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The Meucci-Bell Dichotomy

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ABSTRACT

The Resolution No. 269 of the U.S. House of Representatives, honoring the life and achievements of Antonio Meucci and his work in the invention of the telephone, also contains statements that may be interpreted as discrediting Alexander Graham Bell. This has naturally caused reactions from many parts, as from the Canadian Parliament, which, shortly after, voted a motion upholding Bell's merits. This paper aims at shedding some light on what was, at the time, a harsh dispute, that may resurrect today with undue impetus, given the work done in the meantime by impartial historians. This author feels his duty to bring to the attention of the scientific community some evidence, as stemming from little known documents, not considered before.

Foreword

Italians or Italian descendants, particularly in the United States, as well as Cubans[1], exulted on the evening of July 11, 2002, when the U.S. House of Representatives passed Resolution No. 269 "to honor the life and achievements of 19th Century Italian-American inventor Antonio Meucci, and his work in the invention of the telephone" [2][2].

The resolution, however, also recited "in March 1876, Alexander Graham Bell, who conducted experiments in the same laboratory where Meucci's materials had been stored, was granted a

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[1] Antonio Meucci lived 15 years in Havana, Cuba, from 1835 to 1850. He made his discovery of the electrical transmission of speech in Havana, in 1849, one year before emigrating to the United States [1].

[2] All other documents (6 until now) of the U.S. House of Representatives relating to Antonio Meucci, in addition to [2], can be accessed from http://thomas.loc.gov/home/thomas.html, by typing "Meucci" in the "Search" string.

patent and was thereafter credited with inventing the telephone." This would imply, in more crude words, that Alexander Graham Bell stole Meucci's invention.
Immediately, Bell supporters rose, in the United States as well as in Europe and Canada, to remind the world of the greatness of their idol, compared to the insignificance of his contender, who had been called by Bell's lawyer "the silliest and weakest impostor who has ever turned up"[3].
There are also the more diplomatic, such as Bill Gates, the renowned president of Microsoft Corporation, who try to content everybody by affirming that "truth can be relative" [4]. More precisely, he wrote "Did the American Alexander Graham Bell invent the telephone? Or was it the Italian-American Antonio Meucci? . . . . In a forthcoming Italian version [of *Microsoft Encarta Encyclopedia*] Meucci is credited with developing the first rudimentary telephone in 1854 and filing preliminary papers with the U.S. patent office in 1871. In 1876 another inventor, A.G. Bell, patented a similar device. . . . Bell obtained fame and wealth, while Meucci died in poverty."
Gates's statement, of course, was good to promote sales of his Encyclopedia worldwide and also for this author, who got a contract from Italian *Encarta 2001 Encyclopedia* to draft biographies of telephone inventors, including Antonio Meucci. But it is hard to accept the idea that truth is like a rubber thing, that can be adapted to the beliefs of individuals or individual countries. Most of us, especially researchers, as is this author, have dreamed of truth as a magnificent lady — as beautiful as she is difficult to reach —worthy to be approached as much as possible. Shall we throw our dream away? If not, where does the truth lie about the Meucci-Bell dichotomy?
I should remark, beforehand, that the issue of whether Bell did or did not "steal" Meucci's invention should be irrelevant to Meucci fans, given that Meucci's priority has now been largely and unquestionably proven [6, 7, 8, 9], independent of whatever Bell did afterwards. But it is not irrelevant to Bell fans and to the memory of Alexander Graham Bell, not to speak of people who love gossips and those who cannot live without an enemy. I will, therefore, try to shed some light on the issue of when, where, how and to what extent — and whether or not — Mr. Bell could have gotten information on Meucci's telephone, that he may have later exploited in his own telephone devices and/or system.

The origin of the suspicion

When the news spread of Bell's first telephone patent [10][4], Meucci and his friends were literally shocked, as they could not believe that the invention of the telephone could have been credited to anyone else but Antonio Meucci. The latter, in particular, stated in his affidavit of October 9, 1885 [12]:

> . . . . I never in my life heard of a telephone, or of an invention for speaking over wires, electrically, except my own invention, until I saw, during the centennial year, that Gray and Bell[5] had patented my invention. . . .

A friend of Meucci, Leonard D. Cunningham, echoed, in his affidavit, Meucci's dismals [13]:

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[3] This statement is said to be contained in a letter addressed to Alexander Graham Bell by James J. Storrow, his lawyer ([3], p. 272]).
[4] The general public was aware of Bell's telephone many months after his first patent [10] was granted. A modest publicity was given to Bell's demonstration at the Philadelphia Centennial Exposition of June 25, 1876. Much more publicized were his succeeding public demonstrations, made in several cities of the United States between May and June 1877 (three of them were held in New York, three in Boston, one each in Lowell, MA, Springfield, MA, Lawrence, MA, New Haven, CT, Manchester, CT and Providence, RI). An extensive and detailed report on the aforesaid demonstrations is given in [11].
[5] The reason why Gray's name was coupled with Bell's by Meucci and his supporters stems from the fact that both of them filed their invention in the Patent Office on the same day for the same thing and also because, for some time, Gray had seemed to uphold Bell's invention.

. . . . The next thing that I knew about the telephone excepting what Mr. Meucci said was, I saw notices that some kind of a talking over wires would be exhibited at Steinway Hall by Bell or Gray, and this exhibition was as I remember in the Fall of 1876[6]. I did not attend the exhibition. As soon as I saw these notices and before the exhibition, I sent for Mr. Meucci to bring all the papers in connection with his "Sound Telegraph." He did so, bringing me the evidence of his caveat [16] with the two renewals, his original description in Italian and the paper I wrote for him. I took them to Professor Parmelee and asked him to look these over as I contemplated to notifying Bell that Antonio Meucci was the inventor of the very process, which they intended to exhibit at Steinway Hall. He kept the papers over night and in the morning I met him by appointment in Room 34, Cooper Building. He then and there told me that he had examined the papers and that Mr. Meucci had the same thing that Bell and Gray claimed was their invention, and that Meucci was entitled to the invention and I had better see a lawyer about it. . . . .

It was natural for Meucci to wonder how his invention could have been seized by others. Indeed, he was aware that, after filing his caveat "Sound Telegraph" [16] in December 1871, he had been giving ample publicity to his *telettrofono*. This is what he stated in his aforesaid affidavit:

. . . . During these years [1872 and seq.] I made no secret of my invention, described it to my friends, and allowed the instruments to a good many people . . . . Prior to December 1871, I tried to keep my invention in secret, talked mostly to my wife through it, and a few friends. After I received my caveat, I have never made a secret of my invention; have told many people about it, and talked with numerous persons through it. After I received my caveat, some reporters came to see me. I told them about it, and a description of it was published in some paper in New York; I don't know which one; I think the *Tribune*. I can say positively that more than twenty persons knew about my invention, and to whom I showed the instruments, and did talk through them with many. . . . Some time in 1873, as I recollect, William Carroll, a diver, who knew that I had invented a telephone, asked me if I could not fix it so that divers could use it [7] . . . .

Meucci's incautious behavior was corroborated by several witnesses, among them Joseph Conti, Secretary of the Italian Consulate in New York, who stated in his affidavit of 1885 [17]:

. . . . I first became acquainted with Antonio Meucci of Staten Island, in the latter part of 1872. . . . Mr. Meucci and I often talked together, and in the presence of other people about his Speaking Telegraph. He frequently came to our office which was at that time at No. 7 Broadway, and talked freely about his inventions. . . .

A similar statement was released by John Fleming, a neighbor of Meucci, in his affidavit of 1885 [18]:

. . . . [Before 1872] Mr. Meucci told me all about it [his speaking telegraph], but seemed to be careful that I should not know too much. I did not want to push the matter, and ask him if I might talk through it, as he seemed to want to keep the matter to himself. Not quite a year after he was hurt [i.e. in 1872], he told me he had a caveat; he then talked freely about his inventions, describing them, and also told me he was going to get some men in New York to help him put them into practical use . . . .

[6] It was probably in 1877 at the Chickering Hall. In fact, Bell mentions lectures at the Chickering Hall, in New York, on May 17, 18 and 19, 1877 [14; 15]. Please, note that both Mr. Chickering and Mr. Steinway were famous piano makers. Bell gave lectures in the "Music Hall" of several cities, because of their good acoustic properties.

[7] Details of Meucci's "marine telephone" allowing communication between divers working underwater and the mother-ship are given in [8], p. 67-68.

Hence, Meucci had been too confident that filing a caveat would give him full protection, also given that in his caveat he had disclosed less than he was broadcasting. Moreover, he had erroneously thought that drawings, fully explaining his invention, and furnished to his patent lawyer, Thomas D. Stetson, had been filed with his caveat: this was not the case[8]. Then, too, the mere notice spread around that Meucci had invented a device to talk through electrical wires might only have stimulated the creativity of other inventors towards developing a device of their own. But the question is: how could they get *technical details* of Meucci's invention, to be able to reproduce it quickly and consistently?

The more plausible explanation points towards Edward B. Grant, vice president of the American District Telegraph Company of New York (hereinafter ADT). This is because, in the summer of 1872, Meucci had explained to him in much detail his invention, handing him his caveat and abundant documentation; and, thereafter, he had repeatedly called on him, up to the summer of 1874, hoping to get the promised assistance for field-testing his system on the company's wires[9]. This is what Meucci stated on this subject in another affidavit [19]:

> . . . . Mr. Grant promised to assist him [Meucci] and agreed to put his telephones or instruments on his lines. This was in 1872. He [Meucci] called to see Mr. Grant almost every week for nearly two years when Mr. Grant informed him that his drawings, his specifications and diagrams left with him had been lost and that he would do nothing about it. At the time, Gray, Edison, Bell and others were exhibiting their devices in telephony . . . .

There were a number of similar statements made by Meucci's friends in the same period. Among them, the detailed affidavit of Angelo Bertolino [20], a Notary Public of New York and one of Meucci's best friends, who most of the times had accompanied Meucci in his visits to Mr. Grant:

> . . . . Before his death, Breguglia[10] introduced Mr. Meucci to Mr. Grant in order to have the means to conduct the experiments, on the wires of the District Telegraph Company; and in consequence of this Mr. Meucci and I went to see Mr. Grant, tendering him the description of the invention and a copy of the caveat, and he promised that he would have some experiments made and that he would put a wire at his disposal to make the experiments, and that he would send us a notice of the day in which we could make the experiments. Meucci having said to me that he had the necessary instruments prepared and could make the experiment whenever he could get the wire.
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> About two months after said interview and conversation, at the request of Mr. Meucci, I called upon Mr. Grant to know whether he had prepared for said experiments. Mr. Grant kindly answered that the office had been very busy and that nothing had been done yet, but that he would have it done as soon as possible.
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> Two weeks after I called at Mr. Grant's office, and again at intervals several times, for the same purpose, but either I would not meet Mr. Grant or was answered that he had no time or opportunity to do anything about it. After about two years Mr. Meucci despaired of Mr. Grant doing anything, and, at Mr. Meucci's request, I called upon Mr. Grant to have returned the said papers relating to the said invention, and Mr. Grant stated that said papers had been lost, and neither I nor Mr. Meucci have ever obtained them back. . . .

Even a witness for the American Bell Telephone Company (hereinafter called "the Bell Company" for short), George F. Durant, who had been superintendent of ADT (see Appendix 1) testified that "they [Meucci and Bertolino] called repeatedly, at intervals, perhaps of two weeks or a month" [21].The suspicion that Bell and Gray could have obtained details on

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[8] See [8], p. 66 & 71.
[9] See [8], p. 67.
[10] Sereno P. Breguglia, whom we will more extensively deal with in the following.

Meucci's invention through ADT-Western Union was explicitly advanced by G. Francesco Secchi de Casali, the Editor of *L'Eco d'Italia*, an Italian newspaper of New York, who, in addition to stating that, "we will recognize Mr. Antonio Meucci as the first, the one and only inventor," wrote [22] (translated from Italian):

> . . . . There is no doubt that Messrs. Bell and Gray. . . . were the first to obtain a patent for their invention; but nobody can deny that in 1871[11], five years before they applied for a patent, Meucci gave to one Mr. Grant, then Superintendent of this city's District Telegraph Company, the task of performing large scale experiments on electrical wires, handing him a model and a description of his invention and the method to put it in practice, as well as the *Caveat* that he had obtained from the Patent Office to protect himself. They could not deny it because, being technical operators depending on Mr. Grant, they had got all the stuff with the object of conducting experiments. Quite often, from then on, Meucci requested to see the results, but he could never obtain satisfaction . . . . It was answered to him, with seeming regret and begging thousand apologies, that everything went lost. . . . Two years afterwards he heard with utmost astonishment that Messrs. Bell and Gray had obtained a patent for the invention, for which he had been working for 30 years . . . .

Of course, Bell and Gray were not exactly "technical operators depending on Mr. Grant" but rather independent inventors interacting with Western Union; moreover, Gray had a caveat, not a patent. This notwithstanding, Secchi de Casali thought that anything in the hands of ADT would easily come in the hands of Western Union and therefrom in the hands of those who used to make experiments in its laboratories, as Bell and Gray. A similar allegation was advanced in a piece appeared in *The Electrical World* [23], where it was reported ". . . . it is further alleged that Mr. Bell was the electrical expert of the telegraph company whose president had possession of the original models and papers of the Italian . . . .". Here again, Bell's relation with Western Union was not exactly reported.

As mentioned elsewhere ([8] p. 69-70, [24] p. 428 & 432, note 5)[12], the above allegations concerning Bell and Gray were also put forward, quite strongly, during the hearings of November 9-14, 1885, before the Secretary of the Interior, Lucius Q. C. Lamar. We remind the reader that these hearings ended with the recommendation to the U.S. Department of Justice to proceed against Alexander Graham Bell and the Bell Company.

In particular, a petition to the Department of Justice, filed just before the beginning of those hearings by the Globe Telephone Company, which owned Meucci's rights on the telephone, recited [25]:

> . . . . It has recently come to the knowledge of your petitioner, that at the time of the filing of the application of patent of A. G. Bell, Professor Gray filed an application for a similar device, and through some means contrary to the rules of the patent office, the description of the Gray device was made known to Dr. Bell, and for ought we know, the caveat of Mr. Meucci then supposed to be in the secret archives of the Patent Office was exhibited in the same manner. . .

Note that the Globe Company charged the Patent Office to have unduly allowed inspection of Meucci's caveat, still kept in their archives, though it had expired in December, 1874. In addition, Dr. Seth R. Beckwith, general manager of the Globe Telephone Company, in his argument of November 14, 1885 before Hon. Lamar, pointed out [26]:

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[11] Talks to Mr. Grant were had in December 1871, as also reported by Prof. Parodi, whose account we will quote in the following. However, the first visit at Mr. Grant's office was in the summer of 1872.

[12] In the following, the trial instituted by the U.S. Government against Alexander Graham Bell will be referred to as the "U.S. vs. Bell" trial.

> . . . . He then [Meucci, in 1872] with Mr. Bertolino visits the New York District Telegraph Co., and its Vice-President, Mr. William[13] Grant, receives from him a description of his device, a copy of his specifications and caveat, looks at the picture of two men talking[14], and says, "I will furnish you the wires, and means to put your telephone into use," and for two years he was visited by Meucci, and Mr. Grant finally tells him that he has lost all his papers, and will have nothing whatever to do with it. . . .

Following the conclusion of the aforesaid hearings, Hon. George A. Jenks, Assistant Secretary of the Interior, went one step further in his final report to Hon. Lamar [27]:

> . . . . He [Meucci] claims that in 1872, he went to Mr. Grant, Vice President of the New York District Telegraph Company, explained his invention, and tried repeatedly to have it tried on the wires of the Company. This, it is claimed, was used by the telegraph company, and was the basis of the contract between the Western Union Telegraph Company and the Bell Telephone Company, dated November 10, 1879. . . .

The novelty contained in Jenks's report was that, from the relevant arguments and proofs exhibited at the hearings, he gathered that an important factor for Western Union's well known compromise with the Bell company (in the *Dowd* case [28]) was to avoid Meucci's invention to come before the court, as it would render both Bell and Western Union owned patents void[15]. This other allegation, however, though in line with the premise that Western Union had got hold of Meucci's invention, opens another dispute on the reasons behind the Bell-Western Union settlement, that would require a more extended analysis, not within the scope of this paper.

Summarizing all the above, we may group the various allegations as follows:

1. Bell heard of Meucci's invention from *vox populi* in New York, since, from 1872 on, Meucci had talked freely of it to anybody he met.
2. Bell got details of Meucci's invention through Western Union in New York, the latter being strictly tied with ADT, with whom Meucci had left documents and prototypes.
3. Bell got details of Meucci's invention through the Patent Office in Washington.

If none of the above allegations can be demonstrated, one should conclude that Bell might have invented his telephone independently of Meucci, notwithstanding all suspicions outlined above.

Allegation no. 1: Bell heard of Meucci's invention from vox populi *in New York*

There were several places in New York where news on Meucci's invention was spread. After all, in the period considered (1870s), New York was one-tenth its present size, mostly like one of today's *small* cities, where it is rumored that everybody knows everything about everybody else.

In addition, Antonio Meucci was quite known both in the center city and in Staten Island, both because of his inventiveness and his patriotism. In particular, New Yorkers appreciated the fact that he had hosted for several years Giuseppe Garibaldi and his aid-de-camp, Colonel Paolo Bovi Campeggi. Later on, after Garibaldi had left the United States (in 1854) to fight for the liberation of Italy, Meucci's cottage in Clifton, Staten Island, became the place of pilgrimage

[13] It was Edward B.

[14] See Figure 3 ahead.

[15] In fact, Sec. 24 of the U.S. Patent Act of July 8, 1870, then in force, prescribed that an invention could only be patented if it was "not known or used by others in this country, and not patented, or described in any printed publication in this or any foreign country." [29].

for thousands of Italian Americans to celebrate the victories of the "Great Liberator." Meucci himself was named President of the New York *Permanent Central Committee,* which collected funds and five hundred volunteers to fight for Italy in the independence war of 1866 ([30], p. 241-248).

We must also recall that, soon after Meucci's death, obituaries were published widely in New York newspapers: *The New York Herald* (3); *The New York Daily Tribune* (2); *The New York Times*; *The New York Sun*; *The New York World*; *The Richmond County Gazette*; *The Richmond County Sentinel*; *The Staten Islander*; *L'Eco d'Italia* (4); *Il Progresso Italo-Americano* (4); *Le Courrier des États Unis*. His claims to the invention of the telephone were emphasized in all the obituaries, together with the widespread appreciation for his integrity and creativity.

However, the most likely place where information could be gathered on any news concerning the telegraph field was the Western Union headquarters, which also hosted their main laboratories. This was because swarms of inventors would go there to submit their inventions to the renowned electricians of that big corporation, namely George B. Prescott, Frank L. Pope, George M. Phelps and Albert B. Chandler, if not directly to its powerful president William Orton[16].

From 1866 to 1875, Western Union's headquarters was located at 145 Broadway, corner with Cedar Street, the same building hosting Associated Press[17]. Thereafter it moved to a more awesome building, surmounted by an elegant clock tower, at 195 Broadway, corner with Dey Street (Figure 1)[18]. Just across the street, at 198 Broadway, was the headquarters of its main competitor, the Atlantic & Pacific Telegraph Company (A&P), owned by Jay Gould, an unscrupulous financier and William Orton's fierce opponent.

The headquarters of ADT in New York was in a building with main entrance at 62 Broadway and back entrance at 27 New Street, quite opposite the New York Stock Exchange ([32], p. 13). Note (Figure 2) that this building was a few blocks away from Western Union headquarters (145 or 195 Broadway). Also shown in this figure is the location of the headquarters of A&P, of Associated Press and of Globe Telephone Company at 15 Broad St. The figure also shows the locations of: the Lemmi & Bertolino Law Firm (Meucci's lawyers) at 121 Liberty St., the Pinkerton's National Detective Agency at 66 Exchange Pl., and the renowned Hoffmann Café (about in front of the New York Stock Exchange), where a variety

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[16] All of them were renowned technical experts of Western Union since its consolidation in 1866. More precisely:

- George Prescott's main task was "to act as barrier to a flood of inventions brought to the company for attention." Moreover, "all telegraph innovations of the time. . . were put into practical operative shape under his immediate direction," as well as "the construction and reconstruction work of the company." [31].
- Frank L. Pope, since 1875, specialized in electrical patents, his duties being "to examine into the novelty and utility of the various new inventions relating to telegraphy, which were constantly being presented to the officers of these companies for approval or adoption." [32, 33, 34].
- George M. Phelps is known as the long time technical director of Western Union. He was quoted by William Orton as the leading "electro-mechanician" in the telegraph industry, together with Thomas Edison. A detailed biography of George M. Phelps ca be found in [35].
- Professor Albert Brown Chandler, was a long time telegraph expert and Western Union official. [36, 37]

[17] This was explicitly stated by David H. Craig, at the time general manager of the New York Associated Press, in Answer No. 34 of his deposition [38]. As extensively reported in [30], p. 216-241, Meucci was well known by Associated Press officials, since he had won a contract for the production of paper after his own patents.

[18] As shown in Figure 1, the building at 145 Broadway had hosted the headquarters of the American Telegraph Company, acquired by Western Union in 1866. Before 1866, Western Union's headquarters was in Rochester, NY. In 1930 the headquarters of Western Union relocated at 60 Hudson Street, New York, NY. These statements are confirmed by Harding [39]. The two locations of the Western Union Headquarters before 1930 are also clearly indicated in [40].

of businessmen used to convene, either to dine or to have a drink and smoke a cigar, while discussing matters of interest [19].

Figure 1. *Western Union's Headquarters at 145 Broadway (left) and 195 Broadway (right)*

It clearly appears from Figure 2 that the aforementioned buildings were a few blocks away from each other along Broadway or one or two blocks at a 90 degree angle, i.e., within a rectangle of 1,000 by 1,300 feet, in the heart of Manhattan's business area.

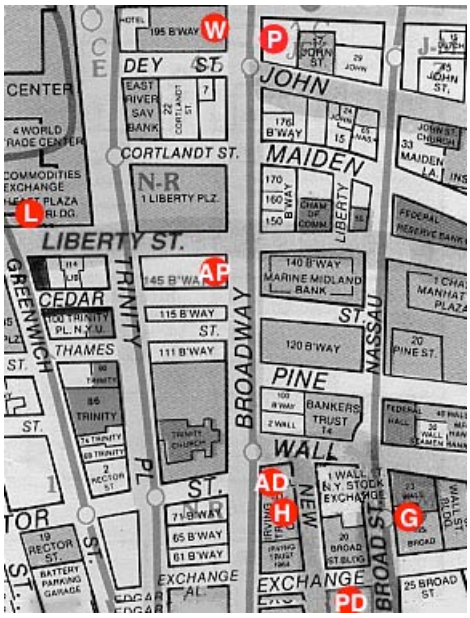

Figure 2. *Headquarters of Western Union Telegraph Co. (W), Atlantic & Pacific Telegraph Co. (P), Associated Press (AP), American District Telegraph Co. (AD), Globe Telephone Co. (G).*

[19] The exact position of buildings considered in this paper was determined by using either the *Street Atlas USA* (CD-ROM Edition for Macintosh, v. 2.0, DeLorme Mapping, Freeport, ME, 1993) or the *Yahoo! Maps and Driving Directions*, available on Internet at site http://maps.yahoo.com/. The location of the A&P Headquarters in the 1870s was kindly furnished by the Museum of the City of New York (see Acknowledgements).

Also shown the Hoffmann Café (H), Lemmi & Bertolino Law Firm (L) and Pinkerton's National Detective Agency (PD).

The Hoffmann Café was a quite strategic point in that area, being patronized by bankers, merchants, lawyers, business men and industrial managers. It was the place where Meucci's *Telettrofono Company* was born, on December 12, 1871, as also related by Professor Parodi, a friend of Meucci's (see [8], p. 65 and [41]):

> . . . . I was invited to assist at a meeting of these gentlemen at the Hoffman 'Café' in New St. nearly opposite the Stock Exchange. I went there after the rush of bankers, merchants, lawyers and buongustais [gourmets] was over. Sitting at a table in a corner of the Restaurant, I found some old friends and acquaintances who introduced me to the rest and acquainted me with the object of the meeting, the spokesman saying: "We are all friends of Antonio Meucci and Initiators of the Company which will be formed to exploit his discovery, operate his device to demonstrate the application under the appellative of Meucci's Telettrofono Company, and we are expecting Mr. Sereno Breguglia with important communications."
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> Mr. Breguglia was a Ticinese[20] , a pleasing, intelligent and smart young man, an ex employee at Delmonico[21] and lately lessee of the Cigar and Tobacco Stand of the Hoffman's Café. His personality, pleasing manner and activity were greatly appreciated by his patrons, among them by a Mr. Horton or Norton[22] . . . . Breguglia in conversation with him spoke of Meucci discovery and of the need of the forming Co. to have it tested on a grand scale, by a prominent Engineer and if found practical to obtain his endorsement. Mr. Norton offered himself to make the experiment telling him, that the Concern which employed him was just then engaged in placing wires from New York to Albany, and that as soon as the opportunity presented itself, he would make the experiments, adding: "bring me the Drawing, Specification and the transmitting device". . . .
>
> Mr. Breguglia was just there back from one of his visits to Mr. Norton's Office and reported that the Engineer had told him that for lack of opportunity he had still been unable to make good his promise reiterating his assertion that he would do so very soon. On this occasion Nestore Corradi, the well known miniaturist, painter of portraits, churches and parlors and ex basso in Marty's Opera Company, showed me the original drawing he had made of his dear old friend Meucci's contrivance for the transmission of sound from a distant point to another[23]. . . . . I then left pleased at the exhibition, and hopeful of a great success for Meucci and the future *Telettrofono Company*.

Another corroborative testimony on that important meeting at the Hoffmann Café was given by Charles Bertolino, son of Angelo Bertolino (the notary public), and Michael Lemmi's partner in the Lemmi & Bertolino Law Firm [44]:

> Chas. Bertolino. . . . being duly sworn says: That on the evening of December 24th, 1871, at the request of his father Angelo Bertolino, he stopped on his way home, at a restaurant in New St.[24] New York City, where he met A. A. Tremeschin, A. Zilio Grandi, S. G. P.

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[20] An inhabitant of Ticino Canton, in Southern Switzerland, of Italian language.

[21] Lorenzo Delmonico (1813-1881) Swiss-born American who opened one of the most exclusive restaurants in New York City, popularizing European cuisine and was largely credited with establishing the restaurant as an institution in American cities [42].

[22] Prof. Parodi probably meant Mr. William Orton, president of Western Union. It must be taken into account that Parodi wrote this manuscript when he was 92 years old and was recounting events of more than 50 years before. He might therefore have mistaken Mr. Orton for Mr. Grant (vice president of ADT), because of the ties of ADT with Western Union.

[23] Nestore Corradi swore an affidavit [43], where he testified that he made that drawing (very similar to that sketched by Charles Bertolino, and reproduced in our Figure 3 ahead) in about 1857 or 1858.

[24] It clearly was the Hoffmann Café, which was equipped with luxury dining facilities.

Breguglia [Meucci's partners in the Telettrofono Company], and his said father A. Bertolino. That owing to his being acquainted with each and all of the 4 mentioned gentlemen, he was allowed to sit at the same table where said persons were discussing an invention in Sound telegraph, recently made by Antonio Meucci of Staten Island. That from the conversation of said persons affiant learned that they had interested themselves in said invention, for which an application for a Caveat had been made only a few days previous, and that the invention above referred to was styled "Telettrofono", or the transmission of the human voice on electric wire.

That he remembers distinctly, that amongst the papers exhibited and to be seen on the table between and before said parties, was a drawing of two persons in a sitting position, each of them holding in his hand an instrument connected with wires, which wires were also connected to two electric batteries placed at the lower corners of the drawing. That said parties apparently were trying to speak to one another, as one held the instrument to his mouth and the other to his ear. That said drawing was an exact facsimile of exhibit A - hereto attached.

That the entire conversation of the said 4 gentlemen was relative to the ways and means of developing said invention . . . .

Angelo Bertolino, in his aforementioned affidavit [20] confirmed his son's account:

. . . . I remember in the last part of December 1871 of meeting the three above named gentlemen, and while we were there my son Charles came, as I had told him to come and see me there that we might go home together. The object of my meeting these gentlemen was as Mr. Meucci's friend, to determine if they would put up as much money was possible to carry out the conditions of the agreement and to advance the interests of the concern [25]. . .

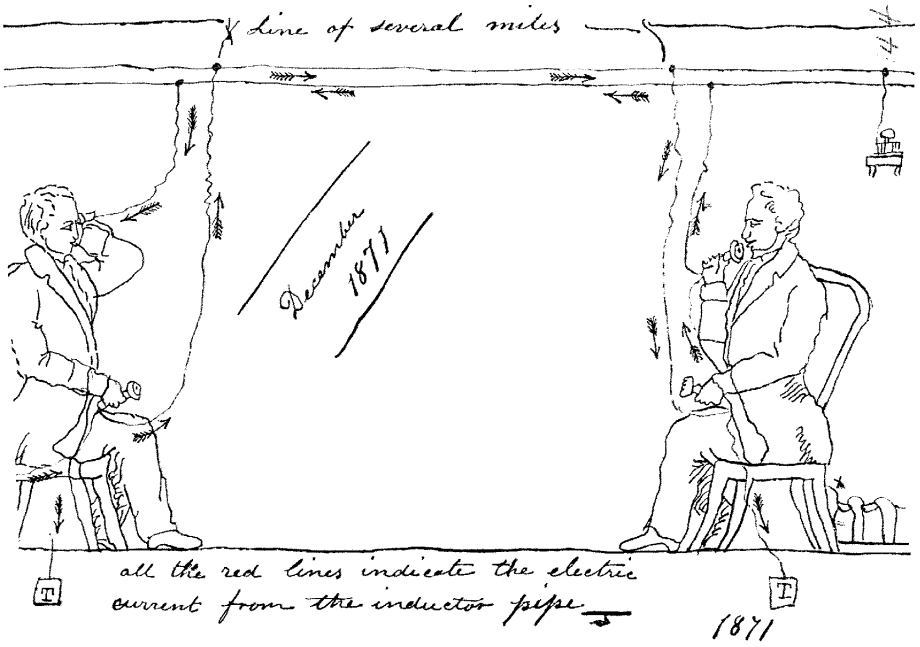

Figure 3. *"Exhibit A" attached to Charles Bertolino's affidavit of 1885.*

It may be noted that both Prof. Parodi and lawyer Charles Bertolino noted the drawing which encompassed the essentials of Meucci's invention, including the call signaling, the anti-

[25] The agreement between Antonio Meucci, Angelo A. Tremeschin, Sereno G. P. Breguglia and Zilio Grandi, instituting the *Telettrofono Company*, was drafted by Notary Public Angelo Bertolino [45].

sidetone layout and the inductive loading[26]. Charles Bertolino, in particular, redrew the drawing and attached it to his aforesaid affidavit, as reported in Figure 3 below[27].
In conclusion, the Hoffmann Café was a good place where to pick up information on a variety of matters, including Meucci's invention.
The ease with which news were captured in New York, as well as in Washington, DC, in Boston (Bell's work place) and Chicago (Gray's work place), was well-known to both Gray and Bell. These are a few examples of what they, or their lawyers, stated in 1875-76:

— Elisha Gray: "He [Bell] claimed to Orton that he could antedate me in everything that I ever claimed to do. . . ."[28].
— Elisha Gray: "Bell seems to be spending all his energies in the talking telegraph. . . ."[29].
— William D. Baldwin, Gray's patent attorney: "[Bell] has been very much annoyed by spies set upon him, probably by the Western Union. . . ."[30]
— Graham Bell: "During the year 1875 . . . . I believed him [Gray] capable of spying on me . . . . Indeed this idea subsequently led me to remove my apparatus from Mr. Williams's shop to private rooms at Exeter Place. My mind was so filled with suspicion that I did not feel full confidence that I could safely have apparatus constructed until I had protected myself by obtaining a patent, or at least a caveat. . . ." ([14], Answer No. 597)

If not by the means outlined above, any kind of confidential information could be gathered through the professional services of the many detective agencies, the most renowned of which being then the Pinkerton's National Detective Agency, whose eastern division was seated in New York at 66 Exchange Pl. (Figure 2). This agency, in particular, followed Meucci between October 26 and November 5, 1885, on behalf of W. C. Tompkins, head of the intelligence of the Bell Company in Boston [49].
In addition to places in Manhattan, it must be taken into account that many businessmen or wealthy New Yorkers had a resort in Staten Island, where Meucci lived. The island was reachable from the Battery (South Manhattan) through the finely appointed *Staten Island Ferry* in about twenty minutes (very much like today). The most important landing in the Island was the Vanderbilt Landing, in Clifton, ten minutes walk from Meucci's cottage ([30],p. 47).
William H. Vanderbilt – the major stockholder and controlling director of Western Union — had a luxury residence (as well as the family tomb) in Staten Island, in addition to a dwelling in Manhattan. Vanderbilt knew very well Meucci and gave him permission to shelter his catboat at his private docks at the Vanderbilt Landing ([50], p. 166)[31]. More important, Vanderbilt told Meucci that he was willing to patronize his priority in the invention of the telephone ([50], p. 163]. This happened, however, in 1881, just after Jay Gould had gained control of the Western Union and Vanderbilt had resigned as a director of the same. This circumstance, as recounted by Adolfo Rossi, then editor of the other Italian newspaper of New York, *Il Progresso Italo-Americano*, reveals another highway through which Western Union might have been well

[26] Full discussion on Meucci's conception of these advanced telephone techniques is reported in [7].
[27] The drawing reported in Figure 3 is very similar to that reported in Meucci's Affidavit [12], also reported in [8], p. 60, Figure 5.
[28] Taken from [46]. Note that Bell had first met Mr. Orton in Washington on February 21, 1875 ([3], p. 137)—only three weeks before Gray's letter to Hayes.
[29] Taken from [47]. This letter is also quite amazing, because Bell had jotted down his specification a few weeks before, after having made his first discovery of speech transmission in June, and performed unsuccessful tests of his first prototypes in July of the same year.
[30] Taken from [48].
[31] Rossi also reported that Meucci's catboat, named "Ugo Bassi" after a chaplain who was executed by the Austrians, was used to go fishing with Giuseppe Garibaldi. Vanderbilt's permission meant not having to carry it back and forth onto land.

acquainted with Meucci's invention, since, before 1881, Vanderbilt was a faithful and powerful officer of the same (see Appendix 2).

Allegation no. 2: Bell got details of Meucci's invention from Western Union

We begin noting that, just when, in the summer of 1874, Mr. Grant told Meucci that all his material had gone lost and that he would do nothing about field testing Meucci's *telettrofono*, the following episodes occurred:

1. By 1874, ADT became "the delivery department of the Western Union Company under a rigorous contract for faithful service."[32]
2. In October 1874, ADT superintendent, George F. Durant, left the company and was succeeded by Henry W. Pope, the brother of Frank L. Pope, a prominent electrician of Western Union ([32], p. 158; [21] Answer No. 4).
3. In the summer of 1874, in Brantford, Graham Bell would come up with his first conception of the telephone ([14], Answer No. 32÷35).
4. By late spring of 1874 Elisha Gray "was using a completely different type of receiver, a metal diaphragm vibrated by an electromagnet . . . . [and] in mid-1874. . . Gray's receivers would respond to any frequency . . . "([3] p. 114-115).
5. On May 10, 1874, Gray demonstrated his "music by telegraph" at Western Union's headquarters in New York. On June 13 he showed it to a scientific audience at the Smithsonian Institution in Washington, Joseph Henry presiding[33]. Other demonstrations he held in Boston, as well as in Europe.
6. On July 10, 1874, the *New York Times* ran an article on Gray's "music by telegraph," reporting a statement by a prominent electrician and Western Union official, Professor Albert Brown Chandler, according to which "he regards it as the first step toward doing away with manipulating instrument altogether, and that he believed that in time the operators will transmit the sound of their own voice over the wires and talk with one another instead of telegraphing."[37].

It therefore appears that, all of a sudden, interest on the electrical transmission of speech grew up in several minds, at the same time that, by odd coincidence, Meucci was told by ADT that the same was not of interest and his papers went lost.
Other meaningful episodes occurred shortly after, such as:

1. Meucci's caveat "Sound Telegraph,"[16] filed December 1871, expired on December 28, 1874, he not having been able to pay the $10 fee for its renewal. Hence, in 1875, Meucci's invention ceased to be protected.
2. On March 2, 1875, while being in Washington to file his harmonic telegraph patents, Bell asked Prof. Henry's advice about the apparatus that he had "designed for the transmission of the human voice by telegraph." [51].
3. On March 3, 1875, on his way to Boston, Bell stopped in New York at the Western Union headquarters to make arrangements for field testing his harmonic telegraph there. He wrote his parents "I have made arrangements to spend Saturday and Sunday every week at the Western Union Building, so to have the assistance of Mr. Prescott." [51].
4. From March 15 to March 18, 1875, Bell was at Western Union's headquarters in New York to demonstrate his harmonic telegraph. William Orton and George Prescott

[32] See [32], p. 158. Schiavo quotes James D. Reid, *The Telegraph in America*, New York, NY, 1886, and, regarding the contract, a piece of April 25, 1874, in *Telegraph*, a periodical, Vol. 10, p. 100-101. We may note, however, that, even before this contract, ADT was providing delivery services to Western Union.
[33] See [37]. Gray's demonstration consisted in playing and transmitting popular motives along telegraph wires.

watched his demonstration and gave him assistance, also furnishing him with more powerful magnets [51].

5. On the same occasion, Frank L. Pope, the other prominent electrician of Western Union, took interest in Bell's autograph, and wrote a letter to Bell on that subject on May 4, 1875 ([14], Answers No. 59 & 60).
6. After his visits to Washington (February 16 to March 2, 1875) and to New York (March 3 and March 15-18, 1875) Bell made his accidental discovery of the possibility of transmitting speech on June 2, 1875 and constructed his first "gallows model" telephones early in July 1875, though they didn't work ([14], Answer 82).
7. By July, 1875, Thomas Edison became acquainted with the telephone of Philipp Reis, thanks to information received by William Orton.

On this latter point, it is interesting what Edison wrote to George Prescott (italics ours)[34]:

> . . . . Some time in or about the month of July 1875, I began experimenting with a system of multiple telegraphy which had for its basis the transmission of acoustic vibrations. Being furnished, at the same time, by Hon. William Orton, President of the Western Union Telegraph Company, with a translated description from a foreign scientific journal of Reiss's telephone[35], I began a series of experiments, *with the view of producing an articulating telephone*. . . .

Edison corroborated the above circumstance in his affidavit, where he stated [53]:

> . . . . I am the Thomas A. Edison, the patentee mentioned in English Patent of July 30, 1877, No. 2909, for telephone[36]. The inventions described and stated in that Patent were made by me in 1875, the experiments continuing from that time right along, and culminating in the carbon telephone, now universally employed. . . . I had no knowledge of Bell's inventions in speaking telephones when I made that invention. I had knowledge of the Reis publications at that time.

From all the above it clearly appears that, though it was generally felt (or led to believe) that the electrical transmission of speech was far from the interests of telegraph companies, an intense research work in that field was begun in 1874-1875, almost simultaneously, by Bell, Gray and Edison, all of them being, in one way or another, connected with Western Union. As Schiavo pointed out ([32], p. 178).

> . . . . at the very time that Bell and Gray were conducting their experiments in the Western Union laboratory in New York, the Western Union President, Mr. Orton, was very much interested in the electric transmission of the human voice. That may explain why Mr. Hubbard, Bell's financial backer and future father-in-law, all of a sudden became interested in the telephone and urged Bell to apply for a patent instead of a caveat, without the least delay. That also could explain many things, such as Mr. Orton's alleged lack of interest in the Bell patents.

Let us add that possibly "at the very time" Mr. Orton was handing Edison a publication on Reis "telephon," he was also obtaining from Mr. Grant the papers on Meucci's "telettrofono." In fact, as Schiavo pointed out ([32], p. 167):

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[34] See [32], p. 178-179, where reference is made to [56], p. 110.

[35] The mentioned paper and journal was probably a lecture by William Ladd [52], where he mentions the Reis telephone as a means "to form a sound alphabet somewhat similar to the signals written by Morse's telegraph" by "regulating the length of the notes [through the telegraphic key]". Its application to the harmonic telegraph was probably the main reason why it attracted the interest of Western Union.

[36] Edison quoted his English patent [54], which was promptly granted. On the contrary, his corresponding U.S. patent [55] was granted to him fifteen years later (May 3, 1892), following the Bell/Western Union controversy.

. . . . It is logical . . . to assume that since the American District Telegraph Company was practically a branch of the Western Union, Mr. Grant must, or may, have asked the opinion of both Mr. Pope and Mr. Prescott on Meucci's invention.

We must stress that, as amply demonstrated elsewhere ([7], p. 681-686; [8], p. 59-64), already by 1870 Meucci had quite fully perfected his system, having developed his best telephone ([8], Fig. 6 on p. 62), his anti-sidetone layout, his inductive loading of long-distance telephone lines, his call-signaling method, his many structures of long-distance telephone lines for optimum frequency response[37], and his provisions for working in a quiet environment. Therefore, whoever had got hold of that information, must have had a complete and detailed picture of Meucci's scheme for long distance telephone transmission. According to George F. Durant, who testified in favor of the Bell Company against Meucci, Meucci's description that was handed to Mr. Grant was quite extended, being "ten or a dozen pages of legal cap. . . . written on both sides" ([21],Answer No. 12).

Now, for what concerns Bell's frequentation of Western Union, we know from his own words that he was in their main laboratory in New York on March 3 and then on March 15-18, 1875, and that he had made arrangements "to spend Saturday and Sunday every week," as mentioned above. In addition, from George B. Prescott we learn ([56],p. 444-445, italics ours):

> . . . . In the summer of 1875 Mr. Bell asked permission of the Western Union Telegraph Company to conduct experiments in the office of their electrician at New York. This was granted but shortly after Mr. Bell began his experiments there, Mr. Orton, the president of the company, learned that Mr. Gardiner G. Hubbard, who was personally obnoxious to him, was pecuniarily interested in Mr. Bell's inventions, and immediately directed that the permission to conduct his experiments should be withdrawn.
>
> After Mr. Bell had brought his invention before the public, and was endeavoring to perfect it by experimenting over actual telegraph lines, orders were given to exclude him from the Western Union wires. *In spite of these orders, however, telephone experiments were conducted over them*, but for a long time the results, while regarded with interest, were looked upon as possessing *little practical value, and it was not until the summer of 1877* that the progress of Mr. Bell's invention was deemed to have arrived at such a state of efficiency as to threaten to be a serious competitor of the telegraph.
>
> At this juncture, August, 1877, Mr. Frank L. Pope, the electrical expert of the Western Union Telegraph Company, saw and talked through a speaking telephone in Boston for the first time, and soon after mentioned the fact to Mr. Orton, who said "*I have been looking into this matter of the telephone somewhat, and regard it as a matter likely to be of considerable future importance*. If this proves to be the case it is very necessary that we should have the right to use it; therefore I wish you *to make a careful and thorough investigation of the whole subject*, and ascertain what are the fundamental principles of the invention, and what inventions or patents it will be desirable or necessary for us to acquire the control of, in order to be able to use the invention in connection with our business."[38]

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[37] He had devised and experimented on various solutions, such as: surface treatment of the line conductor; adoption of larger cross-section of the same; use of copper instead of steel; use of a plaited insulated copper wire. The latter was his preferred solution, and was communicated to Mr. Grant ([12], Answer No. 545): ". . . . in the explanation I gave to Mr. Stetson for the application for the caveat, and in *the one I gave to Mr. Grant*, I said that using a cable of copper wires the exact transmission of the word was obtained more easily. . . ." (italics ours).

[38] It must be remarked that Mr. Orton had been greatly encouraged, in April-May of 1877, by Thomas Edison, who informed him of the excellent results just obtained with his carbon microphone, that dramatically outperformed Bell's electromagnetic transmitter. We recall that the relevant Edison's patent "Speaking Telegraph," was filed April 27, 1877, as mentioned above.

These latter circumstances were confirmed by Frank L. Pope in his testimony in the *Dowd case* ([57], Answers Nos. 3 and 4, p. 776-777):

> . . . . I do not know that my attention was directed to the speaking telephone, beyond the occasional notices which I read in the papers, until some time in the summer of 1877. Some time during the summer, being in Boston on business, I saw and talked through a speaking telephone for the first time, and within a short time thereafter, which was in the month of August, 1877, I was directed by Mr. Orton, then president of the Western Union Company, to make a thorough investigation of the whole subject, as far as practicable. I accordingly made such an investigation, and from that time until the present have endeavored to inform myself as completely as possible of everything in relation to the subject of speaking telephones. . . . .
> I had before mentioned to him [Mr. Orton] the fact of my having seen and talked through a telephone in Boston (I suppose it to have been a Bell telephone), and it was some days after I had mentioned this to him that he sent for me, and said to me in substance, — I do not pretend to give his exact words, — "I have been looking into this matter of the telephone somewhat, and regard it as a matter likely to be of considerable future importance. If this proves to be the case, it is very necessary that we should have the right to use it; therefore I wish you to make a careful and thorough investigation of the whole subject and ascertain what are the fundamental principles of the invention, and what inventions or patents it will be desirable or necessary for us to acquire the control of in order to be able to use the invention in connection with our business." I accordingly set about this investigation and was engaged in it for two or three months, all the time I could spare from any other duties. I think my report was made in October or November, 1877.

Frank L. Pope was even more specific in his deposition at the *People's case* (italics ours) ([57], Answer No. 2)[39]:

> During a visit to Boston, in 1877, I casually saw, for the first time, a speaking-telephone apparatus and heard words transmitted through it from a point half a mile off. . . . . At a later day, however—if I recollect rightly, in the summer of 1878—the companies by whom I was employed had become convinced of the importance and value of the speaking-telephone, and the result of this conviction was that I was directed by Mr. William Orton, then president of both companies, to make a thorough investigation of the subject, and ascertain under what patents, if any, the right to use the apparatus would have to be obtained. *Every possible facility was placed at my disposal in the prosecution of this investigation*. A general order was sent to Europe for every book and pamphlet that could be obtained which had been published within the last fifty years, relating to electricity, the telegraph and allied subjects. . . A skilled scientific translator, *familiar with eight different languages*, was employed to assist me in going over it. In this manner, I became thoroughly familiar with the state of the art with reference to the electrical transmission of vibrations and also with the patents relating to the subject, which were, however, at that time very few in number. *I presume that at the end of the year 1878, I was more fully acquainted with the state of the art with relation to this subject than any other one person*, owing to the extraordinary facilities which had been freely placed at my disposal by President Orton.

It would be therefore hard to believe that Frank L. Pope was not fully acquainted with Meucci's telephone invention, as well.
Going back to Prescott's account, we have learned that Bell repeatedly conducted experiments at Western Union up to the summer of 1877. At that time, Mr. Orton, who "had been looking

[39] This is reported in the "People's case," Vol. II, part II, p. 1287 (erroneously referenced by Schiavo as p. 1286).

into the matter" for some time, ordered a "careful and thorough investigation of the whole subject" towards controlling the telephone business. Schiavo, however, maintained—in full agreement with Prescott— that, prior to the summer of 1877, Mr. Orton and his electricians had disregarded the importance of the telephone, and that, therefore ([32], p. 158):

> . . . . the electricians of the Western Union, Mr. Pope and Mr. Prescott, may have disclosed the details of Meucci's invention to Alexander Graham Bell and Elisha Gray, in the spring of 1875, without being aware of the importance of the invention.

Figure 4. *Giovanni Schiavo, a renowned historian who did extensive research on Antonio Meucci (photograph from an unknown newspaper of the 1950s, kindly supplied by Tony De Nonno, Brooklyn, NY).*

We must point out that Giovanni Schiavo (Figure 4) did one of the most accurate and in-depth research on Antonio Meucci and that he has been an indispensable source of information for all subsequent scholarship. Worth to be quoted here is an important incident, reported by Schiavo in his book, relating to Mr. Orton's thrust to deeply investigate on the telephone. This incident was first reported by Frank L. Pope in his testimony in *The People's case*[40], where he testified for the Bell Company, as follows ([57], Answer No. 172)[41]:

> *Cross-Q*. 172. While you were making your investigations in the fall of 1877, did you get possession of some of the instruments put out under the authority of the owners of the Bell patents, and make tests of them?
>
> *Ans*. Not exactly; some Bell instruments were placed in the hands of the American District Telegraph Company, of New York; I don't know for what purpose. My brother Henry was at that time superintendent of the American District Company, and one evening he brought over two sets of these instruments and attached them to a private Morse telegraph line connecting his residence with my own, near Elizabeth, N. J., on which occasion we spent two or three hours talking back and forth through the telephones. This was some time in the fall of 1877, and was, I think, the only circumstance in the nature of a test which took place before I made my report.

[40] This trial, also known as *The Drawbaugh case*, was initiated by the Bell Co. in October 1880, in the Circuit Court, Southern District of New York. Testimony was taken from February, 1881 to June, 1884. Opinion of Judge William J. Wallace (the same who ruled against Meucci) was given in favor of the Bell Co. on December 1, 1884 ([58], p. 161-228).

[41] This is found in "The People's case," vol. II, Part II, p. 1400 (Schiavo says "between p. 1397 and 1423").

This is what Schiavo observed on that incident ([32], p. 167-168):

> . . . . What were those instruments doing in the office of the American District Telegraph Company, of all places? . . . . Is it not logical to suppose, instead, that the set found by Mr. Henry W. Pope was the very set Meucci had brought to Mr. Grant in 1872? Is it not also likely that the two Pope brothers made their experiment as part of the groundwork which led to the formation of the new telephone company set up by the Western Union?[42]

Schiavo's assumptions seem quite plausible since, following Mr. Orton's directions, Frank Pope would have certainly investigated on and tested every device he could get hold of, including Meucci's prototypes. Note, also, that these prototypes could have been easily constructed by anybody following the detailed Meucci's description handed to Mr. Grant in 1872. We further observe, however, in relation to the above passage of Pope's deposition, that, as Thomas Watson punctually reported in his aforementioned affidavit, at the end of October, 1877, only 3,000 telephones were in use in the United States, all of which manufactured under his own supervision[43], including the pair of telephones tested by Frank Pope in Boston[44]. No comment was given by Mr. Watson on the pair of telephones tested in New Jersey by the two Pope brothers in the fall of 1877, quite probably because they were not of Bell Company manufacture. Very meaningful is, in this respect, Frank Pope's statement "I don't know for what purpose," which leads to believe that it was not the usual purpose of a Bell leased line (the language "Bell telephone" was used, in our opinion, as a synonymous of "magneto-telephone"). Also the statement "we spent two or three hours talking back and forth through the telephones" is meaningful, in that it implies that the two telephones worked successfully. One further remark is in order for what concerns the strict relationship between ADT and Western Union: the two Pope brothers, by admission of Frank L. Pope in his above deposition, strictly collaborated in investigating the potentiality of the telephone, though working for two different companies. One last remark concerns the employment of Frank Pope by the American Telegraph Company (the ancestor of the Western Union Telegraph Company) in the years 1857 to 1858 and 1862 to 1864[45], just when the Associated Press—then in the same building as the American Telegraph Company (Fig. 1 left)—was discussing a contract with Antonio Meucci for paper production ([38], Answer No. 2).

Of course, Frank L. Pope, in his deposition in the People's case (begun March 29, 1883) testified in favor of the Bell Company. As Schiavo remarked ([32], p. 175):

> . . . . although in 1883 Mr. Pope stated . . . "I was entirely unable to discover any apparatus or method anticipating the invention of Bell as a whole, and therefore concluded that the patent was valid and so advised my employers,[46]" four years before, in 1879, he had told a different story. In 1883, of course, Mr. Pope was in the service of the Bell Telephone Company, but in 1879 he was working for the Western Union.

Notwithstanding, Mr. Pope's full acquaintance with the telephone field, achieved after the summer of 1877, though highly meaningful in respect that his knowledge of Meucci's invention would have greatly influenced the course of the Bell-Western Union litigation, it

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[42] The mentioned "new company" was the American Speaking Telephone Company.

[43] More precisely ([11], p. 152):

- By July [June] 30, 1877, about 164 hand and 70 box telephones were in public use.
- By July 31, 1877, about 658 hand and 120 box telephones were in public use.
- By Aug. 31, 1877, about 1,000 hand and 300 box telephones were in public use.
- By Oct. 31, 1877, about 3,000 telephones of both descriptions were in use.

[44] See [11], Answer No. 46, p. 119: ". . . Mr. Frank L. Pope, electrician, called as an expert witness for the defence in said suits, said that in the summer of 1877, he saw used in Boston a pair of telephones which were identified as Bell telephones, made by Mr. Bell's licensees. They were in fact made under my supervision."

[45] This is found in [57],"The People's case," Answer No. 1, vol. II, Part II, p. 1284-1285.

[46] See [57], "The People's case," Vol. II, Part II, p. 1304.

bears little weight on the Meucci-Bell controversy, except confirming that Meucci's instruments and/or description given to Mr. Grant were not actually "lost."
We have found two more passages wherefrom Mr. Grant and/or ADT proved, years after, to cultivate direct and continued interest in the telephone business. The first quotation refers to telephone service offered by ADT in 1878 (only four years after Meucci's dismissal by Mr. Grant), in Chicago, IL and in San Francisco, CA, though "in connection with Western Union" ([28],p. 279, 332 and 349).

> . . . . The situation in Chicago remained unchanged until mid-May [1878] when [Samuel] Hubbard[47] learned that the American District Telegraph Company was going to organize a telephonic exchange there in connection with the Western Union. . . .
> Sam Hubbard anticipated a "share fight" from the American District [Telegraph] Company when he began to establish a telephonic exchange [in San Francisco], because it would be superior to a cumbersome district telegraph-telephone system which the ADT controlled . . . .
> Sam Hubbard reported that his opposition in San Francisco expressed interest in pooling the exchange business and perhaps paying a royalty.

The second passage relates to a chance encounter in 1883, between Mr. Grant and Angelo Bertolino, as reported in the latter's affidavit [20]:

> . . . . I did not talk with Mr. Grant any more about Meucci's telephone, until about two years ago when I met him in a Third Avenue car one afternoon going up town. He asked me, "What about your old friend, Meucci? He was a great fool not to come to me some months ago when I told him to come to my office that I could do something for his invention." I answered Grant, "I think in that moment, Meucci had some other engagement about his telephone." He said "Well he did wrong not to come, because I had a party in Philadelphia that would have done something in order to have Meucci's telephone succeed, and I think we could have made a hundred thousand dollars, and fifty thousand dollars for him, and fifty thousand dollar for me would have been rather good at this time." He left the street car then, and that is the last time I talked to him about the telephone.

This last passage shows that Mr. Grant, in 1883, was trying to negotiate Meucci's invention with "a party in Philadelphia" —and to make money out of it. Apparently, he had not lost interest in Meucci as he had "lost" his material. More than that, at about the same time, Mr. Grant was talking on the same subject with Chauncey Smith—the attorney for the Bell Company since its inception— as reported by George Durant in a letter to Theodore Vail, general manager of the same company (italics ours) [59]:

> Mr. Chauncey Smith told me that Grant told him the same story [about Meucci's visits], some months ago, adding that Meucci had made some experiments over one of our circuits at 62 Broadway one evening. None of our people witnessed that experiment however, and if I ever knew anything about it, I have no recollection of it now. . . . *Mr. Smith knows Grant very well* and if any suit grows out of the affair, Grant can be found, if wanted, through H. L. Hotchkiss 66 Exchange Place NY. . . .

Note that Chauncey Smith, residing in Boston, knew very well Grant, residing in New York, and, that, in the summer of 1884, he was conversing with Durant, residing in St. Louis, on the subject of Meucci's invention. Note, also, that, at that time, Durant had not direct contacts with Mr. Grant, but he had been in touch with the Bell Company since at least August 28, 1884, when he had mailed to Mr. Vail a clipping on Meucci taken from the *St. Louis Democrat* to alert Vail on Meucci's enforced claims [60]. In the same letter Durant wrote (italics ours):

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[47] Samuel Hubbard, brother of Gardiner G., resided in San Francisco, CA, and was apparently an agent of the Bell Company ([28], p. 324).

. . . . About that time [1880] I met Grant one day in the office of Hotchkiss & Burnham in New York. . . . He asked if I remembered those papers of the "Cuban" [Meucci]. I said I did and laughed. *He said he had, or thought he had, those papers somewhere* and remarked "perhaps, after all that fellow might have had something."

Finally, Grant admitted that he had not "lost" Meucci's papers. Another testimony corroborates Mr. Grant's continued interest on Meucci's telephone: it is from Michael Lemmi, Charles Bertolino's partner in the *Lemmi & Bertolino Law Firm* (Meucci's lawyers), who stated in his affidavit [61]:

. . . . Mr. Welch[48] made some remarks . . . . pointing out especially the note and the affidavit of the Notary A. Bertolino, concerning the presentation of the description and drawings to Mr. Grant, which went lost, saying that he had seen Mr. Grant, several years ago, and that Mr. Grant told him that the documents referred to, had been returned.

The above should have happened "several years" before 1883, hence, in about 1880 or earlier. It can easily be inferred that the Bell Company was interested in what had happened to Meucci's papers and that this time Mr. Grant did not state that they had been "lost" but that they had been "returned." This says much about Mr. Grant's sincerity and his penchant for profiting and bargaining whenever he could. It also shows in how many ways and with how many persons Mr. Grant was trying to exploit his knowledge of Meucci's invention.
In regards to Mr. Welch, Schiavo quoted another incident "which may explain how the Meucci papers may have been brought to the attention of Bell and Gray" ([32], p. 165), namely the cross-examination of George Durant by David Humphreys, Meucci's counsel in the Bell vs. Globe trial[49]. We quote here below a brief passage of it ([21],Answers No. 73÷76):

Cross-Int. 73. Do you know of Mr. Grant's talking in your presence to Mr. Welch of Boston about it?
Ans. I do not.
Cross-Int. 74. Do you know Mr. Welch?
Ans. Welch and Andrews, you mean? Yes, I know him. . . . .
Cross-Int. 76. What do you know of Mr. Grant's passing those papers over to Mr. Welch?
Ans. That I know nothing about.

Though Mr. Durant (obviously biased in favor of the Bell Co.[50]) denied his awareness of any attempts made by Mr. Welch to get Meucci's papers from Mr. Grant, his cross-examination proves that Meucci's counsel was quite convinced of the contrary and that he believed that contacts between Mr. Grant and Mr. Welch must have occurred "before October, 1874, when Mr. Durant had left the American District Telegraph Company," as also remarked by Schiavo ([32], p. 168). If this were true, it would uncover another highway through which details on Meucci's invention might have reached Bell, in that he knew Mr. Welch before July 1877, when the Bell Company was first incorporated. At all events, it has been firmly established that Mr. Grant and Mr. Welch had discussed Meucci's invention "several years" before 1883. We refer the reader to a previous paper and related literature for what concerns the negotiations

[48] According to Schiavo ([32], p. 169-170, quoting the "1883 Directory of the City of Boston"), in 1883 Mr. E. B. Welch was the president of the Mexican National Bell Telephone Co., 95 Milk St., Room 67, Boston, MA, in the same building as the Bell Company's headquarters, the two companies being obviously connected with each other. See also [62], where William W. Goodwin (President of the Globe Telephone Company) gives in minute details "a synopsis of the correspondence and proceeding of the Bell Co., or its Agent [Mr. Welch] in their letters to suppress the Meucci testimony and to secure control of his invention in Telephony."
[49] The "Bell vs. Globe trial" is, for short, the trial instituted in New York by *The American Bell Telephone Co. et al.* vs. *The Globe Telephone Co., Antonio Meucci, et al.*, of which we give references in this paper for individual depositions and/or affidavits.
[50] See Appendix 1 as for his involvement with the Bell Company.

undertaken in August 1883 by Mr. Welch (seemingly on behalf of the Bell Company)—and, directly, by the Bell Company itself—to acquire Meucci's invention ([8], p. 69; [24], p. 430).
From the above it is clear that Mr. Grant was well aware that Meucci had no means, not even being able to renew his caveat on December 1874, and therefore could do no harm to him. He had the whole thing— oral information, written description, caveat, and apparatus—in his hands without paying a penny. Why should he have helped Meucci? He probably thought better to keep the thing with himself, to exploit it in any forthcoming chance, as confirmed by the many incidents reported above.

Allegation no. 3: Bell got details of Meucci's invention at the Patent Office in Washington

It may be helpful to locate some places in Washington, DC, which are relevant to our inquiry, as we have done above for New York City. In Figure 5 is shown the location of the following buildings: the U.S. Patent Office, which was then located in the block between F Street and Eighth Street NW; the Pollok & Bailey Law Firm (Bell's lawyers), which was located at 620 F Street NW, quite near to the Patent Office[51]; the U.S. Capitol; the Smithsonian Institution (in Adams Drive, between 9th and 10th Sts.); the Washington residence of Gardiner G. Hubbard, at Dupont Circle; and the house of Zenas Fisk Wilber, an examiner of the Patent Office who examined Bell's, Gray's and Meucci's applications, at 1327 Pennsylvania Avenue [52].
Bell paid three visits to Washington, DC, in the period from the beginning of 1875 to mid 1877 ([14],Int. 251): the first, from February 16 to March 2, 1875 ([14], Answers No. 45 & 46); the second, from February 26 to March 6, 1876 ([65]; [14], Answers No. 46, 106 and 109); and the third, from before January 2 to after January 13, 1877 ([14], Answers No. 178 & 251). We will analyze in the following some relevant details concerning these visits.

BELL'S FIRST VISIT TO WASHINGTON (FEBRUARY 16 TO MARCH 2, 1875)

Bell's first visit to Washington, following his early work in harmonic telegraphy, was from February 16 to March 2, 1875. In that period, he met Mr. Orton in Mr. Hubbard's house (by way of introduction by the latter), his lawyers[53], Anthony Pollok and Marcellus Bailey, "the most eminent men connected with the Patent Office" and Prof. Joseph Henry at the Smithsonian Institution [66].
The extent to which Pollok & Bailey were *connected* with the Patent Office must have been remarkable, as Bell wrote to his parents [67]:

> . . . . my lawyers—Pollok and Bailey—found on examination at the Patent Office, that I had developed the idea [of multiple telegraphy] so much further than Gray had done . . . . Whenever Gray's lawyer heard that I was in town, he applied to the Patent Office to complete[54] Gray's patent, and thus force me to a law-suit . . . .

As pointed out by a contemporary scholar ([63],p. 46):

> . . . . Incredible as it seems, Pollok knew before he even filed Bell's last application that at least one of them would be in interference with Gray's still-pending, and supposedly confidential, application, the one Gray had filed only a few days before . . . .

[51] Other patent solicitors' offices — as well as copyists, notary public, draftsmen — were also located near the Patent Office ([63], p. 66).
[52] Wilber was formerly living at 23rd St. NW, between K and L ([64], p. 1176 and p. 1182).
[53] In fact, they were Gardiner Hubbard's lawyers. Bell's previous lawyer, Joseph H. Adams of Boston, was abandoned by Bell just before leaving for Washington ([63], p. 43).
[54] The word "to complete" was mostly used with reference to a caveat that was followed by an application for a regular patent on the same subject.

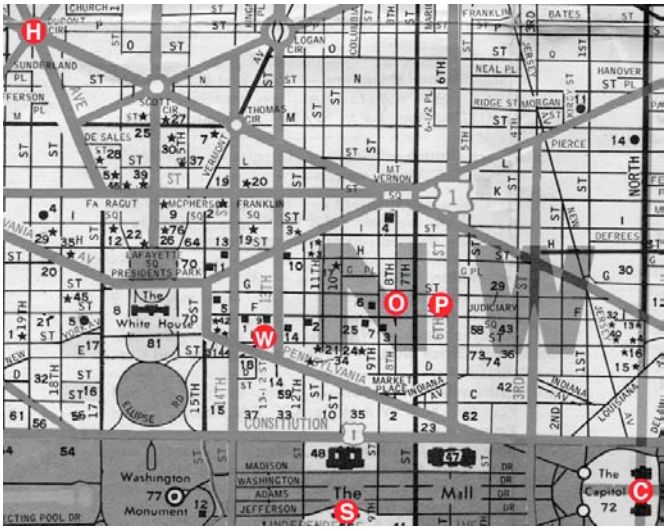

Figure 5. *Relevant places in Washington, DC (1870s): Hubbard's home (H), U.S. Patent Office (O), Pollok & Bailey (P), Smithsonian Institution (S), The U.S. Capitol (C) and Wilber's house (W).*

Thus, Pollok and Bailey would have managed to examine, at the Patent Office, the pending application, filed by Elisha Gray on multiple telegraphy, and then split Bell's specification into three different applications, in order to let two of them be put into interference with Gray [67]. Needless to say, the Patent Office should have not allowed inspection of Gray's pending application by any third parties.

Moreover, it is quite surprising, by today's standards and ethics, to learn what happened in Pollok's office, according to Bell's account [67]:

> . . . . Another fortunate circumstance was this, that the very examiner [Mr. Wilber] into whose hands this [application] will come, happened to be in Mr. Pollok's office one day when I called, so that I had a long interview with him, in which I explained everything to him . . . .

Of course, in today's practice, a Patent Examiner is not supposed to pay visits at any patent lawyer's office, nor to discuss matters concerning a patent application before it was filed, but Zenas Fisk Wilber had reasons for doing so. During the Civil War, when he had served as Major in the Union army, he became acquainted with Major Marcellus Bailey. After the war, the two comrades happened to work quite near to each other, as Wilber became Examiner of the Patent Office and Bailey became Pollok's partner, their office being half a block away, as shown in Figure 5. Profiting of the much wealthier standing of his comrade, Wilber often borrowed money from him, apparently to satisfy his drinking habits, and thus was soon heavily in debt to him [69][55]. Obviously, he had to repay his friend in some other way.

After Bell had finished working with his lawyers to finalize his three applications, he paid two visits to Prof. Henry, on March 1 and 2, 1875, respectively, shortly before leaving Washington for New York ([14],Answer No. 52). According to his account, Bell asked Prof. Henry's advice about his idea of "telegraphing vocal sounds" ([51], italics replacing underlined words):

> . . . . I determined to ask his advice about the apparatus I have designed for the transmission of the human voice by telegraph . . . . Such a chimerical idea as telegraphing *vocal sounds* would indeed to *most minds* seem scarcely feasible enough to spend time in working over. I

[55] Copy of the original manuscript affidavit is in possession of this author. Evenson ([63], p. 167-171) also reports this affidavit, as taken from "The Latest Wilber Affidavit," *The Electrical World,* May 29, 1886, p. 252-253, erroneously said to have been sworn on April 6, 1886. Evenson also states that the same affidavit appeared in *The Washington Post* on May 22, 1886 (title not shown).

believe, however, that it is feasible, and that I have got the cue to the solution of the problem.

On the same occasion, Prof. Henry showed him the Reis telephone ([14], Answer No. 54):

> . . . . Professor Henry illustrated his remarks by showing me the Reis telephone itself. He had, at the Smithsonian Institution, both the Reis transmitter and the Reis receiver, and he showed them to me, either on the 1st or 2d of March, 1875.

This passage of Bell's letter deserves some comments. The "apparatus" mentioned therein should be the so-called "harp" apparatus, that Bell declared to have conceived — but never built — in the summer of 1874, it being "the first form of speaking telephone that occurred to my mind"[56]. This apparatus had been described in a letter of Bell to parents (italics ours)[68].

> The idea to which I allude is an instrument by which the human voice might be telegraphed without the use of a battery at all. . . . If a permanent magnet is made to vibrate in front of the poles of an electro-magnet -- an induced oscillating current will be produced in the coils of the electro-magnet. The oscillations of the electrical current will correspond in number and amplitude with the vibrations of the permanent magnet. Hence if *we have a harp of steel bars* made permanently magnetical arranged over an electro magnet; and if we have the bars tuned to minute intervals of pitch if we talk into one harp certain rods will vibrate with certain amplitudes. Their vibrations will create an electrical vibration in the line wire and will force into vibration the corresponding rods of the other harp. . . . Mr. Farmer & Dr. Blake both pronounce it feasible.
>
> Please keep this paper as a record of the conception of the idea in case any one else should at a future time discover that the vibrations of a permanent magnet will induce a vibrating current of electricity in the coils of an electro-magnet.

Independent of the maturity and relevance of Bell's idea of a speaking telephone[57], what actually matters here is that, when he set out to Washington, he was already deeply interested in the electrical transmission of speech, to the point that he amply discussed the subject in Boston with Mr. Farmer and Dr. Blake and, in Washington, with Prof. Henry, in this latter case with special reference to the Reis telephone. We are inclined to think that he discussed it as well with his lawyers, no less than towards being acquainted with any prior art, as resulting from the Patent Office, given his explicit statement at the end of the above passage on his intention to protect his idea. At that time, however, the only prior art resulting from the Patent Office archives was Meucci's caveat [16], which had just expired, on December 28, 1874. Given the *connections* of Pollok & Bailey with the Patent Office, it would have been easy for them to inspect (or let Bell to inspect) Meucci's caveat, as they had seemingly done with Gray's pending application. Moreover, as Meucci's caveat had expired, there would be minor legal impediments for Bell to file a patent or a caveat encompassing all or part of Meucci's specification, as it would be hard to prove that there had been breach of secrecy from the Patent Office[58].

As known, after returning home from Washington and from his two visits at Western Union in New York, Bell engaged to perfect his harmonic telegraph, though constantly having in mind

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[56] See [14], Answers No. 34 & 35. The above statement was objected to by the counsel for complainant (the U.S. Government) as "incompetent and argumentative" (*ibid.*).

[57] The method of having the voice acting on a series of tuned reeds seemed to Bell himself far for being exploited in practice [68].

[58] It must be pointed out that the Patent Office was bound to maintain Meucci's caveat secret in any event. In fact, Sec. 40 of the 1870 Patent Act recited ". . . . such caveat shall be filed in the confidential archives of the office and preserved in secrecy, and shall be operative for the term of one year from the filing thereof. . . . " ([29], App. 14-10). Therefore, its preservation in secrecy was prescribed indefinitely and unconditionally, whereas the term of one year was prescribed for it being "operative," i.e. for the Patent Office to advise the caveator of any new relevant application and ask him "to complete" the caveat within three months.

his speaking telegraph. Thus when, on June 2, 1875, he discovered that he could get rid of the make-and-brake scheme in his harmonic telegraph, he became convinced that he could transmit speech with a similar scheme. In fact, as shown in Figure 6 —comparing Fig. 5 and Fig. 7 of Bell's patent of 1876 ([10],Figs. 5 & 7)— he thought that all he needed to convert his harmonic telegraph scheme into a speaking telegraph was to have the steel spring armature of his speaking telegraph "*fastened loosely* by one extremity to the uncovered leg *d* of the electro-magnet" instead of being "*firmly clamped*" to the same ([10], p. 3, italics ours), and to add a couple of cones with diaphragms to concentrate the voice, with the free end of the armature glued to the center of the diaphragm. He made a couple of trials of this idea in July 1875 with his two "gallows-model" telephones, which were unsuccessful, as "the character of the articulation produced was rather disappointing ([14],Answer No. 84) and, thereafter, he made no further attempts to make his telephone talk, until March 8 of the following year.
This notwithstanding, between September-October of 1875, and the beginning of January of 1876, Bell engaged in jotting down a specification for his new form of harmonic (and speaking) telegraph, evidently convinced that one day his telephone scheme would work ([14], Answers from No. 94 to No. 102).
His intention was to file a patent application in England and then file a caveat in the United States; but Pollok & Bailey, so instructed by Gardiner Hubbard, did not wait and, on February 14, 1876, they filed a regular patent application in the U.S. Patent Office "without Bell's knowledge or consent" ([14], Answer No. 105). Moreover, this application reached the Examiner room on the same day [70], because "the person who brought in Bell's application demanded that it be taken immediately to Room 118 [Examiner Wilber's office]"([63], p. 69).

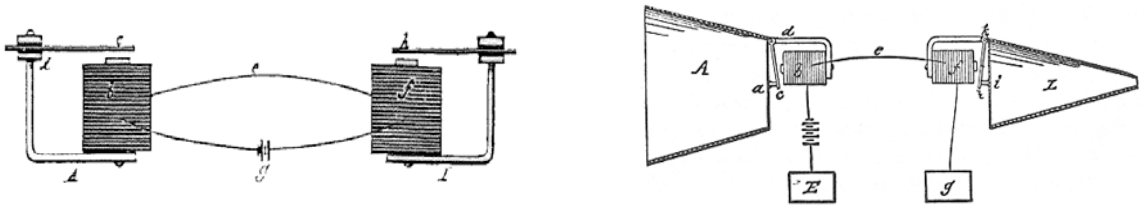

Figure 6. *Elementary layout of Bell's harmonic telegraph (left) and telephone (right).*

Strangely enough, at about the same time as Bell was writing his specification, Elisha Gray was jotting down his caveat titled "Art of Transmitting Vocal Sounds Telegraphically" [71], he too not having a working apparatus (he had not built any), evidently convinced that one day his telephone scheme would work[59]. Gray's caveat was filed on February 14, 1876, the same day of Bell's application, but remained in the "in-basket" up to the end of the day, as was the practice of the office ([64],p. 1217)[60].
That hasty filing must have been decided because both parties had reasons to suspect and anticipate each other—or a third party—and therefore rushed, in the hope of avoiding a lengthy and exhausting process of interference.
Somewhat unexpectedly, however, on February 19, 1876, examiner Wilber declared the interference and notified Gray to *complete* his caveat ([64], p. 1217-1218)[61]. On February 24, toward blocking that process of interference, Bell's attorneys wrote the Commissioner of

[59] According to his deposition in the *Speaking Telephone Interferences*, Gray had the idea of how to transmit vocal sounds about two months before ([36], p. 153-154). Prescott, however, notes that "he neither disclosed them [his ideas] to others nor clothed them in any fixed and positive form until he made the sketch for his caveat, February 11, 1876" ([56], p. 452).
[60] Bell's application turned out to be the 5th entry, thanks to its immediate hand delivery to Wilber's room, whereas Gray's caveat turned out to be the 39th entry ([63], p. 69).
[61] According to Patent regulations, the caveator had three months to *complete* his caveat i.e. to file a regular patent application, that would be examined together with the interfering application (Sec. 40 of the 1870 Patent Act [29]).

Patents, Robert H. Duell, stating that they had inquired the time of filing and had found that Bell's application was filed earlier in the day than Gray's caveat [72]. The Commissioner consented to their objection and immediately instructed the Examiner to withdraw the interference. The latter promptly notified the withdrawal to both parties on February 25, 1876 [73]. That same day, however, according to his statement, Wilber acquainted Bailey with the reasons that had led him to declare the interference, unduly revealing to him details of Gray's caveat [69]. Immediately, Bailey telegraphed Bell to rush to Washington.

BELL'S SECOND VISIT TO WASHINGTON (FEBRUARY 26 TO MARCH 6, 1876)

On February 26, Bell arrived to Washington ([14], Answer No. 106) and, soon after calling upon his attorneys, he went straight to Wilber's Room No. 118, at the Patent Office.
Here, Wilber's account [69] differs substantially from Bell's. Bell stated [74] that Wilber did not allow him to see the Gray's caveat, only pointing to a paragraph of Bell's specification relating to the use of variable resistance[62]. In addition, still according to Bell, Wilber allowed him to make an amendment to said specification because it seemed to interfere with a prior one of the same Bell, filed February 25, 1875 ([75]; [14], Answer No. 108). The amendment consisted in quoting said previous Bell's application in his new one. This amendment was filed on February 29, 1876 ([14], Int. No. 108) and then a patent issue was passed on Friday, March 3, 1876. Bell's patent was actually issued the following March 7, 1876 [70, 76])[63]. Bell, wholly satisfied, left Washington on Monday, March 6, 1876 [65].
Examiner Zenas Wilber, however, told a different story about Bell's visit at the Patent Office. Here are a few passages of his affidavit of 1886 ([69], italics ours) [64]:

> When I suspended Bell's application, because of the Gray caveat, I did not, in the official letter to Bell, give the name of the caveator nor his date of filing. Major Bailey appearing before me in regard to such suspension I allowed him to become acquainted with both facts, telling him personally the same, so that he immediately knew the exact facts upon which to base the project he subsequently filed against such suspension . . . .
>
> After the suspension of Bell's application had been revoked, Prof. Bell called upon me, in person, at the office, and *I showed him the original drawing of Gray's caveat, and fully explained Gray's method of transmitting and receiving. Prof. Bell was with me quite a time on this occasion—probably upward of an hour—when I showed him the drawing and*

[62] However—as reported by the New York Times in [69]—"Bell himself, in his testimony in the Dowd case, says that . . . . while the Examiner would not show him the caveat, he went away with the impression that the interference had something to do with a wire dipping in water." Who told him about "a wire dipping in water"? In his deposition at the U.S. vs. Bell trial, Bell stated that he had thought of it as a natural solution, previously adopted in his spark-arrester ([14], Answer No. 266).
[63] The "marvelous rapidity with which Bell's Application ripened into a patent" is analyzed in detail by George Gantt [76] in his aforesaid argument before the Secretary of the Interior, upon written information received by the Chief Clerk of the Interior Department, the same Schuyler Duryee, author of [70].
[64] This affidavit has a peculiar story, fully recounted by the *New York Times* where it was published [69]. It was drafted by Wilber as a reaction to "the [bad] treatment he received at the hands of the counsel of the Bell side during the inquiry last year before Secretary Lamar," and was handed by Hon. Casey Young to the Chairman of the Pan Electric Investigating Committee (*Pan Electric Investigation,* 1886) on May 21, 1886. Due to the opposition of some of its members, this affidavit was not read nor included in the official records. Therefore, it is only available today from the newspapers that published it, the original autograph copy having been in possession of Lloyd Taylor, as stated by himself [77]. Since Prof. Taylor is deceased, his papers are now kept at Oberlin College's Special Collections. Hon Casey Young offered to produce witnesses, instead of reading the above affidavit, but his offer was also refused. Strangely enough, a couple of affidavits discrediting Wilber were allowed to be put in the records ([64], p. 1182-1184). It was also an odd coincidence that Wilber was arrested for drunkenness on August 25, 1885 — and immediately affidavits (the same that were put in the records) were sworn on his arrest— less than a month after having sworn his first affidavit (dated July 30, 1885, as aforementioned) relating to irregularities in granting Bell's first patent [78, 79]. Bell denied Wilber's statements in his affidavit sworn shortly after the latest Wilber's affidavit [74].

explained Gray's method to him. This visit was either the next day or the second day after the revocation of the suspension.

There were several clerks and assistants in the room at the time, who might have heard the conversation, when I showed Prof. Bell the drawing and verbally explained to him the method of Prof. Gray. Bell had been in the office before this, on several occasions, in relation to other cases, so we were then acquainted; on this visit he was alone, and the visit occurred in the forenoon. About 2 P. M. of the same day he (Bell) returned to the office for a short time. On his leaving I accompanied him into the hall and around the corner into a cross hall leading into the courtyard, where Prof. Bell presented me with a one-hundred-dollar bill[65] . . . . .

The assistants and clerks had free access to the archives and records in the room; they could go in and out, outside of the regular office hours; the [Gray's] caveat was for some weeks in a file box on my desk and could have been taken therefrom and from the office, and kept over night without my knowledge, either by a messenger, a watchman, a clerk, or an assistant, or by a clerk or assistant from other divisions; at that time *Examiners' rooms were not locked and the key kept at the desk of the Captain of the Watch*, when the rooms were not occupied, outside of office hours, as is now the case; *nor were passes then required for employees to enter the building outside of the regular office hours*. . . . .

It was objected by Bell supporters that Wilber was not credible[66] both due to his drinking habits and because he had released before (on behalf of the Bell Company) another affidavit in which he had made statements in favor of Bell [81]. But the columnist of the *New York Times*, who reported the latest Wilber's affidavit, found other witnesses, who confirmed most of Wilber's latest version. This is what the columnist wrote ([69], p. 2, italics ours):

As regards the substance of the [Wilber's] affidavit now under consideration, there is much to be gleaned from forthcoming testimony of persons associated with Wilber at the time mentioned. In the office with him in 1875-6 were the following persons: H. C. Townsend, Assistant Examiner; J. H. McDonald, Assistant Examiner; Miss S. R. Noyes, Assistant Examiner; W. S. Chase, acting Assistant Examiner, and Mrs. S. R. Andrews, clerk. All these, with the exception of Mrs. Andrews, who is absent in Europe and has been absent since the first telephone suit, are available, and their testimony goes far to corroborate the affidavit made by Wilber, especially in the points of Bailey's influence over him, and that of the easy accessibility to caveats and so-called secret archives.

J. H. McDonalds, now a Solicitor of Patents in this city, was questioned to-day. He said that nothing he knew could go to snow that Wilber had been crooked, although *it was easy for him or anybody in the office to have shown a caveat or any other secret archive*. . . . .

A more important interview was held with H. C. Townsend, who said: "I am an attorney at law and solicitor of patents at No. 234 Broadway, New York. I was in Wilber's office in 1875, 1876, 1877, and was first Assistant Examiner until May, 1877, when Wilber was promoted to be Examiner of Interferences, and I was promoted to be principal Examiner in charge of the electrical division. I remember that Prof. Bell called several times on Major Wilber. . . . . I also distinctly remember that Major Bailey, Bell's attorney, had a powerful swing over Wilber, and that his hold on him was notorious among us in the office. Bailey had more influence over Wilber than any other attorney, and could get more out of him than anybody else. The reason of this influence I did not know nor investigate. . . . . *The 'secret archives,' as they were called, never amounted to anything in our office. The door*

[65] A map showing the place were Bell had allegedly bribed Wilber was annexed to this affidavit.

[66] However, Anthony Pollok had praised Wilber's technical competence [80]: "Mr. Z. F. Wilber, the examiner in charge, was for many years in the Patent Office, and I knew him during all that time. . . . He always evinced an intelligent appreciation of the inventions submitted to him, and showed himself to be well informed in regard to the state of the art to which they related, and was so considered by the authorities in the Patent Office."

was always open, and caveats and applications were kept in pigeon holes and unlocked drawers, accessible to any one gaining admittance to the building. Any one of these papers could have been taken out and returned without discovery by any one belonging in the room. As to the date of filing, the records in the office could not possibly show which application, Bell's or Gray's, was filed the earlier on the same day."

Also worth to be reported is a passage from Evenson's book ([63],p. 166):

> Wilber maintained throughout the rest of his life (he died in August 1889) that this affidavit, his last one, was completely true. The document, and its associated map, does have the ring of truth to it, and many of the events he mentions, as we have seen, agree with known facts in the case. Aside from the objections and denials of Bell and the Bell interests, nothing has ever surfaced to disprove what is claimed in Wilber's last affidavit.

Corruption and breach of secrecy at the Patent Office

All passages above, relating to the lack of secrecy existing at those times at the Patent Office, as well as to the ease with which confidential documents could be viewed and even taken in and out from the same office are by no means a result of a partisan view of the matter. A number of testimonies and documents widely support the state of negligence and permissiveness, to say the least, existing at that office at the time.
William W. Goodwin, president of the Globe Telephone Company, declared [82]:

> . . . . Affiant and his friend [Howard Munnikhuysen, Globe's lawyer] asked said Clerk [of the Patent Office] to show them the original Caveat of Meucci and were taken into a room in the upper part of the building which the Affiant has been informed is the Copying division, and found in said room the Meucci Caveat lying on a desk, and said Affiant asked the said Clerk the question "Why a Caveat of such value and twelve years old was found in such a place". Said Clerk replied to this question that they "had had occasion to examine the Caveat a short previous" . . . .

As we have said, the fact that Meucci's caveat had expired, was not an excuse for the Patent Office to leave it free to inspection to any visitor. To make this directive most explicit, the British Parliament passed an amendment to their Patent Act, some months before Wilber's and Goodwin's affidavits were sworn, which recited [83]:

> . . . . where an application for a patent has been abandoned or becomes void, the specification or specifications and drawings (if any) accompanying or left in connection with such application, shall not at any time be open to public inspection or be published by the comptroller. . . . . In pursuance of this enactment instructions have been received at the inspection department of the Patent Office not to allow lapsed provisional specifications to be inspected in future . . . .

It must be pointed out that, since many years before, the U.S. Commissioner of Patents, Charles Mason, had complained about the corruption of Patent Office officers, in his report to the U.S. Congress [84]:

> . . . . The attention of Congress is invited to the importance of providing some adequate means of preventing attempts to obtain patents by improper means. Several cases have occurred during the past year wherein persons interested in pending cases have sent or offered money to the Examiners having their cases in charge for the purpose of securing favorable action upon their respective applications. This has sometimes apparently been done through ignorance or thoughtlessness, but in other cases evidently with a premeditated corrupt intent. In cases of this kind it seems proper and necessary that penalties commensurate with the enormity of the offense should be visited upon the heads of willful transgressors. . . .

Among the records of the Department of Justice, we have found more documents [85÷88], that corroborate the state of corruption at the Patent Office, in addition to explicitly charging the U.S. Commissioner of Patent, Benton J. Hall, to be biased in favor of the Bell Company [89]. However, the most important substantiation of the charges regarding the improper behavior of the Patent Office came from the Secretary of the Interior, Lucius Q. C. Lamar, as well as from the Commissioner of Patents, Martin V. Montgomery (the predecessor of Benton J. Hall), in their conclusive reports following the hearings, held in November 1885, towards deciding of recommending a suit by the Government against the Bell Company ([24],p. 434-435). Here are their statements (italics ours):

> (Lamar, [90]). . . . As the Patent Office appertains to this Department, I have been especially desirous to understand fully all that is alleged as ground for relief in these petitions in regard to what was done in that office . . . . The grounds of invalidity alleged against the Bell Telephone patent may be substantially summarized thus:
>
> *First*, The patent was procured by the fraud of the patentee through the collusion or mistake of the officers of the Patent Office and in violation of the rights of a caveator named Elisha Gray.
>
> *Second*, The invention patented was not patentable, because already public. . . .
>
> The allegations and the evidence touching the circumstances attending the issue of the patent are of such a nature and have such a support as to render it in my opinion improper to ignore or dismiss them. Such a case is presented as I think ought to undergo thorough judicial investigation. . . .
>
> (Montgomery, [91]). . . . No matter how many suits might be brought and conducted to a termination by private litigants, there is but one way to actually invalidate, annul, and destroy a patent, and that is by suit such as is proposed in these petitions. . . . .
>
> In the absence of any defenses and in the absence of any explanation, a strong presumptive case was made out against respondents [Alexander Graham Bell and the American Bell Telephone Company], which would make it the clear duty of the Government to institute suit to vacate the patents. . . . .
>
> It is asserted on the part of the petitioners that Mr. Bell in this invention was anticipated by at least two inventors, Antonio Meucci and Philipp Reis, respectively . . . . In conclusion, I submit that, in my opinion . . . . the Department of the Interior should recommend to the Department of Justice that such a suit be brought.

As known, on January 14, 1886, Secretary of the Interior, Lamar, recommended the Department of Justice to proceed against the American Bell Telephone Co. and A. Graham Bell, on the ground of fraud, collusion, and misrepresentation, notwithstanding the fact that, at the time, the Patent Office reported to himself [90]. As reported elsewhere ([24],p. 432, 438), the above suit was first instituted in Tennessee, then in Ohio and finally in Massachusetts, where it finally took off. The Bill of Complaint, filed on January 13, 1887 charged that ([92], italics ours):

- letters patent issued to Alexander Graham Bell, the one dated March 7, 1876, numbered 174465, and the other dated January 30, 1877, numbered 186787, were, and each of them was, illegally and improperly procured to be issued . . . .
- up to the time of issuing of the said patent the said Bell has never in fact been able to transmit articulate speech by the method or with the apparatus described in his said application, but that he purposely framed his said application and claim, in ambiguous and general terms, in order to cover both antecedent and future inventions. . . . [and] entitled it an application for an “improvement in telegraphy” . . . .
- the examining officer of the Patent Office communicated to the said Bell, very soon after the filing of the said caveat, the [Gray’s] fact and date of the filing thereof, the

name of the caveator, as well as the general nature of the claim contained therein, and some information as to the particular method employed;

- the said examining officer did then, on or about the 26th or 27th day of February, 1876, exhibit to the said Bell the drawings of the said caveat of Gray, and did then and there fully describe to the said Bell the construction and mode of operation of the telephone, illustrated in the said drawing, and the method disclosed by the said Gray in said caveat, of transmitting and receiving vocal sounds.
- these facts showing fraud, collusion, and overreaching in the obtaining of the said Bell patent long remained artfully concealed . . . .
- Bell, in his specification and claims, did not and does not point out or describe any device, apparatus, mechanism, or means of carrying his pretended invention or process into effect in such form and with such clearness that the same can be constructed and operated by others . . . .
- the said Bell was anticipated in the discovery of the electric speaking telephone by Philipp Reis, Cromwell Fleetwood Varley, Antonio Meucci, Elisha Gray, Thomas A. Edison, Ashael K. Eaton, and many others . . . .
- a model should be required in every case, when the nature of the case admitted of such illustration[67], and that such model should exhibit every feature of the machine which formed the subject of a claim of invention . . . . a model illustrating the said invention was constructed by the said Bell, but was not deposited by him in the Patent Office . . . .
- [Bell] made another application for a patent to be issued to him, upon which application a patent was issued, No. 186787, dated January 30, 1877 *had been taken bodily by him from well-known and existing apparatus, devices, and plans invented and contrived by others* for the purpose of transmitting articulate speech by means of electricity. . . . .
- especially *is it true that said invention was known and used by . . . . one Antonio Meucci, at Staten Island, New York, from 1856 to 1870, and by him published* in the Eco d'Italia, published in New York about September 1860, and August, 1865, and in Il Diritto, a newspaper published in Italy in 1865; and that said Meucci, in order to secure his invention to himself, his heirs and assigns, on the 26th day of December, 1871, filed a caveat for the same in the Patent Office of the United States, and renewed the same on the 28th day of December, 1875 [1874], which said caveat of said Meucci on his said invention is still of record in the Patent Office of the United States . . . .
- [The Bell Co.] has brought and is carrying on a multiplicity of suits against divers citizens of the United States as alleged infringers of the said patents. . . .
- said [two Bell] patents were, and each of them was, wrongfully procured to be issued by means of fraud, false suggestion, concealment, and wrong on the part of the said Alexander Graham Bell. . . .

Improvements made by A. G. Bell on his telephone after filing his first patent

Soon after Bell returned home from Washington, he resumed his work on the telephone, beginning March 8, 1876, and for the first time he began recording his experiments in a notebook[68]. For many months, however, the results obtained were quite far from the minimum affordable quality of a viable telephone conversation.

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[67] This remark of the Bill of Complaint makes reference to Sec. 29 of the Patent Act of July 8, 1870, which recited ([29], App. 14-8): "That in all cases which admit of representation by model, the applicant, if required by the commissioner, shall furnish one of convenient size to exhibit advantageously the several parts of his invention or discovery."

[68] Bell's notebooks can be found in Internet among "Alexander Graham Bell Family Papers at the Library of Congress" (http://memory.loc.gov/ammem/bellhtml/bellhome.html). His first Notebook begins with an isolated

The historic phrase "Mr. Watson come here, I want you!" was "heard" by Thomas Watson, on March 10, 1876, while pressing his ear against a tuned reed receiver (still *clamped*, not *hinged* on a leg of the electromagnet), the transmitter being a liquid transmitter similar to that sketched out in Gray's caveat. As remarked by Prof. Finn, "the circumstances surrounding this event and those that followed are virtually unknown" [93]. In fact, the degree of intelligibility of all Bell's various prototypes, constructed and tested before October 9, 1876, was inadequate, the vowels only being reproduced satisfactorily, the consonants barely discriminated ([93], p. 12). In this respect, as noted by Bell himself, "expectancy sometimes led him [Bell] to anticipate what was said through his early telephone" ([14], Answer No. 111, and note on Answer No. 267), as a result of the capability of the human brain to aid the ear by "prediction," whereby the "perceived" sound of the words may recall to mind something that has been already "heard and understood" before.

On April 1, 1876, Bell modified his reed receiver by physically separating the reed from the electromagnet and gluing it at the center of an animal diaphragm, thus approaching Meucci's receiver of 1860 ([8], p. 59), though not yet using a screw-regulation of the air gap. Once more, "vowel qualities could be discriminated, but no consonant sounds," as Bell reported in his notebook on the same date ([93], p. 12).

The same happened with Bell's prototypes demonstrated at the Massachusetts Institute of Technology, in Boston, at a meeting of the American Academy of Arts and Sciences, on May 25, 1876, the same day that the Philadelphia Exhibition was inaugurated. In fact, the *Boston Evening Transcript* of May 31, 1876, reported: "vowels are faithfully reproduced; consonants are unrecognizable" ([3], p. 189; [14], Answer No. 120.).

Even regarding Bell's demonstration at the Centennial Exhibition in Philadelphia of June 25, 1876, there are some less triumphant accounts, with respect to those found in most of the available literature. For example, Sir William Thomson, who was one of the judges at the Exhibition, while testifying in England in the case of "United Telephone Co. v. Alexander McLean," stated the following [94] (italics theirs):

> . . . . This eminent professor [William Thomson] stated that . . . . Bell "showed to him an instrument capable of producing a fixed note", but "not capable of producing articulate speech." Afterwards Bell showed him something else, which he (Bell) said: "he would hardly call an invention, but which might ultimately become an invention, and then the telephone was shown to him in connection with a battery and line wires," and Bell said: "he could show us something which would speak, and on that occasion, in presence of the Emperor of Brazil (here parenthetically let me say that no doubt it was in deference to the august presence of his imperial majesty that the "telephone after some troublesome adjustment," spoke six monosyllables — "to be, or not to be" — from a royal speech. Oh! wonderful effect of royalty). Sir William proceeds to state: "I felt so very much interest that I went too far and said the thing was done." My friend, Professor Watson, heard it faintly; it required very minute attention, but I am absolutely convinced myself that I did hear it." This was the only occasion on which Sir William heard of the receiver, and this in the presence of royalty. Mr. Bell gave to Sir William instruments, which Sir William brought to Scotland, and Sir William proceeds to say: "I tried them and worked a good deal with them; I tried various combinations of battery powers, but all with no effect." "I continued my experiments for some considerable time, making several experiments, but never got it to speak a word," and, again, Sir William said: "I dropped my experiments at Glasgow as a failure." . . . .

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experiment with clamped reeds, dated "October 1875" but reported in his notebook on February 21, 1876. After that are reported a few experiments, dated between February 18 and February 24, 1876, but concerning Bell's autograph telegraph, electromagnetic tone transmission and a form of manometric capsule. The date of the following entry—the first one, concerning his speaking telegraph—is March 8, 1876, i.e. soon after his returning home from Washington.

> It is really surprising that *Sir William* with his extensive knowledge should have failed to make an instrument repeat in *Glasgow* what he had seen or heard it do in Philadelphia. Can it be possible that Bell's instrument was merely a sort of improvement on the toy telephone which was the nuisance in the streets several years ago, called the "lovers' telephones," which did talk, but whose talking qualities were destroyed or curtailed by the supposed improvements by Bell. . . . . I wish, for future reference, to make a point here. That this instrument of Bell's could not be made to talk by Sir William; and I here state that Bell's invention of a speaking telephone cannot be dated back further than October 9th, 1876[69] . . . .

From his part, Gray, who had watched Bell's demonstration declared ([3], p. 197):

> I listened intently for some moments, hearing a very faint, ghostly, ringing sort of a sound; but, finally, I thought I caught the words, "Aye, there's the rub."

Soon after watching Bell's demonstration, Gray instructed his instrument maker, William Goodridge, to construct a liquid transmitter as described in his own caveat and, after a few weeks (July, 1876), he tried it in connection with one of his "wooden sounding box" receivers used in his octuplex on display at Philadelphia. However, the test failed. Gray later attributed its failure to the unsuitable type of receiver employed ([36], p. 155; [56], p. 457)[70]. As a matter of fact, the receiver employed (Fig. 7) was essentially a reed receiver, whose armature was connected to a sounding box, in order to enhance its selectivity, since operators would receive by ear [95]. It therefore was utterly unsuitable to receive (wideband) vocal sounds. This wrong choice may mean that Gray had not, at that time (July, 1876), a clear insight of the requirements for the transmission of speech though, as remarked by Hounshell, he was affected by his uneasy condition, as: "he passed out in the streets of Philadelphia either from heat prostration or a mild heart attack. He spent over a month in bed for recovering from this attack." ([36], p. 135).

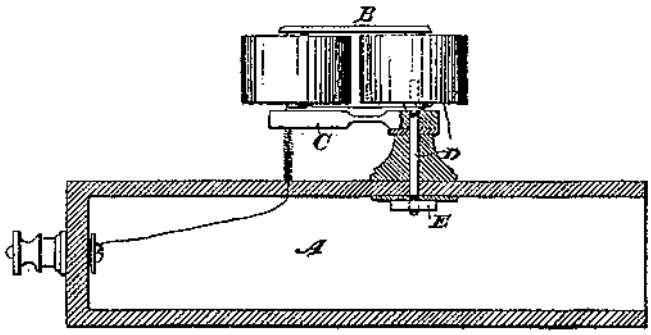

Figure 7. *Gray's "wooden sounding-box" receiver, tried in Philadelphia in connection with his liquid transmitter.*

After said failure, Gray abandoned his telephone scheme and, the following March 5, 1877, wrote to Graham Bell: "I do not, however, claim even the credit of inventing it, as I do not believe a mere description of an idea that has never been reduced to practice—in the strict sense of that phrase—should be dignified with the name invention." [96].
In conclusion, after about five months from their filing at the Patent Office, neither Bell nor Gray could get their "invention" work satisfactorily or work at all.
The interested reader is referred to Appendix 3 for a discussion on Gray's and other inventors' "electromagnetic" receivers, similar to that shown in Gray's caveat of 1876.

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[69] As a matter of fact, Bell himself spoke of October 9, 1876 as "the proudest day of my life" ([3], p. 204).
[70] Hounshell [36] quotes the "Deposition of William Goodridge," in *Elisha Gray's Case, Speaking Telephone Interferences,* p. 18. Prescott [56] quotes Gray's own statement (probably in the same proceeding).

We note, incidentally, that the apparatus (both transmitter and receiver) tried by Bell on April 1, 1876 (Fig. 8 below[71]), which was "essentially the same as the transmitters Bell would take to the Centennial in June and as those that he would demonstrate successfully during the summer" ([93], p. 13) had a striking resemblance with the receiver depicted in Gray's caveat (reproduced at right of our Fig. 10 ahead). In fact, as stated by Finn, it featured "a piece of steel spring glued to the membrane of the transmitter,"([93], p. 12-13) whereas Gray's caveat described his receiver as "an electro-magnet of ordinary construction acting upon a diaphragm to which is attached a piece of soft iron and which diaphragm is stretched across a receiving vocalizing chamber. . . ." [71].

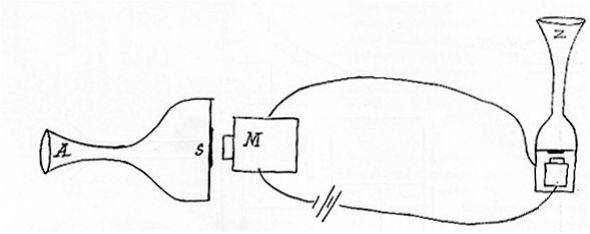

Figure 8. *Apparatus tried by Alexander Graham Bell on April 1, 1876.*

However, as outlined above, the quality of speech obtained by Bell with that apparatus was not much different from that obtained by Philipp Reis[72] and Innocenzo Manzetti[73], between 1861 and 1865. In fact, both of them mostly succeeded in public demonstrations by singing or uttering particular phrases rich of vowels or with a high degree of predictability[74].
The quality of speech transmission did not substantially improve during Bell's experiments performed on August 10-12, 1876, in Brantford, ON (Canada). Once more, songs were executed and well recognized, whereas speech quality was marginal, as remarked by the *Scientific American* [100] (italics ours):

> Several familiar questions were, it is said, understood *after a few repetitions*[75]. The vowel sounds alone are those faithfully reproduced; diphthongal sounds and rotund vowels are readily distinguished, but consonants are generally unrecognizable. Now and then, however, a sentence comes out with almost startling distinctness, the consonants as well as the vowels being clearly audible . . . .

As reported in the same paper, the instruments still employed a diaphragm "of goldbeater's skin, about 2 inches in diameter" with "a circular piece of clock spring . . . glued to the middle of the membrane."

Satisfactory results were ultimately achieved by Bell on October 9, 1876, on a 2-miles line between Boston and Cambridge. They were mainly due to the use of membrane diaphragms with metallic discs covering about the entire membrane, which were to be soon followed by

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[71] Taken from [97], Figure 3, p. 69 (dated April 1, 1876).
[72] See, for instance, [98], where Reis stated (p. 17): "in reference to the capabilities of the telephone, it may be stated that I was enabled to render audible to the members . . . melodies which were sung (not very loud) into the apparatus in another house . . . Hitherto it has not been possible to reproduce the tones of human speech . . . with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree."
[73] See, for instance, [99] where it is stated: "On transmet parfaitement la musique; quand aux paroles, celles qui sont sonores s'entendent distinctement . . . ".
[74] As hinted above, modern audio-compression techniques exploit the "prediction," ability of our brain, i.e. to figure out words or other sounds before they are uttered or played, based on previous knowledge of the same or even simply of the subject dealt with in the session. One example is the renowned phrase "to be or not to be."
[75] This agrees with Thomas Watson's recount ([101], italics ours): "during the summer of 1876 the telephone was talking so well that one didn't have to ask the other man to say it over again more than three or four times before one could understand quite well, *if the sentences were simple*."

metallic diaphragms alone ([14], Answer No. 163). The affordable quality of speech was so commented by the *Boston Evening Transcript* of October 19, 1876 ([11],p. 92):

> The registry of sounds by telegraph has now been carried to such a point that the delicate variations involved in the articulation of human speech are transmitted with such unerring accuracy and distinctness that one may talk with another through the telegraph as though face to face . . . .

Between October 19 and 20 Bell constructed his "box telephone," which was substantially like that described in detail in his second patent ([102], Figure 1), and later put into experimental commercial service, in April 1877.

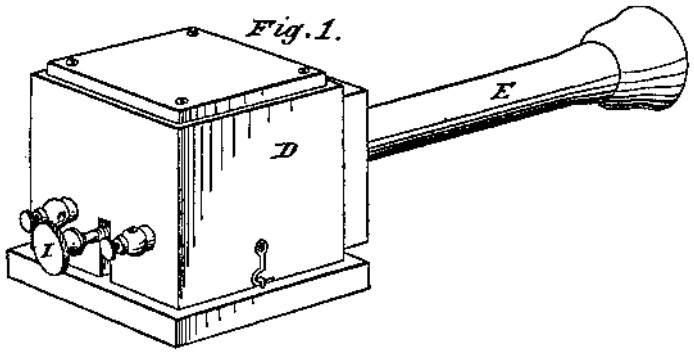

Figure 9. *Bell's "box telephone" as represented in his second patent.*

The main distinctive improvements of Bell's "box telephone," as described in his 1877 patent, are:

- A (square) plate of iron or steel— clamped at two of the four edges of the sounding box— is substituted for the membrane-with-glued-armature diaphragm, in both the transmitting and receiving instrument;
- Positioning the coil at the end of the magnet nearest the diaphragm;
- An adjusting screw (*I*, in Fig. 9 above) is added, whereby the air gap may be finely adjusted to a minimum, but non-zero, value;
- The need of a call bell is recommended, though of a non-specified construction or principle;
- The use of a permanently magnetized core, allowing to eliminate the battery, is envisaged[76].

Notwithstanding the substantial improvements outlined above, we must remark that, during Bell's exhibition before the Philosophical Society in Washington, on the evening of January 13, l877, he still spoke "of the difficulty with such consonants as *p*, *t* and *k*. . . ." ([14], Answers No. 183 seq.). This happened two days before filing his second patent [102], which was granted with even greater "marvelous rapidity" (two weeks), than that of his first patent ([76], p. 44).

As known, the first commercial telephone line was opened in Boston on April 4, 1877 and connected the office of Mr. Charles Williams, Jr., 109 Court Street, Boston, with his residence in Somerville ([14], Answer No. 271). The instruments used were substantially of the type described in Bell's second patent. As recounted by Bell's assistant, Thomas Watson ([101], p.

[76] A note in Meucci's laboratory notebook reads "At the centre of the wire, a strong magnetic iron protected by a bobbin do not need any battery at all and is a good conductor of the sound." ([103], p. 57, note dated May 20, 1862, corresponding to p. 2 of Meucci's *Memorandum Book*). This means that Meucci first experimented with permanently magnetized cores since 1862.

20): “Williams on his line used to call by thumping the diaphragm through the mouthpiece with the butt of a lead pencil.”
There would be still a long way before Graham Bell could challenge the results achieved by Antonio Meucci. In fact:

- to see a circular iron diaphragm firmly clamped along its rim— though not as well as in Meucci’s shaving soap-box telephone of 1864 ([8], p. 64)[77]— we must wait until May of 1877, when Bell made his first “hand telephone” and exhibited it before the Society of Arts, in Boston ([14], Answers No. 202 seq.);
- to see the first provisions to insure a quiet environment—as recommended by Meucci’s caveat of 1871[78]— we must wait till the early summer of 1877 ([101], p. 17; [7], p. 685-686);
- to see a first non trivial call signaling—vaguely challenging the telegraph sounder method, indicated in Meucci’s layout of 1858 (Figure 3 above), and described in Meucci’s caveat of 1871[79]—we must wait until January 1878, when the so-called *Watson buzzer* was introduced [104];
- to see a telephone line capable of coping with the skin effect— as widely investigated on by Antonio Meucci from 1862 to 1870, who recommended from a copper conductor of larger section to a twisted plait of insulated copper wires[80]— we must wait until the beginning of the 1880s ([104], p. 99 and 203; [7], p. 683);
- to see the first inductive loading and the first anti-sidetone circuits—that Meucci had devised since 1862 and 1858 respectively[81]— we must wait until the beginning of the next century, though introduced by Michael I. Pupin and George A. Campbell, not by Graham Bell himself[82].

Conclusions

A general remark must be made—not merely relating to our analysis—i.e., one cannot fully understand what had happened well over a century ago, without delving into the relevant space-time environment where the events under consideration took place. If we try to draw conclusions based on today’s standards of behavior and ethics, we may arrive at wrong deductions. In this respect, discrimination and prejudice then existing towards non-Anglo-Saxon ethnic groups—that definitely advantaged persons like Orton, Hubbard, Grant, Bell and Gray vis-à-vis Meucci— did certainly play a role. Moreover, being Meucci completely destitute of means and barely integrated in the contexture of influential persons, he was an easy prey for anyone wishing to appropriate his inventions. Finally, corruption of public administration also played a significant role. Fighting corruption was, in fact, a crucial issue for the rise to power in 1885 of President Cleveland, who engaged to eradicate it at all levels, leading the U.S. government to investigate on its own officers in the trial against Alexander Graham Bell and the Bell Company ([24], p. 432).

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[77] A theoretical understanding of the optimal construction of the diaphragm was to be given many years later [105].
[78] Meucci’s “Sound Telegraph” [16] recites, “When my sound telegraph is in operation, the parties should remain alone in their respective rooms, and every practicable precautions should be taken to have the surroundings perfectly quiet.”
[79] Meucci’s “Sound Telegraph” [16] recites, “To call attention, the party at the other end of the line may be warned by an electric telegraph signal, or a series of them. The apparatus for this purpose, and the skill in operating it, need be much less than for the ordinary telegraphing.”
[80] See [7] p. 682-683, where ample reference is made to Meucci’s caveat as well as to his *Memorandum Book*, as translated in Lemmi’s affidavit, above mentioned.
[81] See [7], p. 682-684, quoting entries in Meucci’s *Memorandum Book*, and [43].
[82] See [104], p. 107 (Campbell’s Anti-Sidetone) and p. 243-244 (Pupin’s & Campbell’s inductive loading).

Turning now to the specific issues stemming from our inquiry, and taking into account the circumstances outlined above, it is hard to believe that Bell knew little or nothing about Meucci's telephone before filing his patents, or even before his first devising the possibility of the electrical transmission of speech. It would be even harder to believe that such a smart personality as Gardiner G. Hubbard—who rushed to file Bell's first patent "without Bell's knowledge or consent"—as well as a smart organization as the Bell Telephone Company, well endowed with the best lawyers and detectives of the country—who quickly discovered everything about Elisha Gray, and challenged in 1878, and defeated in 1879, a giant company as the Western Union—did not timely uncover the great value of the telephone inventions of Antonio Meucci, a totally unarmed individual, as compared with any other adversary of the Bell Company.

As for the highways through which information on Meucci could have been obtained, it appears from our analysis that the great bulk of information could be gathered in New York, chiefly through the Western Union's electricians, Frank L. Pope and George B. Prescott. We know, in fact, that Bell and Gray repeatedly called on Western Union between 1874-1875 and 1877, and that, up to the summer of 1877, the same Western Union saw little practical value in the electrical transmission of speech ([56], p. 444), therefore considering any related information in its possession not worth to be kept as company confidential. Hence, since Western Union was uninterested, Bell and Gray, having an adequate background and—contrary to Western Union—judging the subject interesting, could have easily drawn that information from Pope and/or Prescott.

The highways through which information on Meucci's telephone could have reached Western Union were: Edward B. Grant, vice president of ADT, since, starting from 1874, he reported to Mr. Orton, president of Western Union; Henry Pope, superintendent of ADT from 1874 onwards, he being the brother of Western Union's chief electrician, Frank L. Pope; William H. Vanderbilt—who knew very well Meucci and lived near him— because, up to 1881, he was the controlling stockholder and director of Western Union. Some information might have also been furnished by David H. Craig, general manager of the Associated Press (quite connected with Western Union[83])—who had finalized a contract with Meucci in1864-65, the same year when Meucci realized his best telephone—although he testified for the Bell Company in 1886, denying that he was cognizant of Meucci's telephone ([38] Answer No. 16)).

For what concerns the Washington highway, we should observe beforehand that the suspected inspection of Meucci's caveat at the Patent Office (by either or both Bell and his lawyers), would have served little towards reproducing (in part or fully) Meucci's telephone sets, being Meucci's caveat—unlike Gray's caveat— mostly devoted to system requirements. Learning, however, from Meucci's caveat (or from some employee at the Patent Office) the name of Meucci's patent lawyer, Thomas D. Stetson, residing in New York, the latter could be contacted and a quite complete knowledge of Meucci's invention could be obtained from him. This hypothesis is far from being remote, since, as it was shown elsewhere ([9], p. 119-120), Stetson appears to have been bought by the Bell lawyers at the time of the Bell vs. Globe trial, given his ambiguous deposition, formally as a witness for Globe and Meucci but substantially for the opposing party.

Moreover, we must stress that specific and complete technical information on Meucci's telephone sets and telephone transmission techniques was mostly in the hands of two persons (apart Meucci himself), namely Edward B. Grant and Thomas Drew Stetson, both of them residing in New York and both in possession of written, extended and detailed technical information on Meucci's telephones and system[84].

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[83] Both because of the role of telegraph in the transmission of news and because, as abovementioned, their headquarters was in the same building from 1866 to 1875.

[84] Specification handed to Thomas Stetson was prepared by Meucci and translated into English by Angelo Bertolino [12, 20].

In addition to the above, our analysis has proved that Mr. Grant had deceived Meucci, when he told him that his papers were lost, as he himself, years later, admitted to Mr. Durant (a witness for Bell) that they were still in his possession[85]. Also relevant is the abovementioned fact that, in 1878, ADT was putting up its own (Meucci's?) telephones both in Chicago and in San Francisco, and that, soon after the settlement between Western Union and the Bell Company (November 10, 1879), Mr. Grant endeavored in many ways to sell his knowledge on Meucci's telephone to persons like Chauncey Smith and E. B. Welch, connected with the Bell Company, as well as to others, such as the same Philadelphia syndicate, who finally would acquire Meucci's rights through other negotiators ([24], p. 427). As these facts happened after 1880, they prove once more that Mr. Grant was still in possession of Meucci's papers at that time, since otherwise about what could he negotiate with all those gentlemen? Noteworthy are, in this same respect, the two telephone sets brought by Henry Pope, ADT superintendent, to his brother Frank L. Pope, Western Union electrician, to be evaluated in the fall of 1877 in New Jersey, in the frame of the 360-degree survey of the telephone field, ordered to Frank L. Pope by Western Union's president, Mr. Orton.

On the other hand, our investigation failed to provide a unique and satisfactory explanation of the circumstance that Meucci's many contrivances were allegedly applied by either Bell or his associates with such long delays as outlined above. Note, for instance, the long process of Bell's improvements of the diaphragm, from 1875 to 1877: he began using a clamped reed, then he changed it to a hinged reed, then to a glued reed, subsequently to a glued button, to glued buttons of increasing diameter, to a square iron diaphragm clamped at one edge, then clamped at two edges, then to a big circular iron diaphragm clamped with a ring fixed with screws and finally to his "hand telephone," featuring a circular iron diaphragm—though not as elegantly clamped as Meucci's shaving-soap box telephone of 1864 ([9], p. 131).

A simplistic explanation of that "slowness" would be that Bell followed his own path from scratch, either not having the slightest knowledge of Meucci's invention or just feeling too proud to fish out ideas from others. Another possible explanation would be that he was not as quick in reducing his invention to practice—despite the valuable help provided him by Thomas Watson's great mechanical skill—as he was in theory. A contemporary scholar advances a third hypothesis, i.e. that Bell adopted a Machiavellian strategy, purposely delaying the application and/or divulgation of concepts or techniques (such as Gray's liquid transmitter), that he supposedly had fished out from his rival inventors[86]. This somewhat echoes what is recounted about legendary bank or train robberies, where the loot was not spent or sold for years to avoid it to be traced to the robbery.

Turning now to the motivation of the present paper—i.e. the charge, implicit in the aforesaid U.S. House Resolution of June 11, 2002, that Alexander Graham Bell had fished out Meucci's ideas in the Western Union laboratory—two facts seem to corroborate the same: *first*, both Gray and Bell rushed up to file their caveat/patent on the telephone without having a working prototype, and long before they could make one work; *second*, both Gray and Bell began to be interested in the telephone when, by odd coincidence, Meucci was told by ADT Vice President, Mr. Grant, that his papers were lost, which statement proved afterwards to be false, as well as concealing his dishonest intention to trade Meucci's invention to his own advantage.

However, our last above paragraphs are far from constituting incontrovertible proofs, and only provide us with circumstantial or presumptive evidence. We concur with Aristotle's assertion that "people will not accept the statements of a speaker unless he gives a mathematical proof" (or, as per Ross's translation: "some people do not listen to a speaker unless he speaks

[85] See [60], where Durant wrote: "He [Mr. Grant] said he had, or thought he had, those papers somewhere and remarked «perhaps, after all that fellow [Meucci] might have had something»".

[86] See [63], p. 100, where Evenson wrote (notes in square brackets ours): "With the exception of this letter to his father and a few notation in his laboratory notebook, it would be many years before Bell would make any further mention of his March 10 [1876] telephonic breakthrough [where a liquid transmitter was used]. It was to remain secret for over six years, only to be revealed by Watson during a court trial [The People's Case] in 1882."

mathematically" [106]. And—we dare to add— "a mathematical proof" is one that can be expressed in numbers[87].

Now, we have *the mathematical proof* that Meucci preceded Bell, as well as others from the Bell Company, not only in the invention of the electromagnetic telephone but also in many advanced techniques for long distance telephone transmission, such as the inductive loading, the anti-sidetone layout, the structure of the transmission line to cope with the *skin effect*, the provisions for call signaling and for operating in a quiet environment. This was demonstrated with precise dates of affidavits sworn before a notary public, the paramount of which was Meucci's Laboratory notebook, translated into English by Michael Lemmi[88].

There appears not to exist equally incontrovertible proofs that either Bell or Gray or any of their associates have drawn up ideas from Meucci's inventions, although the demonstrated priority of Antonio Meucci, does suggest that they had all the means to obtain that information. The fact, however, that such "Aristotelian" proofs do not exist does not mean that, in particular, Bell and his associates are exempt from any suspicion that they actually did what the U.S. Government (and others) had charged them to have done. Nor do we have a decision on the U.S. vs. Bell trial of 1885-1897, which dealt with that issue because it was discontinued with no winners or losers. In fact, when recommending the cloture of the case as moot, the U.S. Attorney General, Hon. Judson Harmon, in his report of November, 1896, "said he had made arrangements with opposing counsel whereby no advantage would be taken of the Government's inaction . . . " [109]. As a consequence, the Bell Company could not claim, from the outcome of that trial, that Bell was the inventor of the telephone, nor could the U.S. Government claim that he was not ([9], p. 124).

This notwithstanding, the stalling of the U.S. vs. Bell trial after twelve years of testing, together with the unending series of (hundreds of) local trials won by the Bell Company in the 1880s, gradually brought up the deification of Alexander Graham Bell, as the unique and sole inventor of the telephone, denying the least recognition of contributions given by anyone else. More than that, we have assisted to a systematic defamation and vilification of all other claimants[89], with about no exception. Bell gradually became "untouchable." He was depicted by a swarm of complacent writers as being completely exempt of any fault or defect whatsoever, sometimes threatening to sue whomsoever would dare to doubt or slightly deviate from the dogma emanated from the same authors, devoted to the Bell Myth.

Myth, as President John Kennedy justly pointed out, is even worse than distorting the historical truth. In his words: "The great enemy of the truth is very often not the lie—deliberate, contrived, and dishonest— but the myth—persistent, persuasive, and unrealistic" [111, 112].

Although this state of affairs cannot be sustained anymore, to be consistent with our conduct, we must equally be loyal towards Alexander Graham Bell and not perpetrate the mistake of doing him what his supporters have done to Meucci and others in the past, that is to fall into the defamation or vilification of his contribution to the invention of the telephone and to the progress of science.

More specifically, in our opinion, Bell's theoretical description of the principle of analog electric telephony in his first patent is nearly perfect and has the merit of having been the first

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[87] According to the Greek philosopher Phylolaos [107]: "[the number], by harmonizing in the soul all things with the sensations, renders them knowledgeable." Lord Kelvin was even more specific [108]: "When you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge. . . ".

[88] See [9], p. 125-129 (The Scientific Proofs) and [103] (Translation of Meucci's *Memorandum Book*).

[89] See, among others, reference [110], where it is stated: "It seems likely that Bruce's narrative account of Bell's invention of the telephone will—with its shading and emphasis—be the definitive one. Bruce's treatment of rival telephone inventors is less convincing, however, simply because he labels them in such an offhand fashion—Daniel Drawbaugh, the 'Charlatan,' Antonio Meucci, the 'innocent,' Elisha Gray, whose 'bitterness' caused him 'to lash out [at Bell]'." See also Bruce's mention of Meucci being deemed as "the silliest and weakest impostor who has ever turned up" ([3], p. 272]), already quoted above.

clear and inspired treatise on the subject. It would have been a magnificent piece to be published in the proceedings of the American Association for the Advancement of Science or some renowned scientific magazine, such as *Nature*, not to be put in a specification for a patent, which is definitely something else[90]. The improper nature of Bell's first telephone patent (1876) was one of the main issues why the U.S. Government pursued him for twelve years.

One more warning for those who have unfairly accused Alexander Graham Bell for the unjust trial of 1885-1886 instituted against Meucci and the Globe Company: Bell was completely blameless, because he had not participated to the main decisions of the Bell Company since about 1879, having been detached from the management of the same, together with the "old guard," Gardiner Hubbard, Thomas Sanders and Thomas Watson (who left the company by 1881)[91].

Finally, let us spend some words in recognition of the merits of Elisha Gray. His outstanding contribution to the advancement of science and technology is proven by his over seventy patents granted to him in the course of his life. The fact that he preferred to bring to a success his harmonic telegraph (octuplex)—which eventually *did* work (contrary to Bell's harmonic telegraph that did not enjoy the same success)—was determined by his evaluation of its superior commercial value with respect to the telephone. We have no doubts that he would have brought to success the telephone, if he had fully perceived its prospective commercial value. In this respect, both Meucci and Bell must be praised, since in no instances and in no moments they doubted of the success of the telephone and therefore engaged for years (Meucci since 1849, Bell since about 1874) to reduce it to practice and bring it to the benefit of the society.

Moreover, the Bell Telephone Laboratories—born from the pioneering work of Alexander Graham Bell—have given the world most of the modern technologies in the field of telecommunications, as well as in many other fields. This writer, among others, has learned much from the *Bell System Technical Journal*, as well as from his frequent contacts with researchers from the Bell Labs, during his active life as a researcher in telecommunications.

Let us end this paper with Meucci's words [117], regarding Innocenzo Manzetti from Aosta, or "the Meucci-Manzetti Dichotomy," also applicable to "The Meucci-Bell Dichotomy," as remarked by Alan Chynoweth, Retired Vice President of Bellcore Applied Research [118]:

> "I only wish to make it evident that two thoughts can be found to contain the same discovery and that by uniting the two ideas, one can more easily reach a certainty about a thing so important."

One final curiosity: Florence—the birthplace of Antonio Meucci—and Edinburgh—the birthplace of Alexander Graham Bell—are twin towns.

Appendix 1—The American District Telegraph Company (ADT)

Many scores of telegraph companies (such as Western Union) grew up in the United States following Morse's telegraph demonstration of 1844, to supply telegram service. In addition to them, there existed a number of parallel businesses, wholly dependent on the telegraph, which usually ran their own telegraph network. Among these were [119]:

— the *railroad traffic control*, which was one of the earliest applications of the telegraph,

[90] A good example is that of the inductive loading technique. Besides Meucci's pioneering work (1862-1870), the relevant theory was published in 1887, quite simultaneously, by: Alfred Vaschy [113], and by Oliver W. Heaviside [114]. However, the relevant technique was patented by Michael Idvorsky Pupin in 1900, in his two patents [115, 116].

[91] See [3], Chap. 23 "Disconnected," p. 281-290.

— the *telegraph press service*, for the transmission of news across the country, that followed shortly after [92], and
— the *alarm and security services*.

Hence, railway, telegram, press and security organizations were strictly tied to the telegraph (and often one to another), as happens today with communication-based enterprises.

Subservient to the big telegraph companies, as well as to any of the above companies, was an important class of telegraph-based companies, known as *district telegraph companies*. These companies were, in a first time, mere *delivery companies*, providing hand delivery of handwritten messages (telegrams) both from local customer's offices to the nearest telegraph office, and from the destination telegraph offices to the final addressees. They usually employed young boys, called *messenger boys* [120] and were generally tied to one of the giant telegraph companies by strict contracts. Since each delivery company served only its own particular district, they were also called *district companies* [120][93].

The district companies gradually offered a variety of other services, such as transmission of fire alarms, police calls and similar urgent requests. In addition, they supplied other delivery services, such as package delivery[94].

The task of district companies was greatly simplified after the introduction of *call-boxes,* serving small city areas, connected to a central station. Each call box, when pulled, sent a suitably coded telegraph signal to the corresponding central station, to ask for service. This system was first introduced in Boston in 1851, by W. F. Channing and Moses G. Farmer. New York and other major U.S. cities followed, shortly after. In 1871, E. A. Callahan of New York extended the call-box/central station concept both to *district messenger service* (that would allow subscribers to call for a messenger) as well as to *burglar alarms* [120, 121].

In December of the same year, 1871, the American District Telegraph Company of New York was organized by Horace L. Hotchkiss, to commercially develop Calahan's inventions [125, 126]. The president was E. W. Andrews and the vice president was Edward B. Grant ([21], Answer No. 8). William H. Sawyer, formerly Superintendent of the Gold and Stock Telegraph Co.— a subsidiary of Western Union ([3], p. 260)— became General Superintendent of ADT as of May 1, 1872 [126].

George F. Durant declared that he had been superintendent (electrician) of ADT, New York Division, "from about 1871 to October, 1874" ([21], Answer No. 4). William Sawyer, however, stated that "I cannot state positively regarding my engagement of Mr. Geo. F. Durant. His name appears in print as Supt., January 31st, 1873. My recollection now is that he entered the service of the ADT Co. late in the summer, or early in the fall of 1872, as he had been employed but a few months when the circular bearing his name was issued" '126]. According to Sawyer's statement, George Durant was not with ADT in the summer of 1872, when Meucci first called on Mr. Grant, contrary to Durant's own testimony ([21], Answer No. 12)[95]. He declared on the same occasion that "Mr. Grant's desk was adjoining mine on the right-hand

[92] Among the first were the *Associated Press*, which was formed in the United States in 1848, and Paul Julius *Reuter*, who initiated telegraph press service in Paris, in 1849 [119].

[93] The division into districts (and sub-districts) seems to have originated in New York, after the fire of December 16, 1835, which destroyed almost all of South Manhattan. The major cause of the enormous damages ensued was the nearly simultaneous sounding of all of the warning bells, that prevented each local fire brigade to recognize its own alarm. As a remedy to that, in 1847, all New York districts were connected by telegraph [120, 121].

[94] We invite the reader to have a look to the several direct and interesting testimonies reported in [122, 123, 124].

[95] It must be pointed out that in 1886 Durant testified for the Bell Company in the trial instituted by the latter against the Globe Telephone Company and Antonio Meucci. At that time he had the position of "Vice-President and General Manager of the Bell Telephone Company of Missouri." ([21], Answer No. 1). He was hired by that company around November 1884 as General Manager, when the Vice President was George S. Drake [127]. Shortly before, he was with another company, though negotiating a "permanent license" from the Bell Company, and had repeatedly offered to the latter his services respecting the Drawbaugh and Meucci cases [59].

side, about a foot or two away; Mr. Sawyer's was about the same distance on the left." ([21], Answer No. 11).

In the summer of 1874 Sawyer left the company [126] about the time that ADT had become "the delivery department of the Western Union Company under a rigorous contract for faithful service" ([32], p. 158])[96]. At that time, ADT was operating 12 central stations in Manhattan, after having acquired 57 diverse *district* telegraph delivery companies. In October 1874, George Durant left the company and was succeeded by Henry W. Pope, brother of Frank L. Pope, electrician of Western Union ([32], p. 158).

By 1887, there were as many as twenty ADT companies in cities such as Philadelphia, Chicago and Baltimore. ADT became a subsidiary of Western Union in 1901, being largely devoted to security protection. Today ADT still exist, being a world leader in security services [120, 121].

Appendix 2—A short biography of William H. Vanderbilt

The Vanderbilt was a prominent family in the nineteenth century, due to the early engagement of William's father, Cornelius W. Vanderbilt, with rail and water transportation. The latter was born in Staten Island on May 27, 1794 and died there on January 4, 1877. He started a ferry service between Manhattan and Staten Island at the age of 16. He, then, gradually extended his operations to the whole United States and, in the 1850s, he entered into the transatlantic transportation business. In the 1860s he entered into the railroad field, rapidly expanding his operations with his *New York Central Railroad*. He founded the Vanderbilt University in 1875. At his death, Cornelius Vanderbilt's fortune was estimated at $105 million of the time.

William Henry Vanderbilt, one of Cornelius' 13 children, was born in New Brunswick, N.J. on May 8, 1821, and died in New York City on December 9, 1885. He inherited about 86% of his father wealth and was notable for having greatly expanded the family railroad holdings. According to *Scientific American*, he was the richest man in the world, his estate having been estimated at $200 million of the time. In spite of his great wealth, amounting to probably not less than $22,000 a day, William was very simple in his habits, and found his greatest pleasures within the family [128].

According to the Dictionary of American Biography [31], William was a major stockholder and a director of the Western Union Telegraph Co., leading the conservative eastern stockholders who controlled the Western Union [39]. He was in that responsibility already in 1873 [129], that he kept after the death of William Orton (1878), under the presidency of Norvin Green, formerly vice president of the company. William Vanderbilt resigned his directorship and sold most of his holdings in 1881, after Jay Gould took control of Western Union, whereas Norvin Green maintained the presidency of the company until his death in 1893.

Unlike his father, William Vanderbilt tended toward appeasement in business struggles. This is why, after his father's death, occurred in 1877, and Mr. Orton's death, occurred in 1878, being faced with the prospect of a struggle with Jay Gould, "he lacked the courage, character, or personality" to persevere in the corporate battle with the Bell Co. and accepted a compromise settlement in the fall of 1879[97].

[96] Schiavo says that he derived this information from "*Telegraph*, a periodical, Vol. 10, April 25, 1874, p. 100-101."

[97] See [28], Chap. XIV "The Western Union Settlement," p. 491.

Appendix 3—Early "electromagnetic" receivers

A few remarks should be made regarding the receiver described in Gray's caveat of 1876[98], as we have found in it some contradiction or ambiguity. Indeed, Gray begins his caveat specification by stating:

> . . . . my present invention is based upon a modification of the principle of said invention which is set forth and described in Letters Patent of the United States granted to me July 27, 1875, respectively numbered 166,095, and 166,096[99], and also in an application for Letters Patent of the United States filed by me February 23, 1875."

Now, in Gray's patent No. 166,095—the more relevant to the subject— he had stated (italics ours):

> My invention relates to what I term an "electro-harmonic telegraph," and is based upon the fact well known to electricians that *an electromagnet elongates* under the action of the electric current, and contracts again when the current ceases. Consequently a succession of impulses or interruptions will cause *the magnet to vibrate*, and if these vibrations be of sufficient frequency a musical tone will be produced, *the pitch of which* will depend upon the rapidity of the vibrations . . . . . *as the receiving electro-magnet* is connected with this circuit it *will be caused to vibrate*, thus *producing a tone of corresponding pitch*, *the sound of which may be intensified by the use of a hollow cylinder*, S, *of metal, placed on the poles of the magnet*.

Note that the receiver described in said Gray's patent No. 166,095 (reproduced at left of our Fig. 10) is called in the remainder of the aforesaid Gray's patent an "electro-magnet receiver," though it clearly operated by magnetostriction, i.e. under the well known principle of "galvanic music," discovered by Charles Page in 1837 [133], and exploited, among others, by Philipp Reis in his "telefon" of 1861 [98].

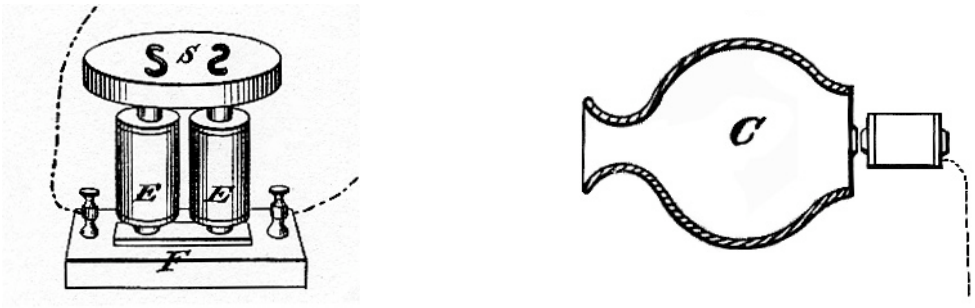

Figure 10. *Left: Elisha Gray's tin-can receiver shown both in his G.B. Patent No. 2646 of 1874 and in his corresponding U.S. Patent No. 166,095 of 1875. Right: Gray's "vocal sound receiver" depicted in his caveat of 1876.*

In Gray's caveat, although reference is made to his aforesaid previous patent—hence to his magnetostriction receiver—the following language is used to describe the *modus operandi* of the receiver quoted in the same caveat (italics ours) [71]:

> . . . . an electro-magnet of ordinary construction *acting upon a diaphragm to which is attached a piece of soft iron* and which diaphragm is stretched across a receiving vocalizing

[98] We have no remarks whatsoever regarding his liquid transmitter, being it derived from his earlier commercial water rheostats, manufactured by Western Electric Manufacturing Co. in 1872-1874, while Gray was its superintendent ([36], p. 153). Note that a similar device was employed, among others, by Edison in1873 [130].

[99] Both patents were derived from [131]. This latter was split into two parts which were granted in the USA with Nos. 166,095 and 166,096 respectively. Patent No. 166,095 is referenced as [132].

chamber C . . . . The diaphragm at the receiving end of the line *is thus thrown into vibration* corresponding with those at the transmitting end and audible sounds or words are produced.

This description is accompanied by a sketch (Fig. 2 in Gray's caveat, reproduced at the right side of our Fig. 10 above), wherefrom it appears that a non-zero air gap is adopted. This has been judged by some writers [134] as being a peculiar feature of an electromagnetic telephone receiver—exactly like Meucci's or Bell's electromagnetic receivers—therefore concluding that Gray's receiver did not operate by magnetostriction, but by attraction and repulsion of the (button) armature from the electromagnet. Aitken, in particular, made reference to a lecture delivered by Gray on March 17, 1875 [135][100], before the American Electrical Society, where he stated that his receiver (italics ours) "is a common electro-magnet having a bar of iron rigidly fixed at one pole, which extends across the other pole, *but does not touch it by about one sixty-fourth of an inch*". Aitken, however, did not report in his book what was stated by Gray just two lines above that sentence ([135], p. 9, italics ours):

> It is a well known fact that *an iron rod elongates when magnetized, and contracts again when demagnetized*. The elongation and contraction are so sudden, that an audible sound is produced at each change. In order to convert this sound into a musical tone it is only necessary to repeat it uniformly and at a definite rate of speed, which shall not be less than sixteen nor more than four thousand per second.

According to Gray's lecture, it appears that a small air gap would improve the sound transmission from the core of the electromagnet to a sounding box (or *vocalizing chamber*), with respect to a tight connection. We think, however, that said improvement was also due to the attraction/ repulsion of the armature, as exerted by the electromagnet. In the latter case, however, the amount of the air gap is a critical parameter, requiring to be set by fine adjustment, such as Meucci did since 1860 by threading the magnet core at the distant end from the diaphragm[101].

As a confirmation of our hypothesis above, we quote an article ran by *The Telegraphic Journal and Electrical Review* [136], where a couple of interesting receivers (Fig. 11), made by Philip H. Van der Weyde were described. Both were quoted as improvements of the (magnetostriction) Reis receiver of 1861 and were made by Van der Weyde in 1869 and 1870 respectively. This is what the columnist reported:

> . . . . He [Van der Weyde] soldered an iron button to the centre of a brass plate (see fig. 11 [at left of our Figure 11]), placed in front of an iron bar, surrounded with a coil, and this was the instrument used as a receiver at the lecture of January 8th, 1869[102]. In August, 1870, he read a paper before the American Association for the Advancement of Science which that year assembled at Troy, N.Y., the paper being entitled "Further improvements in the method of transmitting musical melodies by telegraph wire." In the discussion which followed the reading of the paper, one or two of the members present stated that they had obtained good results by placing a tinned iron plate in front of the poles of a horse-shoe electro-magnet, and mentioned this as a well-known device; and on arriving at home in September, 1870, he constructed the apparatus shown in fig. 12 [at right of our Figure 11], in which a tinned iron plate was used. . . .

As Robert Bruce noted, one of the persons present at the aforesaid Van der Weyde's lecture was Prof. Edward C. Pickering of the Massachusetts Institute of Technology, who "got up and described his tin-box receiver, which would make such transmissions even more audible" ([3], p. 115). Referring, more specifically, to Pickering's experiments with his tin-box receiver, Bruce remarked ([3], p. 93, italics ours):

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[100] Aitken erroneously quotes this lecture as delivered on March 13, 1875.
[101] See [12], Answer No. 30 and associated Fig. 7.
[102] See also similar lectures in [137, 138], as quoted in [139, 140].

A vibrating tuning fork made and broke a battery-powered circuit, as in the Helmholtz device. The intermittent current passed through an electromagnet fixed *near* the tin-plate bottom of an open box. *The intermittent force of the magnet vibrated the tin-plate sheet like a drumhead* or diaphragm, thus making a loud tone of the same pitch as the tuning fork.

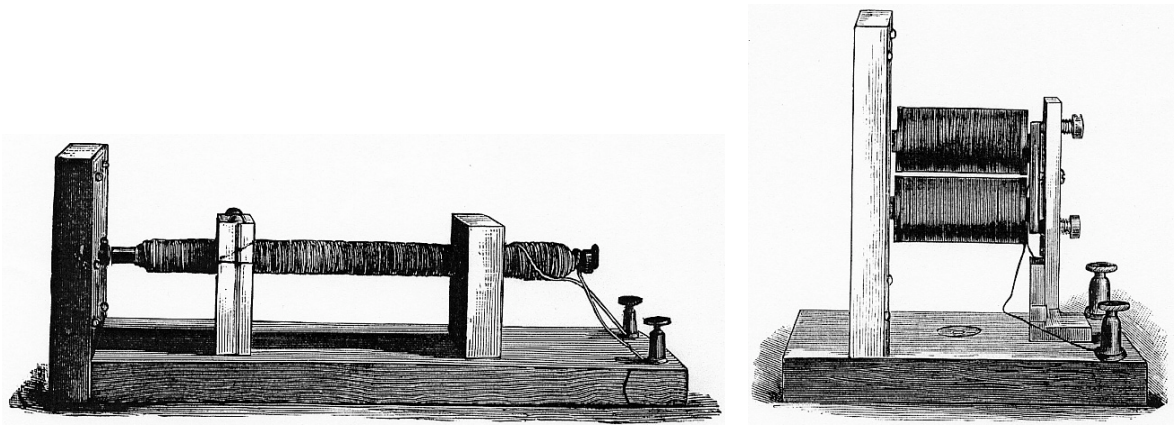

Figure 11. *Van der Weyde's improved Reis receivers (left, made in 1869, right, made in 1870).*

We concur with Robert Bruce on his analysis of the nature of Pickering's tin-box receiver, also for it having anticipated Gray's receiver ([3], p. 269). It must also be remarked that, both in Bell's deposition ([14], Cross-Int. No. 327) and Charles R. Cross's deposition [141], it was stated that in Prof. Pickering's tin-box receiver the poles of the electromagnet "were quite close to the plate [diaphragm], but not in contact with it."

We can, therefore, conclude that all early electromagnetic receivers described above were conceived to work by magnetostriction, though, at the same time, whenever a small air gap was provided (or happened to exist), attraction and repulsion of the (button) diaphragm from the electromagnet was helpful to the reproduction of sounds—often with the unawareness, on part of the experimenters, of the role played by the electromagnetic attraction-repulsion of the armature.

Appendix 4—Resolution NO. 269 of the U.S. House of Representatives, June 11, 2002

Expressing the sense of the House of Representatives to honor the life and achievements of 19th Century Italian-American inventor Antonio Meucci, and his work in the invention of the telephone.

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 communication 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 con-ducted 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.

Acknowledgements

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— Professor A. Edward Evenson for permission to quote passages from his book "The Telephone Patent Conspiracy of 1876;"

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— Sal Serio, American Italian Museum and Library, Renaissance Foundation, New Orleans, LA, for supplying literature and useful information on Giovanni Schiavo.

— Professor Charles R. Twardy, of Monash University, Computer Science & Software Engineering, Melbourne, Australia, for supplying useful bibliographic references as well as his unpublished biographic notes relating to Peter Van der Weyde.

Note: References made in this article to American Bell (also referred to as Bell Company),Western Union Telegraph Company, American District Telegraph Company, and so on are merely in regard to companies that were active during the time with which this article deals, namely, the 19th century.

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[104] In addition to his chairing the "150th Anniversary Antonio Meucci Memorial Committee," and his leadership in promoting the New York Council's and the U.S. Congress Resolutions, see [142, 143, 144]

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