

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyrighted, 1887, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LVII.—No. 27.
[NEW SERIES.]

NEW YORK, DECEMBER 31, 1887.

[\$3.00 per Year.]

THE NEW PHONOGRAPH.

Ten years ago a young man came into the office of the SCIENTIFIC AMERICAN, and placed before the editors a small, very simple machine about which very few preliminary remarks were offered. Our visitor without any ceremony whatever turned the crank, and to the astonishment of all present the machine said: "Good morning. How do you do? How do you like the phonograph?" The machine thus spoke for itself, and made known the fact that it was the phonograph, an instrument about which much was said and written, although little was known.

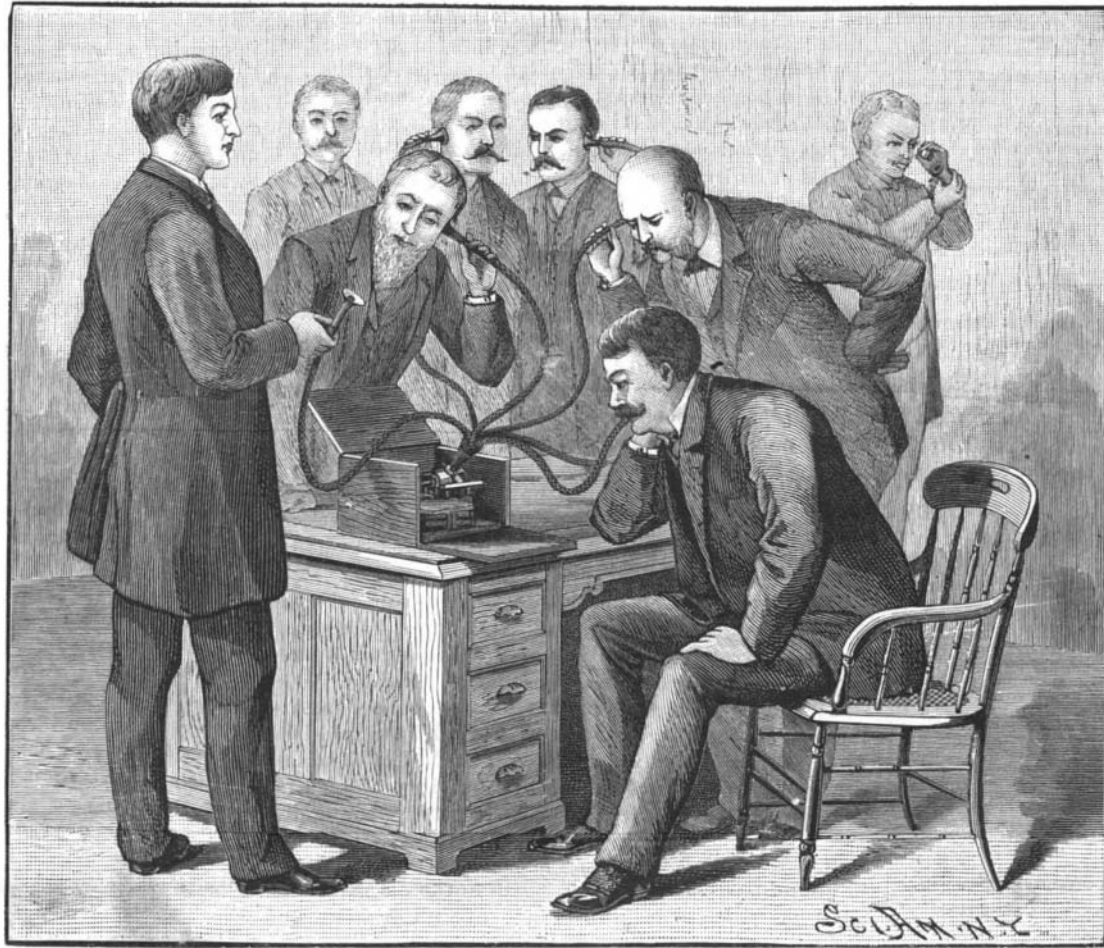
It was the latest invention of Edison, and the editors and employes of the SCIENTIFIC AMERICAN formed the first public audience to which it addressed itself. The young man was Mr. Thomas A. Edison, even then a well known and successful inventor. The invention was novel, original, and apparently destined to find immediate application to hundreds of uses. Every one wanted to hear the wonderful talking machine, and at once a modified form of the original phonograph was brought out and shown everywhere, amusing thousands upon thousands; but it did not by any means fulfill the requirements of the inventor. It was

scarcely more than a scientific curiosity or an amusing toy. Edison, however, recognized the fact that it contained the elements of a successful talking machine,

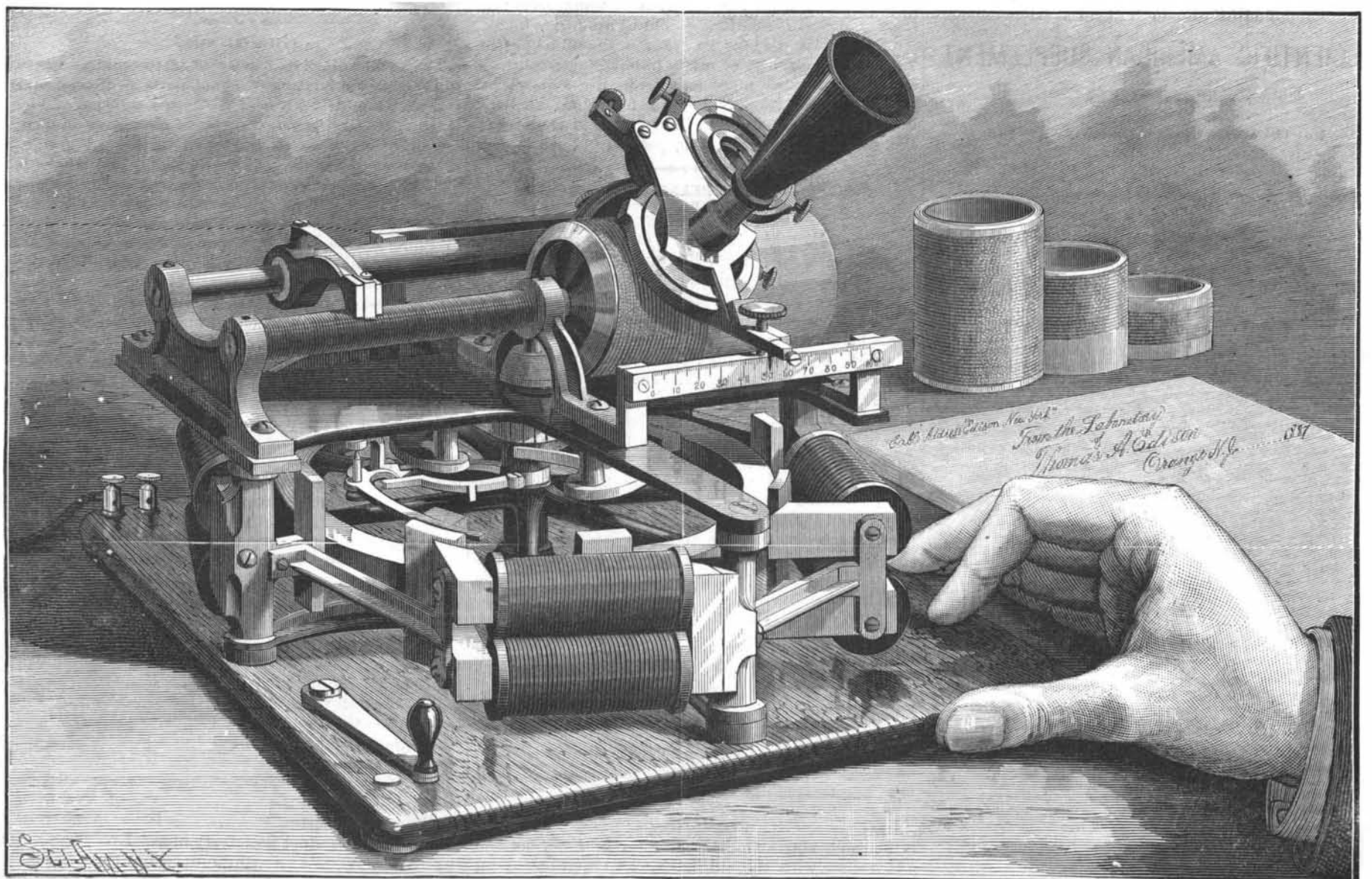
and thoroughly believed it was destined to become far more useful than curious or amusing. He contended that it would be a faithful stenographer, reproducing

not only the words of the speaker, but the quality and inflections of his voice; and that letters instead of being written would be talked. He believed that the words of great statesmen and divines would be handed down to future generations; that the voices of the world's prima donnas would be stored and preserved, so that, long after their decease, their songs could be heard. These and many other things were expected of the phonograph. It was, however, doomed to a period of silence. It remained a toy and nothing more until a few months since, when it was made known to the public that the ideal phonograph had been constructed; that it was unmistakably a good talker; and that the machine which most people believed to have reached its growth had after all been refined and improved until it was capable of faithfully reproducing every word, syllable, vowel, consonant, aspirate, and sounds of every kind.

During the dormancy of the phonograph its inventor secured both world-wide fame and a colossal fortune by means of his electric light and
(Continued on p. 422.)



PHONOGRAPH WITH MULTIPLE EARPIECE.



THE NEW TALKING MACHINE, EDISON'S WONDERFUL PHONOGRAPH.

THE NEW PHONOGRAPH.

(Continued from first page.)

other well known inventions. He has recently devoted much time to the phonograph, and has not only perfected the instrument itself, but has established a factory provided with special tools for its manufacture, in which phonographs are to be turned out in large numbers, with interchangeable parts.

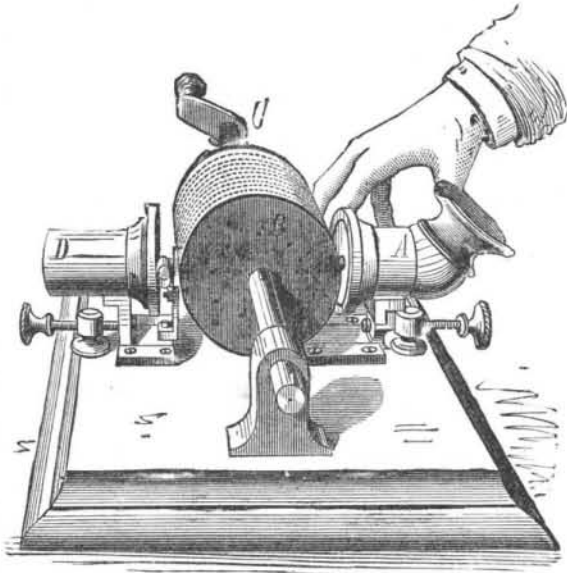
The original instrument above referred to is shown in one of our cuts, which is a reproduction of the engraving published in this journal just ten years ago, in the issue of December 22, 1877. This instrument consists of three principal parts—the mouthpiece, A, into which speech is uttered; the spirally grooved cylinder, B, carrying a sheet of tin foil which receives the record of the movements of the diaphragm in the mouthpiece, A; and a mouthpiece, D, by which the speech recorded on the cylinder is reproduced. In this instrument the shaft of the cylinder, B, is provided with a thread of the same pitch as the spiral on the surface of the cylinder, so that the needle of the receiving mouthpiece is enabled to traverse the surface of the tin foil opposite the groove of the cylinder. By careful adjustment this instrument was made to reproduce familiar words and sentences, so that they would be recognized and understood by the listener; but in general, in the early phonographs, it was necessary that the listener should hear the sounds uttered into the receiving mouthpiece of the phonograph to positively understand the words uttered by the instrument.

In the later instruments, such as were exhibited throughout the country and the world, the same difficulty obtained, and perfection of articulation was sacrificed to volume of sound. This was necessary, as the instruments were exhibited before large audiences, where, it goes without saying, the instrument to be entertaining had to be heard. These instruments had but one mouthpiece and one diaphragm, which answered the double purpose of receiving the sound and of giving it out again. Strangely enough, the recently improved phonograph is more like the original one than any of the others. It is provided with two mouthpieces, one for receiving and one for speaking.

The new phonograph, which forms the subject of the larger illustration, is of about the size of an ordinary sewing machine. In its construction, it is something like a very small engine lathe; the main spindle is threaded between its bearings, and is prolonged at one end to receive the hardened wax cylinder upon which the sound record is made. Behind the spindle and the cylinder is a rod upon which is arranged a slide, having at one end an arm adapted to engage the screw of the spindle, and at the opposite end an arm carrying a pivoted head, provided with two diaphragms, whose positions may be instantly interchanged when desirable. One of these diaphragms is turned into the position of use when it is desired to talk to the phonograph, and when the speech is to be reproduced, the other diaphragm takes its place. The diaphragm which receives the speech and makes the impressions upon the cylinder is shown at 3 in one of the small cuts. The needle by which the impressions are made in the wax is attached to the center of the diaphragm, and pivotally connected to a spring arm attached to the side of the diaphragm cell. The device by which the speech is reproduced is shown in section at 4. The cell contains a delicate diaphragm of gold beater's skin, to the center of which is secured a stud connected with a small curved steel wire, one end of which is attached to the diaphragm cell. The spindle of the phonograph is rotated regularly by an electric motor in the base of the machine, which is driven by a current from one or two cells of battery. The motor is provided with a sensitive governor which causes it to maintain a very uniform speed. Motion is transmitted from the motor to the spindle by beveled friction wheels. The arm which carries the diaphragms is provided with a turning tool for smoothing the wax cylinder preparatory to receiving the sound record.

The first operation in the use of the machine is to bring the turning tool into action and cause it to traverse the cylinder. The turning tool is then thrown out, the carriage bearing the diaphragms is returned to the position of starting, the receiving diaphragm is placed in the position of use, and as the wax cylinder revolves, the diaphragm is vibrated by the sound waves, thus moving the needle so as to cause it to cut into the wax cylinder and produce indentations which correspond to the movements of the diaphragm. After the record is made, the carriage is again returned to the point of starting, the receiving diaphragm is replaced by the speaking diaphragm, and the carriage is again moved forward by the screw, as the cylinder

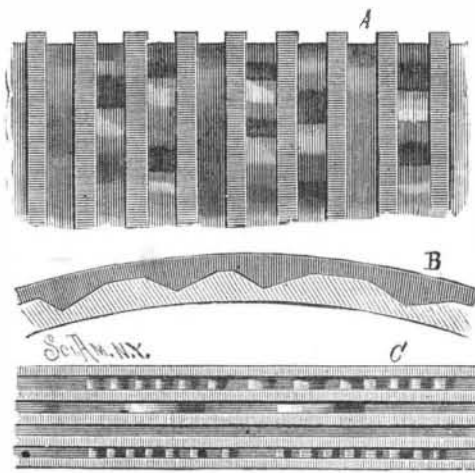
revolves, causing the point of the speaking diaphragm to traverse the path made by the recording needle. As the point of the curved wire attached to the diaphragm follows the indentations of the wax cylinder, the speaking diaphragm is made to vibrate in a manner similar to that of the receiving diaphragm, there-



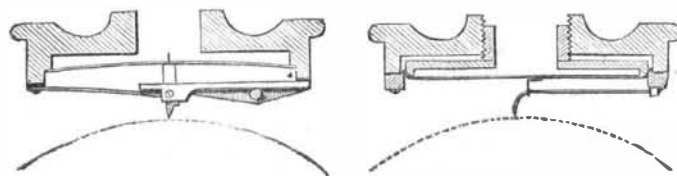
THE FIRST PHONOGRAPH.

by faithfully reproducing the sounds uttered into the receiving mouthpiece.

A crucial test of the capabilities of this machine was recently made in our presence, at Edison's laboratory, near Llewellyn Park, Orange, N. J. A paragraph from the morning newspaper was read to the machine in our absence, and when upon our return to the instrument it was reproduced phonographically, every



PHONOGRAPHIC RECORD MAGNIFIED.



RECEIVING DIAPHRAGM.

SPEAKING DIAPHRAGM.

word was distinctly understood, although the names, localities, and the circumstances mentioned in the article were entirely new and strange to us. Another test of the perfection of the machine was the perfect reproduction of whistling and whispering, all the imperfections of tone, the half tones and modulations even, being faithfully reproduced. The perfect performance of the new instrument depends upon its mechanical

perfection—upon the regularity of its speed, the susceptibility of the wax cylinder to the impressions of the needle, and to the delicacy of the speaking diaphragm. No attempt is made in this instrument to secure loud speaking—distinct articulation and perfect intonation have been the principal ends sought.

A highly magnified section of the phonograph cylinder, showing the indentations, is illustrated; A representing a section of the face of the cylinder, B a transverse section of a portion of the cylindrical wax shell, and C showing a less magnified face view of a small portion of the cylinder.

The new phonograph is to be used for taking dictation, for taking testimony in court, for reporting speeches, for the reproduction of vocal music, for teaching languages, for correspondence, for civil and military orders, for reading to the sick in hospitals, and for various other purposes too numerous to mention.

Imagine a lawyer dictating his brief to one of these little machines; he may talk as rapidly as he chooses, every word and syllable will be caught upon the delicate wax cylinder, and after his brief is complete he may transfer the wax cylinder to the phonograph of a copyist, who may listen to the words of the phonograph and write out the manuscript. The instrument may be stopped and started at pleasure, and if any portion of the speech is not understood by the transcriber, it may be repeated as often as necessary.

In a similar manner a compositor may set his type directly from the dictation of the machine, without the necessity of "copy," as it is now known.

Mr. Edison informs us that the whole of Nicholas Nickleby could be recorded upon four cylinders each 4 inches in diameter and 8 inches long, so that one of these instruments in a private circle or in a hospital could be made to read a book to a number of persons. The multiple earpiece by which this is accomplished is shown in one of our engravings.

The little wax cylinders upon which the record is made are provided with a rigid backing and the cylinders are made in different lengths; the shortest—1 inch long—having a capacity of 200 words, the next in size 400 words, and so on. These cylinders are very light, and a mailing case has been devised which will admit of mailing the cylinders as readily as letters are now mailed. The recipient of the cylinder will place it on his own phonograph and listen to the phonogram—in which he will not only get the sense of the words of the sender, but will recognize his expression, which will of course have much to do with the interpretation of the true meaning of the sender of the phonogram.

A very interesting and popular use of the phonograph will be the distribution of the songs of great singers, sermons, and speeches, the words of great men and women, music of many parts, the voices of animals, etc., so that the owner of a phonograph may enjoy these things with little expense.

It may even be pressed into the detective service and used as an unimpeachable witness. It will have but one story to tell, and cross examination cannot confuse it.

Extensive preparations for the manufacture of the phonograph have been made, and it is probable that within a short time these instruments will be as common and as indispensable as the sewing machine or the type writer.

The Trial of the Chicago.

This new war steamer lately went on her first trial up Long Island Sound. Capt. Robeson, commanding the Chicago, and Mr. Thomson, her chief engineer, report that the trial was successful; that her engines worked easily and with no sign of weakness, and that she made an average of fifteen knots per hour, reckoning on the resistance of the tides, in a trial of six consecutive hours. The pounding and thumping noticed in the first dock trial of her engines disappeared with the alteration of the valves; there was no need

of resorting to forced draught; her steering capacity was all that could be desired; she was steady and free from immoderate vibrations.

In the Chicago's trial on the Sound the horse power developed has not yet been officially made known, but it is believed to be less, on an average, than the 5,000 which the contract calls for. The average speed secured is also somewhat less than was expected, as it was thought that this might be near sixteen knots. Still, on the whole, the results are thought satisfactory. The type of engines used is wholly experimental in war vessels, though known to a small extent on merchant steamships.

A VERY useful polishing powder for metals and glass is made of very finely ground glass mixed with a small proportion of dried soda ash.



THE PHONOGRAPH IN COURT.