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THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 98,
For the Week ending November 17, 1877.

A WONDERFUL INVENTION.—SPEECH CAPABLE OF INDEFINITE REPETITION FROM AUTOMATIC RECORDS.

It has been said that Science is never sensational; that it is intellectual not emotional; but certainly nothing that can be conceived would be more likely to create the profoundest of sensations, to arouse the liveliest of human emotions, than once more to hear the familiar voices of the dead. Yet Science now announces that this is possible, and can be done. That the voices of those who departed before the invention of the wonderful apparatus described in the letter given below are for ever stilled is too obvious a truth; but whoever has spoken or whoever may speak into the mouthpiece of the phonograph, and whose words are recorded by it, has the assurance that his speech may be reproduced audibly in his own tones long after he himself has turned to dust. The possibility is simply startling. A strip of indented paper travels through a little machine, the sounds of the latter are magnified, and our great grandchildren or posterity centuries hence hear us as plainly as if we were present. Speech has become, as it were, immortal.

The possibilities of the future are not much more wonderful than those of the present. The orator in Boston speaks, the indented strip of paper is the tangible result; but this travels under a second machine which may connect with the telephone. Not only is the speaker heard *now* in San Francisco for example, but by passing the strip again under the reproducer he may be heard tomorrow, or next year, or next century. His speech in the first instance is recorded and transmitted simultaneously, and indefinite repetition is possible.

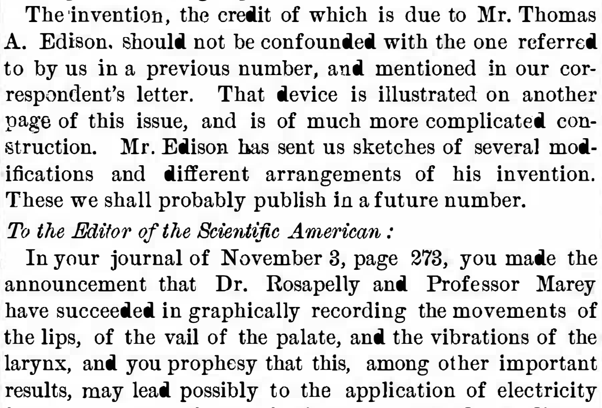
The new invention is purely mechanical—no electricity is involved. It is a simple affair of vibrating plates, thrown into vibration by the human voice. It is crude yet, but the principle has been found, and modifications and improvements are only a matter of time. So also are its possibilities other than those already noted. Will letter writing be a proceeding of the past? Why not, if by simply talking into a mouthpiece our speech is recorded on paper, and our correspondent can by the same paper hear us speak. Are we to have a new kind of books? There is no reason why the orations of our modern Ciceros should not be recorded and detachably bound so that we can run the indented slips through the machine, and in the quiet of our own apartments listen again, and as often as we will, to the eloquent words. Nor are we restricted to spoken words. Music may be crystallized as well. Imagine an opera or an oratorio, sung by the greatest living vocalists, thus recorded, and capable of being repeated as we desire.

The invention, the credit of which is due to Mr. Thomas A. Edison, should not be confounded with the one referred to by us in a previous number, and mentioned in our correspondent's letter. That device is illustrated on another page of this issue, and is of much more complicated construction. Mr. Edison has sent us sketches of several modifications and different arrangements of his invention. These we shall probably publish in a future number.

To the Editor of the Scientific American:

In your journal of November 3, page 273, you made the announcement that Dr. Rosapelly and Professor Marey have succeeded in graphically recording the movements of the lips, of the vail of the palate, and the vibrations of the larynx, and you prophesy that this, among other important results, may lead possibly to the application of electricity for the purpose of transferring these records to distant points by wire.

Was this prophecy an intuition? Not only has it been fulfilled to the letter, but still more marvelous results achieved by Mr. Thomas A. Edison, the renowned electrician, of New Jersey, who has kindly permitted me to make public not only the fact, but the *modus operandi*. Mr. Edison in the course of a series of extended experiments in the production of his speaking telephone, lately perfected, conceived the highly bold and original idea of recording the human voice upon a strip of paper, from which at any subsequent time it might be automatically re-delivered with all the vocal characteristics of the original speaker accurately reproduced. A speech delivered into the mouthpiece of this apparatus may fifty years hence—long after the original speaker is dead—be reproduced audibly to an audience with sufficient fidelity to make the voice easily recognizable by those who were familiar with the original. As yet the apparatus is crude, but is characterized by that wonderful simplicity which seems to be a trait of all great invention or discovery. The subjoined illustration, although not the



actual design of the apparatus as used by Mr. Edison, will better serve to illustrate and make clear the principle upon which he is operating.

A is a speaking tube provided with a mouthpiece, C—; X is a metallic diaphragm which responds powerfully to the vibrations of the voice. In the center of the diaphragm is secured a small chisel-shaped point. D is a drum revolved by clockwork, and serves to carry forward a continuous fillet of paper, having throughout its length and exactly in the center a raised V-shaped boss, such as would be made by passing a fillet of paper through a Morse register with the lever constantly depressed. The chisel point attached to the diaphragm rests upon the sharp edge of the raised boss. If now the paper be drawn rapidly along, all the movements of the diaphragm will be recorded by the indentation of the chisel point into the delicate boss—it, having no support underneath, is very easily indented; to do this, little or no power is required to operate the chisel. The tones of small amplitude will be recorded by slight indentations, and those of full amplitude by deep ones. This fillet of paper thus receives a record of the vocal vibrations or air waves from the movement of the diaphragm; and if it can be made to contribute the same motion to a second diaphragm, we shall not only see that we have a record of the words, but shall have them re-spoken; and if that second diaphragm be that of the transmitter of a speaking telephone, we shall have the still more marvelous performance of having them re-spoken and *transmitted by wire at the same time to a distant point.*

The reproductor is very similar to the indenting apparatus, except that a more delicate diaphragm is used. The reproductor, B, has attached to its diaphragm a thread which in turn is attached to a hair spring, H, upon the end of which is a V-shaped point resting upon the indentations of the boss. The passage of the indented boss underneath this point causes it to rise and fall with precision, thus contributing to the diaphragm the motion of the original one, and thereby rendering the words again audible. Of course Mr. Edison, at this stage of the invention, finds some difficulty in reproducing the finer articulations, but he quite justified by results obtained, from his first crude efforts, in his prediction that he will have the apparatus in practical operation within a year. He has already applied the principle of his speaking telephone, thereby causing an electro-magnet to operate the indenting diaphragm, and will undoubtedly be able to transmit a speech, made upon the floor of the Senate, from Washington to New York, record the same in New York automatically, and by means of speaking telephones redeliver it in the editorial ear of every newspaper in New York. In view of the practical inventions already contributed by Mr. Edison, is there any one who is prepared to gainsay this prediction? I for one am satisfied it will be fulfilled, and that, too, at an early date.

EDWARD H. JOHNSON, Electrician.

INFLUENCE OF HEAT ON THE TENACITY OF METALS.

A very important series of experiments has recently been conducted by the Admiralty at Portsmouth, England, with a view of ascertaining what loss of strength and ductility takes place in gun metal composition when raised to high temperatures, the especial object being to discover whether gun metal would be more or less suitable than cast iron for making such articles as stop and safety valve boxes, steam pipe connections, fastenings, etc., which might be subjected to high temperatures, either from superheated steam or from being placed in proximity to hot uptakes or funnels. The gun metal was cast in the form of rods one inch in diameter, and composed of five different alloys as follows: No. 1. Copper, 87·75; tin, 9·75; zinc, 2·5. No. 2. Copper 91; tin, 7; zinc, 2. No. 3. Copper, 85; tin, 5; zinc, 10; No. 4. Copper, 83; tin 2; zinc 15. No. 5. Copper, 92·5; tin, 5; zinc, 2·5.

The specimens were heated in an oil bath near the breaking machine, and the operation of fixing and breaking were rapidly and carefully performed so as to prevent, as far as possible, loss of heat by radiation. The strength and ductility of the above alloys at atmospheric temperature were as follows: No. 535 pounds, 12·5 per cent; No. 2, 825 pounds, 16 per cent; No. 3, 525 pounds, 21 per cent; No. 4, 485 pounds, 26 per cent; and No. 5, 560 pounds, 20 per cent. As the heat was increased a gradual loss in strength and ductility occurs, up to a certain temperature at which, within a few degrees, a great change takes place, the strength falls to about one half the original, and the ductility is wholly gone. Thus in alloy No. 1, at 400° Fah., the tensile strength had fallen to 245 lbs., and the ductility to 0·75 per cent; the precise temperature at which the change took place was ascertained to be about 370°. At 350° Fah., the tensile strength was 450 lbs., and ductility 8·25 per cent. At temperatures above the point where this change begins and up to 500° Fah., there is little if any loss of strength.

It is scarcely necessary to point out the practical importance of this discovery; 370° is a comparatively low temperature and easily reached under no abnormal conditions in cannon and in many parts of machinery which are now made of gun metal. If specimens of the best alloys of that description are liable to become so seriously impaired in strength by the change, the question of course arises as to what alloys may be substituted for gun metal which shall not partake of its unreliable character.

Various other alloys have been tested during the same series of experiments in order to investigate this, and the subject will be further pursued in other trials. It appears that phosphor bronze, the only metal in the series which from its strength and hardness could be used as a substitute, was less affected by temperature, and at 500° retains more than two thirds of its strength and one third of its ductility. The experimenters suggest however that before adopting