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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.

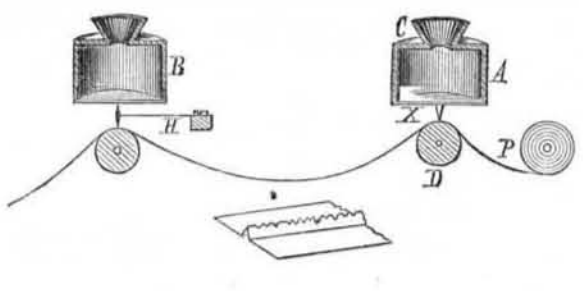
The new invention is purely mechanical—no electricity is involved. It is a simple affair of vibrating plates, thrown into vibration by the human voice. It is crude yet, but the principle has been found, and modifications and improvements are only a matter of time. So also are its possibilities other 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

phosphor bronze as a substitute for gun metal, it should be determined what difference may arise from variations in the process of casting or difference in the quality of the material used, also whether it is possible to harden any of the other compositions without loss of strength.

It is further stated that rolled Muntz metal (copper 62, zinc 38) and copper are satisfactory up to 500° and may be used as securing bolts with safety. Wrought iron, Yorkshire and remanufactured, increases in strength up to 500°, but loses slightly in ductility up to 300°, where an increase begins and continues up to 500°, where it is still less than at ordinary temperature of the atmosphere. The strength of Landore steel was not affected by temperature up to 500°, but its ductility is reduced more than one half.

A NEW AND REMARKABLE STRIKE.

For three weeks past a strike has been progressing in this city which, both in its origination and the manner in which it has been conducted, presents some remarkable features. The striking workmen number about ten thousand, and their trade is the manufacture of cheap cigars, mainly of Connecticut tobacco. There are over 1,800 cigar manufacturers in this city. By far the larger number are small manufacturers, who employ from five to fifty hands in a shop. The present strike is almost confined to the large manufactories, some sixty in number, and which are run by piecework under two systems. Either the hands come to a "shop," or the work is given out to families who live in tenements belonging to the firm. In the tenements the pay averages from $4 to $4.50 per thousand for the cheapest grade of cigars; in the shops the pay for the same kind is $1 higher per thousand. In the latter, however, the leaf is furnished stripped and booked, while the "house workers" have the additional labor of doing this themselves. "Stripping and booking" is worth 75 cents per 1,000 cigars. The real disproportion between shop and tenement work is, therefore, $1.75 per thousand. There is no reason for the distinction, and to equalize the rates is the main object of the strike. Of the 10,000 strikers, about 6,000 are "house workers," and the hardships which it is now sought to obviate mostly relate to the tenement house system. In shops, division of labor exists—in tenements it does not, except so far as different members of a family divide it among themselves. To make clear this distinction it is well to state that, in a shop, the tobacco leaf is first "stripped" by children, who remove the stems. It is then "padded" into "books" of 50 or 100 leaves each, which are dampened. The best leaves are used for "wrappers," or outer envelope of the cigar; the next best for "binders," or inner wrappers; and the small and broken leaves, together with the cuttings and scraps, are cut up by machines for "filling." The "bunch maker" rolls the filling in the binder and places it in a cigar form or mould, where it is pressed into shape. It then passes to the "roller," or, as he is technically called, the "cigarmaker," who encloses it in the "wrapper" and applies the finishing touches. The finished cigars are then handled by the "packer," who selects and classifies them into various grades, according to strength, color, gloss, and other variations. They are then put in boxes and stamped.

In hand work moulds are not used, each cigar being rolled and put together by one man, who must be a skilled workman. The form cigars are the cheapest made.

The revenue laws require that a license should be paid and a bond filed for every place where cigars are manufactured. To make the expense as little as possible, manufacturers who have work done outside hire a block of tenements and put their "house workers" in possession. The hands to obtain work are obliged to live in these tenements. A family occupies from two to three rooms, for which they pay one third more rent than for similar apartments elsewhere; $11 is paid, when $8 would be a fair sum. These families are supplied simply with forms and crude leaves, so that they are obliged to do everything up to the packing, which involves special skill. The "house workers" are almost all Bohemians, and their entire families, even to children as young as five years, work together. The children usually "strip," the husband "bunches and moulds," and the wife, who is generally the most skillful, does the final rolling. A fair week's work for a family of four or five is 2,500 cigars, and to accomplish this they must often work sixteen hours a day. They would earn about $11 per week. If there are three adults working, $15 per week would be a high figure. The tobacco supplied is often poor, fragile, and difficult to handle, and then still fewer cigars per week are made. The "shops" are ill-ventilated, improperly drained, and consumption among the workers is frightfully prevalent. The tenements are, perhaps, a little better where improvements have been introduced; in many instances they are, if anything, worse than the shops. The destitution and physical condition of the "house workers," especially the children, is very great; the mortality among them has frequently caused the Health Board serious alarm.

The manufacturers explain this condition of affairs with the statement that the tenement workers are inferior hands, making the cheapest cigars, and that the competition of Western manufacturers compels them to keep wages down. On the other hand, the manufacturers who have shops only condemn the tenement system in unmeasured terms.

The cigarmakers now demand that $6 per 1,000 be the lowest rate paid either for shop or tenement work, and that the rates on higher grades of cigars be raised to a fair sum. This amounts to the abolition of the tenement system, as it is doubtful whether it would be profitable under the above conditions. The strike first attained prominence among the "house workers," but soon spread to the large shops, until the above mentioned total was reached. Bunchers averaged from $7 to $10, and rollers from $9 to $12, in shops. No intimidation, no coercion was resorted to, absolutely nothing has been done to compel the disaffected to join the movement. The only means adopted, besides simple argument, were the stationing of pickets at the doors of striking factories and tenements, who reasoned with men who came to take the places of the strikers, and if possible induced them to join the union. If the men persist, they are peaceably permitted to accept employment, but no union man will work in the same shop with them, nor can they afterwards join the union except on paying a large fine.

No sooner had the strike been fairly started than an organization was effected. The striking shops and tenements elected delegates proportioned to their numbers, who met and formed the Central Association of Cigarmakers. Of this body an executive committee arbitrates and equalizes prices for the various shops, manages financial affairs, etc. An organization committee organizes each individual shop, making each a perfect sub-organization, controls pickets and matters of discipline. A relief committee collects funds, examines applications for relief, personally investigating the condition of each applicant, and if worthy delivering certificates in proof of authenticity. These certificates when presented to a sub-relief committee are exchangeable for orders on the relief stores. The orders give details concerning the holder and his family, and call for a ration in accordance. An order for a family of six is exchangeable for seven pounds of flour, two pounds of coffee, four pounds of sugar, one peck of potatoes, three heads of cabbage, besides pease, beans, rice, salt, and soap. This is a weekly ration, and one dollar in cash for small expenses accompanies it. A daily ration of meat and bread is given out, the applicant's name being taken from the weekly order and enrolled in a record. For the sick there are special rations of wine, etc., and provision made for a doctor's attendance. All this organization is entirely separate from the trades' unions. People who receive its benefits are not necessarily union members, although all have since joined the unions. But the unions, of which there are three in the city, contribute largely to the support of the organization. Aid is also furnished by unions out of the city, by unions of entirely different trades, by private subscription, but mainly by weekly contributions from hands in factories which have yielded to the strike and in small shops where adequate wages are paid.

A very strong manufacturers' combination is opposing the strike, so that its success is yet problematical. We have entered into the details of the uprising because they are in marked contrast with the characteristics of other strikes of late occurrence. At the time of writing 2,000 families, numbering over 6,000 people, are drawing upon the relief stores, and nearly all of them are in a state of total destitution. Nevertheless there have been no outrages, no immoderate harangues; in fact, were it not for the published accounts in the daily journals, few would know that 10,000 people in in this city were carrying on a great strike.

NOTES OF DECISIONS OF THE COURTS.

In the case of Lane *vs.* Peck, lately decided by Judge Shipman, the complainants sought to restrain the defendants from the infringement of letters patent for a self-closing faucet, which were issued to Nathaniel Jenkins, June 27, 1875, and which had been duly assigned to the complainants. The defendants admitted the infringement; and the sole question before the court was as to the novelty of the alleged invention. The invention consisted in opening a self-closing faucet by means of a quick-threaded screw follower, the threads of which were inclined at so great a pitch that, when the power to turn the screw was removed, the pressure of the water, and of a spiral spring under the valve, forced the valve to its seat, where it was held by the pressure of the water. As self-closing faucets opening by means of a lever, and also by means of a quick-threaded screw, have long been known, the invention in question was the combination of a quick-threaded screw, valve, and spring.

The French patent of Chrétien Morand, dated November 14, 1851, was chiefly relied upon by the defendants as anticipatory of the plaintiff's patent. The Morand device was designed in part to prevent what is called the "water hammer," or the unpleasant sound which is caused by the reaction of the water when the valve is suddenly closed. The Morand faucet was of two parts of an unequal size; the induction way was of a larger size than the eduction way. There were two valves, also of unequal size. The outer valve was in rigid connection with and was turned by a quick-threaded screw spindle. This valve was so connected with the inner one that the inner valve was guided longitudinally, and was forced to its seat by the same rotation of the screw follower which operated upon the outer valve The connection of the inner valve with the spindle was not by means of a swivel joint. Below the inner valve was a spring, which, with the pressure of the water, caused the valves to be closed when the power that turned the screw was removed. By the use of two valves, the body of water lying between the valves formed a cushion, which checked the force of the sound, or of the blow of the water hammer, when the faucet was suddenly closed. Morand stated in the specifications of his patent that, while he preferred two valves, it would be understood that in certain cases he could employ but one. But the manner in which the faucet would then be constructed he did not describe.

It will be seen that the principal elements employed to produce a self-closing faucet, to wit: the screw follower with a quick-threaded screw, valve, and spring: are found in both the Morand and Jenkins patents; but the double valves of Morand, and the general method in which the mechanism of the inner valve and the spring were arranged, with reference to each other and the water way, caused his faucet to be cumbersome and lacking simplicity and economy. It was a contrivance of many parts, and lacked general utility. Jenkins omitted one of the valves, and of course discarded the connection between the two, and made the passage ways for the entrance and discharge of the water of the same size, and connected the valve and the screw follower by a swivel, and generally materially simplified the construction and arrangement of the valve and spring mechanism. He thus made a simple and economical self-closing faucet. He produced the old result of Morand in a more economical and beneficial manner.

The court, in determining the question of novelty, holds that while the invention of Jenkins is subsidiary to that of Morand, yet Jenkins has essentially changed the Morand device in such a manner that, by the change, the thing which is produced is practically a new structure; that the change introduced by Jenkins is not merely formal, but is, to a certain extent, a structural change and modification of the parts of the Morand faucet, which change required inventive and not merely mechanical skill, and required a sufficient exercise of the inventive faculty to justify the grant of a patent. The Jenkins' patent is therefore sustained, and an injunction and an account decreed against the defendants.

PROFESSOR JAMES ORTON.

We regret to announce the sudden decease of Professor James Orton of Vassar College, one of the foremost of American naturalists and geographers. He was on his homeward journey from Bolivia, and was crossing Lake Titicaca to Peru, where he was seized with a malarial fever and died on the 24th of September. He was interred, the *Panama Star and Herald* says, "on a little island within gunshot of the shore in the port of Puno," 130 miles from Arequipa. Professor Orton was born at Seneca Falls, N. Y., April 21, 1830. He graduated at Williams College in 1855, studied theology at the Andover, Massachusetts, Theological Seminary, and was ordained a congregational minister in 1860, after traveling in Europe and the east. Attracted by scientific pursuits he left the pulpit and in 1866 became an instructor in natural sciences at Rochester University. In the following year he took charge of an expedition fitted out by Williams College to explore the northern regions of South America. Landing on the Pacific coast this expedition proceeded to Quito and thence crossed the continent through the valleys of the Napo and the Amazon, discovering in its course the first fossils ever found in the Amazon valley. On his return in 1869 he became Professor of Natural History at Vassar College. In 1870 he published his well known work, descriptive of his South American journey, entitled "The Andes and the Amazon." In 1873 Professor Orton made a second journey across South America landing at Pará on the Atlantic coast and crossing the Peruvian Andes to Lima, from which city he proceeded by invitation of the late Henry Meiggs to Southern Peru, and by way of Arequipa and Puno reached Lake Titicaca. He came home in 1874. About a year ago he went back to South America for the third and last time, to complete the exploration of the great Beni river, which carries the waters of Eastern Bolivia to the Amazon, by way of the Madeira. For some reason he relinquished his purpose and started, as we have stated, for home, when the disease overtook him. Besides "The Andes and the Amazon," he was the author of many other valuable scientific works.

Professor Orton was a brilliant writer possessing descriptive powers of a high order, as the many letters which he has contributed to these columns while pursuing his South American explorations abundantly testify. His last communication was an excellent paper on the "Sugar Interest in Peru" which appeared in our issue of September 15th last. His death leaves a vacancy in the ranks of workers in Science not easily filled, for it is rarely that the qualities of the scientist, the explorer, and the writer are found united in such eminent degree.

Influence of Light on Metals.

We have already noted M. Siemens' discovery of the influence of light on the electrical resistance of selenium, and his construction of a new photometer based on this principle. Recent experiments have shown that light similarly acts upon tellurium, but in less degree. In a note to the Philosophical Faculty of Heidelberg, M. Bœrnstein states that light also affects platinum, gold and silver, and probably all the metals.

The Sir John Franklin Relics Probably Discovered.

Mr. Thomas Barret, mate of a whaling brig recently lost in Hudson's Bay, has, it is reported, discovered proof of the existence of the records of the ill-fated Arctic expedition, which was commanded by Sir John Franklin. The natives have specified exactly where the books, etc., are to be found, so that Mr. Barret is about to organize an expedition to sail from New York in the spring to obtain them. Some years ago Parliament, it is stated, offered a reward of $100,000 for the recovery of these relics, and on the present maintenance of this offer, the sailing of the new expedition will be contingent.