BORNH Bulletin of Regional Natural History

Formerly **Bollettino della Societá dei Naturalisti in Napoli**

South-risk, South-safety: the lightning rod in enlightenment Naples

Mauro Gargano

DOI https://doi.org/10.6093/2724-4393/12971

***Correspondence:**
mauro.gargano@inaf.it
https://orcid.org/0000-0002-4582-704X

Affiliation:
National Institute for Astrophysics Astronomical Observatory of Capodimonte Naples

Competing interests: The Author declares that he has no competing interests for this work.

Financial Disclosure Statement: the Author declares that no specific funding was received for this work.

Submitted: 18 Sept 2025
Revised: 10 Dec 2025
Accepted: 12 Dec 2025
Published: 18 Dec 2025

Associate Editor:
Antonino Pollio

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Abstract

The Enlightenment's pursuit of natural philosophy found fertile ground in Naples, which became a leading center for the dissemination of Newtonian physics and the study of electricity. Within this intellectual climate, a network of scholars, including Della Torre, Bammacaro, Ardinghelli, and Poli, fostered experimentation, technological innovation, and early strategies for confronting environmental risk. This study examines the introduction of lightning rods in Naples as both a scientific breakthrough and a symbolic gesture of risk mitigation. British diplomat William Hamilton played a pivotal role in promoting their adoption, notably through the Italian translation of *Chiare istruzioni per costruire ed innalzare sicuri conduttori*, translated by astronomer Felice Sabatelli. By making Franklin's theories on electrical conductors accessible to Italian audiences, the pamphlet helped foster a new culture of safety and public awareness. Naples thus emerges as a pioneering site where vulnerability catalyzed technological ingenuity and cultural transformation.

Keyword: History of Physics - Electricity - Lightnings - Conductors - Risk Culture - Naples

Riassunto

La filosofia naturale promossa dagli ambienti illuministi trovò terreno fertile a Napoli che divenne un centro di riferimento per la diffusione della fisica newtoniana e per lo studio dell'elettricità. In questo vivace clima intellettuale, una rete di studiosi, tra cui Della Torre, Bammacaro, Ardinghelli e Poli, promosse la sperimentazione, l'innovazione tecnologica e le prime strategie per affrontare il rischio ambientale. Questo studio analizza l'introduzione dei parafulmini a Napoli come svolta scientifica e, al tempo stesso, come gesto simbolico di mitigazione del rischio. Il diplomatico britannico William Hamilton svolse un ruolo decisivo nel promuoverne l'adozione, anche attraverso la pubblicazione di *Chiare istruzioni per costruire ed innalzare sicuri conduttori*, tradotto in italiano dall'astronomo Felice Sabatelli. Rendendo accessibili al pubblico italiano le teorie di Franklin sui conduttori elettrici, il libretto intendeva contribuire a diffondere una nuova cultura della sicurezza e della consapevolezza pubblica. Napoli emerge così come un luogo pionieristico in cui la vulnerabilità ha catalizzato l'ingegno tecnologico e la trasformazione culturale.

Parole chiave: Storia della Fisica - Elettricità - Fulmini - Parafulmini - Cultura del Rischio - Napoli

Introduction

Throughout history, lightning has inspired a wide range of interpretations, reflecting the evolution of human thought and the transformation of scientific paradigms. From antiquity to modernity, observations of electrical phenomena gradually moved beyond mythical and divinatory frameworks, embracing experimental inquiry and instrumental analysis. Philosophers such as Thales, Plato, and Pliny the Elder had already noted the attractive properties of amber (ἤλεκτρον in Greek), anticipating the notion of an invisible force. The term ēlektron first appears in Homer's Odyssey (Book IV), when Telemachus admires amber-inlaid decorations on the walls of King Menelaus' palace in Sparta. The word shares an Indo-European root with ἠλέκτωρ, meaning "shining sun", suggesting that amber was primarily valued in antiquity for its brilliance and luminous quality.

Among natural phenomena, lightning remains one of the most powerful and awe-inspiring manifestations of electrical energy. In ancient cosmologies, it was regarded as a principal attribute of deities such as Zeus, Teshub, and Thor, conceived as the meteorological expression of divine will.

In his *Meteorologica*, Aristotle proposed a naturalistic explanation, attributing lightning to dry exhalations released from clouds during the condensation of air, producing thunder through collision:

> "*Etsi fulmen nomen commune sit ad omnem exhalationem quae e nube erumpit eiaculaturquae ardens: peculiare tamen ipsum faciunt ad eam quae nubem prumpit & fulgetrum nuncupant eam quae longiore tractu nubem findit*". (Aristoteles, 1512, f. LXXV)

Five centuries later, Pliny the Elder, in his *Naturalis Historia*, expanded on the topic by referring to Etruscan traditions, which viewed lightning as divine messages:

Tuscorum literae novem Deos emittere fulmina existimant, eaque esse undecim generum: Iovem enim trina iaculari. (Plinius Secundus, 1831, p. 166)

He distinguished between dry, wet, and bright lightning, each bearing ritual and divinatory significance. Struck locations, named *bidentalia,* were considered sacred, and lightning itself was categorized as "familiar" or "infernal", believed to be summonable through specific ceremonies. This theological-natural conception embedded atmospheric electricity within a ritual and augural system:

> "*Fulminum ipsorum plura genera traduntur. quae sicca veniunt, non adurunt, sed dissipant; quae umida, non urunt, sed infuscant. tertium est quod clarum vocant, mirificae maximae naturae, quo dolia exhauriuntur intactis operimentis nulloque alio vestigio relicto, aurum et aes et argentum liquatur intus, sacculis ipsis nullo modo ambustis ac ne confuso quidem signo cerae*". (Plinius Secundus, 1831, p. 166)

The transition to a scientific understanding of lightning unfolded gradually. In 1600, William

Gilbert (Fig. 1) introduced the term *electrica* to describe the behavior of rubbed amber (Gilbert, 1600, p. VIr), as he demonstrated during a presentation for Queen Elizabeth (Fig. 1). In 1646, Thomas Browne was the first to use the term *electricity* in its modern sense, contributing to the lexical foundation of a field that would evolve autonomously in the centuries to follow.

This article analyzes the development of atmospheric electricity theories, with particular focus on the urban and scientific context of 18th-century Naples. Through the examination of documentary sources, it traces key stages in a cultural and epistemological transition: from sacred vision to physical-natural interpretation; from symbolic risk to technical planning; from *South-risk*, marked by exposure and vulnerability, to *South-safety*, understood as a culture of prevention and rationality.

Figure 1: *Dr. William Gilberd demonstrating his experiments on electricity to Queen Elizabeth and her court.* Painted by Arthur Ackland Hunt, 19th century. Credit: Colchester and Ipswich Museums.

The Concept of Electricity Between the 17th and 18th Centuries

At the close of the 16th century, William Gilbert laid the groundwork for the systematic study of electrical phenomena in his treatise *De Magnete*. Observing that certain materials, when rubbed, emitted an invisible effluvium capable of attracting light objects such as paper fragments, Gilbert hypothesized the existence of an undefined natural force. He invented the *versorium*, a device with a rotating needle that anticipated the principle of the electroscope (Heilbron, 1979, pp. 169-179). Brilliant though his insights were, they remained steeped in philosophical analogies, reflecting the transitional nature of early scientific thought.

With the dawn of the 18th century, lightning began to be interpreted not as an isolated celestial event, but as an atmospheric manifestation linked to observable electrical properties. In 1709, Francis Hawksbee introduced glass globes to generate electricity and studied the behavior of electrical light in a vacuum. Soon after, Stephen Gray and Reverend Granville Wheler demonstrated the transmission of electricity over long distances, contributing to the concept of the insulated conductor. Their experiment, using a hemp cord suspended with silk supports, highlighted the importance of insulation in preserving electrical charge (Heilbron, 1979, pp. 229-234).

In the following decade, attention turned to rotating machines capable of producing sparks visible even in daylight, leading to a new generation of electrostatic devices. In parallel, the atmospheric phenomenon of lightning began to be associated with the electrical fluid studied in laboratories.

Benjamin Franklin, renowned as one of the founding fathers of the United States of America, was also a pioneering scientist and inventor whose contributions to the study of electricity had profound implications for both scientific progress and public safety. Among his most influential innovations was the lightning rod: a device that came to symbolize the Enlightenment's union of reason, experimentation, and civic utility.

Franklin's *Experiments and Observations on Electricity*, published in 1751, established what many regard as the first coherent paradigm of electrical theory. In respect to the models proposed by his contemporaries, Franklin's framework was clear and practical. He conceived electricity as a single elastic fluid, governed not by collision but by forces of attraction and repulsion (Pense, nd).

Building on this theoretical foundation, Franklin began to explore practical applications of electrical principles. As early as 1749, he hypothesized that lightning was a natural manifestation of electrical phenomena (Franklin, 1961a). In his *Opinions and Conjectures concerning the Properties and Effects of the Electrical Matter, arising from Experiments and Observations made in Philadelphia, 1749*, sent to the botanist Peter Collinson dated 29 July 1750, Franklin proposed a simple experiment to test the electrical nature of lightning:

> *"On the Top of some high Tower or Steeple, place a Kind of Sentry Box big enough to contain a Man and an electrical Stand. From the Middle of the Stand let an Iron Rod rise... pointed very sharp at the End... a Man standing on it when such Clouds are passing low, might be electrified, and afford Sparks, the Rod drawing Fire to him from the Cloud"*. (Franklin, 1961b)

Furthermore, Franklin outlined the first description of the power of points, which could:

> *"be of Use to Mankind in preserving Houses, Churches, Ships &c. from the Stroke of Lightning; by Directing us to fix on the highest Parts of those Edifices upright Rods of Iron, made sharp as a Needle and gilt to prevent Rusting, and from the Foot of those Rods a Wire down the outside of the Building into the Ground; or down round one of the Shrouds of a Ship and down her Side, till it reach'd the Water... These pointed Rods... thereby secure us from that most sudden and terrible Mischief!"* (Franklin, 1961b)

In this way, Franklin proposed that electrical charge might be siphoned from the clouds without producing a violent discharge. Alternatively, if a building were struck directly, the destructive power could be channeled away from the structure using a conductive wire, much like how damp clothing might redirect lightning away from a person's body, reducing the risk of injury.

Figure 2: *Benjamin Franklin Drawing Electricity from the Sky*, painted by Benjamin West, ca. 1816. Tribute to Franklin's 1752 experiment proving the electrical nature of lightning. Credit: Philadelphia Museum of Art.

While the sentry box experiment remained theoretical, Franklin famously demonstrated the electrical nature of lightning in June 1752 with his iconic kite experiment. He launched a silk kite fitted with a metal tip and grounded via a key, allowing electricity to be drawn from storm clouds and confirming the link between atmospheric phenomena and electrical discharge (Fig. 2).

The experiment was described in the *Pennsylvania Gazette* on 19 September of that year:

> *"This Kite is to be raised when a Thunder Gust appears to be coming on, and the Person who holds the String must stand within a Door, or Window, or under some Cover, so that the silk Ribbon may not be wet; and Care must be taken that the Twine does not touch the Frame of the*

> *Door or Window. As soon as any of the Thunder Clouds come over the Kite, the pointed Wire will draw the Electric Fire from them, and the Kite, with all the Twine, will be electrified, and the loose Filaments of the Twine will stand out every Way, and be attracted by an approaching Finger. And when the Rain has wet the Kite and Twine, so that it can conduct the Electric Fire freely, you will find it stream out plentifully from the Key on the Approach of your Knuckle. At this Key the Phial may be charg'd; and from the Electric Fire thus obtain'd, Spirits may be kindled, and all the other Electric Experiments be perform'd, which are usually done by the Help of a rubbed Glass Globe or Tube; and thereby the Sameness of the Electric Matter with that of Lightning compleatly demonstrated".* (*Philadelphia*, October 19, 1752)

From these observations, the lightning rod was born: a pointed metal conductor mounted atop a structure and connected to the ground via an insulated wire, designed to safely disperse electrical energy (Heilbron, 1979, pp. 324-343; Krider, 2006).

Through these discoveries, Franklin advanced scientific understanding, and exemplified the Enlightenment ideal of knowledge applied in service to society.

However, Franklin's proposal sparked a heated debate with English scholar Benjamin Wilson, who argued that pointed tips were too attractive and advocated for spherical terminations, which he believed were less likely to provoke discharges. The controversy peaked in 1777, when lightning struck a powder magazine in Purfleet-on-Thames despite the presence of Franklin-style tips. Wilson staged a public demonstration at London's Pantheon, showing how pointed conductors could attract discharges even from significant distances. King George III supported Wilson's position, and for several years, blunted versions were officially adopted (Tunbridge, 1974).

On the European continent, a key figure in the dissemination of Franklin's theories was the French naturalist Thomas-François Dalibard, who translated Franklin's works into French alongside the eminent scholar Georges-Louis Leclerc, Comte de Buffon. On 18 May 1752, Dalibard conducted the first European experiment aimed at capturing atmospheric electricity, installing an insulated metal rod in Marly-la-Ville, near Paris. Although Dalibard oversaw the installation, he was recalled to Paris on urgent business before the experiment could be conducted. In his absence, the task was entrusted to Coiffier, a resident and former dragoon cavalry soldier, whose reliability and courage Dalibard valued. The Prior of Marly, Raulet, later had Coiffier deliver a letter announcing the experiment's success.

Dalibard's successful experiment, conducted weeks before Franklin's own, marked a turning point in European scientific discourse. It confirmed the electrical nature of lightning and helped legitimize the lightning rod within academic circles (Krider, 2006). During a session of the Académie Royale des Sciences on 13 May, Dalibard read his memoir *Des expériences et observations sur le tonnerre relatives à celles de Philadelphie*, declaring: "The idea conceived by Mr. Franklin is no longer a conjecture; it has now become a reality".

Jean-Antoine Nollet and the Theory of the Double Fluid

Among the most significant figures in the development of 18th-century electrical physics, Abbé Jean-Antoine Nollet occupies a central place. A student of Du Fay and Réaumur, he engaged with prominent advocates of Newtonian physics, including John Theophilus Desaguliers and Willem Jacob 's Gravesande. Nollet was among the first to draw an analogy between electricity and lightning, and his theories advanced the understanding of charge attraction and dispersion.

His theory of electrical fluid rested on the existence of two subtle, invisible components: the *effluent* (outward flow) and the *affluent* (inward flow), which corresponded to opposing directions of electrical movement through the pores of electrified bodies. Expanding on Du Fay's model of vitreous and resinous fluids, Nollet envisioned these flows as opposing polarities responsible for phenomena of attraction and repulsion (Heilbron, 1979, pp. 346-362).

A particularly significant chapter in Nollet's intellectual trajectory unfolds through his encounter and subsequent correspondence with Maria Angela Ardinghelli, partially included in *Lettres sur l'électricité* (1753 and 1767), translated into Italian two years later. The volume consists of a series of unsent letters, many of them addressed to Benjamin Franklin, in which Nollet defends his own theories on electricity while critically engaging with Franklin's experimental claims. In his letter to Ardinghelli, Nollet commented on Franklin's work with a tone that subtly asserted European scientific primacy: "[Although] Mr. Franklin appears in his observations to be very ingenious and perceptive… [it is] quite likely that a man of the New World, residing in a colony where commerce is valued more than science, may have been unaware of what was taking place in Europe regarding electricity". While Nollet recognized the experimental validity of Franklin's observations, he approached overly optimistic interpretations with caution, fearing that "a real discovery might be abused" through premature generalizations. His theoretical prudence, steeped in epistemological depth, helped establish a more nuanced and critical interpretive framework for atmospheric electricity.

Nollet met Ardinghelli in Naples in 1749, during his travels in Italy, and was immediately struck by her scientific acumen and clarity of thought. Although the letter addressed to her was never sent, it reflects a genuine intent to engage in dialogue and stands as a rare instance of intellectual exchange, albeit one-sided, between a French academic and an Italian woman scholar. The text offers a vivid glimpse into the theoretical controversies of the time, with Ardinghelli emerging as a

Figure 3: A group of scholars, including Della Torre and Ardinghelli, engaged in early electrical demonstrations within the scientific circle at the palace of Prince Spinelli di Tarsia. Engraving from *Scienza della natura*, vol. 2. Credit: Astronomical Observatory of Capodimonte.

rigorous, incisive, and original interlocutor. Nollet openly acknowledges her authority and receives her insights with marked respect and attentiveness (Bertucci, 2013).

Although a lightning rod was installed on a public building in Paris - the Louvre - in 1782, the concept had already inspired creative expressions within French culture well before its official adoption. In 1773, Jacques Barbeu du Bourg, a French translator of Franklin's works, proposed a "parapluie paratonnerre": an umbrella equipped with an iron rod, grounded by a trailing wire. This fusion of utility and spectacle soon found expression in Parisian fashion. For a brief period, women adopted a fashionable reinterpretation: a tall, wide-brimmed conical hat adorned with feathers and edged with metallic wire, which connected via a silver chain to the wearer's heels. In this instance, fashion appropriated scientific principles to protect the coiffed heads of Parisian elites from celestial fire: the "chapeau paratonnerre" (Figuier, 1868, p. 568, 597).

Italian Contributions to Atmospheric Electricity Studies

In the European scientific landscape of the eighteenth century, Italy played a pivotal role in advancing the study and application of atmospheric electricity. Prominent scholars such as Giuseppe Veratti, Giovanni Battista Beccaria, and Giuseppe Toaldo helped legitimize Benjamin Franklin's theories and transform them into practical innovations in urban planning, architecture, and public safety.

Giovanni Battista Beccaria, a physicist and mathematician from Piedmont, was among the first in Europe to replicate Franklin's experiments. In his *Dell'elettricismo artificiale e naturale* (1753), he endorsed the theory of electrical fluid and demonstrated its physical and measurable nature through rigorous experimentation. His contribution extended beyond theoretical discourse: on 2 July 1752, he installed lightning rods on his own residence in Turin to replicate phenomena previously observed by French physicists. A year after publishing his treatise, he further tested the device's effectiveness by placing two insulated metal rods on the Valentino Castle. In 1764, he proposed equipping Milan Cathedral with a lightning rod, an unprecedented move that marked a turning point in the protection of public buildings. His correspondence with Franklin and membership in the Royal Society attest to his international recognition (Proverbio, 2001).

In Bologna, Laura Bassi and Giuseppe Veratti initiated a period of intense experimentation on electricity. In 1746, they equipped their laboratory with a machine inspired by the model developed by Hauksbee. Two years later, Bassi presented to the Academy of Sciences of Bologna her treatise *De aere in fluidis contento*, in which she expressed a keen interest in contemporary debates on electricity. She drew an analogy between the behavior of air and that of light, noting that both, like electricity, obey the laws of attraction and repulsion and tend to accumulate at the extremities and corners of bodies (Cavazza, 2009).

Bassi and Veratti embraced the theory of a single electrical fluid formulated by Franklin and supported in Italy by Beccaria, including the hypothesis regarding the electrical nature of lightning. In July 1752, Veratti replicated the experiment conducted by Dalibard at the observatory of the Institute of Sciences in Bologna. With the assistance of the astronomer Petronio Matteucci, along with the young Tommaso Marino, Gabriele Brunelli, and Antonio Paganuzio, Veratti installed a long metal rod atop the tower of Palazzo Poggi. During a thunderstorm, he successfully obtained electrical sparks, thereby providing experimental confirmation of Franklin's theory. In a detailed account, Veratti wrote:

> *"The electrical principle is diffused throughout nearly all terrestrial bodies... Yet almost no one had claimed that it also pertained to clouds and celestial bodies... The first to attempt something, as far as we know, was Franklin in America... To ensure that Italian experiments were not lacking, I decided to conduct trials myself... On 27 July, around fourteenth hour* [approximately 11:15 of 28 July]*, the sky darkened with thick black clouds... small flashes of lightning appeared and faint thunder was heard...* [after a while] *I approached the key and touched it: I found it electrified, with very clear sparks emerging from it... They lasted for seven minutes and were beautiful. Suddenly, a bolt of lightning struck, and the person holding the iron rod with his right hand... was shaken with such violence throughout the right side of his body that words cannot describe it; the pain extended to his foot and persisted for many hours"*. (Veratti, 1755)

The experiments were repeated in the following days with similar results. However, the intensity of the electrical discharges and the direct involvement of the experimenters raised serious concerns among local authorities. The ensuing controversy led to the suspension of the trials and a prohibition on installing lightning rods on public buildings, despite their proven effectiveness (Cavazza, 2009).

The Padua astronomer Giuseppe Toaldo emerged as another key figure in the Italian reception of Franklin's theories. Appointed professor of astronomy in 1762, he supported Franklin's theories and opposed the cautious stance of the French school led by Nollet. His treatises *Della maniera di difendere gli edificj dal fulmine* (1772), and *Dell'uso de' conduttori metallici a preservazione degli edifizj contro de' fulmini* (1774) promoted the use of lightning rods, overcoming both popular

Figure 4: A group of scholars, including Della Torre and Ardinghelli, engaged in early electrical demonstrations within the scientific circle at the palace of Prince Spinelli di Tarsia. Engraving from *Scienza della natura,* vol. 2. Credit: Astronomical Observatory of Capodimonte.

and religious resistance. Toaldo implemented protective systems atop churches and bell towers, including that of St. Mark in Venice, as well as on the Padua Observatory (Fig. 3), and even on Venetian naval vessels (Lepschy, 1998).

In 1769, Grand Duke Pietro Leopoldo of Lorraine ordered the creation of a network of lightning rods to safeguard the powder magazines of Tuscany's major cities. The first Franklin-type device was erected in Siena on the Torre del Mangia in September 1776, under the supervision of physicist Domenico Bartaloni and architect Antonio Matteucci (Bartaloni, 1781). The decision met with significant resistance, fueled by the widespread belief that such instruments attracted lightning rather than protected buildings and people from its strikes, as reported by the mathematics professor at the University of Siena, Andrea Pistoi, wrote:

> *"The people who do not study physics cannot so easily be persuaded of the usefulness of new discoveries, and some, mockingly, when the electric pole was being installed, called it the 'heretical pole'. Yet the Sienese people, docile and curious by nature, are inclined to embrace any novelty and to admire its inventor as soon as they are in some way convinced of its truth and usefulness. It will be helpful, for greater understanding, to first explain the nature of the conductor"*. (Pistoi 1781)

That skepticism was dispelled the following year, on 18 April 1777 when the lightning rod proved its full effectiveness. Pistoi commented:

> *"The Sienese people, always sensitive and grateful toward those who do good for humanity, are surprised that statues are so often raised to those who have ruined cities, and so rarely to those who preserve them. Mr. Franklin... will surely feel an ineffable consolation in hearing of his great triumph and the praise bestowed upon him by peoples so distant from his homeland, who see in his prodigious rod the most conspicuous trophy of the greatness of his immortal genius"*. (Pistoi 1781)

Remarkably, the device remained in operation until 1996.

Other installations followed in Livorno and Poppi, where a lightning rod was placed on the tower of the Castle of Counts Guidi in 1786. This installation served not only to protect the building but also to experimentally test the competing theories of Franklin and

Wilson regarding the shape of the rod's tip, pointed versus spherical. To test Coulomb's conclusion, Felice Fontana and Giovanni Fabbroni constructed a dual-tip conductor and conducted comparative observations.

Beccaria's instructions for constructing Franklin-style lightning rods were widely disseminated and adopted by scholars and enthusiasts alike, drawn to both their theoretical foundations and practical applications. Among them was the Piarist Girolamo Maria Fonda, who in 1769 succeeded Francesco Jacquier as chair of experimental physics at the "Roman Archiginnasio known as La Sapienza". Following a lightning strike on the dome of the church of Sant'Ivo alla Sapienza on 17 June 1770, Fonda contributed to the design of a lightning rod that was not only effective but also respectful of the architectural harmony envisioned by Borromini: "I would like the uniformity, spirit, and liveliness of Boromini's thought to be preserved" (Fonda, 1770). Two years after equipping the Observatory of the Roman College with a lightning rod, the astronomer Giuseppe Calandrelli was commissioned in 1789 to design and install protective systems for the Quirinal Palace and the church of Castel Gandolfo. These interventions signal a growing acceptance of electrical safety measures within religious and political institutions in central Italy (Calandrelli, 1789).

Electrical Experiments in Naples

Amid the vibrant intellectual landscape of 18th-century Naples, few figures rivaled the influence of Sir William Hamilton, British envoy extraordinary to the Bourbon court from 1764 to 1800 and a central figure in the city's political and cultural life. His contributions were instrumental in advancing the study and practical understanding of electrical science. Hamilton's tenure was also marked by a deep engagement with the natural world, particularly the volcanic phenomena of Vesuvius and Etna. This culminated in the publication of his influential work *Observations on Mount Vesuvius, Mount Etna, and other Volcanos*, which enriched contemporary scientific discourse and positioned Naples as a nexus of Enlightenment-era inquiry. Between 1772 and 1773, Hamilton guided the young Swiss Alpine expert Horace-Bénédict de Saussure up Vesuvius during his stay in Naples. In return, de Saussure later offered Hamilton a sublime experience: a tour of Chamonix in July 1776. Moreover, de Saussure shared news of Hamilton's electrical experiments with Franklin and conveyed Hamilton's volcanic theory, arguing that the entire Bay of Naples, from the sea to the Apennines, had been thrust up from the seabed by subterranean fires. In Hamilton's view, this region was not merely the site of volcanic destruction, but itself a creation of volcanic power. A passionate connoisseur of Greek vases as well as Etruscan and Roman antiquities, William Hamilton actively promoted the diffusion of aesthetic knowledge and helped popularize the neoclassical taste that defined the era. Many of his prized pieces were later acquired by the British Museum, substantially enriching its classical collections. During his Italian journey in 1787, Johann Wolfgang von Goethe paid a visit to Hamilton and was deeply struck by the ambassador's remarkable trove of antiquities and his magnetic intellectual presence. In his travel writings, Goethe lauded Hamilton's pioneering studies of volcanic activity and described his vase collection as among the finest in Europe (Darley, 2011, pp. 64-95).

The fascination of Hamilton with electricity, then an emerging field of study, was closely tied to his interest in volcanic phenomena, particularly the lightning associated with eruptions. In 1773, he acquired a Ramsden telescope to observe, from Naples, the violent ejections of stones and molten lava from the crater of Vesuvius. He also commissioned an electrical machine built by Edward Nairne, crafted according to specifications originally

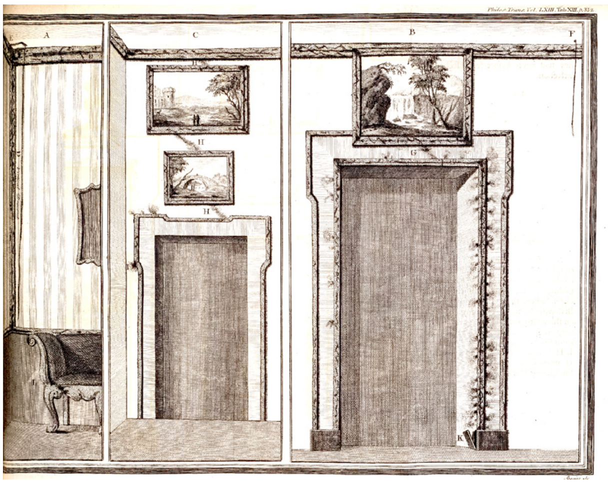
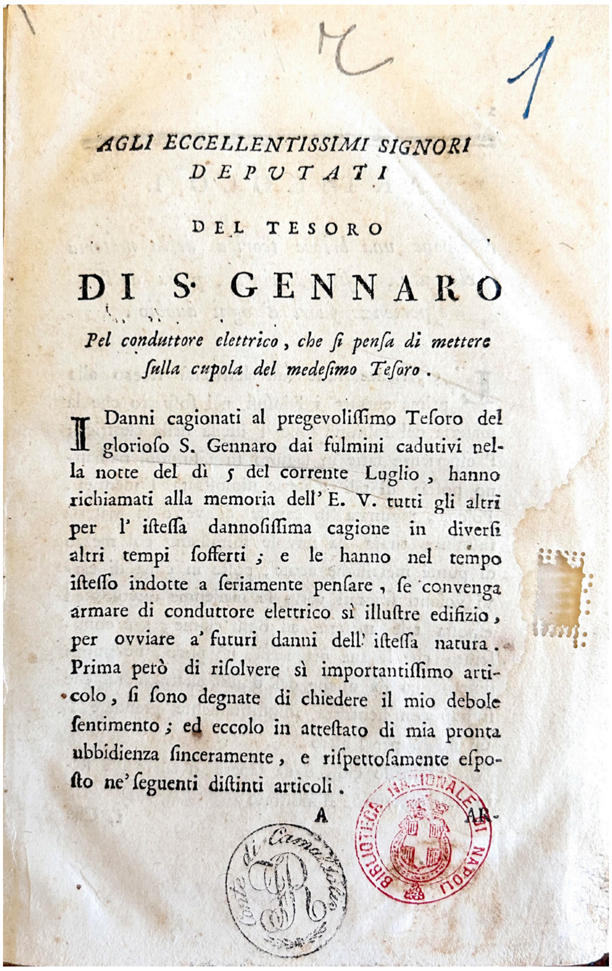


Figure 5: Lightning damage at Tinley's residence in Naples, as documented by William Hamilton. Credit: Royal Society.

proposed by Benjamin Franklin. The device was capable of producing sparks visible from several centimeters away, and emitted a "torrent of divergent light" from its conductor. Described by Hamilton as "the wonder of this country", the machine was employed in public and educational demonstrations, helping to foster scientific awareness and culture throughout Neapolitan society (Hamilton, 1773).

In parallel, Naples was home to a vibrant group of local scholars. Giovanni Maria Della Torre, a Somascan priest and a central figure in 18th-century Italian science, was among the first to replicate and comment on the experiments of Franklin, Gray, Du Fay, and other pioneers of electrical physics (Baldini, 1989). He collaborated with Felice Sabatelli, professor of astronomy, Vito Caravelli, mathematician, and the remarkable Maria Angela Ardinghelli, whom Lalande described as "the foremost among the illustrious women devoted to science in the beautiful country" (Vitrioli, 1874; Bertucci, 2013). Experiments were conducted in the *Bibliotheca Spinella*, housed within the palace of Prince Ferdinando Spinelli di Tarsia, which had been transformed into a genuine scientific laboratory. There, Peter Johann Windler, a traveling Saxon demonstrator who had



AGLI ECCELLENTISSIMI SIGNORI
DEPUTATI

DEL TESORO

DI S. GENNARO

Pel conduttore elettrico, che ſi penſa di mettere ſulla cupola del medeſimo Teſoro.

I Danni cagionati al pregevoliſſimo Teſoro del glorioſo S. Gennaro dai fulmini cadutivi nella notte del dì 5 del corrente Luglio, hanno richiamati alla memoria dell' E. V. tutti gli altri per l' iſteſſa dannoſiſſima cagione in diverſi altri tempi ſofferti; e le hanno nel tempo iſteſſo indotte a ſeriamente penſare, ſe convenga armare di conduttore elettrico sì illuſtre edifizio, per ovviare a' futuri danni dell' iſteſſa natura. Prima però di riſolvere sì importantiſſimo articolo, ſi ſono degnate di chiedere il mio debole ſentimento; ed eccolo in atteſtato di mia pronta ubbidienza ſinceramente, e riſpettoſamente eſpoſto ne' ſeguenti diſtinti articoli.

A AR-

BIBLIOTECA NAZIONALE NAPOLI

Figure 6: Frontispiece of the letter by Vito Caravelli. Credit: National Library of Naples.

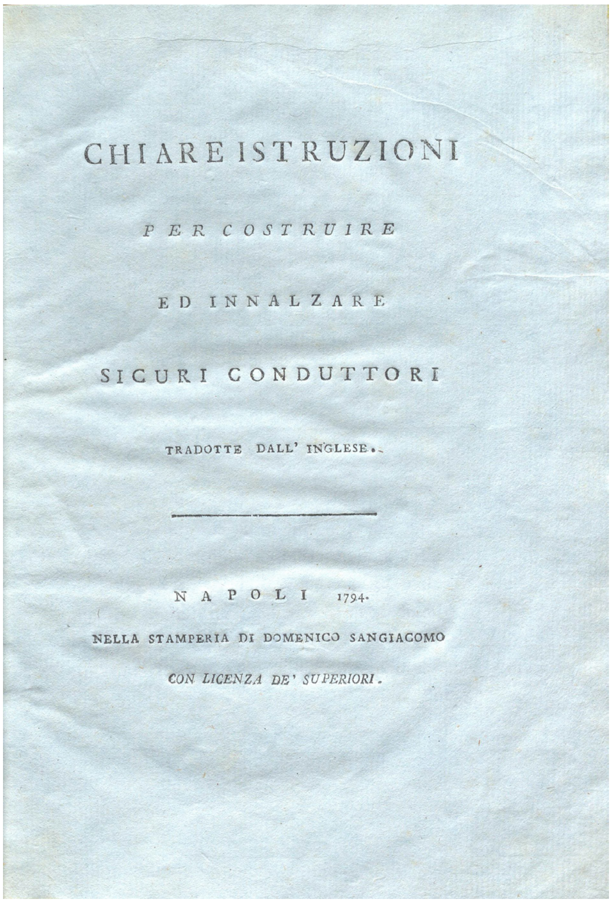
previously exhibited his apparatus in Rome, impressing audiences with spectacular electrical displays in the dark, conducted experiments on electrical phenomena that similarly captivated the Neapolitan public. His demonstrations, marked by dramatic sparks and shocks, drew considerable interest from local scholars. Windler's notes culminated in the publication of *Tentamina de causa electricitatis* in 1747, which included trials conducted using an electrical machine designed by the prince himself, clear evidence of the direct involvement of Neapolitan nobility in scientific research. This electrical machine (Fig. 4) served both as a marvel for entertaining the prince's guests and as a valuable instrument for academicians, who employed it to elevate their standing within the broader landscape of

Neapolitan scientific culture (Bertucci, 2013).
In the second edition of *Scienza della natura generale*, Della Torre devoted extensive attention to electricity, describing its properties, the atmospheric conditions favorable to its manifestation, and the dynamics of attraction and repulsion between electrified bodies. He examined the electrical machines of Guericke, Hawksbee, and Musschenbroek, referencing the experiments of Windler and Mattia Boze. During public demonstrations, he observed that black silk was attracted more readily than white, and that humidity diminished electrical responsiveness, insights that presciently underscored the importance of material properties and environmental conditions (Della Torre, 1777, pp. 295-338).
This experimental environment also benefited from the contributions of Niccolò Bammacaro, professor of philosophy at the University of Naples and author of *Tentamen de vi electrica ejusque phaenomenis* (1748). In this work, Bammacaro challenged Jean-Antoine Nollet's double-fluid theory, dismissing the notion of "affluent matter" as an unverifiable hypothesis. Instead, he proposed a model based solely on "effluent matter", which compressed the surrounding air to form a "vortex aëreus", an electrical atmosphere exerting mechanical pressure that pushed bodies toward the electrified source, offering a physical alternative to fluid-based explanations. Although Nollet contested the theory for lacking vacuum-based experimentation, Bammacaro's work stands as an original Italian contribution to the interpretation of electrical phenomena.
Finally, Giuseppe Saverio Poli, professor of experimental physics at the University of Naples, played a pivotal role in consolidating the teaching of electrical theories. As early as 1772, he published *La formazione del tuono, della folgore e di varie altre meteore spiegata giusta le idee del Signor Franklin*, a treatise that drew upon Franklin's theories to explain atmospheric phenomena, reflecting the integration of experimental science into contemporary educational practices. Over the following two years, Poli published *Riflessioni intorno agli effetti di alcuni fulmini* (1773) and *Continuazione delle riflessioni intorno agli effetti di alcuni fulmini* (1774), in which he critiques a purely theoretical and book-centered approach to science, advocating instead for a method of inquiry grounded in inductive reasoning and direct observation. In the 1773 volume, Poli also documented experiments conducted in the presence of several distinguished figures, among them William Hamilton; Simone Cavalli, Resident of the Republic of Venice; Prince Casimiro Pignatelli d'Egmont; and Ascanio Filomarino, Duke della Torre. In his *Elementi di fisica sperimentale* (1781-1783), Poli devoted extensive sections to electricity and lightning, noting the presence of a Dollond electrical machine belonging to Giovanni Vivenzio, Archiater and Royal Protomedicus. The instrument formed part of a scientific collection used for public demonstrations and experimental instruction. Poli's method, grounded in direct observation and empirical practice, significantly strengthened the teaching of natural sciences in the Kingdom of Naples and promoted a systematic, functional approach to atmospheric physics (Schettino, 2001).

Chronicles of Lightning in Naples

Across the centuries, Naples has endured atmospheric phenomena of extraordinary violence, including lightning strikes in densely populated quarters of the city. These episodes, vividly chronicled by clerics, historians, and scholars alike, offer a valuable lens through which to interpret the evolving worldviews within the Kingdom of Naples. Interpretations, layered and diverse, oscillate between faith and empiricism, miracle and measurement.
One of the earliest recorded lightning strikes in Naples occurred on 29 September 1600, at the Church of San Paolo, built atop the ruins of the ancient temple of the Dioscuri in the agora of Neapolis. Tommaso Costo, Secretary

Figure 7: Palace Doria d'Angri in Naples, with a lightning rod visible atop the building. Depicted in *Via Toledo dalla piazza dello Spirito Santo*, an 1837 painting by Gaetano Gigante. The same lightning rod is more clearly visible above the Italian flag in the *Ingresso di Garibaldi a Napoli*, a hand-colored ink drawing by Martino Francesco Wenzel, dated 1860 and housed at the Municipal Museum of Castel Nuovo. Credit: Museum of San Martino.



CHIARE ISTRUZIONI

PER COSTRUIRE

ED INNALZARE

SICURI CONDUTTORI

TRADOTTE DALL' INGLESE.

NAPOLI 1794.

NELLA STAMPERIA DI DOMENICO SANGIACOMO

CON LICENZA DE' SUPERIORI.

Figure 8: Frontispiece of the book translated by Felice Sabatelli. Credit: Astronomical Observatory of Capodimonte.

of the High Court of the Admiralty of the Kingdom of Naples, recounts that the bolt "caused great damage, particularly breaking the bell tower, the tribune and part of the choir above the main altar" (Costo, 1613, p. 159). Mere weeks later, on 25 November, chronicler Domenico Parrino notes that another bolt struck the Basilica, again targeting the bell tower and choir with severe destruction. That winter proved especially harsh: by January 1601, torrential rains and violent winds sank a galley, six ships, and numerous smaller vessels along the stretch between Naples' port and the Gulf of Salerno. On 30 November of that same year, lightning struck the Convent of the Cross of the Reformed Fathers of Saint Francis, located on the site that would later become Palazzo Salerno in Piazza del Plebiscito. The bolt tore through the bell tower and entered a chapel during a Eucharistic celebration. The officiating priest fell supine to the ground, unconscious. Upon recovering unharmed, "he looked into the chalice containing the consecrated blood and found it, as a result of the strike, to be of a bruised, livid color" (Costo, 1613, pp. 162–163), so he replaced it to continue the celebration. Parrino later reported a different version, in which the officiant observed a strange discoloration in the consecrated hosts: "he found them livid and changed in color" (Parrino, 1730, p. 9), and promptly replaced them. The Viceroy, Count of Lemos, witnessed the event and personally funded the restoration of the bell tower and the damage caused to the church. As storms and illness continued to afflict the city, the Viceroy ordered a solemn procession carrying the relics of Naples' seven patron saints, including Saint Januarius with his miraculous blood. In the days that followed, the weather cleared, widely interpreted as a sign of divine intervention (Costo, 1613, pp. 162–163; Parrino, 1730, p. 9).

Years later, on 30 November 1656, a "terrible lightning bolt" devastated the Basilica of Santa Maria del Carmine, destroying the bell tower, roof, and choir, and collapsing the attic. Reconstruction was made possible through the generosity of the Neapolitans, among them Viceroy García de Avellaneda, Count of Castrillo, and Domenico Del Giudice, Prince of Cellammare. The phenomenon returned on 19 September 1728 and once more on 27 September 1745, when another lightning bolt struck the bell tower, tearing off massive blocks of marble and piperno, which crashed down onto the roof. Sweeping through the church, the bolt reportedly ruined both organs. Yet, in what was deemed miraculous and attributed to the protection of Mother Mary, the choir monks present remained unharmed. Despite repairs, the bell tower again succumbed to lightning in 1762 (Filangieri, 1885, pp. 176-180).

Another extraordinary episode unfolded on 30 June 1714 at the Monastery of Santa Maria della Provvidenza, nestled in Largo dei Miracoli within Naples' Sanità district. As nearly fifty nuns chanted canonical praises, a bolt of lightning struck with terrifying force, piercing both the bell tower and the choir. According to Serafino Montorio (1715, p. 74), the discharge surged through the entire complex, even reaching the distant washhouse, yet astonishingly, no one was harmed. The nuns, attributing their preservation to the Virgin Mary, expressed their gratitude with a solemn procession, carrying her miraculous image through the streets.

With the rise of scientific culture in the eighteenth century, the understanding of lightning underwent a profound transformation. No longer viewed solely through theological or symbolic frameworks, atmospheric electricity began to be examined through empirical observation and experimental inquiry. William Hamilton, in a letter to Matthew Maty, secretary of the Royal Society, precisely described an episode that occurred on 15 March 1773 at the Neapolitan residence of Lord John Tylney:

> "*On Monday last, about half past ten at night, I had the satisfaction of being one, of many witnesses, to several curious phenomena, occasioned by the lightning having fallen on Lord Tylney's house, in this city*". (Hamilton, 1773, p. 324)

A discharge passed through nine rooms, damaging gilded surfaces, bell mechanisms, and metal furnishings, without injuring any of the 500 guests present.

> "*A Polish prince, who was playing cards, heard the report (which he took for a pistol), and feeling himself struck, jumped up, and, clapping his hand to his sword, assumed a posture of defence. I was sitting at a card-table, and conversing with Monsieur de Saussure, Professor of Natural History at Geneva… I thought an Indian cracker had been fired, while Monsieur de Saussure believed it was the report of a pistol; but amid the confused cries and noises, we heard a voice exclaiming,* Un fulmine, un fulmine! *We began to examine the gallery in which we were*". (Hamilton, 1773, pp. 324-325)

Hamilton analyzed the conductive path of the lightning along frames, gilded surfaces, and metallic materials, replicated the phenomenon in the laboratory, and confirmed Franklin's theories (Fig. 5). His observations laid the groundwork for new architectural strategies for electrical protection (Hamilton, 1773).

Complementing Hamilton's efforts, de Saussure provided a contemporaneous account of the strike. He and Hamilton examined the house and terrace the following morning, driven by what de Saussure described as "the spirit of observation and the lights", in an effort to trace the lightning's path. De Saussure concluded that the fulminant charge entered through the gutters of the rooftop terrace, traveled through the house, exited largely through the well, and filtered vertically through the walls. His detailed report echoed Hamilton's findings and culminated in a pointed recommendation: "May this event, which seems to be a warning intended to open the eyes to the use of conductors, serve as an example from one of the most enlightened nations of Europe, making the use of a conductor both so easy and so safe universal" (De Saussure, 1773).

In June 1774, Gaetano de Bottis, professor at the Royal Academy of Nunziatella, offered one of the most vivid first-person accounts of a lightning strike near the Monastery of Santa Chiara. The bolt hit the Palace Invitti of Princes of Conca, generating an intense flame and a vibrating fireball, accompanied by tremors, shattered glass, black smoke, and a pungent smell of sulfur and bitumen. De Bottis wrote:

> "I was in my small study, conversing with a friend precisely about the strange and terrible effects of lightning... I saw the outside air completely enveloped in a dense and vivid flame[1], and it seemed to me that within it appeared a fireball which, by my eye's judgment, had a diameter of about three finger-widths and was radiating rays in every direction[2]. At that very moment, the floor beneath me shook and the windowpanes trembled forcefully; I also distinctly heard many panes of glass shattering violently on the side of the aforementioned palace… Immediately afterward, I heard loud and anguished cries in the streets.
>
> [1] *It took a while to die, since I saw it still burning even after I got up from where I'd been sitting.*
>
> [2] *A similar fireball was seen in the sky above the aforementioned square, which exploded violently, causing two people passing by to fall face down to the ground and become stunned. At the same time, others were observed atop the battlements of a small temple next to the Church of San Domenico Maggiore. Such fireballs have appeared on other occasions, and some have been seen as large as the apparent size of the Moon, and even larger, whose explosions have caused extremely serious destruction, as is well known from Natural History*. (De Bottis, 1774, pp. VII-VIII)
>
> The account, rich in emotional engagement and acute phenomenological observation, culminates in a reflection on the distribution of "electrical matter." De Bottis concluded by affirming the effectiveness of metallic conductors for building protection, fully endorsing Franklin's theories". (De Bottis, 1774)

This convergence of wonder and empirical thought soon gave rise to institutional action. After the lightning strike that damaged the Treasury dome on 5 July 1786, the Deputation of San Gennaro, custodians of the saint's relics and treasure, considered equipping the structure with a lightning conductor to prevent future harm. They commissioned mathematician Vito Caravelli, who proposed the installation of a lightning rod. He presented his plan in a rare pamphlet dated 15 July 1786, *Agli eccellentissimi signori deputati del tesoro di S. Gennaro. Pel conduttore elettrico, che si pensa di mettere sulla cupola del medesimo Tesoro* (Fig. 6). In it, the mathematician outlined the principles of electrical charge and the behavior of lightning, emphasizing how conductive materials could safely divert strikes away from buildings. Caravelli strongly condemned the widespread negligence surrounding lightning protection, even in buildings that sheltered human lives and irreplaceable assets. Addressing prevalent fears that lightning rods might attract strikes, he argued such views stemmed from ignorance of electrical theory. He explained that, when properly constructed, using proportional thickness and uninterrupted pathways, metal conductors allowed lightning to pass harmlessly into the ground. As a final point, Caravelli appealed not just to theoretical understanding but to practical evidence: by that time, countless buildings in Europe and America had already adopted lightning conductors, and none, if built according to scientific principles, had suffered lightning damage in years. He concluded, "Opposition to lightning rods contradicts both theory and experience".

Around the same time, Giuseppe Marzucco, professor of Mathematics at the University of Naples, also endorsed the installation of a lightning conductor. In his *Parere scritto alla Eccellentissima deputazione del Tesoro di S. Gennaro, intorno alla spranga elettrica* (1786), he claimed to have advocated for the idea for over twelve years. Echoing Caravelli's empirical approach, Marzucco affirmed that "anyone well-versed in true physics immediately recognizes when a truth is legitimately derived from experience."

Yet despite scientific support, within a year, another lightning strike darkened the dome, blackened its walls, and stripped gilded ornament from its surface. Restoration efforts ignited fierce debate. Antonio de Simone, the Chapel's official architect, insisted on preserving the original stucco proportions, while his collaborator Gaetano Barba advocated for an academic reinterpretation. Their disagreement prompted intervention from esteemed architects, including Luigi Vanvitelli, Antonio de Sio, and Pompeo Schiantarelli, who ultimately favored De Simone's measured fidelity to the building's historical identity (Croce, 1904).

Despite the combined rigor of Caravelli's and Marzucco's proposals, and the philosophical momentum they embodied, there is no evidence that the dome was ever equipped with a lightning rod.

The episode involving the dome of San Gennaro reflects a broader Enlightenment paradox: science marked the path forward, yet progress remained hostage to fear, tradition, and indecision. The narratives of Parrino, Montorio, and De Bottis, alongside the exhortations of Caravelli and Marzucco, trace an evolutionary arc in Naples' evolving relationship with lightning, spanning transcendent visions, miraculous interpretations, and culminating in scientific analysis.

Naples becomes a stage for cultural transformation. In its majestic destructiveness, lightning inscribes itself into the city's urban fabric, inviting a plurality of interpretations: from celestial messenger to measurable phenomenon, reflecting the ongoing evolution of modern thought. These testimonies preserve the memory of exceptional events and document how society sought to interpret and respond to the sudden blaze that erupted in the heart of the city.

"Chiare istruzioni": Historical Observations and Recommendations for Urban Architecture

Throughout the 18th century, the use of lightning rods gradually became established as a protective measure against damage caused by atmospheric discharges. Numerous documented events helped consolidate the effectiveness of these devices, among which the installation of a lightning rod on Saint Paul's Cathedral in London stands out. In 1764, after a lightning strike near the building, the Royal Society launched a comprehensive study to determine the most effective protection system. A distinguished committee, including John Canton, Edward Delaval, Benjamin Franklin, William Watson, and Benjamin Wilson, proposed a structure of iron bars to be installed on the dome, completed in 1769 (Bristol, 1769). Four years later, the cathedral sustained further damage due to lightning. Upon investigation, the committee found that the original installation instructions had not been properly followed. Despite this setback, the lightning rod remained in place until 1899, affirming the soundness of the principle on which it was founded.

Another incident demonstrating the lightning rod's protective power occurred in the port of Quebec in 1773 and was recorded in *Philosophical transactions*. The event is described in a letter from Captain Richard Nairne, whose account offers compelling evidence of the device's effectiveness. Below is an excerpt from his correspondence describing the phenomenon:

> *"I shall make every observation I can, for the good of electricity, and the satisfaction of my friend Mr. Henley. I put up a longer topgallant mast, the day I arrived at Quebeck. The conductor, by this means, became too short; and my mate still let it hang, without making any addition to it. They had a severe thunder storm that night; but think how pleased I was to find, that, from the wetness of the ship's sides, the elec-*

tricity passed into the water, without the least injury to the ship; but the spark on the point of the conductor, which was very sharp, was so lucid, that my people were very much frightned". (Henly, 1774, p. 139)

The benefit of the lightning rod is further demonstrated by Lieutenant Fairlamb's report on St. Michael's Church in Charles Town, South Carolina. Historically, the church suffered lightning strikes and damage every two or three years, but since the installation of a pointed conductor, it has remained untouched for fourteen consecutive years (Henly, 1774, p. 139).

In February 1778, Naples also entered the history of electrical protection with the installation of its first lightning rod. The initiative, promoted by Duke Ascanio Filomarino and Giovanni Carpintero, was enthusiastically received by the Italian press. The *Gazzetta universale* reported the event in a style that blended scientific spirit with worldly flair:

> *"Fashions multiply quickly, philosophical inventions slowly, but when they acquire the character of fashion, they too spread rapidly. Here is the first metal conductor erected in Naples under the direction of Don Ascanio Filomarino, Duke of Cutrofiano, a gentleman who combines science with practical skill and the refinement of mechanical and mathematical craftsmanship. Mr. Don Giovanni Carpentieri, brother of the Marquise Goizuetta, is the one who had it installed on his residence. Soon, the example will be followed in both private and public buildings".*

To magnify the event, the newspaper concluded the report with Latin verses celebrating the "Ferrea cuspis":

> "Ferrea haec cuspis
> *In summa trabe posita*
> *Tonantem Jovem lacessit*
> *Quippe quae ejus ignes*
> *Per aethereas sedes discurrentes*
> *Absumit devorat*
> *Per que longissimum brachium dissipat*
> *Altero mutilo relicto*
> *Efficacitatis indice ac teste*
> *Primum Neapoli dedicata est*
> *A Johanne Carpintero*
> *Postridie nox Februar*
> *Anno MDCCLXXVIII*
> *Ascanio Philomarino Duce".* (*Napoli 5 Maggio*, 1778)

This lightning rod was installed on the residence of Giovanni Carpintero, brother of Isidora, wife of Juan Asensio de Goyzueta, the Secretary of State and Affairs, who resided in the palace on Via Correra. A specific testimony to the effectiveness of this installation will be examined later. The enthusiastic tone of the *Gazzetta universale* suggests that the lightning rod, originally conceived as a technical device, was quickly gaining symbolic and cultural resonance, transforming into a "useful model" destined for urban diffusion.

A prominent figure in Naples' scientific landscape, Ascanio Filomarino had already distinguished himself for his expertise in mathematics and natural history. As Gentleman of the Chamber to King Ferdinand IV, he authored studies on Vesuvius and collected and cataloged an extensive array of minerals and geological illustrations. His residence in Largo San Giovanni Maggiore, now palazzo Giusso, functioned as a true domestic laboratory, hosting cultural gatherings, scientific debates, and technical experiments, thanks to a cabinet equipped with instruments for detecting seismic movements. Filomarino's intellectual journey came to a tragic end in January 1799, during the unrest preceding the Neapolitan revolution. With the Bourbon court fleeing to Sicily and power handed to the *lazzari*, the duke was accused of collaborating with the Frenchs after a letter was intercepted by his hairdresser, Giuseppe Maimone. On 18 January, his palace was stormed: the library destroyed, artworks looted, scientific instruments ravaged. Ascanio and his brother Clemente were chained, taken to Santa Maria in Porto Salvo, executed by firing squad, and burned inside barrels filled with tar. Their brutal death caused deep shock, depriving Naples of one of its most refined and respected

minds (Iermano, 1997).
In a sonnet dedicated to his brother, celebrated as "honor of Italy and light of the Neapolitan land", Clemente Filomarino poetically captured his fascination with electrical studies and experimentation:

> "[Love]
> *flew to your lodging, O Ascanius, and by the thousands*
> *saw, through the glass wheel spinning round,*
> *swift electric sparks burst forth"*. (Filomarino, 1789, p. 23)

Filomarino's pioneering example did not remain isolated. In the following decades, the culture of the lightning rod gradually extended to other prestigious buildings in the Bourbon capital. Among the earliest notable installations was the residence of William Hamilton at Palazzo Sessa, which also served as the British embassy. Situated at the foot of Pizzofalcone in the distinguished San Ferdinando neighborhood, near today's Piazza dei Martiri, the palace, like other noble residences built between the late 17th and early 18th centuries, enjoyed a splendid view of the Gulf of Naples.
The lightning rod was likely installed in the balcony room on the upper floor, which offers a sweeping panorama of the gulf. Hamilton himself had designed and adorned the room with remarkable flair and ingenuity. It was his cherished retreat, a place for reading, reflection, and quiet contemplation. Even Goethe was captivated by the view, writing in his *Tagebuch*:

> *"the view from the corner room is perhaps unique. Below you is the sea, with a view of Capri; Posilippo on the right, with the promenade of Villa Real… and beyond it the coast stretching from Sorrento to Cape Minerva. Another prospect equal to this is scarcely to be found in Europe"*. (Goethe, 1902, p. 334)

Hamilton's fascination with scientific instrumentation and environmental protection is echoed in Amanda Elyot's novel, where Hamilton proudly references the lightning rod:

> *"We stepped out of the library into a corridor, where Sir William proudly pointed out the water closet. The plumbing in the Palazzo Sessa was the most advanced to be had, and owing to his studies of the sciences and the elements, he had also caused a lightning rod to be installed on the roof. 'Ladies, it gives me pleasure to say that you will be residing in the safest house in Naples' "*. (Elyot, 2007)

It is likely that Hamilton's other residences: Villa Emma in Posillipo, where he spent summers enjoying sea dives, and Villa Angelica in Torre del Greco, from which he made his first observations of the 1766 eruption of Vesuvius, were also equipped with lightning rods, demonstrating his commitment to scientific advancement and his proactive approach to public safety.
Other noteworthy installations included the palace of Francesco d'Aquino, Prince of Caramanico, on Via Medina, and the palace of Prince Doria d'Angri in Largo Santo Spirito, now Piazza Sette Settembre, where the lightning rod was meticulously designed by the architect Schiantarelli.
Such interventions reflect the growing integration of scientific progress into Naples' urban context and the nobility's desire to combine technical modernity with social prestige. The lightning rod thus became a visible emblem of a city that chose to confront environmental risk with knowledge and ingenuity, laying the foundation for a new culture of urban safety.
In 1794, facilitated through the combined initiative and patronage of William Hamilton, the treatise *Chiare istruzioni per costruire ed innalzare sicuri conduttori* was published in Naples, translated from english by Felice Sabatelli and printed by Domenico Sangiacomo (Fig. 8). The volume, dedicated to Princess Doria d'Angri (possibly Giovanna Pappacoda, widow of Giovanni Carlo, or Teresa Doria del Carretto Sforza Visconti, wife of Marcantonio Doria, 8th Prince d'Angri), who had installed a "well-designed conductor" after a traumatic atmospheric event at her residence, marked a pivotal moment in the dissemination of light-

ning rod technology in urban settings.
The publication presents an intriguing chronological anomaly: Sabatelli died in 1788, meaning the Italian edition must have been prepared at least six years before its actual printing. At present, the volume is available in Italy solely through the book collection of the Astronomical Observatory of Capodimonte (STOR. ANT. Meteor. Geof. Geol. I016), while copies of the same edition are preserved at the Harvard Library (Houghton Library GEN *IC7 Sa134 794c), the Smithsonian Libraries and Archives (QC611 .C53 1794), and Yale University's Sterling Memorial Library (Franklin-230 421 1794).
Although the treatise was tentatively attributed to Hamilton, following Sangiacomo's editorial note: "some years ago, the following pamphlet in English was given to me by Sir William Hamilton, a gentleman of great expertise in such matters" (Sangiacomo, 1794), its true author was John Simmons, an English physician and pharmacist with a distinctly empirical interest in electrical phenomena. The original work of Simmons, *Plain directions for constructing and erecting safe conductors*, appeared in 1775. It was published as an appendix to the volume *An essay on the cause of lightning, and the manner by which thunder-clouds become possessed of their electricity, deduced from known facts and properties of that matter*, in which he presented the physical theory of lightning based on natural observations.
Little is known about Simmons's life beyond his medical practice in Chatham and his charitable engagements. Born around 1708 in Luddenham, Kent, and deceased in Faversham in 1794, Simmons was one of the self-taught popularizers who helped democratize science, figures who translated complex theories into accessible, actionable knowledge (Timpson, 1859, p. 436; *The Kentish register*… 1794, p. 75). His treatise, dedicated to Hamilton as a tribute to a leading figure in European naturalism, reflects a pragmatic ethos: it avoids speculative theory and instead offers clear, technical guidance for constructing lightning rods. Simmons builds on the theories of Franklin, Du Fay, and Watson, yet remains firmly committed to an empirical framework. He proposes that electrical fluid accumulates in clouds by ascending from the earth, and that discharges invariably proceed downward, never in reverse.
Simmons's recommendations are precise: conductors should be made of copper or iron, sharply pointed, uninterrupted, and placed at the highest point of a building. They must be grounded directly into moist soil or, ideally, into subterranean water. Crucially, he refutes the widespread belief that lightning rods "attract" lightning; rather, they intercept and safely dissipate electrical discharges already in motion.
The treatise was born from a request in May 1774, when a guest invited Simmons to conduct electrical experiments at his home in Chatham. Encouraged by the enthusiastic response of his "ingenious Friends", he published the text and appended a "very necessary" section designed to make the device intelligible to the general public. In doing so, Simmons helped transform lightning protection from elite science into shared civic knowledge (Simmons, 1775).
The Italian translation, curated by Sabatelli, an astronomer, Newtonian philosopher, and active participant in the experiments at *Accademia Spinella*, was both faithful and enriched with two original notes from the translator.
According to Sangiacomo's introduction, the installation of the first lightning rod in Naples, led by the Duke della Torre and Giovanni Carpintero, was validated just one month later, on 3 March 1778. During a violent storm, witnesses observed a fireball descend onto the tip of the lightning rod on Carpintero's residence and vanish harmlessly into the moist ground. This public and visible event offered compelling proof of the device's efficacy.
Yet despite such evidence, adoption in Naples remained limited. Beyond Carpintero's resi-

dence, only a few installations are recorded, including those at the residences of William Hamilton, the Princess of Caramanico, and Prince Doria d'Angri. This hesitation stemmed largely from a lingering misconception: that lightning rods attract, rather than deflect, electrical discharges.

To counter this, Sangiacomo published the treatise with a clear mission: to make "its reading common in Naples, hoping that the use of the aforementioned conductors, already long adopted in England, Holland, Germany, France, Lombardy, and Tuscany, might likewise gain traction among us. This practice was especially vital in our region, where lightning frequently strikes and often inflicts serious damage" (Sangiacomo, 1794).

The editor emphasized that the device does not lure lightning but intercepts it during descent, ensuring safe dissipation. Moreover, Naples' subsoil, rich in aqueous bodies and deep aquifer networks, was ideal for grounding electrical fluid, unlike neighboring volcanic zones, which required deeper perforations to reach conductive layers (Sangiacomo, 1794).

In light of these observations, it is hoped that the adoption of lightning rods will become standard practice, free from superstition and grounded in scientific evidence. As the publisher writes in the introduction:

> *"I flatter myself that, by dispelling ancient prejudices, the reading of this modest work may help render the highly beneficial use of conductors common among us".*

This statement encapsulates the treatise's broader ambition: to promote a culture of urban electrical safety, rooted in scientific clarity, civic responsibility, and architectural foresight. In this perspective, Naples becomes an intellectual laboratory, where Enlightenment ideals meet architectural pragmatism. Lightning is reimagined: from divine wrath to governable force, from invisible peril to a physical principle mastered through lucid design.

Yet despite this scientific and social momentum, the ancient "lantern of the pier" in Naples, originally erected in 1487 by the king Ferrante d'Aragona and rebuilt multiple times after fires caused by disastrous lightning strikes, was only protected in 1843, when "the expert hand of Melloni lowered an electrical conductor to the ground, shielding it from the ancient calamity" (C[apocci], 1843, p. 119).

Conclusions

The history of lightning, retraced through philosophical, religious, scientific, and urban sources, reveals a long intellectual trajectory spanning millennia of observation, interpretation, and experimentation. From Thales' amber to Hawksbee's globes, from the thunderbolts of Etruscan gods to the laboratory of Palazzo Tarsia, lightning has marked the unstable boundary between terror and prediction, the unknown and knowledge.

Within this historical arc, Naples emerges as a paradigmatic case. Here, the celestial flash is more than a natural occurrence; it is entwined with epistemic ambition, technical innovation, and the urgent imperative of urban protection. Naples answered the challenge of atmospheric discharges with the intellectual rigor of Della Torre, Caravelli, and Poli; the diplomatic finesse of Hamilton; the visionary foresight of Filomarino; and the empirical engagement of Sangiacomo. The city did not merely endure lightning as an event: it interpreted it, replicated it, measured it, and ultimately mastered it.

In this context, the lightning rod transcends its technological function, emerging as a tangible emblem of cultural transformation. Once regarded with suspicion and fear, the lightning rod evolved into a scientifically sanctioned instrument, embodying a transformation in urban consciousness, one that reimagined risk as responsibility and transmuted danger into design. Yet the reluctance and fears that accompanied its adoption reveal that the culture of safety is, at its core, a continuous negotiation between belief, habit, and scientific reason.

The concept of *South-risk* thus reveals its full ambivalence: the South as a place exposed, vulnerable, and subject to intense natural phenomena; but also as a fertile ground for rational, systemic, and design-driven responses, a vision that may be defined as *South-safety*. Naples, with its historical and scientific stratification, offers a unique interpretive lens: a city that has looked to the sky not only with fear, but with method, transforming lightning from a divine threat into an opportunity for knowledge and architectural regeneration.

References

Aristoteles (1512). *Meteorologia Aristotelis*. Impressa Norinbergae, in officina Friderici Peypuss.

Baldini U. (1989). Della Torre, Giovanni Maria, pp. 573- 577. In *Dizionario Biografico degli Italiani*, vol. 37. Roma, Istituto della enciclopedia italiana.

Bartaloni D. (1781). Sul conduttore elettrico della torre della Piazza di Siena. *Atti dell'Accademia delle Scienze di Siena*, **6**, 253-288.

Bertucci P. (2013). The In/visible Woman: Mariangela Ardinghelli and the Circulation of Knowledge between Paris and Naples in the Eighteenth Century. *Isis*, **104**(2), 226-249.

Bristol T., Wilson Chr., Barrington S., Lich J., Watson C.W., Franklin B., Wilson B., Canton J., Delaval E. (1769). Proposal of a method for securing the Cathedral of St. Paul's from damage by lightning. *Philosophical Transactions of the Royal Society,* **59**, 160-169.

Calandrelli G. (1789). *Ragionamento sopra il conduttore elettrico Quirinale*. In Roma, Nella stamperia Salomoni.

C[apocci] E. (1843). Nuovo sistema di fari nel regno. *Annali civili del Regno delle due Sicilie*, **31**, 115-119.

Cavazza M. (2009). Laura Bassi and Giuseppe Veratti: an electric couple during the Enlightenment. *Contributions to science*, **5**(1), 115-128.

Costo T. (1613). Del *compendio dell'istoria del regno di Napoli*, vol 3. In Venetia, appresso i Giunti.

Croce B. (1904). Per la cupola del tesoro di s. Gennaro. *Napoli nobilissima*, **13**(8), 125-127.

Darley G. (2011). *Vesuvius*. Cambridge, Harvard University press.

De Bottis G. (1774). *Breve relazione degli effetti di un fulmine che cadde in Napoli il mese di giugno del presente anno 1774*. In Napoli, Nella stamperia simoniana.

Della Torre G.M. (1777). *Scienza della natura generale, Parte seconda*. In Napoli, a spese di Giuseppe Campo.

De Sassoure, H.-B.(1773). Des effets électriques du Tonnerre observés à Naples dans la maison de Mylord Tilney. *Observations sur la physique, sur l'histoire naturelle et sur les arts*, **1**(mai), 442-450.

Elyot A. (2007). *Too great a Lady: the notorious, glorious life of Emma, Lady Hamilton*. New York, New American Library.

Figuier L. (1868). *Les merveilles de la science*. Paris, Furne, Jouvet.

Filangieri G. (1885). *Chiesa e convento del Carmine Maggiore in Napoli*. Napoli, Tipografia dell'Accademia reale delle scienze.

Filomarino C. (1789). *Poesie varie*, vol. 1. In Napoli, presso Domenico Sangiacomo.

Franklin B. (1961a). Letter to John Mitchell, 29 April 1749, pp. 365-376. In *The Papers of Benjamin Franklin*, vol. 3, L.W. Labaree (ed). New Haven, Yale University Press.

Franklin B. (1961b). Opinions and Conjectures, 29 July 1750, pp. 9-34. In *The Papers of Benjamin Franklin*, vol. 4, L.W. Labaree (ed). New Haven, Yale University Press.

Fonda G.M. (1770). *Sopra la maniera di preservare gli edificj dal fulmine*. In Roma,

nella Stamperia di Paolo Giunchi.
Gilbert W. (1600). *De magnete, magneticisque corporibus, et de magno magnete tellure; Physiologia noua, plurimis & argumentis, & experimentis demonstrata*. Londini, excudebat Petrus Short.
Goethe J.W. (1902). *The Works of J. W. von Goethe*, vol 12, part II: Letters from Italy, N.H. Dole (ed), translated by A. Morrison. London, Boston, Francis Niccolls.
Hamilton W. (1773). Account of the effects of a thunder-storm, on the 15th of March 1773, upon the house of Lord Tylney at Naples, *Philosophical Transactions of the Royal Society*, **63**, 324-332.
Heilbron J.L. (1979). *Electricity in the 17th and 18th Centuries*. Berkeley, Los Angeles, University of California Press.
Henly W. (1774). Experiments concerning the different efficacy of pointed and blunted rods, in securing buildings against the stroke of lightning, *Philosophical Transactions of the Royal Society*, **64**, 133-152.
Iermano T. (1997). Filomarino Ascanio. In *Dizionario biografico degli italiani*, vol. 47. Roma, Istituto della Enciclopedia italiana.
Kridler E. (2006). Benjamin Franklin and lightning rods. *Physics Today,* **59**(1), 42-48.
Lepschy A. (1998). Giuseppe Toaldo e il parafulmine. *Padova e il Suo Territorio*, **13**(76), 16-18.
Montorio S. (1715). *Zodiaco di Maria, ovvero le dodici provincie del Regno di Napoli*. In Napoli, per Paolo Severini.
Napoli 5 Maggio (1778). *Gazzetta universale*, **40**, 320.
Parrino D.A. (1730). *Teatro eroìco e polìtico de' govermi de Viceré del regno di Napoli*, vol. 2. In Napoli, Per Francesco Ricciardo.
Pense E. (nd). *The Development and Spread of Franklinian Theory*. Leverage Institute. Available at tinyurl.com/Development-Franklinian-Theory (accessed 13 August 2025).
Philadelphia, October 19 (1752). *The Pennsylvania Gazette*, 1243.
Pistoi A. (1777). Copia di un articolo di lettera scritta dal sig. Andrea Pistoi, professore di matematica nell'Università di Siena al sig. abate Rozier. *Scelta di opuscoli interessanti tradotti da varie lingue*, **29**, 75-85
Plinius Secundus G. (1831). *C. Plinii Secundi Naturalis historiae libri XXXVII*. Lipsiae, Sumptibus B.G. Teubneri et F. Claudii.
Proverbio E. (2001). Sulle ricerche elettriche di Giovanbattista Beccaria sui suoi rapporti con Ruggiero Giuseppe Boscovich nelle applicazioni dell'elettricismo naturale e artificiale, pp. 231-280. In *Atti del XX Congresso Nazionale di Storia della Fisica e dell'Astronomia*, E. Schettino (ed). Napoli, CUEN.
Sangiacomo D. (1794). Ai Lettori, pp. V-X. In *Chiare istruzioni per costruire ed innalzare sicuri conduttori*, J. Simmons. Napoli, nella stamperia di Domenico Sangiacomo.
Schettino E. (2001). Franklinists in Naples in the Second Half of the 18th Century, pp. 347-352. In *Atti del XX Congresso Nazionale di Storia della Fisica e dell'Astronomia*, E. Schettino (ed). Napoli, CUEN.
Schiantarelli P. (1787). Relazione ingenua del giudizio dato intorno al ristauro della Cappella di S. Gennaro nel Duomo di Napoli al rispettabile Collegio dell'insigne Accademia di S. Luca in Roma, *Giornale delle belle arti*, **32**, 251-253.
Simmons J. (1775). *An essay on the cause of lightning, and the manner by which thunder-clouds become possessed of their electricity, deduced from known facts and properties of that matter*. Rochester, printed and sold by T. Fisher.
The Kentish register, for February 1794, *The Kentish register, and monthly miscellany*, vol. 2. Canterbury, printed by Simmons, Kirkby, and Jones.
Timpson Th. (1859). *Church History of Kent*. London, War.
Tunbridge P.A. (1974). Franklin's Pointed Lightning Conductor. *Notes and Records*, **28**(2), 207-219.

Veratti G. (1755). De electricite caelesti. *Commentarii de bononiensi scientiarum et artium Instituto atque Academia*, **3**, 200-204.
Vitrioli D. (1874). *Elogio di Angela Ardinghelli Napoletana*. Napoli, Stabilimento tipografico del Commend. Gaetano Nobile.

Bulletin of Regional Natural History (BORNH) ISSN 2724-4393.