, and which represent an investment of some $40,000,000. Licensees under Edison patents in this country alone produce upward of 60,000,000 feet of films, containing more than a billion and a half separate photographs.

In making a somewhat radical change of subject, from moving pictures to cement, we find ourselves in a field in which Mr. Edison has made a most decided impression. His corporation in five years has grown to be the fourth largest producer in the United States, with a still increasing capacity. His plant, which occupies 40 acres, represents an approximate investment of $4,000,000 in quarries, railroads, and machinery. The production reaches a grand total of over 5,000,000 barrels of cement up to the present date, having a value of about $4,500,000, exclusive of package. At the time of this writing, the rate of production is over 8,000 barrels of cement per day, or say 2,500,000 barrels per year, having an approximate selling value of a little less than $2,000,000, with prospects of increasing in the near future to a daily output of 10,000 barrels.

Condensing the information above given, we have the following table of Mr. Edison's industrial activity:

STATISTICAL RESUME (APPROXIMATE) OF SOME OF THE INDUSTRIES IN THE UNITED STATES DIRECTLY FOUNDED UPON OR AFFECTED BY INVENTIONS OF THOMAS A. EDISON.

Class of Industry.	Investment.	Annual Gross Revenue or Sales.	Number of Employees.	Annual Pay Rolls.
Central station lighting and power....	$1,000,000,000	$225,000,000	50,000	$40,000,000
Isolated incandescent lighting.....	500,000,000	——	33,000	17,000,000
Incandescent lamps.	25,000,000	20,000,000	14,000	8,000,000
Electric fixtures.....	8,000,000	5,000,000	6,000	3,750,000
Dynamos and motors.	60,000,000	50,000,000	30,000	20,000,000
Electric railways.....	4,000,000,000	430,000,000	250,000	155,000,000
Telephone systems...	800,000,000	175,000,000	140,000	75,000,000
Telephone apparatus.	30,000,000	15,000,000	12,000	5,500,000
Phonograph and moving pictures.. ..	10,000,000	15,000,000	5,000	6,000,000
Moving picture theaters..	40,000,000	80,000,000	75,000	37,000,000
Edison Portland cement.....	4,000,000	2,000,000	530	400,000
Telegraphy.....	[250,000,000	60,000,000	100,000	30,000,000

On the 110,000-volt transmission line running from Grand Rapids to Croton Dam, Mich., triangular steel towers are used, which are placed 528 feet apart. In place of the usual pin insulators, for attaching the wires to the cross arms, a special form of disk insulator is used, consisting of a series of five separate disks of insulating material, which are strung together and suspended from the end of the cross arm. These disks are 10 inches in diameter, and each one is rated to stand 25,000 volts. This system of insulation has proved entirely satisfactory.

* Abstracted from the forthcoming "Life of Edison," by Frank L. Dyer and T. Commerford Martin. Copyright, 1908, by Harper & Bros.

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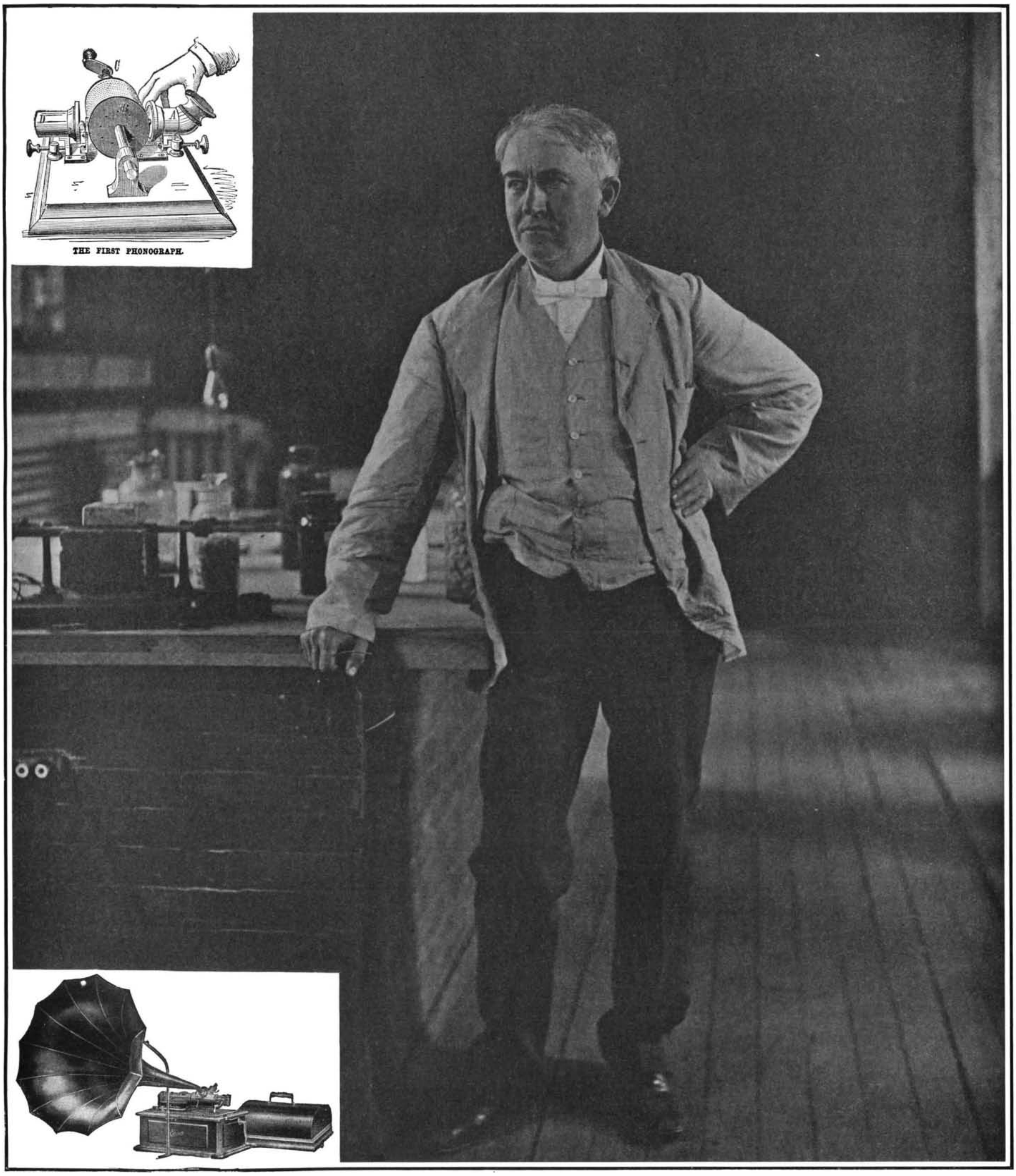

THE FIRST PHONOGRAPH.

The Latest Edison Phonograph.

[See page 171.]

Thomas A. Edison