

# Luigi Palmieri: first scientific bases for geophysical surveillance in Mt. Vesuvius area

Sven Borgstrom, Maddalena De Lucia and Rosa Nave  
*Osservatorio Vesuviano, Ercolano, Napoli, Italy*

## Abstract

Luigi Palmieri (Faicchio 1807 - Naples 1896), was appointed Director of the Vesuvius Observatory in 1855. He realized the first model of electromagnetic seismograph and the uninterrupted use at the Observatory of this instrument represented the first step towards a geophysical *sensu strictu* surveillance of Mt. Vesuvius area. Already at the end of the 18th century, Ascanio Filomarino had built a mechanical seismograph which was able to record the amplitude of the seismic waves, the incoming direction of the earthquake and its starting time. In 1862 Michele Baldacchini proposed to the Neapolitan scientific community a question about the possibility to use the study of precursory signs of the Vesuvian eruptions to inform in advance people living near the volcano. Palmieri answered Baldacchini's request, giving proof of extreme far-sightedness from the scientific point of view but, similarly, much concreteness from the practical point of view: he described, with modern ideas, the things to do in order to carry out the surveillance in the Mt. Vesuvius area, but concluded thus: «Till we have not the (economic and instrumental) means we have spoken above, I think it is useless to entertain the Academy about the nature and the method of the observations and investigations to be performed».

**Key words** *Vesuvius Observatory – electromagnetic seismograph – mechanical seismograph – surveillance*

Luigi Palmieri (Faicchio 1807 - Naples 1896), the famous physicist, obtained the authorization to perform scientific observations – with special reference to atmospheric electricity phenomena – in 1852 at the Vesuvius Observatory and was appointed Director of this institution in 1855. In fact, he built a meteorological tower at the Observatory for this type of studies (Luongo and Nazzaro, 1990).

Palmieri was also appointed full Professor of Geophysics in 1860, which was the year of

Italian unification; indeed, this unification gave him the best «political» condition to work calmly and to carry out different projects. First of all, there was the unification of the University Institute of Geophysics in Naples with the Vesuvius Observatory. The aim was evident, as he said in the preface to the second volume of the *Annali del Reale Osservatorio Meteorologico Vesuviano* (1862):

«Meteorological and geophysical observations at Mt. Vesuvius will not have scientific significance if they are not compared to others performed in the same way into another place more distant from the volcano; this is the reason why I claimed the creation of a meteorological tower and a magnetic room in Naples, which will be used also for teaching».

In the lack of a surveillance network, we feel clearly Palmieri's idea to have, at least, a «reference station» to which to relate any «anomalous» data observed near the volcano, recalling

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*Mailing address:* Dr. Sven Borgstrom, Osservatorio Vesuviano, 80056 Ercolano, Napoli, Italy; e-mail: sven@osve.unina.it

the idea expressed by some European scientists during the first half of the 19th century (Von Humboldt, Melloni) and on which the modern surveillance networks are based.

Among the instruments used at that time at the Observatory, some of which bought in Paris by Macedonio Melloni, Palmieri's predecessor, and some realized by Palmieri in Naples, two instruments in Palmieri's idea stood out for the study of volcanic eruption precursors (Palmieri, 1862):

«The geophysical phenomena which seem to have a stronger relation with the forces for which the volcano erupts are the movements of the needles of the variation instrument of Lamont, the only magnetic instrument of strong accuracy which the Observatory has till now, and the earth's movements signed by the seismograph also before they will be observed by man».

The seismograph which Palmieri refers to is the first model of electromagnetic seismograph (Nazzaro and Tramma, 1985), which he conceived himself.

Until 1839, he was one of the European experimenters who, after the discovery of electromagnetic induction by Faraday in 1831, began to construct many types of electrical machines.

It was evident that the creation, but especially the uninterrupted use of this instrument at the Observatory, represented the first step towards a geophysical *sensu strictu* surveillance of Mt. Vesuvius area. Already at the end of the 18th century, Ascanio Filomarino, a brilliant experimenter, thinking of the strong 1794 Vesuvius eruption, was induced to build a mechanical seismograph (Luongo and Nazzaro, 1990) which, albeit rudimentary, was able to record the amplitude of seismic waves, the incoming direction of the earthquake and its starting time. He writes:

«I have given the description of this machine so that in the capital and in the countries near the volcano, people can use it together with an atmospheric electrometer, and observing them with external signs of the volcano, it could be possible, also if people cannot predict exactly some new eruptions, at least, to conjecture it» (Filomarino, 1797).

From Filomarino's words it is evident the reference to the necessity, in addition to uninter-

rupted volcanic surveillance, to alert people «in the countries near the volcano», giving proof of awareness towards civil protection problems.

Palmieri, half a century later, will take Filomarino's suggestions, using his electromagnetic seismograph. Obviously, the difference as regards Ascanio Filomarino's instrument consists in stronger accuracy of the observed data but above all, being a more sensitive and technically superior instrument, this allowed Palmieri to understand some fundamental principles of modern seismology (Nazzaro and Tramma, 1985), which are:

- Earthquakes are important precursors of volcanic eruptions.
- Lighter earthquakes can precede stronger shocks.
- Eruptions are accompanied by continuous seismic tremor.
- Volcanic structures mitigate the propagation of the seismic waves which cross them.

Unfortunately, in spite of Palmieri's efforts to find the help for guarantee a continuous working of the instruments located at the Observatory, the creation of a surveillance network of volcanic phenomena was never realized. On this subject we must recall the proposal, expressed to the Pontanian Academy in February 1862, by the member Michele Baldacchini, a literary man.

He proposed to the Neapolitan scientific community a question, in the form of an academic program to «Tenore Prize», on this point (Palmieri, 1862):

«Let us determine to which point scientific observations of precursory signs of the Vesuvian eruptions can advertise us about the phenomena so catastrophic for life and properties of the inhabitants and owners of the countries located on Mt. Vesuvius. Let us indicate the most suitable method, if there is someone, to alert previously the more exposed people». *Baldacchini continued...* «The work should be divided in two parts, the first one all theoretical, in which everything concerning science is examined and the other one of practical utility and application, in which the help that, in these occasions, science should give to the humanity should be indicated». (*Some embryonal indications of an emergency plan?!?*).

The member Luigi Palmieri answered Baldacchini's proposal in this way (Palmieri, 1862;

Casertano, 1985), giving proof of extreme farsightedness from the scientific point of view but, similarly, of so much concreteness from the practical point of view:

«I will tell you, illustrious academicians, in a few words the things I think we have to do on this subject.

1° Let us explore periodically and at short time intervals the superior plain of the Vesuvian cone, because here you find continuous signs of the volcanic activity; here the fumaroles with the variation of their temperatures, with the different quality and quantity of their sublimations, with the variety of their aeriform emanations and with other phenomena will give to nature's philosopher clear revelations of the mysterious intense activity which is going to be performed in the burning mountain's viscera.

2° Let us repeat such periodical researches in the principal permanent fumaroles located around Mt. Vesuvius, like in S. Maria del Principio, in Pugliano and somewhere else, although, also if the energy variation of these fumaroles is well-known by common people, in any case there are no regular and comparable observations, neither we know if with their phases they give us some indication of a future eruption. The only thing we can say is that their activity grows up generally at the end of strongest eruptions. For completeness, do not forget the Phlegrean Fields fumaroles, which must be studied with method and order.

3° Let us prepare some underground passages around Mt. Vesuvius; here let us install particular thermometers which are going to indicate by themselves, without any help from an observer, temperature variations which could be caused by the underground «fires» action, giving the advice, always by themselves, with an alarm signal at a central station which could be the Vesuvius Observatory.

4° Let us install some little meteorological stations around Mt. Vesuvius with an electromagnetic seismograph, a variation instrument, a mobile conductor atmospheric electrometer, and also an instrument for the so-called terrestrial currents.

5° Let us keep all the stations in correspondence among themselves and between the Vesuvius Observatory by means of telegraph-wires.

6° Finally, it should be in Naples a Physical Meteorological Observatory in telegraphic connection with the Vesuvius Observatory, and with that one in Rome, which is from a long time in relation with that one in Paris, in order to take part to the European electro-meteorological correspondence.

A Director helped by a scientific commission and a certain number of willing and experienced assistants should constitute the personnel employed in all the investigations that are necessary to perform.

Till we have not the means we have spoken above, I think it is useless to entertain the Academy about the nature and the method of the observations and investigations to be performed».

Palmieri's request to establish a permanent scientific commission at the Observatory was only partially granted. The December 1861 eruption induced the Public Instruction Minister De Santis to appoint the commission, but its life was rather ephemeral, at least from the official point of view, because, after its constitution, the Minister took no interest in its working.

Another important event, which marked the history of the Vesuvius Observatory, was the 1872 eruption. On April 25th a group of young people went up on the volcano to observe the eruption from a closer point of view: they lost their lives because they were swept away by a lava flow which suddenly came out from the north-western side of Mt. Vesuvius. After a few days the Observatory building was surrounded by lava; Palmieri remained in his place in order to observe and to study the eruptive phenomena from a closer stand-point and, for this reason, in 1876 was appointed Senator of the Italian Kingdom. The Observatory isolation noted on that occasion induced the Government to install there a telegraphic station in order to inform people living in the surrounding areas in case of future eruptions (Luongo and Nazzaro, 1990).

## Conclusions

We must consider Luigi Palmieri one of the pioneers of modern volcanology; his activity, extraordinarily fecund for more than twenty years, was dense and useful almost till his death in 1896 at the age of 89.

The principles suggested by Palmieri about setting up a surveillance network are extremely valid and modern: his answer to the Pontanian Academy in 1862 clearly describes the configuration of a geophysical surveillance network, in addition to a geochemical one, with the indication of the instruments which must be utilized in any place; it also points out the necessity of a telegraphic connection among the stations and between these and the Observatory, introducing

the principle of a centralization of data taken by remote stations. Palmieri went on suggesting – something that was really new for that time – a connection between the Vesuvius Observatory and the Physical Meteorological Observatory to be established in Naples and, from this, with those in Rome and Paris «... in order to take part to the European electrometeorological correspondence...» (as Palmieri says).

Finally, Palmieri anticipated the important idea of a continuous surveillance also in the Phlegrean Fields area.

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