causes the bristles to be caught and drawn in between two teeth of the comb, filling the space. The comb then descends, and another supply of bristles is carried in between the next pair of teeth, and thus the operation progresses until the comb is full.

Brush backs and bristles are now ready to be put together, and here begins the work of the principal machine (Fig. 3), most of the working parts of which are sustained by an overhanging arm upon an adjustable table. The comb filled with bristles being placed in position on guides, and the machine set in operation, the bristles are seized by teeth and forced through a spiral passage way, and so turned that they rest against a guide. A point divides a sufficient quantity to form one bunch or tuft. Below this point is a wedge which moves the bunch to a position directly over a tube and beneath a grooved and slotted plunger, A, Fig. 4, which descends upon the center of the bunch and forces it into the tube, doubling the bristles so that they lie in the grooves of the plunger. At the lower part of this tube is a nut having spiral threads within it. This nut is pierced with holes, and when the doubled bunch of bristles reaches the nut, a wire, moved by automatic feed from a reel, is thrust through the nut and folded in the bristles, and then cut off to the required length.

The plunger tube, nut, and inclosed bristles, B, now descend to the stock or block previously pierced with holes to receive the bunches. The block is sustained by an adjustable plate, and is brought to its proper position by a finder or guide. As soon as the nut reaches the block the plunger turns and twists the wire around the bunch into the spiral grooves, which screw the bunch of bristles through the nut into the holes in the stock, as shown at C. These movements are effected so rapidly that sixty bunches can be inserted in one minute. The movements are entirely automatic.

The machine sets the finest or coarsest stock with equal facility, using bristles, hair, tampico, or any other material, and firmly securing the bunches in wood, leather, rubber, bone, ivory, or any other material used for brush backs. It is practically impossible to remove the bunches from the backs, as the ends of the wire after the same has been coiled abut against the adjacent material, and prevent any attempt at unscrewing. Neither are brushes so made affected by water, as the ends of the bunches, with the wire, are tightly imbedded in the wood, and so thoroughly protected.

The next process is trimming of the bristles to uniform length (Fig. 5). This is done by holding the brush against a revolving cylinder on which curved knife blades are longitudinally disposed. Above is a curved stationary blade, and between the edge of this and the swiftly rotating knives the bunches are trimmed at the rate of a gross of brushes every ten minutes. The last operation is sand papering the handles, as shown in Fig. 6, preparing them for the final varnishing or other finish. The sandpapering machine is simply a revolving cylinder, covered with suitable abrasive material.

There are other contrivances in the factory of the Messrs. Woodbury, designed to facilitate brush making operations or to improve the product, all of which are very ingenious. A neat little contrivance, for example, is provided for inserting a bit of wire in the back of a blacking brush handle. This projection, when the round portion or dabber of the brush is put in place, enters the wood back and prevents the dabber from turning when it is held by a single central screw. This enables the three parts of the brush to be securely fastened together by only two screws, and avoids the objectionable use of glue.

The brushes exhibited to us, made by the processes we have described, were of uniformly excellent quality, fine finish, and of much greater strength than brushes formed in the ordinary way. They are now on the market, and further particulars relative to them may be obtained by addressing Messrs. Woodbury Brothers, 103 East Houston street, New York city.

Prosperity of Barrow, England.

Great extension is being made in the docks at Barrow. A new dock, 200 acres in extent, with a depth of 30 feet and an entrance width of 100 feet, is being constructed, and when finished will be the largest dock in the country. The basin of this dock, 7½ acres in extent, has been completed, and the engineers are now filling it with water by means of a siphon. It will be ready for commerce in two or three months, and so soon as it is opened a new line of steamships, owned by a company formed for the purpose, will commence running between Galveston, Texas, and Barrow, with live stock. Special steamships are being fitted for this trade, and slaughter houses are to be erected near the docks, and the meat will find its way into the dead market. According to the new regulations of the Act of Parliament, a new line of transatlantic passenger steamships will also be inaugurated at an early date between Barrow and North America, under the auspices of the Barrow Steamship Company, which already possesses five 4,000 ton steamships engaged in the Anchor line service. The timber trade, which is largely carried on at Barrow, is to be greatly developed, and the promoters of the new docks have made special provision in this direction. The channel and harbor have been dredged to a great depth, and now operations are going on with a view to the removal of Peel Bar, at the entrance to the harbor, which, when completed, will allow large vessels to enter the harbor even at low water. Barrow is making rapid strides towards as important a maritime position as she holds in manufactures

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VOL. XXXVIII., No. 23. [NEW SERIES.] *Thirty-third Year.*

NEW YORK, SATURDAY, JUNE 8, 1878.

Contents.

(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 127,
For the Week ending June 8, 1878.

Price 10 cents. To be had at this office and of all newsdealers.

AMERICAN PRODUCTIONS ABROAD.

We directed attention not long ago to the excellent system now carried out by the State Department, whereby our consuls abroad are required to make reports showing the condition of our trade at their several places of residence, and pointing out how the same might perhaps be improved. In connection with what we have already said with regard to the advantages, in the matter of presenting manufactures and inventions, to be gained by representation in the pages of our forthcoming EXPORT EDITION, the notice of manufacturers generally may now be called to some recent special statements of our consuls, as indicating the demand abroad for American productions and the necessity of action to meet the same.

Mr. Alfred E. Lee, Consul General at Frankfort-on-the-Main, says that, "through the reports of European visitors to the Centennial Exposition, our people have established a reputation on this side of the Atlantic as skilled producers, which it is of the highest importance for them to maintain." Frankfort agricultural machine dealers, for example, inform him that American appliances easily outsell those of German make, and among the other articles which manufacturers are counseled to push in that locality are boot and shoe machines, wooden ware, rubber goods, shirtings, prints (there is good chance of successful competition with England in these), watches, lamps, carpenters' tools, paper hangings, and dental instruments.

Our Consul at Nuremberg cites a suggestive instance of a German-American citizen who, residing in this country, recognized a particular form of turbine as just the thing wanted on the small streams of Bavaria, and accordingly he introduced it there with such success that over 400 wheels are now in use. This is but one example of the success which American inventions encounter abroad as soon as their merits become popularly understood. The same correspondent pertinently adds: "After our productions have once had a fair trial, there will be no danger of our losing the foreign markets, and we can reasonably expect increased demand from year to year, provided, always, that our manufacturers do not rest on the laurels already won, but continue to improve in the future as in the past."

Our Consul General at London calls attention to an article in the *Times*, in which it is "distinctly admitted that American manufactures of tools, locomotive engines, and many other kinds of hardware are now obtained in Canada and Australia almost exclusively from the United States, while it is also stated that not only do we produce at home all the manufactured goods we at one time bought from England, but that we have been able to exclude British manufactures from foreign markets." Leading merchants of Leeds inform our consul there that they "have virtually abandoned the hope of ever again seeing their manufactures exported in large quantities to the United States. . . . England has not only lost an important market, but she has met with an active, shrewd, and powerful competitor, which produces as well as manufactures."

The few instances here cited will serve to indicate roughly the condition of foreign demand for our productions, and the success already attained manifestly due thereto and not to the push of manufacturers themselves. Dr. Grothe, of Berlin, in his important work reviewing the Centennial Exposition, says that "there is spread out in America before the eyes of the observing European a new world of industry, with new forms, new methods of work and traffic, new auxiliaries, and under new aspects and conditions." All that now seems needed is the means for bringing a knowledge of this "new world of industry" into the workshops and factories of the Old World, and this means manufacturers have at their disposal in the EXPORT EDITION of the SCIENTIFIC AMERICAN. Each issue of this periodical will contain nearly 100 large quarto pages, embracing most of the plates of the four preceding numbers of the SCIENTIFIC AMERICAN, and will constitute a splendid illustrated monthly exposition of American inventive and manufacturing genius, which cannot fail to exercise a potent influence upon all foreigners interested in the industrial progress of their nations. The numerous fine engravings embodied in the reading columns will be supplemented by the striking illustrations which advertisers can insert at a very reduced cost in the broad pages especially devoted to their announcements, and these may be still further rendered valuable by the addition of carefully prepared descriptive matter setting forth the particular merits and advantages of the different devices. The circulation of the EXPORT EDITION, the first issue of which will be mailed in June, will extend to every commercial center and important manufacturing district in the world—and this from the outset.

Many enterprising firms, realizing the importance of this EXPORT EDITION as a means of introducing their goods abroad, have secured space in its columns. Among these are the following:

Baldwin Locomotive Works, Philadelphia, Pa.

H. R. Worthington, New York, Steam Pumps and Water Meters.

Erie City (Pa.) Iron Works, Portable Steam Engines.

Finch & Co., Waynesboro, Pa., Portable Steam Engines.

Rue Manufacturing Co., Philadelphia, Pa., Injectors.

Chalmers, Spence & Co., New York, Tube Cleaners.

Reading Iron Works, Philadelphia, Pa., Wrought Iron Pipes.

Hoopes & Townsend, Philadelphia, Pa., Nuts and Rivets.

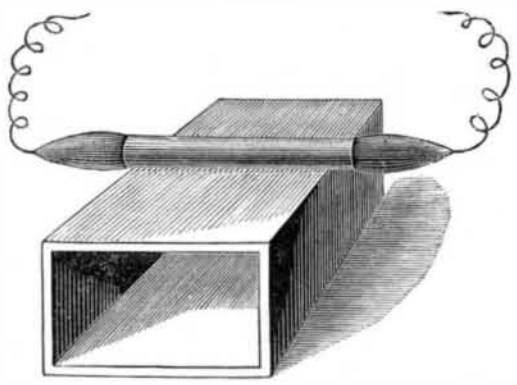
Volney W. Mason & Co., Providence, R. I., Hoisting Machinery.

Alexander Brothers, Philadelphia, Pa., Leather Belting.
Geiser Manufacturing Co., Waynesboro, Pa., Grain Separators.
Jno. Dickinson, New York, Diamonds for Drills.
J. A. Brown & Co., Providence, R. I., Watch Cases.
Chickering & Co., New York and Boston, Piano Fortes.
L. Postawka & Co., Cambridgeport, Mass., Piano Stools.
Horace Waters & Co., New York, Piano Fortes.
Fairbanks & Co., New York, Weighing Scales.
Marvin Safe & Scale Co., New York.
H. W. Collender, New York, Billiard Tables.
Simpson, Hall & Co., New York, Electro Plated Wares.
H. L. Judd, New York, Hardware.
Stout, Mills & Temple, Dayton, O., Turbines.
J. F. Frueauff, Columbia, Pa., Hydraulic rams.
A. H. Watkins, Boston, Mass., Portable Gas Lights.
Stearns Manuf. Co., Erie, Pa., Circular Saw Mills.
First & Pryibil, New York, Wood Working Machinery.
Bradley & Currier, New York, Doors, Windows, etc.
C. B. Rogers & Co., New York, Wood Working Mach'y.
Stanley Rule and Level Company, New York.
Parker Brothers, Meriden, Conn., Firearms.
Carr & Hobson, New York, Agricultural Implements.
E. Gillet, New York, Ice Machines.
A. M. Lesley, New York, Refrigerators.
B. K. Bliss & Sons, New York, Seedsmen.
Beach, Son & Co., New York, Seedsmen.
W. H. Schieffelin & Co., New York, Druggists.
Geo. Mather's Sons, New York, Printing Inks.
Golding & Co., Boston, Mass., Printing Presses.
Francis & Loutrel, New York, Stationers.
Wilkinson Brothers & Co., New York, Paper-makers.
Photo Engraving Co., New York, Relief Plates.
Macgowan & Slipper, New York, Printers.
J. W. Fiske, New York, Ornamental Iron and Zinc Manfr.
Thompson & Bedford, New York, Lubricating Oils.
W. J. Wilcox & Co., New York, Pure Lard and Oils.

THE CARBON TELEPHONE.

Professor Huxley, on May 9th, read before the Royal Institution a communication received the day previous from Professor Hughes, of Kentucky, the well known inventor of the type printing telegraph, now resident abroad, in which is described, as the original discovery by the author, a new telephone, remarkable for its simplicity and its astonishing power of magnifying and so rendering audible the faintest sounds. Professor Hughes claims to have discovered that certain non-homogeneous conducting substances, placed in circuit with a battery, possess the property of converting sonorous vibrations into undulating currents of electricity, by which not only can articulate speech be transmitted to a distant Bell telephone, but the sound is very greatly magnified. It is well known that when contact is made and broken between a battery and a telephone a loud, dull tick is produced. If, however, the resistance of the circuit or of the battery is suddenly changed a sound is made in the telephone, but it is of different nature. If, for example, the conducting wire is torn asunder, there is heard a grating noise; the same is audible if the wire be bent, and it would appear that this is owing to the fibers, which constitute the wire, beginning to give way or

Fig. 1.



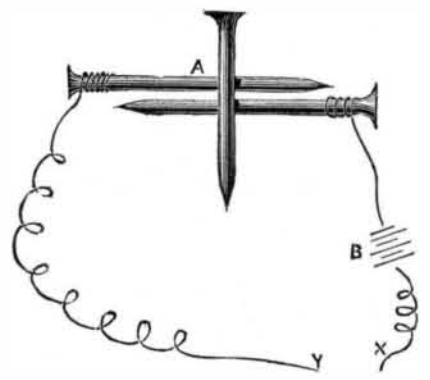
dragging over one another, producing a variation of resistance.

Filling a glass tube with a powder of zinc and tin, Professor Hughes closed the extremities with plugs of gas carbon, which slightly compressed the contents. To these plugs the battery wires were attached, and a galvanometer was placed in circuit. On grasping this tube by the ends, and pulling it so as to subject it to tensile strain, the galvanometer needle was deflected in one direction; on compressing the tube endwise, the needle moved the other way. The particles being separated, in the first instance, and forced together in the second, the resistance of the circuit was varied, increasing the current in the former case, and decreasing it in the latter.

The only disposition of the tube to fit it for the purposes of a telephone was to attach it to the top of a small box which served as a resonator, as shown in Fig. 1. Professor Hughes claims to have found that even a piece of vegetable charcoal impregnated with mercury, or with platinum perchloride, answers nearly as well as the tube, and ordinary mechanical structures which contain a good many joints, such as a small machine or a chain made into a little heap, act almost as well as the substances referred to.

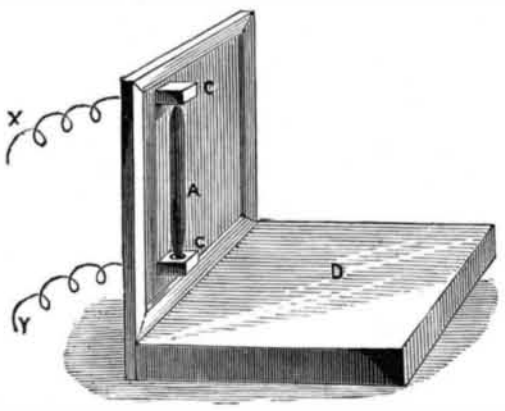
The simplest form of such a structure is shown in Fig. 2, in which two common French nails, A, are fastened down to a horizontal board about a millimeter apart. Wires, X and Y, are attached to them leading to a battery, B, and a telephone, in such a manner that the nails form the only break in the circuit, which can be closed by laying any conducting material across them. When a third French nail is laid across the other two it is clear that (as a cylinder can only touch another cylinder whose axis is not parallel with it in a single point) the electric circuit has a very imperfect connection at the points of contact between the nails, and it is to this faulty connection that the sensitiveness of this arrangement is due. This exceedingly simple device transmits sounds with wonderful distinctness and power. The most sensitive contrivance, however, yet devised by Pro-

Fig. 2.



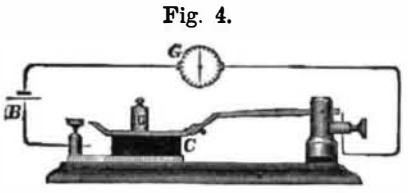
fessor Hughes, is represented in Fig. 3. It consists of a little pencil of gas carbon, A, held in small carbon blocks, C, which are attached to a thin sounding board, secured to a more solid base board, D. The blocks are connected by wires to the battery and line wire leading to the telephone. This little apparatus not only takes up and transmits articulate speech to a distant station with great power and distinctness, but "it detects and converts into loud noises the minutest possible vibrations." Professor Hughes states that "the tip of a soft camel's hair pencil gently stroked along the table on which the instrument is placed is faithfully recorded as a loud rustling sound," and that "the very footfalls of a little common house fly as it walks along the board are heard with unmistakable distinctness by a person whose ear is at the distant telephone, which may be miles away."

Fig. 3.



The discovery on which all this is based seems to us closely similar to that made over a year ago by Edison. He found that, when properly prepared, carbon possesses the remarkable property of changing its resistance with pressure, and that the ratios of these changes, moreover, correspond exactly with the pressure. His device for showing the decrease in resistance is represented in Fig. 4. This consists of a carbon disk, two or three cells of battery, and a galvanometer. The carbon is placed between metal plates, through which and the carbon the current passes. When a given weight is placed upon the upper plate the carbon is subjected to a definite amount of pressure, which is shown by the deflection of the galvanometer needle. The greater the weight, the greater the deflection. Compare this device with Professor Hughes' apparatus for the same purpose, represented in Fig. 5. Here the substance to be tested is placed between the jaws at D, and pressure can be increased or diminished by

Fig. 4.

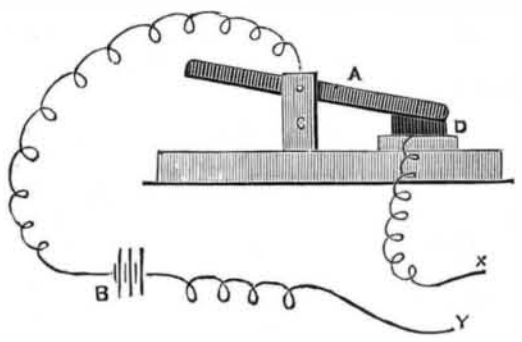


placing small weights on the bar, A, on one side or the other of its pivoted center. The bar is attached through C to the battery, B, and the lower jaw is connected with the telephone and battery by the wires, X and Y. With this instrument Professor Hughes tested powders and various substances in similar manner to Edison, a telephone being used, and the ticking of a clock observed instead of the deflection of a galvanometer needle. It is hardly necessary to point out to the intelligent reader that the two devices are exceedingly alike, and although Professor Hughes in his communication makes reference to Edison's work, he does not seem to have fully apprehended its close bearing upon or possible anticipation of his own. He seems, in fact, to have been oblivious to the various descriptions of Mr. Edison's discovery that have been published here. For example, it would not appear that he had read the description of Mr. Edison's Carbon Telephone, published in the SCIENTIFIC AMERICAN of July 28, 1877.

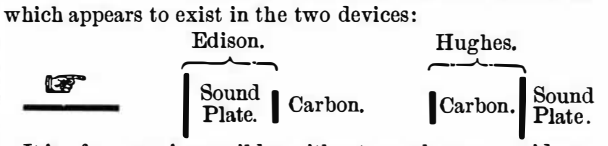
It was of course but a step onward for Mr. Edison to substitute a diaphragm for the weight in his trial apparatus, and to cause the diaphragm to vibrate with varying degrees of pressure against the carbon by the vocal waves. The variations in the current would then cause it to possess all the characteristics of the vocal waves, and by its reaction through the medium of an electro-magnet, might then transfer them to another disk, causing the latter to vibrate, and thus reproduce audible speech.

Edison's telephone, constructed on this principle, is represented in Fig. 6, in which E is the carbon disk, A the diaphragm, and D and G platinum plates which hold the disk, and which are connected in the battery circuit. In a later device Mr. Edison does away with the vibrating diaphragm altogether, and uses simply a rigid plate of metal to "concentrate a considerable portion of the sonorous waves upon the small carbon disk or button."

Fig. 5.

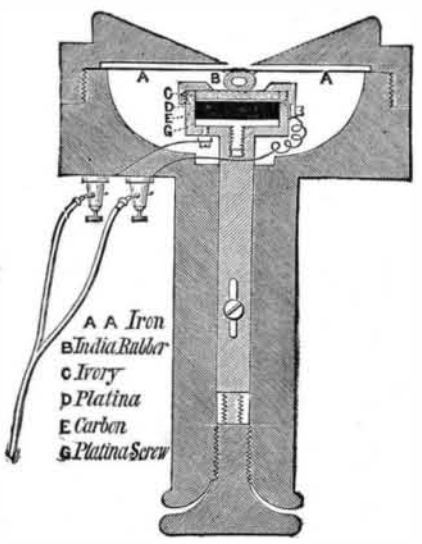


The annexed diagram, in which the hand denotes the direction of the sound waves, will show the small difference which appears to exist in the two devices:



It is of course impossible, without much more evidence than is before us relative to Professor Hughes' experiments, to reach any certain judgment as between him and Mr. Edison, but a *prima facie* case in favor of the priority of the latter seems to us pretty clearly made out. As to the transmission of minute sounds, Mr. Edison some time ago informed us of his having achieved that possibility, which, he said, extended to the registration of minute heat waves. Both inventors, however, are American, both are highly distinguished, and both are equally capable of making so important and creditable a discovery, so that the question we have raised will in no wise, in popular estimation, affect the surpassing value of their work. We are indebted to *Engineering* and to Mr. George B. Prescott's book on the "Telephone" for our engravings. Professor Hughes' communication to the Royal Society, as read by Professor Huxley, will be found in full in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, together with an account of certain practical experiments with some of Mr. Edison's devices.

Fig. 6.



Progress of the Great Tunnel.

A recent report of the inspector of the great St. Gothard tunnel through the Alps states that the irregular character of the formations pierced by the tunnel has entirely ceased, and that the work is now progressing through uniformly regular strata. On the south side the boring progresses at the rate of 10 feet daily through gneiss. The rate is somewhat less on the north side, where the tunnel is not yet out of the serpentine. The thickness of this stratum of serpentine now being pierced is already double that estimated by geologists from the surface indications.