

## BELL'S ARTICULATING TELEPHONE.

### THE TRANSMISSION OF SOUND BY ELECTRICITY.

Attempts to transmit musical or articulate sounds to a distance by means of electrical communication have been made partially successful by the early experiments of Sir Charles Wheatstone in England, Philip Reiss in Germany, and Elisha Gray in the United States; but it has been left to Mr. Graham Bell, of Boston, to invent an apparatus by means of which the sound of the human voice may be transmitted by electricity along a telegraph line, and heard, as a voice, at the other end. The articulating telephone of Mr. Graham Bell, of which we give illustration on page 76, consists of two parts, a transmitting instrument and a receiver, and all the parts are characterized by extreme simplicity.

The transmitting instrument, which is represented in Fig. 1, consists of a horizontal electro-magnet attached to a pillar about two inches above a horizontal mahogany stand; in front of the poles of this magnet—or, more correctly speaking, magneto-electric inductor—is fixed to the stand, in a vertical plane, a circular brass ring, over which is stretched a membrane, carrying at its centre a small oblong piece of soft iron, which plays in front of the inductor-magnet whenever the membrane is in a state of vibration. This membrane can be tightened like a drum by the three mill-headed screws shown in the drawing. The ends of the coil surrounding the magnet terminate in two binding-screws, by which the instrument is put in circuit with the receiving instrument, which is shown in Fig. 2.

This instrument consists of a vertical bar electro-magnet, inclosed in a tube of soft iron, by which its magnetic field is condensed and its attractive power within the area is increased. Over this is fixed, attached by a screw at a point near its circumference, a thin sheet-iron armature of the thickness of a sheet of cartridge-paper, and this, when under the influence of the transmitted currents, acts partly as a vibrator and partly as a resonator. The magnet, with its armature, is mounted upon a little bridge, which is attached to a mahogany stand similar to that of the transmitting instrument. The action of the apparatus is as follows: When a note or word is sounded into the mouth-piece of the transmitter, its membrane vibrates in unison with the sound, and in doing so carries the soft-iron inductor attached to it backwards and forwards in presence of the electro-magnet, inducing a series of magneto-electric currents in its surrounding helix, which are transmitted by the conducting wire to the receiving instruments, and a corresponding vibration is, therefore, set up in the thin iron armature sufficient to produce sonorous vibrations, by which articulated words can be distinctly and clearly recognized. In former instruments the vibrations were produced by a make-and-brake arrangement, so that while a number of vibrations per second, as well as the time-measures, were correctly transmitted, there was no variation in the strength of the current, whereby the quality of tone was also recorded. This defect did not prevent the transmission of pure musical notes, nor even the discord produced by a mixture of them, but the complicated variations of tone, of quality, and of modulation, which make up the human voice, requires something more than a mere isochronism of vibratory impulses. In Mr. Bell's apparatus not only are the vibrations in the receiving instrument isochronous with those of the transmitting membrane, but they are at the same time similar in quality to the sound producing them; for the current being induced by an inductor vibrating with the voice, differences of amplitude of vibrations cause differences in strength of the impulses, and the articulate sound as of a person speaking is produced at the other end. The practical working of Mr. Bell's telephone was shown last summer to a distinguished company of scientific men at the Centennial Exhibition, over a circuit of several miles of wire. Since that time the experiments have been successfully repeated on a circuit of one hundred and fifty miles, and there appears to be no doubt that an audible conversation, so to speak, could be carried on between persons stationed several hundred miles from each other. At the trial in Philadelphia, Professor Watson, of Ann Arbor, read extracts from the morning papers to Sir William Thomson, who was in another building constructively several miles away, and the latter recognized the voice of the reader, and wrote down what he said, to show that the words were accurately transmitted. Such sentences as the following were spoken with unmistakable distinctness by the circular disk armature of the magnet: "The Senate has resolved to print a thousand extra copies. The Americans in London have resolved to celebrate the coming 4th of July." The words were spoken by Professor

Watson, at the far end of the telegraph wire, holding his mouth to the stretched membrane, carrying a little piece of soft iron, which was thus made to perform in the neighborhood of an electro-magnet in circuit with the line movements proportional to the sonoric motions of the air. The apparatus of Mr. Graham Bell is founded on the mathematical conception that "if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously, and, as nearly as may be, in simple proportion to the velocity of a particle of air engaged in constituting the sound." It will be seen from this that, single as the instrument appears to the eye, it is the result of profound mathematical calculations combined with an intimate knowledge of the vibratory movement of sound and of the laws of electrical phenomena.

### AUSTRALIA A CUSTOMER FOR CANADIAN TIMBER.

A correspondent writes from Canada to the *Timber Trades Journal* as follows:—"There is a circumstance connected with the Centennial Exhibition that may result in some benefit to the timber trade in Canada. The Australian Commissioners on duty at Philadelphia were so struck with the excellence and cheapness of several Canadian manufactures, that they expressed the utmost confidence in the possibility of establishing a direct trade between the sister colonies. One of the Commissioners visited the principal cities in the Dominion, and insisted strongly on the advisability of sending samples of several articles manufactured here to the Australian Exhibition, which is to be opened at Sydney in April, 1877. The Boards of Trade representing the leading commercial centres sent delegates to Ottawa to learn how far the Dominion Government would assist in such an enterprise, and the latter, with a readiness which does them credit, stated their willingness to pay the carriage of exhibits to Australia, and to send three commissioners thither, in order to study the commercial position of that country, and to fully report thereon. A vessel was chartered, and sailed from Montreal last fall. Several lumber manufacturers will send specimens of their goods; but, what is of better augury, the same vessel carried some sawn lumber that had been purchased here by an Australian contractor, Mr. Nation, from the Hon. J. Skead, say 70,000 ft. board measure, and 20,000 laths. This is a mere sample order, but a contract has been entered into between the same parties for 1,500,000 ft. per year for three years. Messrs. T. W. Currier & Co. have also sold a number of doors, which will be shipped by the same vessel."—*Builder*.

**A DANGEROUS MATERIAL.**—Within three years, says the *Commercial Bulletin*, there have been three shops destroyed in Massachusetts through lampblack. A hand damp with perspiration, a drop of water, a bit of grease, or a sprinkle of oil, will create combustion which will start the lampblack aglow like charcoal, and so ignite the package, and hence the blaze. In lampblack factories, while great precaution is taken to prevent fires, a rainy or sharp frosty day will start a dampness upon the inside of a window-pane, and the flying particles of dust lighting upon this, create a spark, which, communicating with the pile, may send a glow of fire with wonderful rapidity through the galleries of the shop.

**GOLD LABELLING.** (U. Q.)—The gold labels on chemists' bottles are gilt exactly as in common gilding—*i. e.*, a band of the width of the intended label is painted in gold size, thickened with a little red ochre, the gold leaf is then laid on this, and patted down with a piece of cotton wool. When thoroughly set the words and border lines are painted on in black (with Brunswick black and lampblack), and finally varnished with copal varnish. A common label is made from gilt paper with the letters printed in, which are affixed to the bottle with a stiff "jeweller's cement" (isinglass steeped in water and then dissolved in spirits of wine in which a small quantity of gum mastic has been dissolved), and finally varnished as before. Gold labels in earthenware are usually painted in before the final glazing, and then burnt in. These are almost indelible, and are far superior to every other kind for resisting acids, alkalies, &c. Paper labels can be affixed very securely to glass, &c., by means of acetic glue, made by dissolving pale Russian glue, previously soaked in water till well softened, in glacial acetic acid. When dry the labels should have a coating of the finest copal varnish. For use with such a cement the labels must be gilt and not Dutch metal. If the labels be gilt with the latter metal the best cement is one made with sandarach and white lac dissolved in spirits of wine.