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Undergraduate Acoustics Students
Meucci's Speaking Telegraph
and more**



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of America*

**Penn State's Applied Research Laboratory
Flowthrough, Low-Turbulence Anechoic Chamber**

ANTONIO MEUCCI, THE SPEAKING TELEGRAPH, AND THE FIRST TELEPHONE

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Antonio Meucci (Fig. 1) was born in 1808 in San Frediano near Florence, Italy. He attended the Academy of Fine Arts in Florence and studied mechanical arts, chemistry, and physics including electrology. In 1833 he became assistant chief mechanic of Teatro della Pergola in Florence, where he built a stage house air-tube intercom. His involvement in Risorgimento (Italian reunification) landed him in jail for a time after which he married stage costumer Ester Mochi. They left Florence in 1835 with the Italian Opera Company troupe bound for Havana's Teatro de Tacon where Antonio became the principal "mechanician."

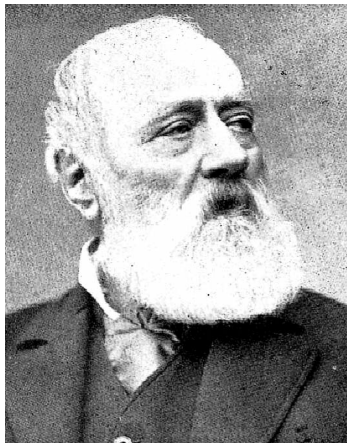


Fig. 1. Antonio Meucci (1885).

During the period 1842 to 1844, Meucci read treatises on galvanoplastics (electroplating) and galvanism by Becquerel, Jacobi, Mesmer and others. At about that same time, he obtained a contract to electroplate army supplies, acquiring a bank of 60 Bunsen electrical wet cells.

In 1849–1850 Meucci became interested in electrotherapy and collaborated with a local doctor using the Bunsen cells. He had already applied some electrotherapy to his wife who was developing arthritis. Meucci's method was comprised of two cork insulated metal contacts (Fig. 2-1) wired to and from a "battery room," where the cells could be connected in series to apply any voltage up to 114 volts DC, though lesser voltage with fewer cells was usually sufficient for effective therapy. One contact was to be held in a patient's left hand, while the second was to be placed wherever the affliction might be on the patient's body. To treat a migraine headache, for example, a patient would place the second contact in his mouth when Meucci called out commands from three rooms away where the Bunsen cells were located. He could connect any number of cells in series with the wires to and from the patient as well as to connect himself to the device as a "monitor." Details of this event were later recorded during the "Globe trial" of the 1880s at which Meucci submitted an affidavit as well as trial testimony. In his (translated) words; "...I held a similar instrument in my left hand. As soon as the person placed the contact on his lip, he received a discharge and shouted out. At the same time, I thought I heard this sound more distinctly than natural. I then put the copper of my instrument to my ear and heard the sound of his voice through the wire."

To continue testing his discovery Meucci added a cardboard bag—a funnel—around each copper contact to avoid injury by flesh contact (See Fig. 2-2). Meucci testified that he ordered the sick person to speak freely into the funnel, relating that "He put the funnel to his mouth, and I put mine to my ear. At each moment that said individual spoke, I heard sound of a

word, not distinct, a murmur, an inarticulate sound." This test was repeated several times that day, and several times on days thereafter. In his words: "From those moments on, I recognized that I had attained the transmission of human words by means of a wire conductor with a battery of electrical cells, and so named it the Speaking Telegraph."

After 1847 public attendance at the Teatro Tacon diminished, and the owner was considering closing it permanently. From 1847 to 1852 the Havana Opera Company engaged in tours to Charleston, Philadelphia, New York, and Boston. Since Meucci's contract with the Teatro Tacon was expiring, his friends suggest-

ed that he should move from Cuba, where venture capital was invested only into sugar production, to the United States where business opportunities for his inventions should be better. Other reasons for leaving Havana were that the local authorities were suspicious of his support of separatist activities and that he was a member of the Mason Lodge. By early 1850 he was convinced to make the move and the Meucci family made travel plans to accompany the Havana Opera Company on their next U.S. tour.

They sailed to New York in April 1850 on the frigate *Norma* bringing with them Antonio's laboratory supplies and their life savings of twenty-six thousand 'pesos fuertes' (about \$500,000 today). Antonio planned to continue his experiments and to develop and sell his chemical and electrical discoveries, despite his lack of knowledge of the English language, so vital in navigat-



Fig. 2-1. Phone used for transmitting and receiving; "a" is metal contact; "b" is handle; and "c" is wires going through the handle. (New York Public Library)

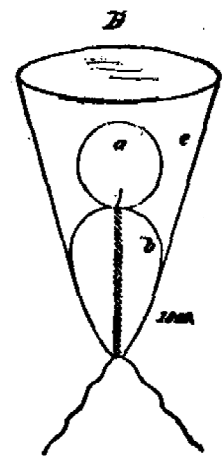


Fig. 2-2. Phone used for transmitting and receiving. (New York Public Library)

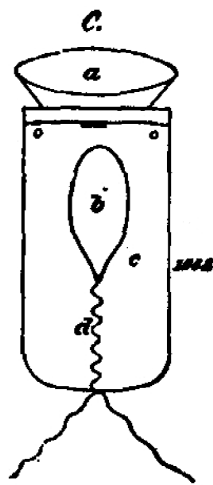


Fig. 2-3. Electrostatic phone used for transmitting and receiving. (New York Public Library)

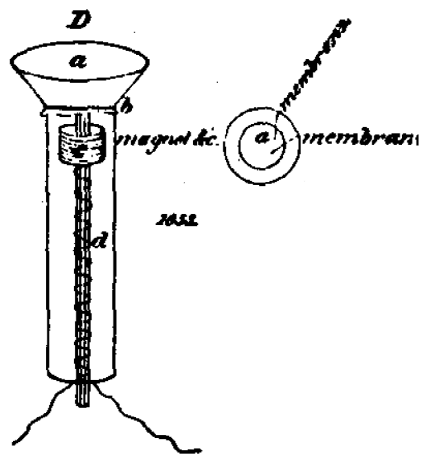


Fig. 2-3x. First electromagnetic phone instrument. (New York Public Library)

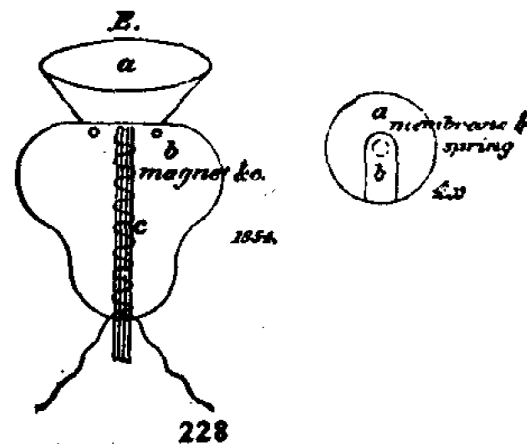


Fig. 2-4. Phone used for transmitting and receiving. (New York Public Library)

ing the complex New York business and financial worlds.

Alexander Graham Bell was but two years old when Antonio Meucci arrived in the United States in 1850. The Meucci's settled on Staten Island and bought a house that stands today as the Garibaldi-Meucci Museum on Tompkins Street. Giuseppe Garibaldi, later hero of the Italian Risorgimento came to live with Meucci between campaigns. He encouraged Meucci to employ other exiles to make stearic candles based on Meucci's original chemical compounds that predated those of Proctor & Gamble.

When Ester Meucci's arthritis confined her to her third floor bedroom, Antonio improved on his Speaking Telegraph (2-3, 2-3x), installing an intercom from there to his laboratories near the kitchen and in their yard. Following Galileo's teaching to *"provando e reprovando"* (try and try again), he experimented with diaphragms of animal material and of metal, first located above, then below, a metal tongue,² with wire windings on a tube filled with steel filings or a metal rod, both magnetized with a loadstone. He found them all to "react with the noise of the word," resulting in successive instruments. See Figs. 2-3, 2-3x and 2-4 (1853). In 1852 he contacted the manufacturers of Morse telegraph equipment—then in widespread use—to inquire where he could purchase materials and was referred to a "Mr. Chester who lived on Centre Street. In 1854...I...obtained bobbins and other utensils from Mr. Chester...he (Chester) showed me all the things necessary used then in the telegraphic art...my memory was opened to build some new instruments...after some reflection, I constructed a first instrument."

The Instrument (1854) used a magnetized rod, with a diaphragm (see Fig. 2-4) with a strange hole and a metallic tongue which he thought necessary to produce a voice signal. Meucci cited a platinum metal tongue, now known to be a slightly ferromagnetic material when containing a nickel impurity. The sound receiver/transmitter he developed was in essence a reversible variable reluctance transceiver. He varied between using ani-

mal diaphragms with a central metal "valve" and a metallic diaphragm set very close to the magnet. In 1856, he switched to a horseshoe magnet with a helical winding (Fig. 3-1, 1856), then back to a magnetized steel bar powered by a bobbin of wire (Fig. 3-2, 1859).

In 1857–1858, apparently ready to move forward with his invention, he asked New York artist Nestore Corradi to make a drawing from his sketch showing "a man in a sitting position holding in his hands two small apparatuses of concave form, attached to electric wires to be used one by the mouth in order to speak into it, the other to be placed to the ear to receive sounds of the human voice, so constituting a speaking telegraph" that he called a telephone.³ In 1860, Meucci wrote an article for publication in *L'Eco d'Italia* in New York detailing his "Speaking Telegraph." Meucci asked acquaintance, Enrico Bendelari, who was planning to spend some time in Naples on business, to seek an Italian backer there since Naples already had an extensive telegraph network. Meucci either gave Bendelari copies of his *L'Eco* article, or sent them to him later. By then Garibaldi had "liberated" Naples. The ruling Bourbon regime was failing, and backers who Bendelari approached were reluctant to proceed due to the evolving political situation in that region.

During the 1850's the Meucci's obtained ownership of the land adjacent to their cottage, and Antonio became a U.S. citizen in 1854. But he then dissipated their savings in poor business decisions and speculative chemical ventures including a candle factory and a brewery. Between 1858 and 1862 the Meucci's land was sold at public auction, but they were permitted to live in the cottage indefinitely. In December 1859 he wrote to his dear friend Garibaldi, now on campaign in Italy, "I have reduced myself to working like a 'garzone' to \$15 to the week, shame for me."⁴ Kerosene from Pennsylvania petroleum oil was discovered in 1859 and it diminished the candle business. His 1860 candle patent only brought him the opportunity to work for William Rider ("New York Paraffine Candle Co."), to

"In 1872, Meucci reproduced a pair of his "teletrofono" from left over parts and parts he could afford to buy and gave them to Grant, who did not seem to know the merit of these instruments."

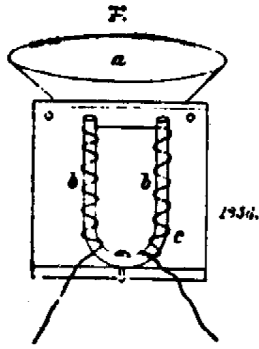


Fig. 3-1. Phone used for transmitting and receiving. (New York Public Library)

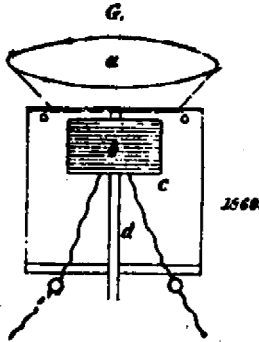


Fig. 3-2. Phone used for transmitting and receiving. (New York Public Library)

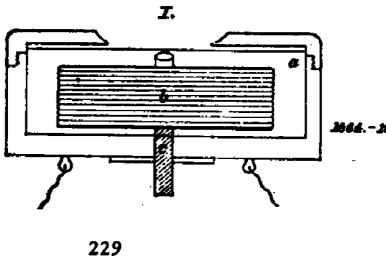


Fig. 3-3. Phone used for transmitting and receiving. (New York Public Library)

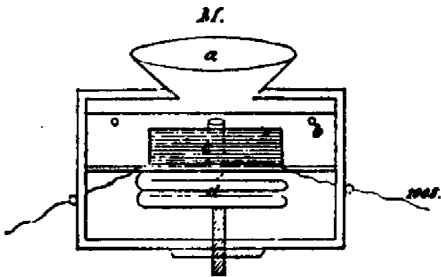


Fig. 4. Phone used for transmitting and receiving. (New York Public Library)

whom he had assigned the patent. Meucci also obtained patents on a bright kerosene lamp (1862), paint oils from kerosene (1863), paper pulp from wood and/or vegetables (1865), wicks from vegetables (1865) and a vitamin drink (1871), a meat sauce (1873) and a Lactometer (1875) that predated the Babcock test by 15 years. He was

encouraged in 1865 to make better records of his telephone experiments which he recorded in a bound memorandum book given to him by Mr. Rider⁵ from the Rider & Clark office on Broad Street in Manhattan, where his candles had been merchandised.

Meucci's fortunes turned decidedly for the worse on the ferry steamer *Westfield* on 30 July 1871 en route from Manhattan to Staten Island when its boiler burst, killing many people on board. Meucci was seriously scalded and his convalescence exhausted his finances in the post-Civil War depression. During that decade, Meucci and his invalid wife lived a frugal existence. They were given charity by their

friends and coal, groceries, and a dollar a week by the Supervisor of the Poor of Staten Island as late as 1880.

His next effort was to form an agreement, validated by a notary on 12 December 1871, founding the "Teletrofono Company" in partnership with acquaintances Italian Consulate Secretary A. Z. Grandi, contractor A. A. Tremeschin and cigar stand operator S. G. P. Breguglia. That agreement predated by four years an analogous February 1875 agreement between Alexander Graham Bell, Thomas Sanders and Gardiner Hubbard. The U.S. Patent office "Caveat," an announcement without drawings of intent to patent for fee of \$10, had

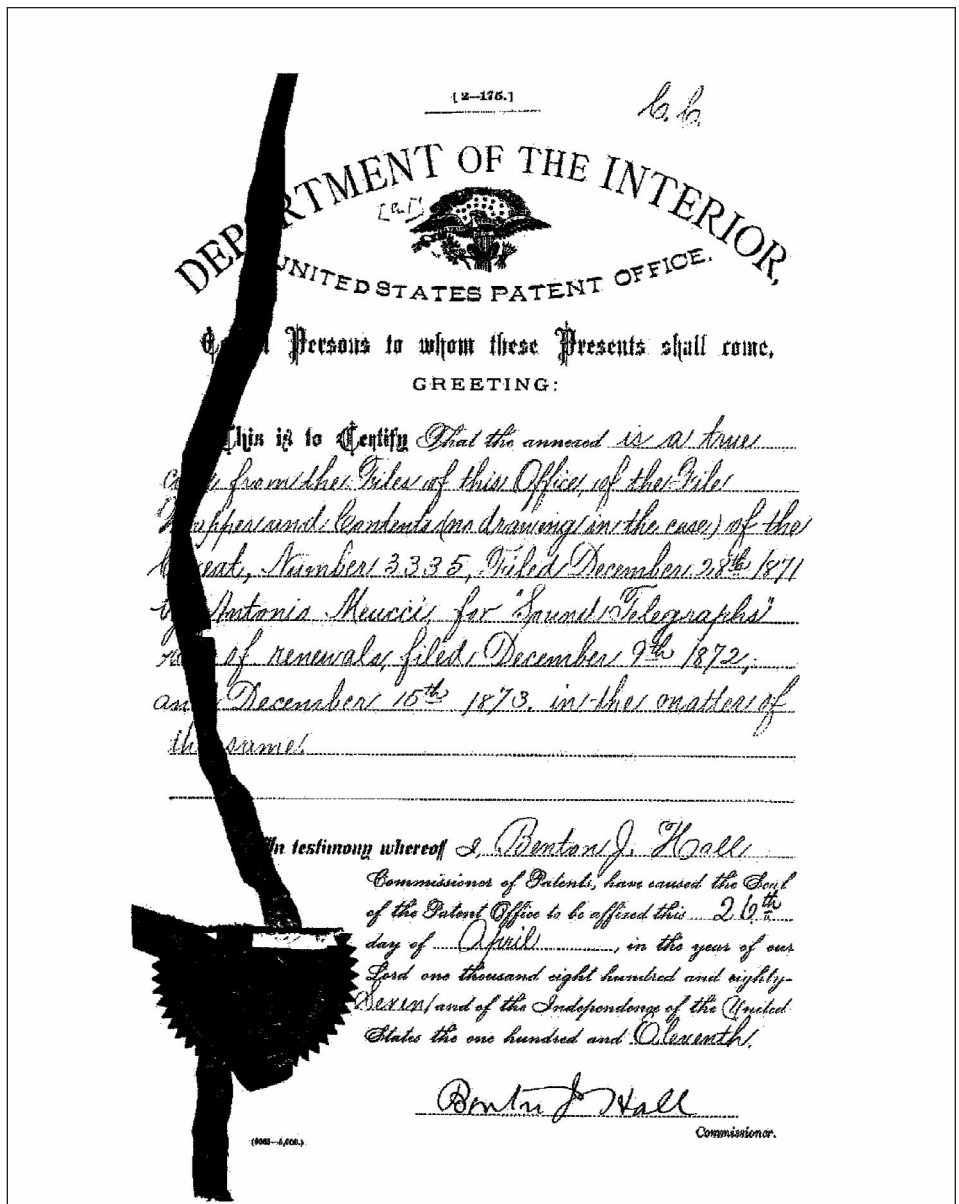


Fig. 5. Certificate verifying the 1871 Caveat¹¹. (National Records Administration, New England Division)

become available in July 1870. On 28 December 1871, Meucci filed a one-year Caveat on his "Sound Telegraph," requiring a \$10 fee plus another \$10 for the lawyers' effort. A full patent including the attorney's fee and drawings would cost \$250 that his partners would not offer to Meucci. Figure 5 is a photocopy of an 1887 certificate testifying to the existence, date and number (3335) of that Caveat.⁷ Figure 6 is an 1880's recreation of the 1859 Corradi drawing,⁸ the original of which could have been submitted with an 1871 patent application, were it to have been filed then. Figures 7-8 are photocopies of the first and last pages of the Caveat on display at the Garibaldi-Meucci Museum⁹ possibly the "copy" referenced in the Certificate. Within the Caveat text, it is clear that Meucci had a clear vision of the system necessary for two-way vocal communication across considerable distances, including the need for quiet.

Since two of his partners left New York in less than a year, Meucci approached Edward B. Grant of the American District Telegraph Company in New York in 1872 with a request that his "teletrofono" be tested on that company's telegraph lines. Meucci explained that his July 1871 injuries had confined him to bed, near death at times, and that his wife sold most of his electrical instruments for money to pay medical expenses and for the necessities of life. Grant said that he would, in Meucci's words "put at my disposal the telegraph lines needed, provided I would bring in an exact explanation of the mode of operation of the affair, and some drawings, and also some instruments to speak."¹⁰ Meucci reproduced a pair of his "teletrofono" from left over parts and others that he could afford to buy and gave them to Grant, who did not seem to know the merit of these instruments.

Enter Western Union electricians Frank L. Pope and George Prescott, and Frank's brother, Henry Pope, a superintendent in the American District Telegraph Company which was a contractor to Western Union. What happened after 1872 is still a matter of speculation. Frank had the duty¹¹ "...to examine the novelty and utility of the various new inventions relating to telegraphy, which were constantly being presented to the officers of these companies (Western Union and the old Stock Telegraph Co.) for approval or adoption." George on the other hand "...had to act as a barrier to a flood of inventions brought to the company for attention."¹² Two years passed during which time nothing was reported to Meucci. In 1874, Meucci demanded "restitution of the descriptions and given designs,"¹⁴ to which Grant replied that he had mislaid them. Lacking even the \$10 to renew the Caveat, Meucci allowed it to lapse on 28 December 1874.

According to sworn depositions, it was not until 1877 that Henry brought "...some Bell instruments that were placed in the hands of the American District Telegraph Company for I don't know what purpose" to Frank's house for testing on a telegraph line between the brothers' homes. The instruments are said to have "...worked well, and they spent two or three hours talking."^{11,12}

Alexander Graham Bell recalled in a 1922 National Geographic article¹³ that in the 1860's, in addition to formal schooling in Scotland, he observed his father and grandfather in their physiological experiments on speech utterances and "vibrations" and in the teaching of deaf students to produce

H. Res. 269

In the House of Representatives, U.S.,

June 11, 2002.

Whereas Antonio Meucci, the great Italian inventor, had a career that was both extraordinary and tragic;

Whereas, upon immigrating to New York, Meucci continued to work with ceaseless vigor on a project he had begun in Havana, Cuba, an invention he later called the 'teletrofono', involving electronic communications;

Whereas Meucci set up a rudimentary communications link in his Staten Island home that connected the basement with the first floor, and later, when his wife began to suffer from crippling arthritis, he created a permanent link between his lab and his wife's second floor bedroom;

Whereas, having exhausted most of his life's savings in pursuing his work, Meucci was unable to commercialize his invention, though he demonstrated his invention in 1860 and had a description of it published in New York's Italian language newspaper;

Whereas Meucci never learned English well enough to navigate the complex American business community;

Whereas Meucci was unable to raise sufficient funds to pay his way through the patent application process, and thus had to settle for a caveat, a one year renewable notice of an impending patent, which was first filed on December 28, 1871;

Whereas Meucci later learned that the Western Union affiliate laboratory reportedly lost his working models, and Meucci, who at this point was living on public assistance, was unable to renew the caveat after 1874;

Whereas in March 1876, Alexander Graham Bell, who conducted experiments in the same laboratory where Meucci's materials had been stored, was granted a patent and was thereafter credited with inventing the telephone;

Whereas on January 13, 1887, the Government of the United States moved to annul the patent issued to Bell on the grounds of fraud and misrepresentation, a case that the Supreme Court found viable and remanded for trial;

Whereas Meucci died in October 1889, the Bell patent expired in January 1893, and the case was discontinued as moot without ever reaching the underlying issue of the true inventor of the telephone entitled to the patent; and

Whereas if Meucci had been able to pay the \$10 fee to maintain the caveat after 1874, no patent could have been issued to Bell: Now, therefore, be it

Resolved, That it is the sense of the House of Representatives that the life and achievements of Antonio Meucci should be recognized, and his work in the invention of the telephone should be acknowledged.

Attest:

Clerk.

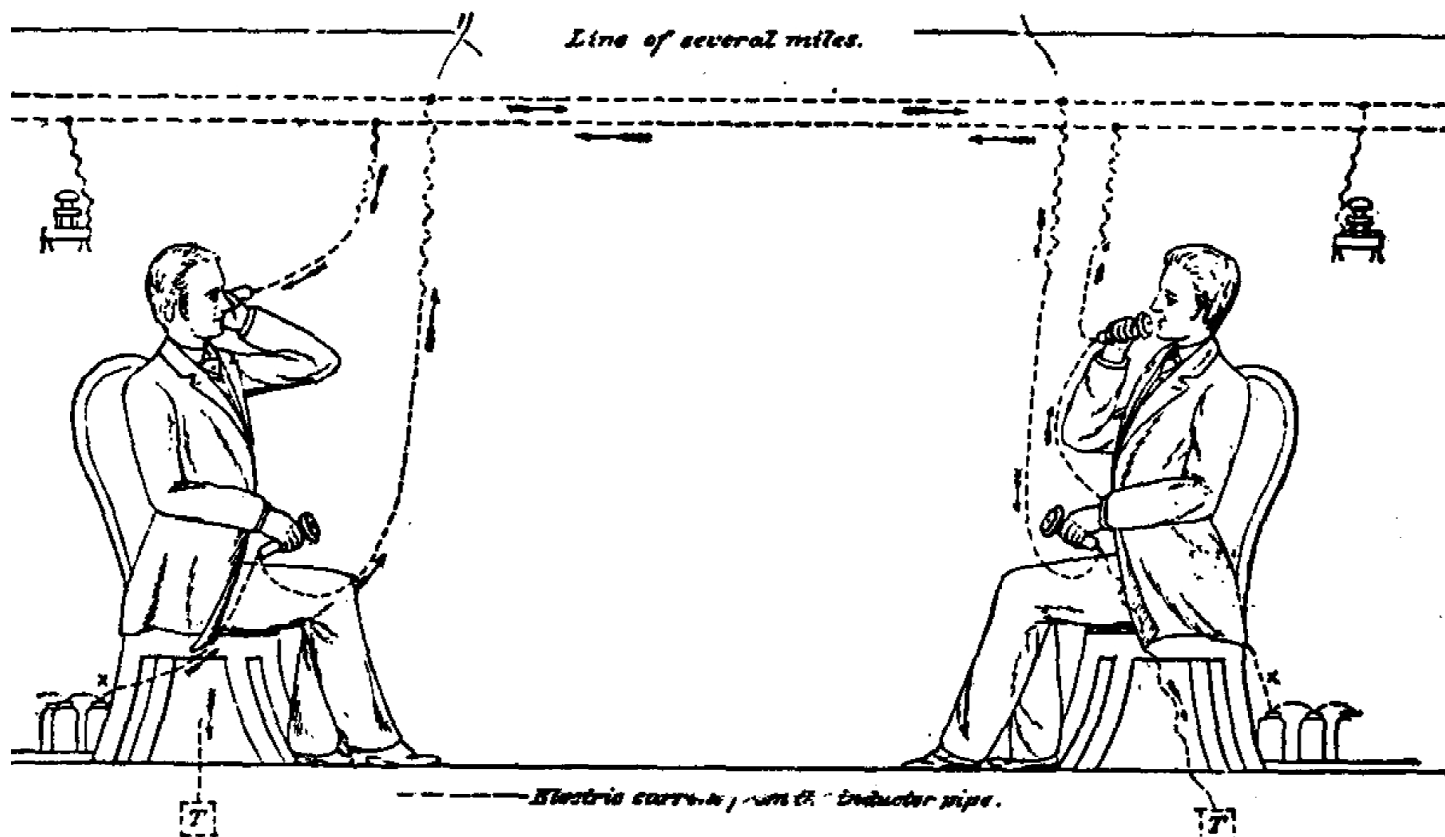


Fig. 6. Corradi's 1883 recreation of the drawing that he furnished Meucci in 1858. (Garibaldi-Meucci Museum)

sounds with their vocal organs. Bell became aware of Helmholtz's works on tone sounds with an electric tuning fork, and those of Wheatstone who had reconstructed a speaking machine suggested by Baron von Kempelen. Alexander and his brother, Melville, attempted to build the same device from artificial vocal cords driven by the wind chest of their parlor organ. Later they caused a dog to produce words by their manipulation of the dog's mouth and throat. In Scotland and in London, as of age 18 (circa 1864), Bell was unaware of electricity and magnetism. Then he immigrated to Boston, Massachusetts to eventually become a professor of vocal physiology at Boston University. While in America, Bell undertook the study of electricity.

Bell's quoted recollection of the foundation for his invention was only "my crude telephone of 1874-1876."¹³ Review of the facts now known of that time indicates that Bell's device would have been created while teaching at Boston University and despite urgings from his associates Messrs. Saunders and Hubbard that "multiple telegraphy" (transmission of several simultaneous telegraph messages over a single wire line) would have much greater monetary value. Bell had made it known in October 1874 of his intent to patent a telephone.¹⁴ Bell then used the New York facilities of Western Union in March, April and May 1875 for his telephone experiments. Bell was assisted by Henry Pope and George Prescott. In May 1875 Bell announced the addition of variable resistance to his initial telephone conception. Bell signed his "Improvement in Telegraphy" patent application on 30 January 1876, which included "...causing electrical undulations, similar in form to the vibrations of air accompanying

said vocal or other sound..."

Both Elisha Gray, an inventor who was also working on a telephone with a liquid microphone invention unbeknownst to Bell, and Bell both filed applications on February 14, 1876. Gray's was for a Caveat, while Gardiner Hubbard's lawyers filed a patent on behalf of Bell. On March 7, 1876 Patent #174,465 was issued to Alexander Graham Bell for his "Improvement in Telegraphy," aimed at performing multiple message telegraphy. Here, an armature moving near the pole of a small electromagnet produced an undulating current. Bell also cited "...another mode...where motion to the armature (is) by the human voice or musical instrument" and a corresponding claim. On March 10, 1876 Bell demonstrated converting words into electrical current using the variable-liquid resistance documented in a second patent.¹⁵ His assistant, in an adjoining room in Boston, heard Bell say over the experimental device the soon-to-be-famous words: "**Mr. Watson, come here, I want to see you.**"

After learning that Bell was granted the March 1876 patent on the transmission of voice over wires, Meucci demanded his priority in the matter. Technically this was possible on the basis of Meucci's 1871 Caveat, renewed for a total of three years through 28 December 1874 while Bell, as he later declared under oath, had his first idea of the (electromagnetic) telephone the summer of 1874. Years later, Meucci's precedence would be based on the fact that Bell's patent did not constitute "*new and useful art... not before known or used in this country, and not patented or described in one whichever printed publication, in this or other countries, and that has not been publicly used or sold for more than two*

years from the date in question.”

On June 25, 1876, Alexander Graham Bell demonstrated his telephone at the Centennial Exposition in Philadelphia. The Bell Telephone Company was formed in 1877. On March 13, 1879, New England Telephone and Bell Telephone merged to become the National Bell Telephone Co. On April 17, 1880, National Bell reached a settlement with Western Union and became the American Bell Telephone Company. In March 1885 American Telephone and Telegraph (AT&T) was incorporated as a subsidiary of Bell Telephone to build and operate a long distance telephone network.

Meucci increased his efforts to capitalize on his rightful invention. After 1880, there were widespread complaints of poor service by the Bell Company. With the aid of Meucci, a syndicate was formed in 1883 and named the Globe Telephone Company. Globe “...(was) formed for the purpose of carrying on some part of its business out of the State of New York ...and the names of the town and county in which the principal part of the business of said Company within this State is to be transacted are the City and County of New York.” Using Meucci’s inventions as the basis, Globe planned to build and sell Meucci telephones to that market as well as “...wire, switchboards, insulators, etc., at low rates.” Globe apparently paid Meucci a salary of \$150/month until 1886.

Globe had by then obtained Meucci’s rights and inven-

tions. They secured evidence that they believed would convince (at the proper time) the highest court in the U.S. of the truthfulness of the statements made in a Complaint filed with the U.S. Justice Department by Globe late in 1885. That Complaint disputed the Bell patents on the basis that the Meucci Caveat filed five years prior to Bell had rendered the Bell Patents as worthless. The ensuing trial led to the Meucci deposition and exhibits supporting his prior discoveries and inventions. The case was heard in U.S. Federal Court during which affidavits by many people from Staten Island and New York attested to the existence of and experience speaking with the Meucci telephone instruments. Bell then sued Globe for infringement in the Southern District Court of New York, presided by Judge William James Wallace. The belabored testimony by Meucci was in Italian, translated to English, then frequently misinterpreted and challenged by the testimony of Charles R. Cross, a Professor-Engineer from the Massachusetts Institute of Technology. In the end, Judge Wallace ruled in favor of Bell, accepting Professor Cross’s interpretations, declaring in his judgment brief that that Meucci’s devices were little more than a toy “string telephone.”

For the 1880’s trials, exhaustive searches by all parties to find a copy of the Meucci telephone article in *L’Eco* and related information failed. In 1880 the Globe Company offered a \$100 reward for “all the numbers of the *Eco d’Italia* which speak of the telephone of Mr. Meucci from 1859 to 1862.” In 1885, the private collection of *L’Eco* owned by Dr. John Citarotto of New Orleans was sold to the Bell Company for \$125. There were many issues missing from that 1857–1881 collection, especially those from 1859 to 1863. To this day, copies of *L’Eco d’Italia* from and including December 1860, all of 1861, 1862 and 1863 have not been found.

Details about Meucci emerged during the 1886 trial where the defendant, Globe Telephone Company, was being sued by Bell Telephone Company for patent infringement. A 214 page deposition by 77 year old Meucci contained a description of twelve of his 30-odd telephone devices created between 1849 and 1865 (Fig. 2-1 through Fig. 4). When asked at one point in cross-examination “What business did you undertake after you gave up the candle factory?” his answer was “Nothing; what I have done all my life—experiments.” (It was within these and other obscure but detailed records in clear Italian and English, including an English translation of his memorandum book for another trial,³ where conclusive proof that Meucci had priority in the invention of the telephone was discovered.)

There followed over several years a series of complaints by Meucci *et al.* against Bell, and demurs by the U.S. Government,¹⁶ ending with case abandonment in 1897; it had by then become “moot” since Bell’s questioned 1876 patent would expire in 1893. Antonio died in October 18, 1889 on Staten Island.

Overall, the U.S. Government actions in response to Meucci’s claims were: March 1886–Bill of complaints in Southern Ohio; December 1886–Ohio Case dismissed; January 1887–Bill of Complaints filed in Massachusetts; Judges sustain demurer by Bell lawyers; November 1887–Government appeals to Supreme Court; November, 1888–Supreme Court reverses verdict, rejects demurer and remands the case for trial;

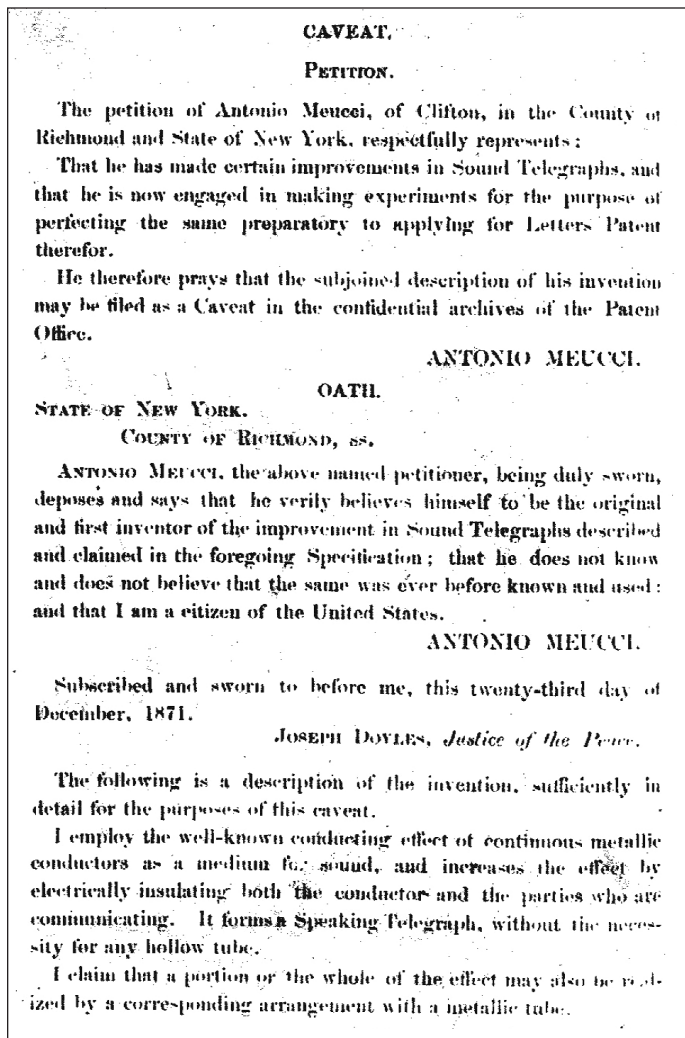


Fig. 7. First text page of the 1871 Caveat. (Garibaldi-Meucci Museum)

fact I may say must be, metallic, and be so conditioned as to be good conductors of electricity.

I claim as my invention, and desire to have considered as such, for all the purposes of this Caveat,

The new invention herein set forth in all its details, combinations and sub-combinations

And more especially I claim

First. A continuous sound conductor electrically insulated.

Second. The same adapted for telegraphing by sound or for conversation between distant parties electrically insulated.

Third. The employment of a sound conductor, which is also an electrical conductor, as a means of communication by sound between distant points.

Fourth. The same in combination with provisions for electrically insulating the sending and receiving parties.

Fifth. The mouthpiece or speaking utensil in combination with an electrically insulating conductor.

Sixth. The ear utensils or receiving vessels adapted to apply upon the ears in combination with an electrically insulating sound conductor.

Seventh. The entire system, comprising the electrical and sound conductor, insulated and furnished with a mouthpiece and ear pieces at each end, adapted to serve as specified.

In testimony whereof, I have hereunto set my name in presence of two subscribing witnesses.

ANTONIO MEUCCI.

Witnesses :

SHIRLEY MCANDREW.

FRED'K HARPER.

Endorsed : Patent

Dec. 28, 1871.

Office.

Fig. 8. Last text page of the 1871 Caveat. (Garibaldi-Meucci Museum)

November 1897—The U.S. Supreme Court trial was closed by consent as moot. In all, some 18,000 pages of testimony and information—never formally published—resulted from these trials which were held over a 12-year period. Neither Bell nor the Bell Telephone Company ever won any of these trials. Much of this information is still available in major libraries throughout the U.S.^{7,8}

In H. A. Frederick's paper on microphone development that was published in the *Journal of the Acoustical Society of America* in 1931,¹⁷ Meucci was not mentioned along with the 19th century works of Reiss, Dolbear, Blake, Drawbaugh and others because Meucci never developed a variable resistance transmitter, later called a "microphone." It was not until 1933 that Guglielmo Marconi, "Father of the Radio," in celebrating contributions to communications at the World exhibition in Chicago, displayed models of Meucci's 1857 and 1867 ear-piece-transmitters.⁵ These were constructed like illustrations in Figs. 2-2 and 2-4, but with a handle. Marconi had commissioned the Galileo Workshops in Florence, Italy to construct four telephone pairs from Meucci's notes and sketches (Fig. 9). One pair remained at the Museum of Science and Industry in Chicago, another in the National Science Museum in Milan, Italy, a third in the SIRT

Telecommunications Museum. Photographs of a pair of these handsets as well as models of earlier Meucci instruments and a rare copy of the famous Caveat are on exhibit at the Garibaldi-Meucci Museum.

Giovanni Schiavo published research on these matters in his 1958 book¹ on Antonio Meucci. In 1998, an Italian telecommunications engineer Basilio Catania,^{8, 18} noticed a newspaper article about Antonio Meucci that claimed that he invented a "Sound Telegraph" before 1870. He found articles about Meucci in his company's library, and more unpublished information about Meucci in libraries in Florence and Rome. Catania began serious research about Meucci upon his retirement in 1990 through a grant from his employer and visited Havana, Washington, Staten Island, and Bayonne, New Jersey. He found historical trial documents at the U.S. National archives and New York and New England archives. It was not until 1994 that he identified convincing evidence of Meucci's inventive priorities in a 1885 translation of Meucci's laboratory memorandum book by Michael Lemmi,⁶ a New York attorney and acquaintance of Meucci.

Most convincing was a sketch created by Meucci about his telephone test wiring in 1862 that showed a large wire coil midway along a long transmission line. Meucci had testified that this coil made long distance voice reproduction stronger and clearer.¹⁹ This phenomenon, inductive loading, was rediscovered by Pupin some 30 years later; 18 years after the 1883 trial. In all, there were four noteworthy discoveries or observations by Meucci: (1) That inductive loading of long transmission lines will "increase the strength and clearness of the voice" Memorandum Book page 35, 1870 (patented by Pupin in 1900), (2) That thicker wires and preferably multiple copper wires wrapped in cotton or paper for insulation were needed to transmit the voice more clearly (realized today as the measure required to counteract the rise in wire resistance to high frequency currents via the "skin effect") and to obtain a distance of about one mile,¹⁹ Memorandum Book, August 1870; (3) There is need for quiet isolation when listening to the transmitted voice; (4) That an anti-side tone circuit is feasible, where a talker does not have to listen to his own voice, and is represented by the second and separate transmission wire in Corradi's drawing, Fig. 6. Discoveries 2 and 3 above were quoted in his 1871 Caveat. Discovery 3 is linked to the hidden benefit of the telephone; that confidential privacy is assured since no one else can see or hear the messages transmitted; an advantage overlooked by most or all 1860-1875 financial backers.

Catania presented a lecture on Meucci at New York University in 2000.²⁰ Peter Vallone, then Speaker of the New York City Council, learned of this lecture and introduced City Council resolution No. 1556, to recognize the priority of Meucci's invention of the telephone that passed unanimously. Representative Eliot Engel, from New York then introduced U.S. House Resolution No. 269 to acknowledge Meucci as the true inventor of the telephone. On June 11, 2002, Jo Ann Davis of Virginia moved to suspend the house rules and agree to Resolution 269. After commemorating statements of several other representatives, H269 was passed with a two-thirds majority.²¹

In Catania's words "This Florentine takes his place

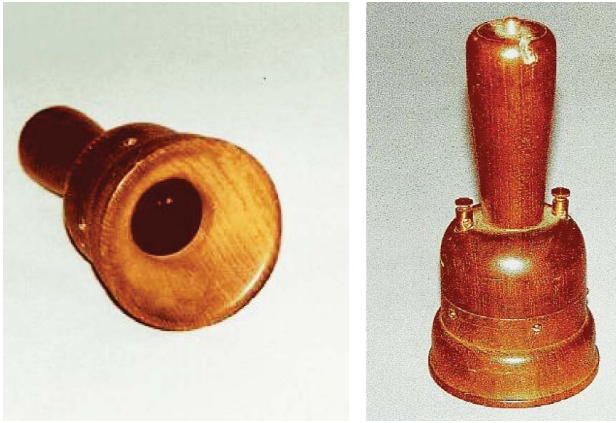


Fig. 9. Marconi's reconstruction of Meucci's 1857-67 Telephone. (Photo by Maurizio Ghisellini for Basilio Catania in the early 1990's).

among others such as Dante, Michaelangelo, Galileo, Lorenzo Ghiberti and Machiavelli." In Jo Ann Davis's words; "Meucci should be remembered with other innovators, like Edison, the Wright Brothers, and Marconi whose vision and tenacity changed our lives for the better."^{AT}

Endnotes:

Figure 1 is a photo of Antonio Meucci by L. Alman. The original is in the Museo del Risorgimento, Milan, Italy.

Since the initial phono-electric effect was first discovered in Havana by accident in 1849, Cuban authorities can claim Havana to be the birthplace of telephony.

In 1881, after the cottage lot was sold to a brewery that had already bought the adjacent lots, the cottage was moved to the easterly side of Forest Street, keeping its orientation unchanged. Later, around 1905 it was moved again to its present location at the corner of Chestnut Avenue and Tompkins Street.²⁴ The Order of the Sons of Italy in America now maintains the Garibaldi-Meucci Museum at 420 Tompkins Street, Staten Island, NY 10305. See <http://www.garibaldimeuccimuseum.org/>.

A detailed obituary of Antonio Meucci was published in the *Baltimore Sun* on 19 October 1889.

American historian-writer Giovanni Schiavo¹ documented Meucci's life in 1958. Basilio Catania, a retired Italian telecommunications engineer, performed in-depth research^{18,23} from 1989 to 2002, on Meucci's works. Details from the works of both these authors were used as the foundation of this article.

A few copies of Schiavo's book on Meucci might be found for sale on the internet. Schiavo's collected works as well as a collection on Meucci may be found at the American Italian Museum and Research Library in New Orleans (www.airf.org).

Catania has available a CD¹⁸ with all his data, document copies and his presentations in English, Italian and Spanish. He has also published a fascinating biography of Antonio Meucci in three phases; Florence, Havana, and New York with comments on the scientific knowledge and social conditions of those times.²⁴

References for further reading:

- 1 Giovanni Schiavo, *Antonio Meucci, Inventor of the telephone*, (The Vigo Press, New York, 1958).
- 2 Deposition of *Antonio Meucci*, rendered Dec. 7, 1885-Jan. 13, 1886, National Archives and Records Administration, Northeast Region, New York, NY. Records of the U.S. Circuit Court for the Southern District of New York. The American Bell Telephone Co. *et al.* vs. The Globe Telephone Co. *et al.* Also "Deposition of Antonio Meucci," New York Public Library (Annex), Answers 14-17 and Meucci deposition of 11 September 1886, answers 626-630.
- 3 Affidavit of *Antonio Meucci*, sworn Oct. 9, 1885, National Archives and Records Administration, Northeast Region, New York, NY. Records of the US Circuit Court for the Southern District of New York. The American Bell Telephone Co. *et al.* vs. The Globe Telephone Co. *et al.* Deposition of Antonio Meucci, Defendant's Exhibit No. 120. Also "Deposition of Antonio Meucci," New York Public Library (Annex), Part 2, pp. 10-32.
- 4 Basilio Catania, www.comunicazioni.it, extract from a 26 December 1859 letter to Garibaldi from Meucci, computer translation into English.
- 5 B. Catania, "Antonio Meucci's 'Teletrofono'—The True Story Behind the Invention of the Telephone," *Accenti*, The Canadian Magazine with an Italian Accent I(3), 16-28 (July-August 2003). Also reproduced in "Puglia Review" (Canada) V(4), Winter 2003; Vol. VI(2), 6-8, 17, 30-32 (Summer 2004). See also Ref. 2, 11 September 1886 deposition answer #3.
- 6 Affidavit of *Michael Lemmi* (Translation of Meucci's *Memorandum book*), sworn Sept. 28, 1885, National Archives and Records Administration, College Park, MD-RG60, Year Files Enclosures 1885-6921, Box 10, Folder 1, 230/3/46/6 (originally filed at the Interior Department file 4513-1885, Enclosure 2).
- 7 A. Meucci, *Sound Telegraph*, U.S. Pat. Off. Caveat No. 3335, filed Dec. 28, 1871; renewed Dec. 9, 1872; Dec. 15, 1873. File wrapper kept at the National Archives and Records Administration, College Park, MD (USA) -RG60, File 6921-1885, Box 10 (or Massachusetts-Box 137), Folder. Also "Deposition of Antonio Meucci" (Defendants' Exhibits No. 111, 122 & 123), Part 2, pp. 1-9, New York Public Library. Also "Deposition of Thomas D. Stetson" (Defendants' Exhibit 141 1/2), Records of the U.S. Circuit Court for the Southern District of New York, "American Bell Telephone Co. *et al.* vs. Globe Telephone Co. *et al.*," National Archives and Records Administration, Northeast Region, New York, NY. Also Records of the Circuit Court of the United States, District of Massachusetts, "United States of America vs. American Bell Telephone Co. and Alexander Graham Bell," Exhibit from Defendants, National Archives and Record Administration—New England Region, 380 Trapelo Road, Waltham, MA (USA)
- 8 Caveat as recorded in the Records of the Supreme Court. Possibly referenced by [5]. Reproduced with the permission of the Garibaldi-Meucci Museum.
- 9 Meucci testimony, Bell vs. Globe, Answer #94. See Ref. 1
- 10 Ref. 5, answer 94.
- 11 Ref. 1, p. 166-168.
- 12 Ref. 1, p 180.
- 13 Alexander Graham Bell, "Prehistoric Telephone Days," *National Geographic Magazine* XLI(3) (March 1922).
- 14 Edwin Grosvenor and Morgan Wesson, "Alexander Graham Bell, The Life and Times of the Man Who Invented the Telephone" relates that in Oct, 1874 Alexander Graham Bell stated his basic idea for the telephone.

- ¹⁵ A. G. Bell, *Improvement in Telegraphy*, U.S. Patent No.174465, filed Feb. 14, 1876, granted Mar. 7, 1876, USPTO. A. G. Bell, *Improvement in Electric Telegraphy*, U.S. Patent No. 186787, filed Jan. 15, 1877, granted Jan. 30, 1877, USPTO.
- ¹⁶ See Ref. 18, “2003c_Toronto_Univ.ppt”. “US/Bell (1) and Bell/Globe (2)”. Articles on the Meucci–Globe trials appeared in the 9 November, 1885 Chicago Tribune (under “Telephone Patents”), and the December, 1885 Scientific American, “Meucci’s Claims to the Telephone” (see <http://www.gutenberg.org/files/13401/13401-h/13401-h.htm#13>).
- ¹⁷ H. A. Frederick, “Development of the microphone,” *J. Acoust. Soc. Am.* **3**(1), 1–30 (1931).
- ¹⁸ B. Catania, Meucci Twin CD, Available on request.
- ¹⁹ Ref. 19, Fig. 2 and ref. 19, August 18, 1870.
- ²⁰ B. Catania, *Antonio Meucci, Inventor of the Telephone: Unearthing the Legal and Scientific Proofs*, New York University, Casa Italiana Zerilli-Marimò, New York, NY, 10 October 2000, also published in *Bulletin of Science, Technology & Society* **24**(2), 115–137 (April 1994).
- ²¹ U.S. Congressional Record: House of Representatives, on June 11, 2002, U.S. Congress enacted House Resolution 269 (Jo Ann Davis, H3308 insert of 5-03-03) that Antonio Meucci, then an Italian-American candle maker, is credited for inventing the telephone, 5 years before Bell.
- ²² Basilio Catania, “Antonio Meucci: How electrotherapy gave birth to telephony,” *European Transactions on Telecommunications* **14**, 539–552 (2004).
- ²³ B. Catania, Antonio Meucci: How electrotherapy gave birth to telephony, ETT—*European Transactions on Telecommunications* **14**(No. 6, November/December 2003, p. 539–552. Errata Corrige of Fig. 12 on Vol. 15, No. 3, May/June 2004, p. 293.
- ²⁴ B. Catania, Antonio Meucci –L’Inventore e il suo Tempo – Da Firenze a L’Avana (Vol. 1). Seat – Divisione STET, Editoria per la Comunicazione, Roma, 1994 and Catania, B., Antonio Meucci –L’Inventore e il suo Tempo – New York, 1850-1871 (Vol. 2) . Seat – Divisione STET, Torino, 1996—Translation in English included in Ref. 3.



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He has presented and published technical papers on acoustics, noise and the associated hearing loss. These

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He is a fellow of the Acoustical Society of America (ASA), a distinguished member of the American Society for Testing and Materials (ASTM) Committee E-33 on Environmental Acoustics (participating in the drafting of national and international acoustical material measurement standards), National Council of Acoustical Consultants, the Concert Hall Research Group, and the Institute of Noise Control Engineers. Angelo formed the Central Ohio Chapter of ASA in 1976 and currently serves as its president. He is an aircraft owner and pilot holding commercial, instrument and flight instructor ratings.