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Scientific instruments and the emergence of experimental volcanology: the case of Mount Etna

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Abstract

This article investigates how volcanology emerged as an experimental science through the study of scientific instruments employed in research on Mount Etna. Etna served as an open-air laboratory, not only to observe volcanic phenomena but also to test competing physical, chemical, and geological theories. From the early investigations of the 1669 eruption by Giovanni Alfonso Borelli, scholars began incorporating new methods and instruments into the study of volcanic activity. Yet, the development of volcanology as an autonomous field was neither linear nor uniform, shaped by the interplay of diverse disciplinary approaches and by the intrinsic complexity of the phenomena under study. The analysis is framed within the cultural and academic context of Catania, starting from the 1779 university reform, which introduced the first chairs in the scientific disciplines and promoted the acquisition and commissioning of instruments from both local craftsmen and prominent European ateliers. Special emphasis is placed on the cabinets of natural history, physics, and chemistry, as well as the meteorological observatory, which housed instruments that were emblematic of the scientific progress achieved within each discipline and concurrently employed in the study of volcanic phenomena. Surviving artefacts today provide tangible evidence of how research and teaching practices converged to establish volcanology as a scientific discipline at the University of Catania.

Keywords: History of volcanology; History of science; History of scientific instruments; Mount Etna; Scientific exhibitions

1. Introduction

Scientific instruments played a central role in both the production of scientific knowledge and the formation of disciplines. Volcanology offers a compelling example; its emergence as an experimental science was closely linked to the adoption of instruments from several disciplines, which enabled systematic observation, accurate measurement, and empirical analysis of volcanic phenomena. The introduction of experimental methods in volcanology can be traced back to Borelli's analysis of the 1669 eruption of Etna (Borelli, 1670; Morello, 2001; Ingaliso, 2014). Between the 18th and the late 19th century, instruments and methods from practical mathematics, physics, chemistry, and later mineralogy and geology shaped the field, laying the transdisciplinary foundations of modern volcanology.

Focusing on Catania, this study closely examines how scientific instruments from early scientific collections enabled the investigation of diverse volcanological phenomena in the first half of the 19th century. Using case studies of instruments from private and university collections now held in the University of Catania Museum System (SiMuA), the analysis emphasizes their central role by revealing both successes and failures in their application. The goal is to illustrate how multidisciplinary instruments shaped the study of volcanic phenomena, and how this process fostered the parallel development of several scientific branches. Volcanology still lacked formal status during this period, partly due to the complexity of the phenomena under study. Nevertheless, as this study argues, the systematic use of scientific instruments was foundational for its eventual recognition as a distinct scientific discipline in Catania, a status formally achieved with the establishment of the first chair in 1919, following early attempts such as the 1877-78 chair in terrestrial chemical physics, assigned to Orazio Silvestri (1835-1890) (Musumarra, 2018).

This paper forms part of a broader initiative to enhance and promote the historical scientific heritage of the University of Catania. A first concrete outcome of this effort was the temporary exhibition Lo studio dell'Etna tra strumenti e rappresentazioni (The Study of Mount Etna Between Instruments and Representations), held at the Museo della Fabbrica, Department of Humanities, from 10 March to 30 April 2025. The preliminary research presented here seeks to open new directions for the study of the University's significant scientific collections, whose instruments stand as an enduring legacy of scientific research and teaching in Catania. These artefacts illustrate how scientific instruments can provide insights that are often absent or only marginally addressed in textual sources, highlighting the importance of their preservation, study, and exhibition.

This article is structured into three sections. Section 2 examines the institutionalization of scientific disciplines following the 1779 university reform and outlines the initial use of instruments. Section 3, which is the core of the paper, traces the formation of the university's first scientific collections, highlighting case studies from early physics, chemistry, and natural history cabinets. Section 4 analyses mid-19th-century risk-mitigation strategies, emphasizing the interplay between scientific knowledge, instrumentation, and emergency communication systems.

2. The 1779 University reform: towards the institutionalization of scientific disciplines

The Enlightenment's intellectual ferment took root in Sicily, fostering leading scientific figures in Catania, many of whom focused their research on Mount Etna. A turning point in the institutional history of the University of Catania was the application of an important reform, formalized in the *Istruzioni per la pubblica generale Università de' Studii di Catania* (Instructions for the General Public of the University of Studies of Catania) (Coco, 2000, 219-232), promoted under the authority of the Bourbon government (1734-1860). The reform established new chairs for a total of 27, including those in natural history, experimental philosophy, astronomy, and chemistry (Baldacci, 2019). This development reflected a broader European trend towards the modernization of university curricula, inspired by Newtonian experimentalism and the integration of demonstrative teaching methods into scientific education, the so-called "lecture-demonstrations." For instance, lectures at Catania began to incorporate experimental demonstrations, further reinforcing the importance of hands-on observation and empirical methods within academic instruction. As a result, the first scientific cabinets were established, contributing to the formation of the university's collections and providing essential resources for teaching and research. Starting from the first half of the 18th century, scientific treatises, correspondence, naturalistic writings, and local chronicles began to report the use of scientific instruments to study Mount Etna's eruptions. These instruments were derived from practical mathematics, and the earliest disciplines to embrace the scientific revolution, namely physics, chemistry, and, later, geology and mineralogy (Rossi, 1997; Rossi, 2006). Among them were thermometers and pyrometers for measuring lava temperature; graphometers and theodolites for morphological and topographic surveys; chemical apparatuses for analyzing eruptive products; electrometers for assessing the "state of electricity" in the air during an eruption; and reflecting goniometers for studying the crystalline structures of the samples.

Scholars and practitioners sought to elucidate the underlying mechanisms of volcanic phenomena by applying the scientific and technical knowledge available at the time. Studying the use of these instruments not only sheds light on the historical development of volcanology as a scientific field but also offers valuable insights into the status of various branches of science, which, in the period under consideration, were still awaiting theoretical clarification, such as those related to thermal phenomena, electricity, magnetism, and the emerging field of physical chemistry.

3. The rise of the first academic scientific collections

After the 1779 reform, scientific production at the University of Catania increased significantly. This growth culminated in the first decades of the 19th century due to the establishment of new chairs in scientific disciplines, the founding of associations, academies, and scientific cabinets, and the regular publication of proceedings, journals, and scientific bulletins.

This section focuses on the establishment of the university's first scientific cabinets, which formed the core of its early scientific collections: the Natural History Cabinet (1781), founded by Giuseppe Gioeni (1747-1822), first professor of natural history; the Physics and Chemistry Laboratory (1805-1806), initially a joint cabinet established under the direction of Carmelo Maravigna (1782-1851), professor of chemistry; and the Meteorological Laboratory (1832), founded by Carlo Gemmellaro (1787-1866), professor of natural history and later of mineralogy and geology. These scholars were not only leading figures in their respective disciplines, but their research also crossed disciplinary boundaries. A common thread in their work was the study of Mount Etna. Their efforts laid the groundwork for the remarkable scientific progress that would define the second half of the 19th century. The scientific instruments housed in their cabinets were either produced by local craftsmen or commissioned from renowned European manufacturers. The latter acquisitions were often made possible through exchanges with distinguished naturalists from across Europe who traveled to Sicily to study Etna's eruptions, with French instrument makers playing a particularly prominent role. While British manufacturers had dominated the instrument market throughout the 18th century, by the end of the century, French precision instrument-making had rapidly advanced, reaching full maturity in the early decades of the 19th century (Brenni, 2004). It is therefore no coincidence that some of the instruments still preserved today bear the signature of renowned French ateliers.

3.1 The Natural History Cabinet

A natural history cabinet was established at the University of Catania in 1781, when the well-known scholar Giuseppe Gioeni from Catania, descendant of the Dukes of Anjou (Condorelli, 2024), donated part of his private collections of Etnean rocks and minerals, along with Sicilian shells and fossils, to the University (Cristofolini, 2016). Appointed to the newly established chair of natural history in 1780-1781, Gioeni became the first professor of the discipline in Catania, widely recognized both in Italy and abroad as a prominent naturalist and man of science, in contact with figures such as Alessandro Volta and Giuseppe Arduino (Maravigna, 1834a, 242-267). The collection donated to the University was initially housed in a personal museum situated in the present-day Palazzo Gioeni in Catania. The museum consisted of ten rooms, each containing natural history, mineralogical, and geological specimens, as well as instruments and apparatus for physics and chemistry experiments, located in the ninth room (Maravigna, 1834a, 260). Many of these instruments were manufactured in Paris and sent by Gioeni's French colleague and friend, the geologist and mineralogist Déodat de Dolomieu (1750-1801). Among the most significant items were several thermometers, barometers, hygrometers, an electrical machine, a perpetual electrophorus, various electrometers, microscopes, and telescopes. Gioeni employed many physics instruments in his studies of volcanic phenomena: we find in his writings notes about thermometers with different graduated scales for measuring lava temperatures, magnetic needles to explore the magnetism of volcanic rocks, and an electrometer to test the atmospheric electricity near the eruption site. In his 1787 volume Relazione della eruzione dell'Etna nel mese di Luglio 1787, for instance, Gioeni noted: "I wished to test here the new atmospheric electrometer by Mr. de Saussure, to then replicate the same experiments during the eruption, but I detected no sign of electricity, repeatedly raising the device as far as my arm could reach." (Gioeni, 1787, 12-13).

Horace-Bénédict de Saussure (1740-1799), a Genevan geologist, physicist, meteorologist, and mountaineer, invented various scientific instruments, including the hair hygrometer, anemometer, and electrometer. During his travels to Italy in 1772-1773, he ascended Mount Etna and measured its height on 5 June 1773. While in Catania, he was hosted by the Prince of Biscari (Freshfield and Montagnier, 1920, 133). His electrometer (see Fig. 1) – a precision device for measuring small electrical charges – was then widely adopted within Catania's scientific milieu. It stands as an emblematic example of the state of volcanology at the time: an exploratory phase in which available instruments were tested in the attempt to identify possible correlations between electrical phenomena and volcanic eruptions.

Gioeni's experimental investigations represent some of the earliest efforts to apply quantitative measurement to volcanic phenomena. Analyzing the instruments he adopted, spanning physics and chemistry, also provides important insight into the development of scientific branches. Indeed, fields such as thermometry, electricity, and magnetism were, at the end of the 18th century, still in the process of acquiring a formal scientific identity. Consequently, it is worth emphasizing the historical significance not only of instruments involved in major scientific achievements or associated with famous scientists, but also those that reveal the complex evolution of knowledge production – marked by failed attempts, methodological dead ends, and negative results – alongside the progressive development of the disciplines involved.

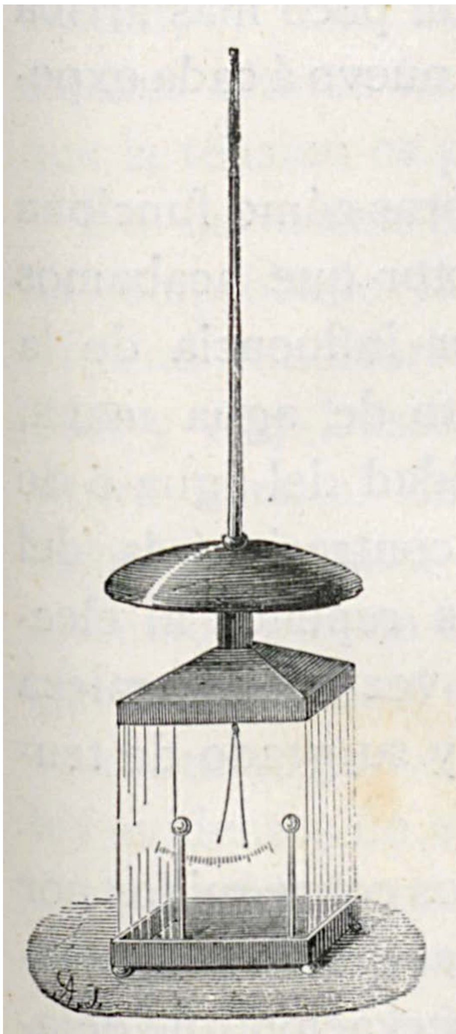

Figure 1. De Saussure's electrometer, consisting of two lightweight gold leaves suspended in a glass enclosure, indicated the presence and intensity of atmospheric electricity. An exemplar belonged to Gioeni's home-museum, though it has not survived to the present day (Guillemin, 1883, 231). Courtesy of the Biblioteca de la Universidad de Sevilla.

After Gioeni, the directors of the natural history museum continued to expand the collections, equipping the laboratory with instruments that reflected the growing needs of research and teaching. Following the disciplinary reorganization, the original natural history cabinet was divided in the 1870s into a "museum of mineralogy and geology" and a "zoological museum," as recorded in the 1871-1872 Annuario (ASUC 1872). Beginning in the second half of the 19th century, the collection of scientific equipment was further expanded to include analytical balances and reflection goniometers for characterizing volcanic products, alongside refined theodolites, spirit levels and water levels (see Fig. 2) for conducting topographic and morphological surveys. These instruments are now preserved in the Museum of Mineralogy, Petrography, and Volcanology of the Department of Biological, Geological, and Environmental Sciences. From Gioeni's original collection, several mineral and rock specimens have survived, although none of his physical or chemical instruments remain.

Figure 2. Water level, signed R. Radaelli, Milan, Italy, first half of the 20th century. The water level is based on the principle of equilibrium in communicating vessels. When placed horizontally and filled with water, the liquid rose to the same height in both glass containers. Equipped with adjustable and measurable sights, the instrument was used to calculate the difference in elevation between two points. It proved particularly important for measuring the new morphological configuration after eruptions of Mount Etna. Museum of Mineralogy, Petrography, and Volcanology. University of Catania. General catalogue number: Instrument_52.

3.2 The Physics and Chemistry Cabinet

The origins of the University of Catania's physics and chemistry collection are closely linked to the work of Carmelo Maravigna, who was appointed professor of chemistry in the academic year 1805-1806 (Maravigna, 1834b). Faced with the absence of adequate instruments for teaching and research, Maravigna undertook the creation of a cabinet furnished with state-of-the-art apparatus to support both his lectures and his scientific investigations. In collaboration with Francesco Landolina, the then professor of experimental physics, he organized the Cabinet of Physics and Chemistry, equipping it with chemistry and physics instruments, such as Voltaic piles, crowns of cups, and electrostatic machines for physics, as well as chemical apparatus designed to replicate Lavoisier's experiments. Other instruments served a wide range of disciplines, including topography, geodesy, and mineralogy. Maravigna, for instance, also engaged in studies of mineralogy and volcanology, to the extent that he arranged within his cabinet a mineralogical collection for his personal use.

In the early stages, a significant number of instruments were commissioned from local craftsmen. The year 1819 marked a period of renewed opportunities, enabling a further expansion of the collection. During the 1819 eruption of Mount Etna, Catania became a focal point for numerous European naturalists interested in studying volcanological phenomena. Among these visitors was Jean-André-Henri Lucas (1780-1825), assistant curator at the Muséum d'Histoire Naturelle in Paris, who resided in Italy between 1819 and 1820 to collect specimens, particularly from Mount Etna (Lacroix, 1938). During this sojourn, Lucas established a relationship of scientific mutual esteem with Maravigna, who subsequently dedicated his memoir, "Istoria dell'Incendio dell'Etna del mese di Maggio 1819" (Maravigna, 1819), among others, to Lucas.

Before returning to Paris, Lucas was requested by Maravigna to initiate contact with the most renowned French ateliers of instrument makers in order to commission new apparatus for his cabinet. Through Lucas's mediation, Maravigna established direct relations with Nicolas Constant Pixii (1776-1861), one of Paris's leading machinists.

As noted by Paolo Brenni, between 1820 and 1850, it was difficult to find an important cabinet of physics that did not include instruments signed by Pixii (Brenni, 2006, 12). Within a few months, a consignment of finely crafted and scientifically advanced physical and chemical instruments arrived in Catania, forming the new collection of the Cabinet of Physics and Chemistry in December 1833. Payments for these instruments were handled through institutional channels, reflecting an administratively mediated procurement process that involved the "Genio Civile" – a state technical-administrative body responsible for public works and university oversight – as an intermediary (Maravigna, 1834b, 15).

Among the commissioned instruments was the Wedgwood pyrometer (Fig. 3), devised between 1782 and 1786 by the English ceramist Josiah Wedgwood (1730-1795) to measure the temperatures of chemical furnaces. The instrument exploited the property of clay to contract in volume as temperature increased and was initially intended for ceramic manufacturing. Owing to its simplicity and versatility, it achieved considerable success and soon became widely used in physics and chemistry laboratories. The pyrometer allowed the relative assessment of high temperatures that exceeded the measurable range of standard thermometers. From the late 18th century up to the first half of the 19th century, it was also employed to estimate the temperatures of lava several days after an eruption, facilitated by its portability and ease of use (see, e.g., Spallanzani, 1792; Introduction, XXV). Although reliable for comparative temperature measurements, the instrument proved unsuitable for determining absolute values due to the non-linear contraction of clay (Newcomb, 2009, 46-49).

Figure 3. Wedgwood pyrometer, 1820 ca., signed Pixii, Paris, France, acquired in 1820. The rectangular mahogany case with sliding lid is divided into two compartments: the lower originally contained cylindrical clay rods (now missing), while the upper holds a brass plate with three graduated rules. Two carry Fahrenheit scales, and the third bears the maker's signature: "Pixii à Paris / Pixii, neveu et successeur du Dumotiez rue du Jardinet numéro 2 à Paris." The rules are separated by two grooves narrowing at one end, the second continuing the first when aligned. Measurement involved inserting a clay rod to mark its initial position, exposing it to the target environment, and repositioning it after cooling. Through mathematical manipulation of the displacement between the initial and final positions, the temperature increase of clay could be expressed in degrees Fahrenheit. The scales, engraved along both sides of the grooves, are graduated from 0 to 240°F (≈ –17.8°C to 115.6°C). Collection of Antique Physics Instruments, Department of Physics and Astronomy, University of Catania. Inventory number: 100100016.

It is worth remarking that in the period under consideration, thermometry and calorimetry had yet to emerge as fully developed and separate branches of science: several thermometric instruments were devised to serve this purpose, gradually finding applications across all domains of natural philosophy (Chang, 2004). Thermometers with different scales were employed to measure the temperature of lava days after an eruption. As mentioned in paragraph 3.1, several naturalists in Catania reported such measurements (see, for instance, Gioeni, 1787; Mirone Pasquali, 1787; Ferrara, 1818). In 1819, Maravigna attempted to measure the temperature of lava one month and twenty-six days after the eruption: "Having then placed the thermometer in contact with the surface of the erupted lava [...] on 21 June it immediately marked 45 + o [approximately] degrees, and the heat felt there was so intense that the hand could no longer endure it, and I was forced to withdraw the instrument." (Maravigna, 1819, 78-79). In this case, Maravigna used the Réaumur scale.

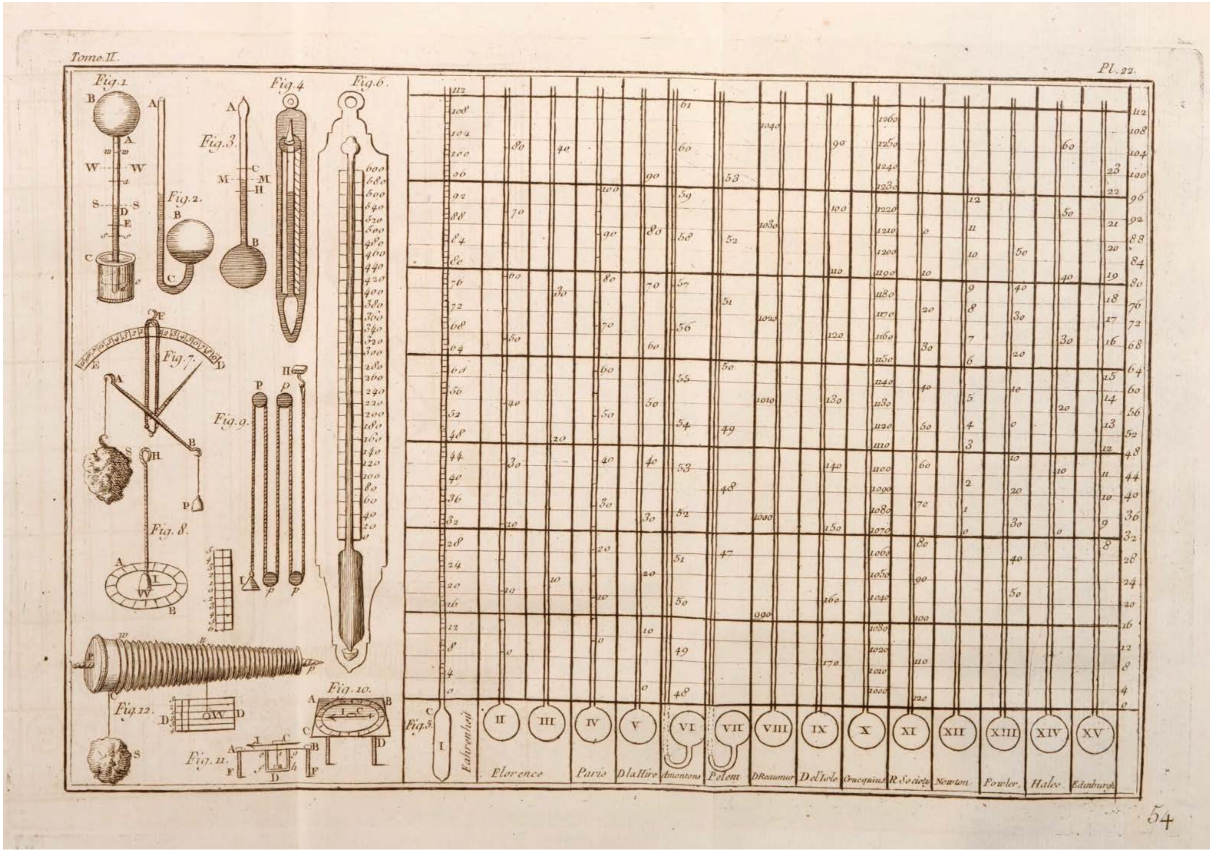

Figure 4. Table comparing the most widely used thermometric scales in the mid-18^{th} century (Desaguliers, 1751, pl. 22). Courtesy of the Bayerische Staatsbibliothek.

An analysis of the different scales employed at the time provides valuable insight into the state of thermometry. In the 18^{th} century, at least twenty-eight different temperature scales were proposed (Middleton, 1966). Among the most widely adopted (see Fig. 4) were the Fahrenheit scale (1724), the Réaumur scale (ca. 1730), and the Celsius scale (1742). The Réaumur and Celsius scales were originally constructed using water-based fixed points as defining references, whereas Fahrenheit's final scale was based on two fixed points: the melting point of ice (32°) and the temperature of the healthy human body (96°) (Middleton, 1966, 79). When these scales are compared with reference to the freezing and boiling points of water, they correspond to 32° and 212° on the Fahrenheit scale, 0° and 80° on the Réaumur scale, and 0° and 100° on the Celsius scale. A general consensus on the use of a single scale was reached only in the 19^{th} century, in connection with the rise of thermodynamics and the growing need for metrological standardization (Middleton, 1966; Chang, 2004). Until then, different scales often appeared on the same device to allow direct comparison. An emblematic instrument in this respect is the double-scale thermometer (Fig. 5), signed by the renowned French atelier Maison Lerebours et Secrétan (Brenni, 1993), specialized in precision instruments. It entered the collection of physics and chemistry instruments around the mid-19^{th} century.

(a)

(b)

Figure 5. (a) Thermometer with Celsius-Réaumur scales, signed Lerebours et Secrétan, Paris, France, ca. 1855-1867. Mercury thermometer with a graduated scale on paper, protected by a glass case. It features both Celsius and Réaumur scales. The maker's signature is engraved on the instrument: "Thermomètre Réaumur and Centigrade Maison Lerebours et Secretan / Secretan succ. opticien de S.A.M. l'Empereur, Paris." Collection of Antique Physics Instruments, Department of Physics and Astronomy, University of Catania. Inventory number: 100100293. (b) Details of the thermometer with indication of the double scales Celsius-Réaumur.

Following the academic reforms of the University, first in 1840 and then in 1860, when the Casati Law was extended to Sicily, the collections began to be recorded in separate inventories, reflecting the establishment of distinct institutes of physics and chemistry.

A comprehensive account of the collections as they stood in 1833 is provided by Maravigna's inventory (Maravigna, 1834b, 20-25). The catalogue additionally records the presence of an eudiometer. Developed in the 1770s, this instrument comprised a graduated glass tube used to measure the volume of gases produced during chemical reactions. It was widely employed in gas analysis, including studies of volcanic gases (Newcomb, 2009, 79). However, no eudiometer from this collection has survived to the present day.

3.3 The Meteorological Observatory

Another scientific cabinet closely connected with the study of Mount Etna was established in 1832 by the naturalist Carlo Gemmellaro, in the form of a meteorological observatory. Gemmellaro was appointed professor of natural history in the academic year 1831-1832, and later of Geology and Mineralogy in the year 1852-1853, at a time when the separation between the life sciences and the Earth sciences was taking shape, although the theoretical frameworks exhibited significant similarities in prominent cases, such as the theory of natural selection

(Darwin, 1859; Sumner, 2002). His scientific production comprises more than eighty works in the Earth sciences, ranging from volcanology and geology to stratigraphy and paleontology. In 1832 he established the Meteorological Observatory of the University of Catania, annexed to the Physics Cabinet. Anemometers and anemoscopes were already in use from that year.

At the time of its foundation, the observatory reflected the state of the art of the instruments available:
"An excellent English barometer by the celebrated Dollond, owned by Prof. Carlo Gagliani, was placed here. Alongside, there was a thermometer on Fahrenheit's scale and a hygrometer by Saussure, both belonging to the Physics Cabinet of the University. However, essential instruments for simultaneous meteorological observations, such as the anemoscope, atmidometer, pluviometer, electrometer, cyanometer, and others, were lacking. With help from Mr. Francesco Giuffrida, a skilled machinist from Catania, I had some of these instruments constructed." (Gemmellaro, 1835, 220).

A modern version of the anemometer used by Gemmellaro, originally preserved in the meteorological observatory, is now housed in the Museum of Mineralogy, Petrography, and Volcanology of the University of Catania (see Fig. 6).

Figure 6. Daloz-type anemometer, signed Officine Compagnia Speciale X, Italy, first half of the 20th century. Its operating principle is based on the deflection of a lightweight sphere, attached to a pendulum mounted on a horseshoe-shaped aluminum alloy bracket. A horizontal counterweight balances the system. The rod supporting the sphere features an indicator needle, which points to the wind speed, expressed in meters per second (m/s), on a graduated scale engraved directly onto the bracket, ranging from 0 to 14 m/s. The sphere is affixed to a pendulum, which is itself mounted on a vane system that allowed the instrument to be oriented in the direction of the wind. As wind pressure acts upon the sphere, the pendulum tilts at an angle proportional to the equilibrium between the sphere's weight and the aerodynamic force exerted by the wind. This angle directly indicates the wind speed. A label reading "Officine Compagnia Speciale X" is affixed to the instrument, likely referring to a unit of the Italian Army's Engineering Corps specialized in chemical defense and active between 1916 and 1919. Museum of Mineralogy, Petrography, and Volcanology. University of Catania. General catalogue number: Instrument_42. Another exemplar of this kind is preserved at the Alpines Museum München.

Within this observatory, Gemmellaro not only carried out meteorological observations, but also recorded attempts to relate meteorological parameters to the occurrence of eruptions of Mount Etna. Valuable information on this emerges from the accounts of his collaborators Carmelo Ferlito Faro and Mario Distefano Caruso, in which, alongside measurements taken with various instruments, references to the state of Mount Etna are also reported (Ferlito Faro and Distefano Caruso, 1839). After Gemmellaro's activity, the observatory remained annexed to the Physics Laboratory of the University. The surviving instruments from the 19th century collections are now preserved in the Collection of Antique Physics Instruments of the University of Catania.

4. Communication and emergency strategies in the 19th century

The complexity of volcanic phenomena still prevented the development of effective disaster prevention strategies during the first half of the 19th century. While scientific knowledge and instrumentation had not yet reached the level required to manage volcanic emergencies directly, practical solutions were adopted to improve communication and civil protection responses. Under the Bourbon government, a semaphore telegraph network was installed around Mount Etna. Depillon's semaphoric telegraph system became a crucial tool for real-time monitoring of lava flows and for organizing rescue operations to support affected populations. The eruption of 1852-1853 (20 August, 1852-27 May, 1853) demonstrated the operational efficiency of this system: the telegraphic network enabled rapid communication and timely interventions. Due to the lanterns positioned at the end of the arms, communication could continue at night. The Depillon semaphore (Fig. 7), with its three articulated arms capable of transmitting 900 distinct signals and 342 combinations, provided reliable transmission of critical information across the region.

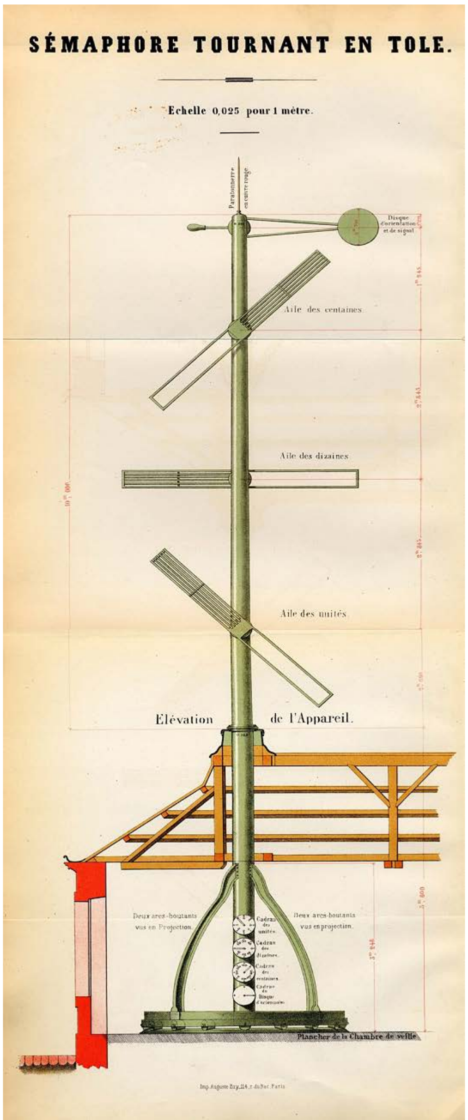

Figure 7. Schematic representation of Depillon's semaphore telegraph (Cabane and Bourlier, 2007).

The interpretation of these signals relied on a dedicated "signal book," which associated each specific arrangement of the three arms with a predefined message. Signal transmission was therefore based on a conventional coding system that required trained operators and a shared interpretative framework, making the decoding process dependent on a standardized and articulated legend (Cavina, 2006, 59-76).

Another important measure adopted by the Bourbon government was to entrust emergency management to specialists capable of coordinating operations and providing technical support. One such specialist was Lorenzo Maddem (1801-1891), professor of physics (from the year 1829-1830) and later of rational mechanics and theoretical geodesy (from the year 1862-1863), who oversaw the organization of relief efforts. In an official dispatch dated 24 August 1852, for instance, the Provincial Intendency ordered that "a courier be dispatched to Catania to recall Engineer Maddem so that he might make whatever arrangements could prove useful in the present emergency." (ASC 1842-1853, b. 4218, fol. 351).

From the mid-19th century onwards, increasingly professionalized roles began to emerge within the University: scientists and professors were tasked with monitoring volcanic activity and safeguarding the local population during eruptions, working in direct coordination with provincial authorities in Catania.

While the state of scientific and technological knowledge at the time did not permit reliable hazard prediction, individual observations and governmental records of volcanological phenomena and earthquakes were nevertheless produced, primarily in qualitative terms rather than through systematic instrumental recording (see ASC 1842-1853, b. 4218). These practices, together with emerging organizational frameworks, laid the groundwork for the more advanced monitoring systems developed in the second half of the 19th century. The gradual disciplinary specialization and institutional development in fields such as geodesy, physics, and volcanology progressively created the conditions for the establishment of the first seismological monitoring network on Mount Etna, initiated in 1881 thanks to the financial support of the Italian government and the efforts of another important figure of the University of Catania, Orazio Silvestri (1835-1890), then professor of geology and mineralogy and of terrestrial chemical physics, with applications to specialized studies on Mount Etna.

5. Conclusions

In the course of the 18th and 19th centuries, the study of Mount Etna progressively evolved from descriptive reports to technically informed analyses, reflecting the extraordinary advances in science, technology, and instrumentation. The systematic use of thermometers, pyrometers, electrometers, surveying devices, and other instruments not only enhanced the accuracy of observations, but also provided insights into the status and development of the disciplines involved, from physics and chemistry to geology and mineralogy. International exchanges with leading European naturalists and instrument makers further reinforced Catania's role as a crossroads of scientific practice. Within this context, the University of Catania became a privileged site where the material culture of science and the specific challenges of volcanic phenomena converged. By the late 19th century, the convergence of disciplinary specialization, methodological refinement, and institutional reforms created the conditions for volcanology to emerge as an autonomous field. This process culminated in 1919 with the formal establishment of the first chair of volcanology. In the academic year 1919-1920, however, volcanology continued to be taught in conjunction with physical geography by Gaetano Platania (1867-1938) (ASUC 1920), while the newly established chair was formally assigned to Gaetano Ponte (1876-1955) only in the following academic year (ASUC 1921), marking the transition from a multidisciplinary approach to a formally recognised scientific discipline.

Today, many of the instruments discussed in this contribution remain relevant educational resources. Their use in teaching and museum-based learning enables students, from secondary school to university level, to engage directly with the materiality of scientific practice and with the experimental processes through which knowledge is produced. As emphasized in recent scholarship (Cavicchi and Heering, 2021), historical scientific instruments should therefore be understood not merely as static museum objects but as active devices for inquiry and learning. Their significance is thus twofold: they are essential both to the historical study of science and to contemporary educational practice, and as such they deserve sustained scholarly and pedagogical attention.

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