Cultural climate in Naples between the birth and development of volcanology

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ABSTRACT

With the Industrial Revolution the laws of physics were introduced to explain natural phenomena. At that time the Vesuvian Observatory emerged as the first volcanological observatory in the world to monitor the activity of Vesuvius on a permanent basis. Naples became an attraction for scholars, who were to analyze volcanic phenomena by developing relationships between the science of laws and those of processes. After World War I interest in Naples-based volcanology further increases, as attested by the founding in the city of Immanuel Friedlaender’s International Institute of Volcanology. Following the twenty-year Fascist period, Italy had two objectives: to reconstruct the network of science laboratories and rebuild the approach to studying Earth Sciences through comparison with more advanced countries. Significant and original contributions were made regarding the new theory of global tectonics and the mitigation of natural risks.

KEY WORDS: Docta Neapolis, Osservatorio Vesuviano, Serapeo, Deep Time, Science of laws, Sciences of processes.

INTRODUCTION

Between the end of the 18th century and the mid-19th century, Europe experienced great changes in the form of two industrial revolutions. The first took place in the latter decades of the 18th century when far-reaching changes occurred in England in the means of production: new sources of raw materials were exploited, new markets were opened up, considerable population growing, and significant changes in the structure of society. In the second industrial revolution in the mid-19th century, scientific discoveries became the main drivers of development.

The industrial revolutions changed the approach to natural phenomena: events were now measured with the laws of physics and represented with thematic maps. In Italy, unlike other European countries, geological studies and research also represented a binding force of the country’s political unification, generated by the geological unity of the Italian peninsula from the Alps to Sicily (Vai & Caldwell, 2006; Vai, 2012). In this context the Vesuvian Observatory was founded, the first observatory to tackle the problem of monitoring volcanic phenomena. In Naples, geology was to become chiefly research on volcanoes. Thus chemists, physicists, geologists, mineralogists and naturalists began to study volcanoes by developing feedback between the science of laws and that of processes (Luongo, 1987; Cubellis & Luongo, 2010). With the emergence of the geological theories of uniformitarianism and gradualism of Hutton and Lyell (Romano, 2015) a conflict was to arise between geologists and physicists on the long time required to interpret geological phenomena and Darwinian evolution. This would be resolved with the discovery of natural radioactivity in the early years of the 20th century extending the age of Planet Earth to billions of years. The new quantitative approach for the study of natural phenomena found fertile soil for the analysis of seismicity with the realization of the first seismic networks and quantification of events through scales of intensity.

Naples became an attraction for scholars for several reasons, among which the presence of the Vesuvian Observatory, and the permanent activity of Vesuvius, the dynamics of the Campi Flegrei, the thermalism of Ischia, and the interaction between volcanic phenomena and ancient settlements. After World War I interest in volcanology grew further, as attested by the founding in Naples of the Immanuel Friedlaender’s International Institute of Volcanology and the decision to house, within the Vesuvian Observatory, the Central Office of the Volcanological Division of the International Union of Geodesy and Geophysics (IUGG).

After the twenty-year Fascist period and the debacle of World War II, Italy had two principal objectives to achieve: to reconstruct the network of university and non-university science laboratories and rebuild the approach to studying Earth Sciences through comparison with more advanced countries. Both objectives would be achieved, Italy proving competitive in various research sectors, as well as Earth Sciences. Significant contributions were made to the new theory of Global Tectonics (see Romano et al., 2017), while contributions made to mitigate natural risks were to prove original.

NAPLES - POLITICAL AND CULTURAL CENTRE AND EARTH SCIENCES IN THE 18TH AND 19TH CENTURIES

In his work “Campanien”, 1879, Beloch recalls the Greek origin of the city of Naples: “Naples was the Greek
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city closest to Rome; and like Greece it was for the ancient world the nursery of culture. Thus Naples played the same role for Italy... No wonder the Roman poets spoke of «docta Neapolis», the city which, more than any other, was born to devote itself seriously to studies». (Beloch, 1989).

In the 17th century two elements contributed together to the cultural growth of the city: the aftermath of the Galilean revolution and the development of interest in volcanic phenomena due to the renewal of activity on Vesuvius with the great eruption of 1631. Despite the great interest aroused in men of culture by Vesuvius's renewed activity, modern volcanology did not start until the late 18th century when Sir William Hamilton, His Majesty's Envoy Extraordinary to the Kingdom of the Two Sicilies, reached Naples in 1764. Attracted by evident volcanic phenomena, Hamilton decided to convey information and images of Neapolitan volcanoes to the Royal Society of London. In those years the first steps were taken in volcanological studies and Hamilton may be considered a precursor of modern volcanology.

During his stay in Naples, Hamilton had occasion to visit several times the Vesuvius, Campi Flegrei and Etna and to make many observations reported by him to the Royal Society of London. Of the foreigner scholars interested in the activity of Vesuvius who preceded Hamilton, no one showed as much passion as the English diplomat, who made in his first 15 years in Naples 250 ascents of the volcano and 58 inspections of the crater peak. Hamilton's first report sent to the Royal Society of London dates back to 1768. From then on, the dispatches became systematic, such that in 1772 the contributions were able to be published in a volume accompanied by a map and five plates (Hamilton, 1772). However, such material was insufficient, in Hamilton's opinion, to get round the great problem “...of the difficulty of conveying, using only the written word, an exact idea of the unusual landscape described especially for those who have not had the opportunity to visit this part of Italy” (Hamilton, 1776). The need to represent with a series of pictures the lava flows, fumaroles, eruptive material, and the very appearance of the area where such phenomena took place, gave rise from 1773 to a new editorial project. Thus arose the work “Campi Phlegraei - Observations on the Volcanoes of the two Sicilies”, 1776, with colour plates by Pietro Fabris “to give the clearest possible idea of each stratification and crater of this place”.

From Fabris onwards the Vesuvian countryside would be seen through the eyes of famous and not-so-famous artists in the gouaches both of the paroxysmic eruptive phases and the conditions of total calm, largely highlighting the contrasts between the beauty of places and the danger of eruptions. This is the Vesuvian landscape described by Johann Wolfgang Goethe (1749-1832) in his “Italian Journey” appearing in 1816-1817, but it is also the landscape described by Spallanzani (1729-1799) and further, it is what appears in the images of the 1631 eruption of Domenico Gargiulo, also known as Micco Spadaro (Luongo, 2012; Cubells et al., 2015a). Only one nature and so many landscapes.

Hamilton's study emerges against the background of the Enlightenment and of reformers headed by Abbot Ferdinando Galiani, Member of the Herculaneum Academy, in a period of cultural maturity both on an international and local level for issues relative to Earth Sciences. Indeed, in those times a debate took place between two schools of geologists, Neptunists and Plutonists, which supported two the different conception of how geological phenomena occur. Neptunists, under the leadership of Abraham Gotlob Werner (1749-1815), attributed each change in the lithosphere to the action of great catastrophes (Morello, 1979). The Plutonists, whose main theorist was James Hutton (1726-1797), believed that the geological changes of the past, just like current changes, occurred due to the constant action of natural forces which have never ceased to act in the Earth's crust (Romano, 2017a). With his “Theory of the Earth” Hutton (1788) developed the paradigm of uniformitarianism, revolutionising the scale of geological times: “...as the natural course of time, which to us seems infinite, cannot be bounded by any operation that may have an end, the progress of things upon this globe, that is, the course of nature, cannot be limited by time, which must proceed in a continual succession”.

In the course of the 18th century, therefore, a modern cultural climate was taking root in Naples, the result of an intense circulation of ideas thanks to its close links with other European cities. In the Kingdom of Naples converged scholars and scientists from every part of the world, due to the several natural attractions and to carry out field research. In this climate of high cultural tension, the bases were laid for the foundation of important scientific institutions.

In the context of Earth Sciences, mineralogy was the most advanced sector and the Royal Mineralogical Museum had the task of providing scientific support for mineral enquiries in the Kingdom. Mineralogical studies develop initially on a broadly international basis. However, the political changes in Europe ushered in with the fall of Napoleon restricted international trade, and scientific interest focused on Vesuvian minerals, entailing specialist detailed research. The mineralogist Nicola Covelli (1790-1829), pupil of Abbé René Just Huy (1743-1822) and belonging to the Plutonist school of thought, founded the modern science of crystallography, continuing the work by Jean Baptiste Romé de L'Isle (1736-1790) who introduced the experimental method into the morphological study of crystals. Covelli worked together with Teodoro Monticelli, permanent Secretary of the Academy of Sciences, the greatest scholar of Vesuvian minerals; the latter, with his Prodromo della Mineralogia Vesuviana (Prodrome to the Vesuvian Mineralogy) provided in 1825 (Monticelli & Covelli, 1825) the first systematic description of the minerals of Vesuvius, becoming a point of reference for all the scholars to visit Vesuvius. Monticelli and Covelli in 1823 proposed the institution of an observatory on the slopes of Vesuvius, noting that “if learned men were at watch in a volcano-meteorological observatory... volcanic physics would become more extensive and less benighted” (Monticelli & Covelli, 1823).

What attracted natural scientists and philosophers was not just the volcanoes of Naples, especially the Vesuvius, with their extraordinary eruptive manifestations and the production of new minerals from the fields of fumaroles. They were also fascinated by earthquakes and by the composition of rocks. The scientific revolution represented a fundamental contribution for a new approach to the analysis of natural phenomena, leaving the supernatural to one side and enhancing empirical knowledge through field observations and the recording of events with the introduction of increasingly complex tools. This new approach
found in the debate on the effects of great Lisbon earthquake of 1755 the starting-point for a deep-rooted revolution in the approach to analysis.

Setting the pace in the new science was the United Kingdom, hit by a sequence of low-energy earthquakes in 1750. There was great interest in such phenomena, and many articles were discussed at the Royal Society of London in which the causes which generated the earthquakes were explored.

This interest grew further after the extremely destructive Lisbon earthquake on November 1st 1755, with several communications on the earthquake reported to the Royal Society. Further progress on the knowledge of seismic phenomena in the final decades of the 18th century resulted from the occurrence of the devastating earthquakes which hit Calabria in southern Italy in 1783. Many observers were involved in the task of damage assessment, publishing reports with political and scientific contents in which new methods were suggested to detect the areas hit by the earthquake. The 1783 sequence of earthquakes in Calabria marked for Italy the transition between ancient and modern seismology, in other words from the seismology of documentary resources to observational seismology (Davison, 1927; Luongo et al., 2012).

In the first half of the 19th century, at the University of Naples the teaching of scientific subjects was carried out in the Faculty of Mathematics and Physics in the following science structures: the Physics and Chemistry Cabinet, the Botanical Garden, the Astronomic Observatory, and Museums of Mineralogy, Zoology and Anatomy. In 1811 the teaching of Experimental Physics was introduced and that of General Physics abolished. At the same time, the Physics Cabinet was separated from that of Chemistry. Research and teaching activities undertaken from 1811 to 1850 are poorly documented: information can be drawn from the analysis of instruments used in practical laboratory activities, largely designed for 18th century research and teaching.

Advances in research tools in the field of electromagnetism were made in the 1830s with the appointment of Mario Giardini (1789-1856) in 1834 to the Chair of Experimental Physics. Such positive developments were ushered in when Ferdinand II acceded to the throne of the Kingdom of Naples in 1830, and declared an amnesty for those who had taken part in the 1820-21 uprisings and had chosen exile. Many returned to Naples, contributing to the development of a new cultural climate in the Kingdom later described by Francesco De Sanctis (Torrini, 1989; 1999) as an "Interval of tolerance to intellectual development". This was a moment of extraordinary vitality, in which the proposal made by Monticelli and Covelli to build an observatory on Vesuvius, supported by many other scholars of volcanology, actually became concrete. Thus in 1841 Nicola Santangelo (1754-1851), the Minister for the Interior responsible for the State Education Department, accepted the proposal and entrusted Macedonio Melloni (1798-1854) with the project to build the Vesuvian Observatory, which would be inaugurated on 28 September 1845 on the occasion of the 7th Meeting of Italian Scientists in Naples. Excelling in the field of electromagnetism in 1847 and founder of the rock magnetism, Melloni was appointed director of the institute. Melloni was relieved of his position as Director in 1848 following the liberal uprisings and cultural climate which at the beginning of the 1840s had surrounded the Vesuvian Observatory. These conditions gave way to absolute rejection because the research structure could have brought more damage than glory to the royal household. This climate would have led to the suppression of the institute if Luigi Palmieri (1807-1896), Chair of Philosophy of Naples University from 1847, had not intervened. He was granted the possibility to use the structure for his research into the volcano. The principal subjects for Palmieri were atmospheric electricity and electro-telluric currents. His interest in earthquakes started in 1852 when he travelled with Arcangelo Scacchi into the region of Monte Vulture, devastated by the previous year's earthquake (Palmieri & Scacchi, 1852). He achieved fame with the electromagnetic seismograph designed by him in 1856 (Palmieri, 1859a), recieving an award by the Lisbon Academy. Palmieri wrote many publications on Vesuvius and in general on volcanology and seismology. He was convinced that with the development of seismological research, earthquakes would have been predicted. Palmieri also investigated the sublimation processes of fumaroles on Vesuvius, and in 1881 announced that he had found helium by using the spectroscope (Imbò, 1949). While Vesuvius erupted, Palmieri never left the Observatory, not even during the 1872 eruption which was extremely dangerous (Palmieri, 1873).

After the unrest in 1848 in Naples the university declined sharply due to a shortfall in resources. There was a change in the organisation of the various disciplines, with a decree in March 1850 creating new Chairs and suppressing others, subdividing the teaching of sciences and the relative buildings into two faculties, one for Mathematical Sciences and the other for Physical and Natural Sciences. The latter now held nine Chairs, including two new subjects, namely Geology and Terrestrial Physics, and the rest following well-established traditions, namely Mineralogy, Botany, Zoology, Experimental Physics, Organic Chemistry, Inorganic Chemistry and Anatomy. Despite the reform the role of the university was substantially limited to conducting exams and awarding degrees, whereas much of the preparation of students was delegated to the large number of private schools. Such schools, often run by teachers who had been expelled from the university for political or cultural reasons, became centres for debate and cultural renewal.

THE GALILEAN SPIRIT GAVE RISE TO THE VESUVIAN OBSERVATORY AND VOLCANO MONITORING

In 1845 an event of political and cultural importance took place in Naples from 20 September to 5 October: the 7th Congress of Italian Scientists, which saw the official inauguration of the Vesuvian Observatory on 28 September
A total of 1611 scholars participated in the Congress, and the General President was H.E. Nicola Santangelo, Secretary of State for Internal Affairs. The Congress was organised in the following topics: Agronomy and Technology, Chemistry, Zoology, Surgery, Physics and Mathematics, Archaeology and Geography, Botany and Plant Physiology, Geology and Mineralogy, and Medicine. The congress gave the Bourbon Minister Santangelo the opportunity, in his opening address, to call attention to scientific rather than political issues:

"Far removed from the tumult of overexcited passions and from the public's noisy applause, who knows whether Italian congresses may be given the chance to establish an age of sciences" (Opening address of the 7th Congress of Italian Scientists; Santangelo, 1846).

During the congress the Geology and Mineralogy Division organised two "geological peregrinations", one to the Campi Flegrei on 23 September, and the other to Vesuvius on 26 September. Short reports of the field trips were given in the Congress Diary (Pareto, 1846). The diary contained the following notice of the General President: "On Sunday 28 September there will be the opening of the new Royal Meteorological Observatory on Vesuvius. Those scientists who would like to intervene should present themselves there at 10 a.m."

On that occasion at the Observatory, Macedonio Melloni, Director of the Institute as well as Vice President of the Physics and Mathematics Division at the congress, made the inaugural speech at the Observatory and expound the research programme, stressing that the role of the Institute was "especially suited to the current practical study of meteorology and terrestrial physics" (Melloni, 1846). Part of his programme was to conduct research into magnetism and atmospheric electricity to enhance knowledge of eruptive phenomena, and there was no shortage of interest in studying the Earth's inner heat. Indeed, in the course of the Congress of Italian Scientists in Naples he communicated the results of his thermal research during the drilling of the Artesian well in the courtyard of the Royal Palace in Naples, obtaining a geothermal gradient above that expected. Melloni studied not only volcanoes like Vesuvius with summital caldera collapse, but also the magnetic polarity of lava, the effect of temperature, and the induced currents of the Earth's magnetic field.

It may be stated that the inauguration of the Vesuvian Observatory gave rise to instrumented monitoring of volcanoes. This was the end result of a long process dating back to the 1631 eruption (Fig. 2) (Luongo, 1997; Cubellis et al., 2015b). This eruption produced a rich literature (Tortora, 2012, 2014). A major player on the scene was the Patron Saint of Naples, Januarius, who stopped the eruption after the procession with Archbishop Boncompagni and the saint's relics, masterfully represented by Domenico Gargiulo with Piazza Mercato crowded with believers,
with Vesuvius in the background and the saint protecting the city in the sky. The miracle would turn the city's patron saint and Vesuvius into cultural heritage of those exposed to eruptions. The volcano with its destructive potential tamed by supernatural forces in the form of Saint Januarius was in itself a natural element desired by God with which one had to coexist.

The sacred would coexist on Vesuvius together with the Galilean scientific revolution despite the Inquisition which opposed any natural interpretation of eruptive phenomena. In time there grew interest in eruptive phenomena and in the 18th century the discovery of the Vesuvian cities (Herculaneum, Pompeii, Stabiae and Oplontis) destroyed by the AD 79 eruption would attract to the Vesuvian area those who studied the Classical World, naturalists and travellers on the Grand Tour (Luongo, 2010).

A considerable impetus to the interest in this area occurred in 1735 when Charles of Bourbon acceded to the Kingdom of the Two Sicilies. In 1738 he resumed excavations in Herculaneum, abandoned by Emmanuel Maurice of Lorraine, Prince of Elbeuf (1677-1763), who had discovered ancient Herculaneum in 1709, through a well dug in the municipality of Resina (present-day Ercolano).

It was Pompeii's turn in 1748 when Charles of Bourbon heard that some farmers when digging furrows at Civita to plant trees had found statues, inscriptions and ancient monuments. The discovery of the Villa dei Papiri with its library in Herculaneum brought Father Antonio Piaggio (1713 - 1796) to Naples in 1754 to unravel the papyrus texts. All over Europe people were curious to know the results of the excavations, seeking news about the monuments brought to light. To satisfy such demands, on 13 December 1755, upon the advice of the Marquis Bernardo Tanucci (then Secretary of State of the Royal Household), King Charles founded an academy which took the name of the Regale Accademia Ercolanese (Royal Herculanean Academy), entrusted with illustrating the monuments found in the excavations. One of the Academicians was Father Giovanni Maria della Torre, expert in Physical Sciences. “As these are antiquities buried by volcanic eruptions, often some points concerning physics will need to be examined” (Castaldi, 1840).

As regards political events at the end of the 18th century (French Revolution, Neapolitan Revolution of 1799 and Napoleonic Wars), the Academy remained inactive for several years but in 1807 another academy was founded, namely the Accademia di Storia e Antichità (Academy of History and Antiquity) with different purposes and different regulations.

In these years of extreme political turbulence, with frequent changes at the head of the Kingdom of Naples, a high-energy earthquake on 26 July 1805 with its epicentre in Molise produced disastrous effects across a wide area, also affecting the city of Naples. It was one of the most powerful quakes after the sequence of earthquakes which hit Calabria in 1783. Yet the earthquake was not a matter for discussion among scholars and hence did not generate any evolution of knowledge concerning seismic phenomena due to the political climate recalled above.

In 1808, under King Joseph Bonaparte, the Società Reale (Royal Society) of Naples was established, divided into three academies, one for History and Literature, replacing the Academy of History and Antiquities in 1807, one for Sciences and one for Fine Arts (Nicolini, 1974). At the same time as this academic activity which was largely engaged in studying archaeological finds, fieldwork start
to be carried out in the Vesuvian area, studying the frequent eruptions and analysing the dynamics of eruptive vents. Mention should be made of Serao (1738) and especially William Hamilton. With his scientific reports to the Royal Society of London, and his famous work on the Campi Phlegraei, he spread the word about volcanism in Naples. A contribution to William Hamilton’s work was also made by Father Piaggio who from Portici observed and described in minute detail the activity of the eruptive vents also through a series of drawings, with a view to interpreting the dynamics at the vents (Knight, 1990).

This approach to studying active volcanoes would survive till the mid 20th century when John Verhooogen produced his fierce critique of “smoke plume volcanology” to indicate a method of inquiry superseded by physical and chemical quantitative techniques.


The Campi Flegrei are well known for their volcanic history, with the succession of two processes of caldera formation produced by two highly explosive eruptions with emissions of hundreds of cubic kilometres of pyroclastites, the development of numerous eruptive centres distributed within the calderas, fumarole emissions, especially intense in the Solfatara crater and on its outer rim in the area of Pisciarelli, widespread thermalism and vertical ground movements with evident rises and subsidence, a phenomenon known as bradyseism (Barberi et al., 1984).

Together with Vesuvius, this area became the focal point of the birth of modern volcanology. For this historic event, is sufficient to recall the work of William Hamilton “Campi Phlegraei” (1776). Still today the Campi Flegrei are a major attractor for scholars of volcanoes and a case study for the resumption of endogenous activity with two crises which have led to evacuation of parts of the city of Pozzuoli; a unique case in the Western world of a large number of inhabitants relocated to safer areas due to the hazardousness of a volcano.

All this is in itself extraordinary, judging alone from the nature of the phenomena recorded, but what makes the Campi Flegrei unique is the interaction between man and the nature of the place, or rather between human history and natural history. The Campi Flegrei were to be studied not only for the volcanic phenomenon alone but also for proof of “deep time” and of new geological theories that were being developed in the United Kingdom with the Uniformitarianism of James Hutton and Charles Lyell.

Between the end of the 17th century and the mid 19th century in the history of the Earth a revolution occurred with the discovery of deep time, insofar as it superseded the Aristotelian concept which considers such history an atemporal description of unchanging elements and entities (Gould, 1987). The discovery of deep time would lead man to live a present behind which stretched almost infinite time, rather than a present time close to the origins. From this result it emerges that the Earth was not ‘created’ for the appearance of Man. The theorising of deep time would be taken up by Darwin because the theory of evolution required boundless time like that in geology. Hence the collaboration between Lyell and Darwin. Lyell attributed great importance to field observations, and to examine the broad spectrum of geological phenomena he would travel far and wide in Europe and North America (Fig.3). One of his aims was to visit the city of Naples with its volcanoes. The ideas that arose from such observations would provide Lyell with the basic elements underpinning his work Principles of Geology (1872). Lyell recognized both the monogenic eruptive centres in the Campi Flegrei and on the islands of Procida and Ischia, and the polygenic structure of Vesuvius.

Lyell visited Pozzuoli in 1828, carried out surveys at the Serapeum (Macellum), where he observed that the paving was covered by about 30 cm of water, detected marine terraces at various altitudes and identified the terrace known as La Starza. The Serapeum would become an effective epitome of the model of the Earth proposed by Lyell insofar as the periodicity of the ground oscillations occurring with gradual processes of immersion and re-emersion of the building were proof of the reliability not only of gradualism and uniformitarianism of Lyell’s theory, but also of the cyclical and non-directional conception of time and geological processes according to a dynamic equilibrium characterised by rising and falling which show repeated small-scale changes of the Earth’s crust in the course of the history. The cause of such movements was attributed to the dynamics of sub-crustal masses, following in this interpretation the theory of Hutton.

Shortly after the excavations at the Macellum in a place known as the Vigna delle tre colonne (Three-column Vine) a lengthy debate arose in Pozzuoli between 1750 and 1753, both among archaeologists regarding the architecture and magnificence of the building, and among naturalists concerning the geological causes which led to the variation in sea level, such as to enable lithophagous molluscs to produce holes in the three columns still standing of the structure at a height of several metres above sea level at that time (Fig.4) (Parascandola, 1947; Ciancio, 2009). Opinions were divided as to the interpretation of the phenomenon observed at the Serapeum insofar as the dominant scientific paradigm in the 18th century envisaged a static behaviour of the Earth’s crust: any changes were associated with catastrophic processes (Romano, 2017 b). This lack of consistency between the phenomenon observed and mechanisms expected according to the dominant thinking produced the effect of the progressive abandonment of the ancient paradigm and opened the way towards the theory of gradualism postulated by Lyell, who maintained that the Earth’s crust was subject to small movements due to endogenous forces, imperceptible in the short term, but generating long-term macroscopic phenomena, like the formation of mountain chains and the sinking of continental masses.

The first scientific report on the Macellum was held at the Royal Society of London in March 1757 by the Reverend John Nixon (1685-1777), who would anticipate Lyell’s theory of the genesis of the phenomenon (Nixon, 1757). Nixon was an antiquarian, yet he had also developed practice as a naturalist. Besides at the Royal Society the line between sciences of antiquities and sciences of nature was not considered a sharp dividing. Thus Nixon in his paper described not only the architectural characteristics of the monument and its functions, but also dealt with the phenomenon of the erosion of the columns to try to isolate the cause; in particular he suggested that the erosive action of the lithophagous molluscs had acted for a long time at that level. Following the reflections of Robert Hooke (1635-1703) on volcanic force and on earthquakes
Fig. 3 - Lyell interprets natural phenomena, his method being grounded not only on Newtonian laws (Science of laws) but also on a model which represents Earth as a product of history (Science of processes) (Cubellis & Luongo, 2010).

Fig. 4 - Serapeum - Macellum in Puteoli (Pozzuoli), 1785-86. Gianbattista Lusieri (in Ciancio, 2009).
capable of overturning the Earth's surface (Waller, 1705). Nixon identified the volcanic energy in the area as causing the sea-level rise and recalled the eruption of Monte Nuovo in 1538 occurring in the area, confirming the energy of volcanism. Nixon interpreted the phenomenon observed on the columns in terms of vertical ground movements, the rising of the water level thus being apparent. This idea would not be accepted by several scholars until the early 19th century, when it would be revisited by the most famous geologists of that time.

On the role of volcanism in the Earth's dynamics, Hamilton may be considered a follower of the theory postulated by Hooke. Indeed, without explicitly pronouncing on the issues concerning the so-called Temple of Serapis among those who had studied the monument, Hamilton indicated in his writings his own theory regarding the cause of the ground movements, having recourse to the action of Phlegraean volcanism, specifically at Monte Nuovo (Hamilton, 1771). Hamilton may be considered a precursor of the long-term paradigm and gradualism whose chief exponent in the early decades of the 19th century was Lyell. Indeed, in natural phenomena he would support the slow work of Nature and the limited breadth of processes, such as to elude observation in the short term on the scale of human lifetimes.

In the second half of the 18th century the Temple of Serapis became the great attractor of naturalists, including the Swedish mineralogist Johann Jakob Ferber (1743-1790) who arrived in Naples in 1762 and carried out measurements at the Serapeum, such as the distance of the building from the sea and the height of the columns vs. sea level, as well as observations of the columns to detect the marine species responsible for eroding the columns. Ferber (1776) inferred from these data that the monument had been under water for a long time, although he did not point to the causes of the phenomenon; in fact his observations clashed with the theories of the top philosophical authorities of the 17th century on the Earth's formation in relation to the gradual retreat of the waters which uncovered continents for their subsequent colonisation. Indeed the temple had been built away from the sea, and hence the waters had had first to rise to a considerable height, well above the tides, and then retreat after a long interval of time. If ground oscillation is ruled out in interpreting the phenomena observed at the Serapeum, according to the dictates of the stability of the emerging Earth, then interpretation of the sea level variation became problematical unless huge changes were invoked on the Earth's surface.

In 1787 during his visit to the Campi Flegrei, Johann Wolfgang Goethe showed particular interest in the ruins of the Temple of Serapis. He did two drawing of the coast of Pozzuoli and the columns of the Temple of Serapis, showing in one, the position of the sea level and the pavement of the Serapeum at the time of its building, and the position of the eroded zone, and in the second the subsequent burial of the columns by volcanic products and the formation of a ridge separating the site of the Serapeum from the sea, as well as a small lake which would allow the reproduction of lithodomes capable of eroding the columns. Goethe's geological interpretation was conditioned by Werner's Neptunist theory, which does not envisage a sea level oscillation of several metres (Goethe, 1824; Werner, 1878).

The end of the 18th century and beginning of the 19th century saw the consolidation of the advances in geological knowledge produced by the higher education reforms in France during the revolution and by the economic importance acquired by the minerals sector chiefly in the German world. This was the direction taken by the natural philosopher and mathematician John Playfair (1748-1819), pupil of James Hutton. Playfair (1802) interpreted the phenomena of the Temple of Serapis without recourse to the use of historical and architectural accounts. He maintained that the method of geology needed to follow that of physics, such that chemistry, physics, mathematics and geometry should be the tools for geological analysis. According to this idea, Playfair, who visited the site of the Serapeum in 1815, elaborated an interpretation of the processes observed in the area, stressing that the change in sea level was to be attributed to the rise and fall of the ground.

The separation between Earth Sciences and the study of Antiquity in the 19th century was reinforced by the naturalist Leopold von Buch (1774-1853), who in his accounts of his travels in Italy in 1797-98 kepted the naturalistic aspects rigorously separate from the antiquarian ones, giving pride of place to the examination of chemical, mineralogical, stratigraphic and morphological aspects (von Buch, 1802-09).

After the separation between geologists and architects at the end of the 18th century, sought by geologists so as to mark a distinction between the two disciplines and reinforce the geology sector; in the early decades of the 19th century the trend was reversed as geologists and architects were to develop shared methods of inquiry in the field.

The debate which had evolved regarding the Serapeum was well summarised in 1820 by D. Andrea De Jorio, General Inspector of Public Education and honorary member of the Academy of Fine Arts: "Those curious about Roman magnificence, architects, naturalists, and antiquarians, do not cease to admire the surprising remains of the Temple of Serapis in Pozzuoli. This monument ... presents in every aspect vast material to discuss, and thorny difficulties to resolve" and maintained the local origin of phenomena observed at the Serapeum "The history and facts thus bear witness that our temple was once covered by the sea, and that the columns were perforated by date mussels, under sea water and not in another site, suggesting the formation of a lake on the shores of Pozzuoli in the precinct of the Serapeum, due to a flood, tidal wave or earthquake." (De Jorio, 1820).

The theory of John Nixon and that of Charles Lyell were opposed in the interpretation by the architect Antonio Niccolini (1772-1850). From 1822 to 1849 Niccolini studied the phenomenon and undertook the draining and conservation of the site. He rejected the theory of most of the geologists of the time who sustained that the phenomena observed at the Serapeum were to be attributed to long-term ground oscillations; in fact he believed that the sea level oscillations observed should be attributed to oscillations of the level of the oceans and not to ground motion.

“One does not understand what need there is to resort to an imaginary movement of the earth conceived among inconsistencies and contradictions, to explain phenomena which become clear once sea level phases are admitted” (Niccolini, 1829). Though recognizing the importance of volcanism and the endogenous forces of the area, Niccolini believed it was impossible that such forces could cause the rise of entire continents without leaving significant trac-
es. In substance, he thought that if ground level rises and falls had occurred in the area of the Serapeum, they would have compromised the feeding system of thermal waters to the cistern found in the Serapeum complex, conditions not found by Niccolini, an expert in the archaeological and architectural aspect of the structure.

The controversy on the interpretation of the phenomenon of bradyseism would also develop with the President of the Geological Division of the 7th Congress of Italian Scientists held in Naples in 1845, Ludovico Pasini (1846), who manifested doubts on the theory of Niccolini.

"Deep time" and Uniformitarianism were to come under further scrutiny in 1862 with the calculations of Lord Kelvin (Sir William Thomson, 1842-1907) on the cooling of the Earth. According to Kelvin the Sun could not be older than 500 million years and from 100 to 200 million years had elapsed since the solidification of the Earth's crust. Lyell supported the stationary nature of geological processes against the model of terrestrial cooling proposed by Lord Kelvin which would produce a progressive decrease in tectonic activity in the course of time ("the death of the Earth").

The contrasting views of Lyell and Kelvin were due to the fact that the results expected by Lord Kelvin were not consistent with geological observations. For Lyell long times were required for such processes while the time elapsing from the forming of the Earth's crust was much lower according to Lord Kelvin's calculation based on the decay of the inner heat of the Earth. (Burchfield, 1990). For Lyell, geological processes were irreversible although he observed the repetition of the geological cycle with the succession of various phases, such as the erosion of continental masses, sediment transport to the sea, the formation of layers, the transformation of sediments into rocks and finally the emergence of the latter with the formation of continental masses, to then resume the cycle (this process had been confirmed in the succession of ground movement oscillations recorded at the columns of the Serapeum). For such a complex process to take place there must be a source of energy, but irreversibility corresponds to dissipation, disorder, to the increase of entropy, which is associated to non-equilibrium. Yet the universe of non-equilibrium is a coherent universe. Indeed, the history of the Earth shows that our planet is a system not in equilibrium. A system in equilibrium cannot have a history; it can only persist in its state.

At this point, either the theory of deep time is wrong or Lord Kelvin's assessment of the energy resources available for the geological processes indicated by the supporters of Uniformitarianism is wrong. There thus arose divergent opinions between geologists and physicists. The former proceeded according to the theory of deep time and the latter according to the line mapped out by Lord Kelvin. Indeed, in 1876 the thermodynamic physicist Peter Guthrie Tait (1831-1901) stated (Burchfield, 1990): "We cannot give more scope for [geologist'] speculation than about ten or (say at most) fifteen million years". The limitation indicated by Kelvin and Tait on the antiquity of life had the same paralyzing effect on evolutionary thought as the mosaic scale of time had had on the geology of Robert Hooke and Niccolò Stenone (1638-1686) in the 17th century.

Yet Lyell's theory was to be confirmed by research into the natural radioactivity of rocks on the part of Antoine Henri Becquerel in 1896 and the husband-and-wife team Pierre and Marie Curie in 1898. With this discovery, contributory factors to the Earth's inner heat were the original heat of the planet and that generated by radioactive decay. With such data, the calculations of Lord Kelvin and Tait were substantially superseded.

The discovery of deep time or geological time and its confirmation from research into natural radioactivity definitively showed that the origin of the Earth had not specifically served the appearance of Man. The revolution of deep time may be considered at the same level as the Copernican revolution, with which the Earth no longer represented the center of the Universe.

**RESEARCH AND TECHNICAL SERVICES FROM THE UNIFICATION OF ITALY TO WORLD WAR I**

The political events in Italy in 1860, including the arrival of Garibaldi in Naples and the subsequent unification of Italy, produced significant changes to university and research structures in the field of geology (Fig.5). The changes also show the interest of Garibaldi and the country's new managerial class to appoint to more delicate organisational positions those intellectuals who had joined the cause of Italy's unification. Thus elements of the managerial class of the past regime were transferred to matters of less cultural importance.

Of much greater gravity was the mooted suppression of the Vesuvian Observatory on the part of the Minister for State Education, Francesco De Sanctis, within the general context of reorganisation and modernisation of research facilities. The eruption of 1861, which affected the town of Torre del Greco, changed the minister's mind, who pointed out that the Observatory's function had to be to monitor the volcano to mitigate the risk to the people living in towns around the volcano. On that occasion Palmieri (Director of the Vesuvian Observatory) developed the control of soil deformations, with geodetic measurements in the area most affected, with which the evolution of the phenomenon was measured.

With the decree of 27 October 1860 and others to follow De Sanctis embarked on a far-reaching reform of the University of Naples, forcing the retirement of teachers most compromised with the Bourbon regime, and nominating in their place as many scholars, several from exile. Yet the changes started by the Minister did not affect in the same way the teachers of science subjects which had achieved appreciable results also in the bleaker periods of cultural control on the part of the authorities. With the reform the change was radical: the scientific and religious control of the clergy over the university, believed to be an offshoot of the Bourbon Court, was henceforth eliminated.

Meanwhile, in the second half of the 19th century, Palmieri continued his studies and organised the system of instrumental monitoring and visual observations, recording in a register both the parameters of volcanic activity and those concerning meteorology. In studying the succession of eruptive events, Palmieri (1896) recognised a periodicity and thus organised the recent eruptive history of the volcano into eruptive periods.

In the 19th century Naples was not only an attractive laboratory to verify the theory of Lyell but was also a destination for Anton Dohrn (1840-1909), one of the foremost German Darwinists, organised the Zoological Station in
Inquiries into extreme natural events received little attention. For the eruptions on Vesuvius and Etna, the distance of urban centres from the eruptive vents made matters concerning the safety of the communities exposed appear negligible. As regards earthquakes, studies were limited to the observation of damage and to town planning and structural issues for the greater safety of urban centres. On the basis of these elements, in the second half of the 19th century there arose interest to create scales of earthquake intensities.

The same years also saw greater interest in setting up seismographic apparatuses to record the seismic waves generated by earthquakes. The Casamicciola event on 28 July 1883 on the island of Ischia occurred in a historic moment during which Europe had radically changed after the industrial revolution. The countries under seismic risk had reached cultural maturity and knowledge on the phenomenon so as to supply more suitable measures for risk mitigation.

With the 1883 Casamicciola earthquake, Italy was to become the country at the forefront in the study of earthquakes. With this earthquake, unified Italy was faced for the first time with the problem of rescue and reconstruction of a seismic area (De Marco, 1998; Luongo et al., 2006). The scientific debate was very lively involving the greatest experts of the time and would advance knowledge of the origins and effects of earthquakes. The various scholars involved often held conflicting opinions. Yet each of them (i.e. M.S. de Rossi, G. Mercalli, L. Palmieri, H.J. Johnston Lavis, L. Gatta, G. Grablovitz) made an interesting contribution for the advancement of seismological knowledge (Luongo et al., 2012a). Localisation of the event was still carried out with Mallet’s method (Mallet, 1862) on the propagation of seismic waves fronts inferred from damage to buildings (Fig. 6). However, the characterisation of damage evolved and intensity scales as created by de Rossi (1834-1898) and Mercalli (1850-1914) were developed. A significant element in the debate was the role of volcanism as the generating cause of earthquakes.

In the aftermath of the Casamicciola earthquake on 20 December 1883 the Geodynamic Commission was established, entrusted with organising the National Geodynamic Service with a view to studying seismic phenomena. In the programme to develop the network of observers of the Geodynamic Service, the chief priority was to set up a network of observers on the island of Ischia. In organising such a network the conflict emerged with the then Director of the Vesuvian Observatory, Luigi Palmieri, due to the unsuitable role assigned to the Observatory. The Ministry of Agriculture, Industry and Commerce, in 1884 appointed Giulio Grablovitz (1846-1928) to elaborate a draft project for the First-Order Geodynamic Observatory and a network of stations on the island of Ischia. Grablovitz presented the “project” to the Ministry in a few days, but it was never completely carried out (Luongo et al., 1987; 2012a).

The second half of the 19th century saw the establishment not only of the networks of state technical services, but also of Scientific Associations. Italy’s Geographical Society was founded in 1867, the Geological Society in 1881, the Botanical Society in 1888, the Society of Physics in 1897 and the Zoological Society in 1900, with each society producing its own professional journal. Only in 1906-1907 was the interdisciplinary Italian Society for the

Fig. 5 - Frontispiece of the Annals of the Vesuvian Observatory, journal founded by Luigi Palmieri in 1859 (Anastatic Reprint 1991).
Advancement of Science (SIPS) founded, according to the models of the more advanced European countries.

In the last decade of the 19th century long effusive phases on Vesuvius produced two structures, with the accumulation of lava that was to change the landscape. The first developed on the northern slope of the Gran Cono from 1891 to 1893 and was called Colle Margherita; the second formed on the western slope of the Gran Cono between 1895 and 1899, and was called Colle Umberto. The two structures, typical lava domes, were named in honour of the reigning sovereigns at the time, renewing an ancient tradition of dedicateing literary and scientific works to the patron, whether sovereign or prince. These lava were used to study the nature of their components and the effusive mechanisms involved. Despite the frequent studies and continuous observations of eruptive activity, in those years no significant progress in the knowledge of the structure of the volcanic edifice and its dynamics was recorded. In the same period, for the Campania Flegrei there was an immense geological literature on specific issues. However, it was somewhat confused, often lacking in rigour and of scant scientific value. However, it is worth mentioning the original interpretation of Giuseppe de Lorenzo (1904) on the evolution of the Campi Flegrei, whose structure would be revisited also in recent times.

The documentation of the archive of the Vesuvian Observatory concerning the activity of Vesuvius between 1903 and 1906 highlights the twofold role of the observatory: that of a scientific research institute and that of monitoring for the mitigation of the effects of eruptions on the inhabitants around Vesuvius. The archives contain considerable correspondence between the Director of the Vesuvian Observatory Raffaele Vittorio Matteucci (1862-1909), and the regional authorities, especially the Prefect, as the State’s representative. The correspondence took place by telegraph and the contents of the messages refer to the evolution of the dynamics of the volcano and assessment of risks for the population. In those days barriers were set up to deviate the lava and avoid any urban centres being overwhelmed. Directing these operations was the Duke of Aosta.

After the 1906 eruption interest in volcanology grew further, as testified by the initiative of Immanuel Friedlaender (1871-1948) who founded in 1914 in Naples on the hill of the Vomero a volcanological institute to replace the planned International Institute of Volcanology, whose project had been opposed by Giuseppe Mercalli, who proposed instead that the Vesuvian Observatory be expanded and then proceeded to found an international organisation to whose activity national bodies would contribute.
The nation's cultural growth from 1870 onwards continually evolved. After a series of successes and setbacks Italy underwent a profound crisis with the advent of World War I, the country joining the war on 24 May 1915. The international scientific community would be torn apart and in Italy the effect of the conflict was to be even more dramatic due to the consequences of the debate between neutrals and interventionists. The same year had begun with the most tragic of omens: on 13 January 1915 there was an earthquake of great intensity which would chiefly hit Abruzzo, known as the earthquake of the Marsica, or the Fucino, or Avezzano (Castenetto & Galadini, 1999). This earthquake was scandalously underestimated, probably because it occurred at a very critical moment, just when Italy had joined the war.

THE FASCIST PERIOD AND SECOND WORLD WAR

The post-war period was to be inordinately turbulent both due to the economic crisis and the disappointment of Italy's territorial gains. After all, it had been one of the countries which had “won” the war. This climate brought to the rise of the Fascist party which rose to government in October 1922. In May of the same year in Rome at the Accademia dei Lincei in Palazzo Corsini the first General Assembly of the International Union of Geodesy and Geophysics (IUGG) was held.

1923 was the year of the great education reform known as the Gentile Reform, as well as the general restructuring of Italian scientific institutions. In the same years the Italian National Research Council (CNR) was founded, an organisation entrusted with running Italy's participation at the Conseil International de Recherches in Brussels. Meanwhile in Naples on 29 April 1923 by royal decree the position of Director of the Royal Vesuvian Observatory was suppressed and the technical and administrative management was entrusted to a Volcanological Committee; the latter consisting of professors from the University of Naples, namely Ciro Chistoni - Professor of Earth Physics-President, Senator Giuseppe De Lorenzo - Professor of Geology, Giotto Dainelli - Professor of Physical Geography, Ferruccio Zambonini - Professor of General Chemistry, Secretary (Gazzetta Ufficiale 21 May 1923 no. 127).

Alessandro Malladra (1865-1944), Conservator, and Giuseppe Imbò (1899-1980), Assistant, were members of the scientific staff of the Observatory. One of the objectives of the committee was to start collaborations with Italian institutions for the study of volcanic phenomena which occurred in the area around the city of Naples. After the death of Mercalli it was Malladra who monitored the activity of Vesuvius, starting from the beginning of the new eruptive period on 5 July 1913. In that year Malladra undertook a descent as far as the “mouth of fire” to gather samples of scoriae. Malladra conducted a later descent into the crater on 21 June 1914 in the company of H.S. Washington. In those years Malladra monitored the evolution of the eruptive cone in the crater of Vesuvius, with the reconstruction and demolition of the cone as well as the filling of the crater through the overlay of lava flows emitted by the eruptive cone.

In 1924 the first number of the Bulletin Volcanologique published by the Volcanology branch of the International Union of Geodesy and Geophysics (IUGG) saw the light. The President of the branch was Antoine Lacroix (1863-1948) who, in presenting the journal, stressed that the study of volcanoes should be tackled by those in the most diverse disciplines, such as geophysics, geology, geography, mineralogy, lithology, chemistry and physics. On May 2 1924 at 7 pm, in a lecture hall of the University of Naples, there was a meeting of the Presidential Council of the Italian Division of Volcanology. The Local Divisions of Volcanology of the National Committees were entrusted to send by telegraph, to the Naples Head Office at the Vesuvian Observatory, information on major eruptions and volcanic phenomena occurring in their countries to allow those concerned to acquire such information. The telegraphic address of the Naples Head Office was: "OBSEVESUVE, ITALIE".

Between 3rd and 8th June 1929 Vesuvius began an extensive new eruptive phase, producing a flow of lava from the crater. The eruption would be called terminal, according to the classification used in the study of the volcano's recent eruptive history, intended as the final eruption after a period of volcanic activity. However, in the years to come, especially after the 1944 eruption, the classification of 1929 eruption was deemed not to correspond to the dynamics of the volcano insofar as it would be the 1944 eruption which would be considered the closing event of the period beginning in 1913. Malladra (1933) published a detailed description of the succession of events during the eruption, starting from the explosions at the cone on June 1st which marked the formation of fractures at the summit of the eruptive cone, from which a very fluid lava flow would stream.

The final phase of the eruption was accompanied by intense seismic activity, and then Vesuvius entered a phase termed solfataric, to indicate intense fumarole activity. The seismicity observed during this eruption was examined by Francesco Signore (1933) whose results were reported in the same volume of the Bulletin Volcanologique. The seismometer which recorded such events at the Vesuvius Observatory was the Alfani seismograph whose characteristics were indicated in the paper, namely the amplification and the period of the instrument. Signore examined the recordings from 2 June to 7 June (1929), reporting the number of explosions and their peak breadth. September 9, 1929 in the middle of the crater of Vesuvius, at the base of the small cone where events of greatest intensity had been recorded between 3 and 8 June, a session of the 42nd Congress of the Italian Geological Society was held with the participation of 100 members.

In 1930 Alfred Rittmann (1893-1980), a volcanologist working with the Immanuel Friedlaender Institute of Volcanology, published a volume on the geology of the island of Ischia accompanied by a geological map on a scale of 1:10,000 (Rittmann, 1930). This work is divided into two parts: the first more substantial part reports the geology of the island, indicating the eruptive centres and major outcrops, eruptive mechanisms, island tectonics, the composition of the fluids of fumaroles and springs, as well as their temperatures, and the volcanic and seismic history of the island; the second part reports detailed chemical and petrographic analysis of ejected products. Rittmann's study supplied a newly-conceived method for studying the volcanic areas in which the author presented a structural and evolutionary model of the island's volcanic system which was effectively illustrated in the geological map attached.
The method of inquiry proposed by Rittman was long followed. In 1932 the Museum of Palaeontology of the University of Naples was founded, with the merging of the collections of the Museums of Mineralogy and Geology. Palaeontology had always occupied a position of importance in Naples, primarily due to Oronzio Gabriele Costa, who had collaborated with Charles Lyell when he came to Naples in 1828 to study marine terraces. After the Unification of Italy the most significant studies in palaeontology were those of Guglielmo Guiscardi (Sirago, 1985). The arrival in Naples of Francesco Bassani in 1887, one of the greatest palaeontologists of his time, constitutes a major turning-point (Parona, 1916; Barattolo & del Re, 1999). Bassani devoted himself to the studies of fossil fish from the Triassic and the Cretaceous in Campania. Between the two wars a notable ichthyopaleontologist was Geremia D’Erasmo (1887-1962) who in 1932 was appointed to the Chair of Palaeontology and in 1942 that of Geology at the University of Naples.

In 1933, Alfred Rittmann published a paper on the evolution and differentiation of the magma of Somma Vesuvius, showing through chemical analysis of rocks the interaction between magma and the carbonatic rocks in the basement of the volcano (Rittmann, 1933). This long remained an essential reference work for scholars of Vesuvius. In 1934 the Higher Institute of Health (ISS) was created, in which Enrico Fermi and his group operated, performing some of the most interesting research in Italian science of the twentieth century. In the 1930s there was a succession of events: the swearing of loyalty to the regime by university teachers and members of academies and cultural institutes, economic sanctions, race laws, the merging of the Accademia dei Lincei and the Italian Academy, and Italy joining the war in 1940 alongside Germany; all these elements resulted in a considerable reduction in freedom of research and the progressive separation of Italy from the international scientific community.

On July 25 1943 Mussolini was toppled as Head of Government and arrested. With the fall of the regime there was a dramatic period for the country which lasted until 1948, which saw the activities of the Resistance from 1943 to 1945, the end of the war in 1945, the transition from the Monarchy to the Republic with the referendum, and the drafting of the new Constitution. In those turbulent years, Benedetto Croce became an important political and cultural point of reference. He gathered around him friends and people of culture, founding in 1946 the Italian Institute for Historical Studies headquartered in Naples at Palazzo Filomarino.

This period was a time of transition for all institutions, including those with cultural aims and engaged in scientific research. All would be run by special commissions and those most compromised with the regime were either dissolved, reordered or modified. The picture was even more confused by what happened in 1943 with the formation of the Italian Social Republic in Salò, insofar as several institutions were transferred to the north, resulting in the contemporaneous operations of some institutes in the north and in Rome. With the birth of the Italian Republic there was a far-reaching transformation in the State, and the same cultural institutions were to be reorganised. A considerable concentration of resources was allocated to basic and applied research in the energy sector which received an allocation of finance granted by the USA for re-construction with the Marshall Plan (European Recovery Programme). The plan was to have a very broad function and comprised the agreements of technical and military cooperation between Italy and the USA. After the war and the bombs of Hiroshima and Nagasaki, in all countries nuclear research was the subject of special attention, both scientific and industrial and political, with the prospect of research into the peaceful applications of nuclear energy.

Italy’s first concrete step in the field of nuclear energy was taken in 1952 with the establishment, in the context of the CNR, of the National Committee for Nuclear Research (CNNR). This was to become the technical consultancy body for the executive of the Italian government’s nuclear policy. Within the CNNR, collaboration developed with the National Institute of Nuclear Physics (INFN) established on 8 August 1951. In 1960 the National Committee for Nuclear Energy was instituted (CNEN). After the energy crisis of the 1970s (the Yom Kippur War, 1973) the CNEN was reorganised and renamed the National Authority for Nuclear Energy and Alternative Energies (ENEA) in 1982. This authority changed its statute in 1991, abandoning research into nuclear energy and the same acronym would stand for “Authority for New Technologies, Energy and Environment”.

In 1956, in the context of the International Geophysical Year, deep seismic soundings were initiated in Italy. Such inquiries developed in the years that followed within the framework of other national and international projects, especially in the course of the Upper Mantle Project launched in the 1960s. In 1960, at the 12th General Assembly of the International Union of Geodesy and Geophysics (IUGG) held in Helsinki, the international scientific Upper Mantle Project (UMP) was proposed for the study of the Earth’s crust and the underlying layer, known as the Upper Mantle, where phenomena occur which have a greater influence on the evolution of the Earth’s crust. The period from 1960 to 1963 was devoted primarily to planning and organising the project, and during the Meeting of the IUGG held in Berkeley in August 1963, the Upper Mantle Committee (UMC) was established with the task of “encouraging and developing research in international collaborations on the upper mantle and its relation and influence on the evolution of the Earth’s crust”. The first official meeting of the UMC was held in Moscow in May 1964. The Upper Mantle Project was officially concluded in 1971 in Moscow during the 15th General Assembly of the IUGG, which saw the triumph of the Theory of Global Tectonics or Plate Tectonics. Ironically, the declaration of the new theory occurred in the country which had the least “mobilist” view of tectonics. In Italy in that period, not only was the paradigm of Global Tectonics established but also, completely original with respect to more developed countries, the principle that the aim of research in sectors in which social utility is more directly and more immediately involved must be to mitigate the risks from natural phenomena.

This new research strand in volcanology in Italy goes back to the bradyseismic crisis of 1970 and the realization that the areas of active volcanism needed surveillance. Against this background, the CNR in 1976 coordinated university and research institutes in the sectors of Earth Sciences and Engineering in the Special Geodynamics Project with two main objectives, namely the mitigation of seismic and volcanic risk. The University of Naples and the Vesuvian Observatory undertook to set up the Structural
Model of Italy, in the seismic monitoring of the Apennines and seismic hazard assessment, in the monitoring of areas of active volcanism to predict eruptions in the short run and the assessment of volcanic risk. The research explored the two catastrophic earthquakes (1976 in Friuli and 1980 in Irpinia) and the bradyseismic crisis in the Campi Flegrei in 1982-84.

CONCLUDING REMARKS

This study prioritised events most directly affecting Naples and its cultural institutions which may have influenced the approaches of those working in volcanological research in the area, whether members of the local scientific community or visiting scholars. It is therefore an analysis of developments in the region, leaving the reader to reflect on the emergence of modern volcanology with the establishment of the Vesuvian Observatory, a destination par excellence for those wishing to study volcanoes.

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