Substantia
An International Journal of the History of Chemistry

Firenze University Press
www.fupress.com/substantia

Historical Article

Exact Time: the First Scientific Application of Radiocommunications

Mario Calamia, Monica Gherardelli

Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Firenze (Italy)
E-mail: mario.calamia@unifi.it; monica.gherardelli@unifi.it

Abstract. Marconi's first experiment of signal transmission by means of Hertzian waves was carried out in 1895. In the following years, wireless telegraphy progressed steadily and worldwide efforts were made to exploit the potential offered by new technologies. In those years Guido Alfani, a young Florentine Piarist teacher of promise in Seismology, joined the Ximeniano Observatory in Florence where he found the ideal environment for his experiments and his insights. He understood the importance of having the exact time in Seismology, to temporally characterize the telluric movements and therefore accurately characterize them. In 1910 when the Paris radio station located at the *Tour Eiffel* began regular broadcasts of exact time, he laid down the issue of its reception. As far as pendulums and chronometers were concerned, no doubt his expertise as seismologist was significant, while problems arose when it came to the radio station, due to the novelty of such situation. For this reason he arranged contacts and managed to set the first Italian radio station to be used in a weather station. Thus, on the night of March 16-17, 1912, he received for the first time the time signal for a particular scientific application. He wrote to Marconi and in 1912 Marconi expressed words of great appreciation and encouragement for such work. Father Guido Alfani's radio station is certainly the first one applied in Seismology and among the first radios made in Italy. It is an extremely important application which demonstrated that the new technique could provide solutions in different situations.

Keywords. Exact time, radiocommunications, Osservatorio Ximeniano.

Citation: M. Calamia, M. Gherardelli (2018) Exact Time: the First Scientific Application of Radiocommunications. *Substantia* 2(2): 119-123. doi: 10.13128/substantia-65

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

INTRODUCTION

The second half of the nineteenth century has been a period where science met with great ferment. Important pages on discoveries or great scientific activities have been written and often people are left wondering on how it was possible to collect such amazing results in such a short and precise time span.

To keep to the topic of our contribution, we will point out that in the second half of the nineteenth century Seismology became a science thanks to some great scientists. Among them, father Giuseppe Mercalli (the Mercalli intensity scale used nowadays to classify earthquakes goes back to those years, namely 1880-90) and all over the world efforts were made to compare both results and experiences.

Since the second half of the eighteenth century the Osservatorio Ximeniano has been working in Florence as a research institution founded by the Jesuit father Leonardo Ximenes and later on run by the Piarists. In 1872 father Filippo Cecchi was appointed Director of the Osservatorio Ximeniano; he was a skilful meteorologist who has left important contributions in weather forecasting. Furthermore, he was not at all indifferent to the great deal of progress made by Seismology and nowadays his works are considered of greatest value. He conceived the first "three-component seismograph" and many other tools, which can still be seen in the exhibition room dedicated to his studies in the Osservatorio Ximeniano.

Finally, the very last years of the nineteenth century could witness for other important scientific developments, thanks to the arrival to the Osservatorio Ximeniano of a young Florentine teacher of mathematics and physics. Father Guido Alfani, who belonged to the Piarist order, was skillful and self-assertive, which helped when he became Director of the Osservatorio Ximeniano in 1905.[1]

In the wake of Father Filippo Cecchi, Father Guido Alfani became soon an important reference in Seismology, he conceived new seismographic instruments, he kept on improving already existent seismograms, while studying deeply any electrodynamics tools.

His contributions to the seismology framework have been of primary importance.

FATHER GUIDO ALFANI AND THE SERVICE OF EXACT TIME

The main focus of this paper is not only the Father Alfani's experiences, but through his experiences we would like to pay homage to many Scientists who could understand the importance of interdependency in the scientific fields.

As to Seismology, the activities carried out by Father Alfani have been presented in many excellent papers, which have already highlighted the importance of his contribution to that area. Therefore it is not our intention to focus on such aspect.

We would like to focus on the work of Father Alfani from a different perspective: he was a mathematician with strong interests in Seismology and even though he was not a radio engineer, his insights enabled him to understand that what he found in a different scientific field could be of great help to Seismology.

He sensed that knowing the exact time was a fundamental issue in earthquake studies. Therefore, he directed his efforts towards "fixing and keeping" the exact time by means of spyglasses, so as to measure culmination in star transit, as well as by means of pendulums to keep the correct measure of time. Let's read once again his words:

> *In modern seismic stations, the accuracy of time is not only one of the important element, but even the most important one. For such reasons, there will never be too much care to get such accuracy and keep it unchanged and exact. As a matter of fact, this Observatory has been working mainly on Seismology, therefore I had great care to define the exact time and make it flawless. Therefore, I have arranged a very special equipment to guarantee results.*[2]
>
> *…omissis….*
>
> *Until 1912 (this was the year I could realize the very first set of equipment related to a radiotelegraphy station dedicated to radio time signals) the exact time reckoning has been carried out on a regular basis, nearly every evening, and at least every two days by means of star culmination measured at meridian circle.*[2]

The "very special equipment" is in fact the first Radio Station he realized in Italy.

In 1910 the *Bureau Central* in Paris, namely the French Observatory located at the Tour Eiffel, began to transmit the exact time signal and it was at that point Father Alfani realized that such transmittance could serve perfectly the purpose of supplementing the star culmination method. He needed a suitable receiver, he integrated his training, he searched for information and he was able to set up a radiotelegraphy station and in the night between the 16th and 17th of March, he received for the first time the exact time from Paris.

It was a crucial step forward in Seismology. No longer depending on star observation at a specific time, but relying on a regular time signal, as the one transmitted from Paris, that was an absolutely exceptional result. Father Guido Alfani was the first to achieve such reception and he dedicated the discovery to Guglielmo Marconi, thus writing: "I would like to dedicate to Guglielmo Marconi these pages on the first radiotelegraphy station working in an Italian Observatory".[3]

The first radio station was nothing else than a starting point for Father Alfani and other seismologists who followed in his footsteps. The course of events related to those years is well described in the quoted passage dedicated to Guglielmo Marconi.

Main components of his radio equipment were the receiver itself and the aerial (the antenna). As to the receiver, he resorted to the expertise and helpfulness of Ducretet & Roger Company and he used "elec-

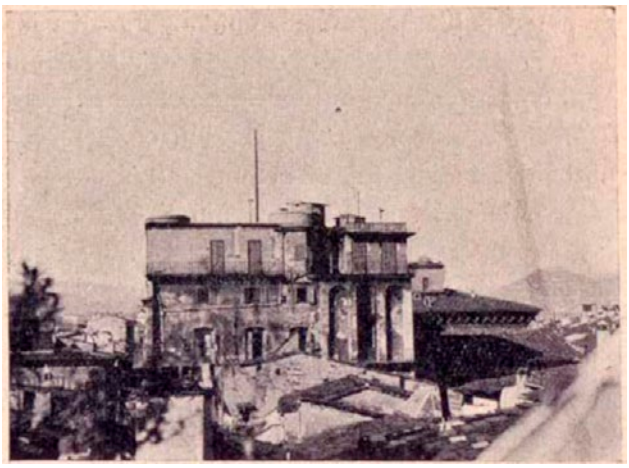

Figure 1. The Ximeniano Observatory seen from South and showing the antenna of the radiotelegraphy station.[3]

trolytic diodes" because "they are much more constant than crystal sets". He had to deal with some drawbacks he promptly pointed out to the Company, thus quickly managing to have reliable components. He kept on working on the improvement of the receiving system; thus in 1923 he exploited the coherer as radio detector in his receiver, only to change in favor of vacuum tubes, once their checkout had turned out to be trustworthy.

Yet, it is the work on the antenna, which took up almost his time. He sensed that the shape of the antenna and the location where to place it were very important factors in defining the quality of the received signal and without such signal there was not too much to detect.

When describing the types of "aerials" he realized at the Ximeniano Observatory (Figure 1 and 2) he wrote:

> *One of such aerials is really great; it is dipole and has its point of support in the Dome of the Florence Duomo. It is made of two wires in phosphor bronze and it is about 300 meters long and 110 meters high. There is an iron pole (15 meters long) which has in its upper end some pulleys to be used to rise or drop the aerial's bays by means of steel cables.*[2]

However, not everything goes so easy as it might appear: the country is going to war (1915-1918) and therefore the government imposes restrictions such as the interruption of the broadcasting station services and the removal of the antennas at the Observatory. There is a very interesting exchange of letters describing the heated argument between Father Alfani and the Government Authorities. His aim is to stand up for his activities with the radiotelegraphy station described as a support to his seismology studies and not at all meant to be part of a

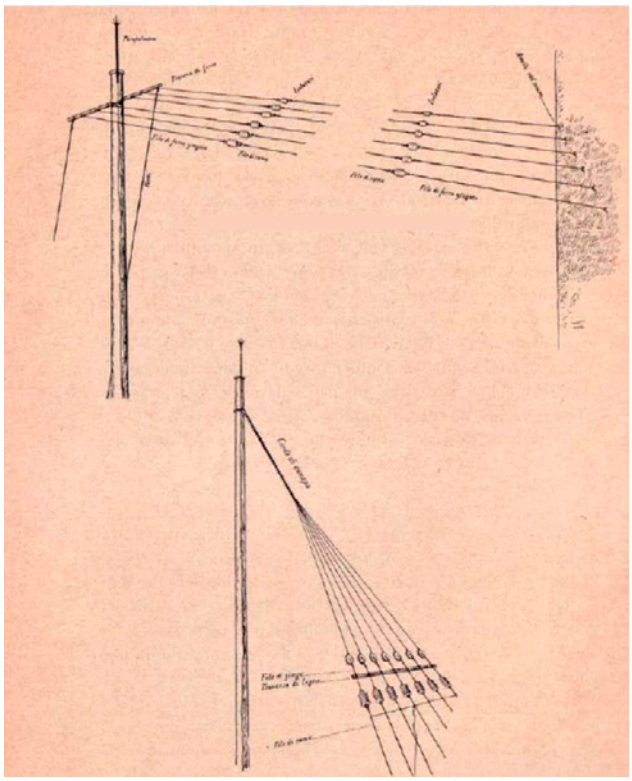

Figure 2. Drawing of the second (upper) and third (lower) radio equipment related to the aerial.[3]

spy ring. As a scientist he cannot accept nor justify any stop to the progress of Science; therefore he builds and adopts quad antennas for his receiver device: once overcome the problems of tuning them with the receiver's interface, the reception capacity of such antennas turns out to be greater and allows him to work.

Figure 3 shows quad antennas, two with rhombic shape and one with round shape.

This is not just a storytelling retrieved from books, which is of great value in itself, but it has been a work of reconstruction based on collected parts which have been brought into use again, thus allowing the recovery of a priceless heritage, along the last ten years.

In the storerooms at the Ximeniano Observatory many items were found and they were supposed to be components of the radiotelegraphy station built by Father Alfani: only a picture could witness that in the booklet already mentioned and entitled *The time service*.[2] One of the authors of this paper, prof. Mario Calamia, was informed about the possible and yet partial recovery of that equipment: the task seemed to be not easy due also to the lack of students to be involved. Eventually in 2006 a solution was within reach thanks to Giovanni Manneschi, an engineer and Arezzo "CEIA

Figure 3. The radiotelegraphy station of Father Alfani at the Ximeniano Observatory.[2]

Figure 4. Radio receiver built in 1912, the model of it is in the booklet Father Alfani dedicated to Marconi during his visit held in 1912.[4] The diode, head-phones and the capacitor are original.

S.p.A" executive, but also very keen on radio engineering. Since then a very methodical work has begun to recover, restore and put that Laboratory (Figure 3) back on its feet. It took about six/seven years to finish the work, but nowadays more than 95% of Father Alfani's Laboratory is on exhibit at the Ximeniano Observatory.[4] It is made of 44 parts ranging from the radiotelegraphy station built in 1912 and already depicted in Figure 4 to several other equipments dating back to 1940 and perfectly operative. The radiotelegraphy station has been restored by using the original Ducretet & Roger thermionic diode, which was found by chance in the Observatory's store-rooms. Actually the station has been tuned again so as to receive the national broadcast "RAI" in amplitude modulation. Another noteworthy article is the radio receiver dating back to 1923 and shown in Figure 5, with its original coherer.

Figure 5. Radio receiver built in 1923 according to the model of Marconi's receiver dating back to 1895.[4] A part from the battery box, all the other components like the coherer (right lower part, near to the antenna) are original.

CONCLUSIONS

Our goal has been focused on informing about events which may seem of minor importance, but which had a great social and scientific impact. This generally happens when Science manages activities in some facilities.

The Ximeniano Observatory has been one of such facilities and yet its renown is mainly related to Meteorology and Seismology. It has a very relevant map projection Department and it is also well-known for Father Eugenio Barsanti's work on the internal combustion engine whose first version he invented.

On the other hand, the Observatory played a leading role in radio engineering during the first half of the 20th century, but this aspect has been a bit underestimated. The research carried out by Father Alfani had the merit of improving radio engineering as well, though his name became notorious for meteorology and seismology studies.

He understood that the main shortcoming in Seismology was the inability to correlate the different telluric phenomena detected along far-off areas. This could be solved if every Observatory was able to benefit from the exact time service and he had the insight that this was possible when he heard of Paris radio station's regular broadcast of time signal.

He did not purchase a receiver, which was not possible, but he improved his learning on radio engineering, so as to define the requirements which could make the reception more and more accurate.

What he wrote in his short, and yet regularly dated and published notes, shows clearly his cleverness. Guglielmo Marconi, invited to Florence, met full of admiration Father Alfani at the Observatory. In fact, Father Alfani had used radio broadcast not only in telecommunication engineering, but also in a scientific field of great social impact.

Finally, we would like to stress that he was never particular about his studies, experiments and outcomes. As a scientist, he was persuaded that the more the Observatories adopted the proposed solution, the greater would be the usefulness of that research.

His words are revealing:

> *The first radiotelegraphic reception occured in the night of the 19th March 1912 , based on Paris time signals. Shortly afterwards, other colleagues joined and followed my example. I went personally to set up new equipments. One of the first radio station I installed was at the Montecassini Observatory on the 26th July 1913.*[2]

REFERENCES

1. D. Barsanti, *Padre Guido Alfani* (*1876-1940),* Osservatorio Ximeniano dei PP. Scolopi, Firenze, **1992.**
2. G. Alfani, *Il servizio dell'ora,* Pubblicazione 136, Osservatorio Ximeniano dei PP. Scolopi, Firenze, **1928**.
3. G. Alfani, *La stazione radiotelegrafica*, Pubblicazione 115, Osservatorio Ximeniano dei PP. Scolopi, Firenze, **1912**.
4. M. Calamia, G. Manneschi, *Kernes: la rivista del restauro*, N. 83 (Eds: Nardini), Firenze, July-September **2011**.