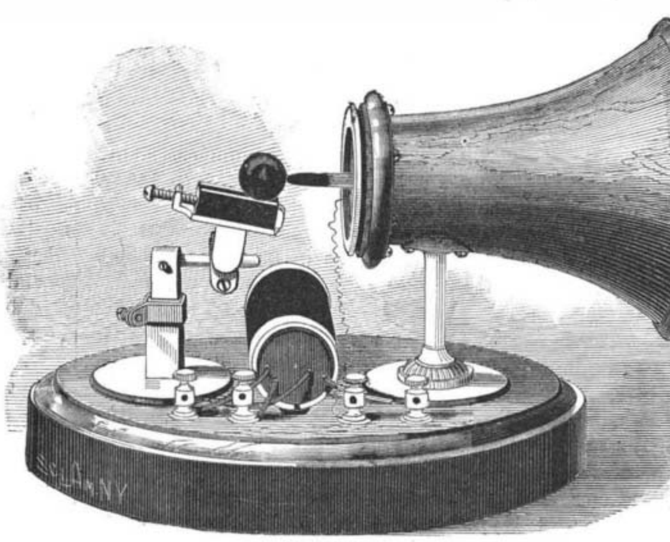
THE BONTA TELEPHONE.

The great Bell telephone patents of 1876 and 1877 are, as is well known to our readers, based upon the theory of the "undulatory current." Substantially the claim is made that speech in all electric telephones is transmitted by a current that is not intermittent or pulsatory, but is continuously undulatory and varies in strength. The wave line representing such a current, as far as its speaking function is concerned, is an unbroken one. This does not imply that there must be no cessation of current. A current that shifts from a maximum in one direction, as from right to left, through zero or total absence of current, to a maximum in the other direction, as from left to right, is considered a continuous undulatory current. This is necessarily the version of the owners of the Bell patents, as precisely such a current, the so-called "shuttle current," is used on their system, as adopted in practical use. The point is, that though there is an infinitely short period of rest, the transition to and from this point is gradual, and is represented by an unbroken portion of an undulating line.

Speech is assumed to be transmitted by a current of this nature. A "make and break" current, it is said by the Bell advocates, cannot of itself transmit speech. The logical deduction is that in telephoning, a perpetual control of the receiving diaphragm is preserved over it by the sending one. Both are assumed to move in unison, and only as the current crosses the zero line, changing in direction, is the distant diaphragm released from control, and then only for an infinitely short period.

The current as used in practice is assumed to be represented by an undulating line crossing as its median a straight line representing the trace of zero or no current. The current goes in one direction as the transmitting diaphragm recedes from, and in the other direction as it approaches the speaker. But it is probable that this reversal of the polarity of the current does not affect the receiving diaphragm, and that the latter is pulled by both impulses of the current, whether positive or negative, as regards the zero base line. The distinction between the undulatory and the pulsatory currents is very sharply drawn in the specification of the Bell patents. From what has been said, it will be clear that the conception of an undulatory current and of its actions is a shadowy thing at best. It is rather a matter for scientists to theorize over than for practical workers to busy themselves with. Yet in a series of very remarkable court decisions it has been made the basis of the most valuable patent right that this country has ever seen.

The telephone shown in the cuts accompanying this article is presented by its inventor, Mr. J. W. Bonta, and proprietors, the American National Telephone Company, of this city, as an apparatus by which speech is electrically transmitted by a pulsatory or a make-and-break current. The essential parts consist of a transmitting diaphragm, to whose back a pencil or rod of carbon is attached, which projects from its center.

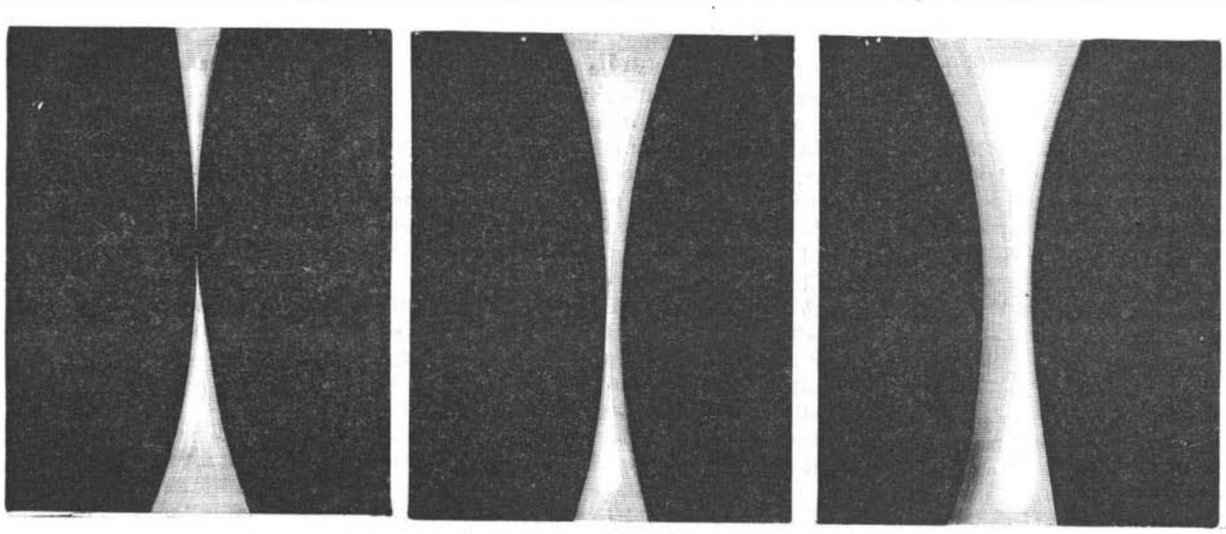


THE BONTA TELEPHONE.

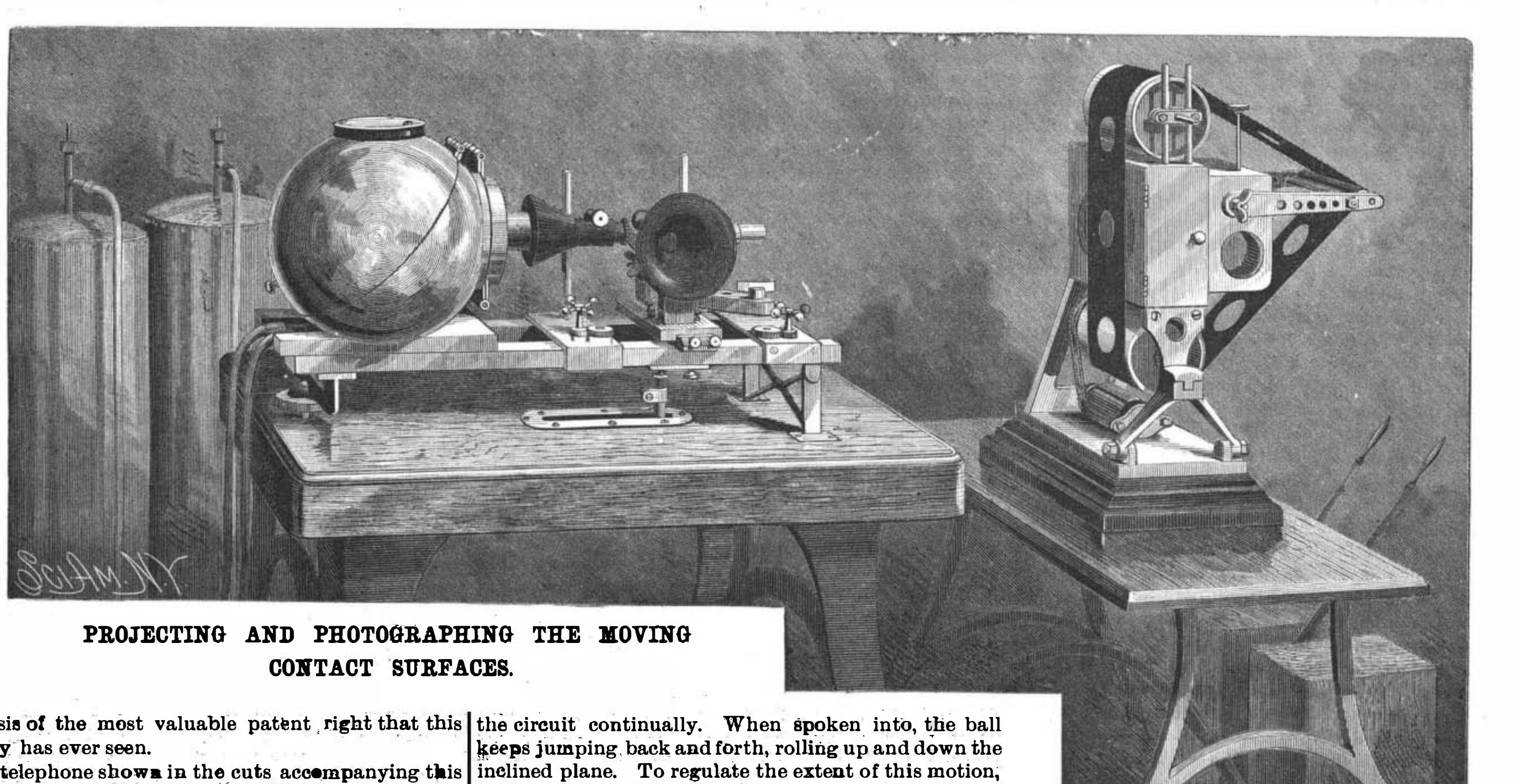
Against the end of this rod a ball of carbon, free to move back and forth in a groove, rests in contact. The groove is formed in a block of carbon, and may, by special adjustment, be more or less inclined. The groove and projecting rod of carbon lie in the same vertical plane. One of the terminals of the circuit connects with the rod, the other with the grooved block. The whole combination forms the transmitting mechanism in connection necessarily with a battery. For use it is connected in circuit with a magneto receiving instrument. When spoken into, the voice is transmitted with great clearness and delicacy. It is exceedingly sensitive. The speaker may stand off several feet, with his back turned to it, and it will still transmit all his words. Its distinguishing peculiarity is that it breaks the circuit continually. When spoken into, the ball keeps jumping back and forth, rolling up and down the inclined plane. To regulate the extent of this motion, the angle of inclination of the plane can be raised, an adjustment, which is shown in the cut, being provided for this end.

As we have seen, the Bell patent is built on a theory, and, strange as it may appear, has been repeatedly sustained on such a basis by the courts. The inventor of this telephone, Mr. J. W. Bonta, has taken the bull by the horns, and has also secured a patent based on a theory. He claims that in the telephone we are describing the intermittent current is used, and not the undulatory. Availing himself of the declarations in Bell's specifications that the undulatory current differs from the pulsatory, which declarations amount to a disclaimer, he declares that his instrument works by the pulsatory current. He asserts that it speaks by the succession of currents of uniform intensity and variable duration, and that their varying duration causes the reproduction of the sound.

In order to illustrate at once and prove his points, Mr. Bonta arranged the apparatus shown in the larger cut. A magic lantern, with microscopic attachment, is set up, and as the object has the pencil and ball electrodes of the telephone in its field, these are projected on a screen as large as may be desired. If now some one speaks into the instrument, the image of the ball is seen to jump back and forth from the pencil electrode, as it opens or breaks the circuit continually. To investigate it still more accurately, a roll of sensitized paper is arranged to continuously rotate in the field of the projected image. In front of the paper, one side of an endless band passes, which band is kept in very rapid rotation. In the band are numerous apertures. This arrangement works like a series of shutters, bringing about a number of short exposures. The movements of the bands are effected by an electric motor, driven by a C. and C. battery. The photographs show the contact points greatly magnified. They appear in every condition of separation or contact. The exposures are at very short intervals, as the band is rapidly rotated, and may run up to a large number per second. In a series of consecutive views, the electrodes are shown for the most part separated, proving that this phenomenon is not only an occasional one, but that it is repeated as long as the apparatus is at work. As a further test, a spring was made to press lightly against the ball. This kept the electrodes in permanent contact, but the telephone would not talk. This was taken as proving that a make-and-break action was essential to its operativeness. The point is also made that spring action interferes with the regularity of the makes and breaks, which regularity is essential. The apparatus for producing the



PHOTOGRAPHS OF THE MOVING CONTACT SURFACES.



PROJECTING AND PHOTOGRAPHING THE MOVING CONTACT SURFACES.

separate exposures is shown in the right hand of the cut.

The proof is not, of course, a complete one. To make it such would involve an exceedingly difficult piece of photographic work, as from one hundred exposures per second upward would have to be effected. Enough has been shown to prove that a great deal of separation does take place, and that the electrodes are continually driven apart. The position of the Bonta patent in the light of the Bell claims is interesting, as it claims to utilize the disclaimed pulsatory current, thus dividing the field of telephony between itself and the Bell patent. It is not saying too much to assert that its theory is as good as that of the Bell specification.

EDWARD SYLVESTER MORSE.

BY MARCUS BENJAMIN.

The names of two men stand out pre-eminent in the history of the United States as having inspired the study of science. The elder Silliman made possible the wonderful strides achieved in the physical sciences, while the impetus given to the natural sciences received its greatest impulse from Louis Agassiz.

Among those who came to follow the lectures of the latter at Cambridge was Edward S. Morse, the retiring president of the American Association for the Advancement of Science, who has attained a high rank among that group of naturalists who sought knowledge from the most distinguished of modern scientists.

Professor Morse is of New England ancestry, and was born in Portland, Me., on June 18, 1838. His early education was acquired at schools in the city, and later he attended the Academy in Bethel, Me., but like many others, the beauties of nature were more attractive to him than the study of Latin or Greek.

At the age of thirteen he began systematically to collect minerals and shells. Indeed, the latter were probably the starting point of those valuable researches in biology which he has since contributed to science.

Yielding to his fondness for natural science, he entered the Lawrence Scientific School of Harvard, in 1859, devoting special attention to the subjects taught by Louis Agassiz, likewise attending the lecture of Jeffries Wyman in comparative anatomy and archæology, with whom he also visited and explored the mound heaps of a prehistoric people situated in New England. He also followed the lectures on chemistry by Josiah P. Cooke, and those on literature by James Russell Lowell.

His early fondness for shells had not been without profit, for from the knowledge now acquired he presented his first paper, on a "Description of New Species of Helix" (Helix asteriscus),* to the Boston Society of Natural History in 1857. This he followed with a second description† of another species (Helix milium), two years later.

During the years 1859–62 he was assistant to Professor Agassiz, and at that time began his special study of the brachiopods, which, although of a low animal type, have a range in time, geographical distribution, and depth of water more extensive than any other class of marine bivalves. He published in 1862 his first contribution to the literature of that subject, entitled "The Haemal and Neural Regions of Brachipoda." ‡ This subject he continued to study for many years and with indefatigable industry, going deeply into the question of their structure and affinities. By the help of embryological analysis, he has thrown new and important light upon their systematic position in the scheme of invertebrate life. They had long been classed as belonging to the mollusks, but after careful researches involving dredgings all along the Atlantic coast, Professor Morse announced his belief in their annelidan nature, placing them among the worms.

Charles Darwin and other eminent naturalists encouraged him in his work, and although he was the first to accumulate evidence for the demonstration of his belief, he was anticipated in its announcement by Japetus Steenstrup, the Danish naturalist.

His most comprehensive paper on this subject is "On the Systematic Position of the Brachipoda," § published in 1873, and dedicated to Professor Steenstrup. It covers the entire group and embraces the results of other studies made by him and contributed elsewhere.

Previous to this however he had been busy with other work, and in 1864 he contributed to the Portland Society of Natural History, "Observations on the Terrestrial Pulmonifera of Maine, including a catalogue of all the species of terrestrial and fluviatile mollusca known to inhabit the State." This pamphlet of some sixty pages includes upward of one hundred illustrations drawn by himself, and nearly all of his papers contain sketches of his own making.

* Proc. Bost. Soc. Nat. His., vol. vi., p. 1.
† Proc. Bost. Soc. Nat. His., vol. vii., p. 1.
‡ Proc. Bost. Soc. Nat. His., vol. ix.
§ Proc. Bost. Soc. Nat. His., vol. xv.

Before this time he held the office of mechanical draughtsman in the locomotive works at Portland, and later he was engaged in Boston, preparing illustrations on blocks for wood engravers. In this manner he acquired the habit of sketching with striking rapidity and minute exactness, and he possesses, moreover, the additional power of being able to draw equally well with either hand. This accomplishment has been of inestimable value in his scientific work.

In 1866 he removed to Salem, Mass., and with Alpheus S. Packard, Alpheus Hyatt, and Frederick W. Putnam, founded the *American Naturalist*, one of the most prominent scientific monthlies in the United States.

His biological work was not neglected, and from 1862 till 1871 he published some twenty memoirs.

In 1871 he became professor of comparative anatomy and zoology in Bowdoin College, Brunswick, Me., and for three years remained in possession of that chair. In addition to his collegiate duties, he found time to prepare two papers on the Terebratulina, which he contributed to the Proceedings of the Boston Society of Natural History.*

Continuing his researches in this direction, he determined, in 1877, to visit Japan for the purpose of dredging along the coasts of the islands of that empire, in search of Brachipods, upon which he was still at work.

His studies soon attracted the attention of the Japanese government, and he was invited to accept the chair of zoology in the Imperial University of Tokio, then recently established. After thoroughly organizing this department and laying the foundations for the splendid collections which have since been made in this field in the imperial museum, he resigned his post in 1879, to resume his labors at home.

RETIRING PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

During his stay in Japan, he established a zoological station in the bay of Yeddo for the purpose of training Japanese assistants in the work, and he obtained a large number of specimens for exchange with American societies.

In the winter of 1877–78, he came back to this country for the purpose of fulfilling certain lecture engagements, and while in Boston he communicated to the Society of Natural History some points new to science concerning the habits of Japanese lingula, † a form of life of particular interest to all naturalists on account of its persistence from the most ancient geological periods to the present time.

He returned to Japan in April, 1878, and again visited that country in 1882, when, after an extensive tour throughout the empire, he proceeded to China and thence home by way of Singapore, Java, and Europe, thus circling the globe.

During his sojourn in Japan, he was led to the study of the prehistoric remains, by his observance of some ancient shell heaps at Omori, not far from Tokio. These he soon examined and found to be similar to those described by Jeffries Wyman, along the shores of New England and in Florida, and those on the Baltic coast in Denmark, made known by Japetus Steenstrup. His researches subsequently embraced critical examinations of a similar nature at Otaru, and Hakodate in Yezo, and Higo.* From all of these localities large collections were made, which now are deposited in the Archæological Museum of the University of Tokio.

* "On the Early Stages of Terebratulina septentrionalis," vol. ii., p. 29, and "Embryology of Terebratulina," Vol. ii., p. 249.
† "On Japanese Lingula and Shell Mounds," *Amer. Jour. Sci.*, February, 1878.

The nature of these finds gave evidence that the pottery found in the mounds was identical with that found in similar deposits in Brazil, thus indicating the common origin of the art. Moreover, in a communication to the Biological Society of the Tokio Dai Gaku,† he showed that this prehistoric people were cannibals, and in their residence of Japan preceded the Ainos, a hairy people, now of the northern islands, who were dispossessed by the present Japanese race, which has lived there over 2,000 years.

Incidentally, these researches led to a comparative examination of Japanese pottery, and from a few pieces his collection has grown to include specimens of all kinds, from the commonest sorts up to the most precious varieties. It is considered the "largest, most valuable, and completest collection of Japanese pottery in the world," and is worth not less than $100,000. The main portion of it is contained in a gallery some eighteen by thirty feet, built expressly for its accommodation, and connected with Professor Morse's residence in Salem.

He is now engaged in making a study of Japanese keramic art from an ethnological standpoint.

In 1881 he became the director of the Peabody Academy of Sciences, an office which he has since held, except during his visit to Japan in 1882.

His work in connection with this institution has been a most valuable one. By his advice important features have been introduced, notably the conspectus of the animal kingdom, for the specimens are so arranged that the series returns to the starting point, the sponges and other of the lowest forms of life confronting the apex of the organic world where the higher mammalia belong.

Professor Morse, as a lecturer, is exceedingly popular with his audiences, talking directly to them like one who has some information that he wishes to impart, and therefore puts his statements in such language that all can understand him.

He has also shown considerable mechanical skill, for besides inventing several plays for children, of which the game of battle is the most popular, he devised a museum bracket shelf that has become a standard feature in many of the largest museums and libraries in the country.

Professor Morse found that dark curtains hung before windows through which the sun shone freely soon became quite warm and induced an upward current of heated air. This led to his apparatus for the utilization of the sun's rays in heating and ventilating apartments, and has been in successful operation at his own residence in Salem, at the Boston Athenæum, and elsewhere.

Another ingenious device was the placing of a sheet iron jacket around a stove, and a pipe from without bringing a constant supply of fresh air to the intervening space, out of which it comes into the room thoroughly heated, so that the apartment is wholly free from the close atmosphere which makes stoves so objectionable.

His latest invention is a pamphlet jacket, consisting of a broad band which, by means of a tape and hook attached, secures a set of pamphlets in a compact bundle that may be easily undone, and attached to the band is a card on which to inscribe the contents.

His separate papers exceed fifty in number, and several of his more important scientific memoirs have been translated into French, Italian, German, and Russian. In addition to these he has contributed largely to newspapers, and to children's magazines such as the *Youth's Companion*, *Wide Awake*, and others, but in book form his publications are: "First Book in Zoology" (New York, 1875), illustrated by its author, and is a favorite text book for schools, both in the United States and England. It has also been translated into German and Japanese. His "Japanese Homes and their Surroundings" (Boston, 1885), likewise illustrated by himself, is an octavo volume of 400 pages, which, according to an eminent authority, "is the first book that has been written about Japan since Siebold."

In 1871, Professor Morse received the honorary degree of Ph.D. from Bowdoin College, and like all scientific men, he is a member of societies. He early joined the Boston Society of Natural History, and is a corresponding member of the Biological So-

* See "Memoirs of the Science Department of the University of Tokio, Japan." Part I. "Shell Mounds of Omori." (Tokio, 1879.) The composition and press work of these memoi s were done in a Japanese office, where the employes were unable to speak English.
† Tokio *Times*, January 18, 1879.