

Biographies of Deceased Italian Seismologists

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PART ONE

Agamennone, Giovanni (Rieti, 1858 June 24 – Rome, 1949 October 3)

After reading Physics at the University of Rome in 1884 Agamennone held an important position in Italian seismology, of which he was a protagonist at different levels for over 60 years from 1886 to 1949.

He started his career in 1886 as the Seismology assistant come at the Geodynamic Observatory in Ischia and later at the Central Office of Meteorology and Geodynamics in Rome. In 1895 he was one of the founders of the Italian Seismological Society. In the same year he was called to Constantinople (Istanbul) by the Turkish government; he stayed in Turkey until 1897 in order to deal with the organisation of the local Seismic Service, founding a seismic station equipped with instruments he himself had invented. In 1899 he succeeded M.S. De Rossi, who had died the previous year, in directing the Geodynamic Observatory of Rocca di Papa, one of the 4 first-order Italian geodynamic observatories.

In 1929 he was called to the Central Office for Meteorology and Geodynamics of Rome to work as Director of the seismic service. He withdrew from institutional posts due to having reached the age-limit in 1931, but continued to contribute at various levels to Italian seismography, until the last days of his life.

He devised several kinds of seismograph, some of which won awards at various national and international exhibitions, and he published almost three hundred scientific papers in numerous seismological matters. He dealt with a number of aspects in the study of earthquakes: the reconnaissance of the field effects, the analysis of the relevant seismograms, on the velocity and the means of propagation of the various kinds of waves. He also intervened in the scientific problem concerning earthquake prediction. In spite of his important contribution to seismometry and his extraordinary scientific longevity, Agamennone did not fully comprehend the importance of the introduction of the damping systems in the seismometers he designed and the use of the seismic network of the UCMG, and on account of this he negatively conditioned the development of the Italian institutional seismometric network until the end of the 1930s.

He was given numerous awards in Italy and abroad, he was the member of national and international scientific Societies and Academies and was Honorary Professor at the University of Athens.

An indefatigable worker, Agamennone took some part in all the fields of experimental seismology for over half a century.

Selected publications

Agamennone, G. (1901). Proposte di nuovi sistemi di amplificazione negli strumenti microsismografici, in *Boll. Soc. Sismol. Ital.* **7**, 299-314.

Agamennone, G. (1901). Macrosismometro a tre componenti, in *Boll. Soc. Sismol. Ital.* **7**, 249-265.

Agamennone, G. (1902). Sulla convenienza di un'alta velocità nelle registrazioni sismiche, in *Boll. Soc. Sismol. Ital.* **8**, 131-142.

Agamennone, G. (1932). La presenza di onde lente nella fase preliminare di taluni sismogrammi *Rend. R. Acc. Naz. Lincei, S.VI.*

Agamennone, G. (1934). Le perturbazioni magnetiche in relazione coi terremoti, in *Boll. Soc. Sismol. Ital.* **32**, 55-78.

Alfano, Giovan Battista (Naples, 1878 December 8 – 1955 December 27)

He read Natural Sciences at the University of Naples in 1906. He was the pupil of G. Mercalli and was proposed by the latter in the role of director of the Geodynamic Observatory Pio X of Valle di Pompei, a position he occupied from 1906 to 1933. At the same time, for at least a decade he collaborated with Immanuel Friedländer in the management of the private observatory that the Swiss volcanologist owned in Naples (in the Vomero area). In 1934 he contributed to founding the observatory of the Episcopal seminary of Capodimonte (Naples), set up with the instruments donated by Friedlaender, of which he was also the first director. He set up the Vesuvius Museum opened on 15th October 1911 comprising a vast historical collection of iconographies, bibliographies and eruptive products of the Vesuvius, a priceless thematic collection, only part of which has survived to this day. He was a member of numerous academies and the author of numerous publications and volumes of seismology and books on the Vesuvius.

Selected publications

Alfano, G.B. (1910). “Sismologia moderna.” Hoepli, Milan.

Baratta, Mario (Voghera, 1868 August 13 – Casteggio, 1935 September 4)

Baratta was graduated in Natural Sciences from the University of Pavia in 1890, under the guidance of Torquato Taramelli. Ever since his university studies his scientific interest was addressed to the historical study of seismic phenomena in Italy, so much so that when he was still a student he published 2 scientific contributions on the Bulletin of the Italian Geological Society. From 1891 to 1896 he was an assistant at the Royal Central Office for Meteorology and Geodynamics in Rome under the directorship of Pietro Tacchini. In 1901 he published “I terremoti d’Italia” (“The Earthquakes of Italy”), his most famous work, in which he cites and reconstructs with monographic descriptions 1,364 Italian earthquakes, from the start of year 1 to 1898. This work still represents a fundamental starting point for all the current research into historical seismology in Italy. After this intense seismological period Baratta addressed his career to the geographical sciences, subjects that he taught from 1903 at the University of Pavia. His forthright nature led him, in 1896, to abandon the UCMG owing to differences of opinion, while his critical stance towards the Italian government after the Calabria earthquake on 8th September 1905 meant he was left out of the geological commission given the job of studying the effects of the Calabria-Messina earthquake on 28th December 1908. For over a year Baratta studied the effects of this earthquake, in a semi-private capacity on behalf of the Italian Geographical Society, and published his results in a highly detailed monograph having great methodological value, Baratta’s interventions in the seismological field became fewer as his commitment to geographical studies increased, even if he did not fail to make original contributions concerning the major Italian earthquakes until the 1920s. He ended his career in 1935 with two contributions dedicated to his two scientific passions, geography and seismology

which were published posthumously: one on the manuscripts by Leonardo da Vinci kept in Windsor and the other “I terremoti in Italia” (“Earthquakes in Italy”) an updated version of his first catalogue.

Selected publications

Baratta, M. (1901). “I terremoti d’Italia. Saggio di storia geografia e bibliografia sismica italiana con 136 sismocartogrammi.” Fratelli Bocca, Turin (anastatic reprint, A. Forni, Sala Bolognese 1979).

Baratta, M. (1910). “La catastrofe sismica calabro messinese (28 dicembre 1908). Relazione alla Società Geografica Italiana.” Società Geografica Italiana, Rome (anastatic reprint, A. Forni, Sala Bolognese 1985).

Baratta, M. (1936). “I terremoti in Italia.” Pubblicazioni della Commissione italiana per lo studio delle grandi calamità, R. Acc. Naz. Lincei, vol. VI, Le Monnier, Florence.

Bertelli, Timoteo (Bologna,1826 October 26 – Florence, 1905 February 6)

Leopoldo Bertelli, the son of Francesco, professor of astronomy at the University of Bologna, after his studies at the Barnabite college, became a Barnabite brother with the name of Timoteo. He taught mathematics and physics at various Barnabite communities in central and northern Italy until in 1867 he arrived at the “alla Querce” boarding school of Florence. In this school Bertelli began and eventually completed his research into microseismic movements, which opened new perspectives in the field of earth physics studies. At the beginning of 1870 he started a series of observations on the minimum oscillations of a common seismometric pendulum (which he would subsequently call ‘tromometer’) specially modified and installed in a basement room of the building. From 1872 he started some fully-fledged tromometric observations with the instrument he had devised himself, which allowed him to obtain a numeric evaluation of the breadth of the pendulum oscillation. Soon afterwards, in order to give more historical breadth to his research, Bertelli published a long and highly detailed essay on all his previous experiences concerning spontaneous pendulum motions. In the period 1873-75 Bertelli and M.S. de Rossi perfected a standard model of tromometer that rapidly spread in over 31 Italian observatories (1886). Thus the first path-breaking observation earthquake network in the world was founded, equipped with standard instruments, albeit not in the modern sense.

In the following decades he performed thousands of tromometric observations also engaging in attempts to interpret and correlated seismic events.

Bertelli’s contribution aroused much interest on the part of the scholars of seismology of the day. From 1895 until 1899 he was also the director of the Vatican Specola in Rome. His major contribution to experimental science was above all seismological, even if he did not fail to contribute in an original way to meteorology and physics.

Extended biography

Timoteo Bertelli was born on 26th October 1826 in Bologna, where his father Francesco was an astronomy professor. He studied at the Barnabite school of Santa Lucia until 1844 when, having decided to become a Barnabite father, he was sent to Genoa for his novitiate studies, where he took his vows on 7th September 1845. He then taught mathematics and physics in several

communities in central and northern Italy. Initially in Rome (1845 -8), then in Moncalieri (1848-50) and in Naples (1850-1) – where he ended his theological studies and was ordained a priest on 27th October 1850 – then in Macerata (1851-3), Bologna (1853-61), and Parma (1861-7). In 1867 he finally went over to the "alla Querce" boarding school in Florence where, except for a short Roman period in the 1880s, he stayed until his death.

In this boarding school Bertelli started and completed his research into microseismic movements, which opened new perspectives in the studies into earth physics. At the beginning of 1870 he started a series of observations on the minimum oscillations of a common seismometric pendulum specially modified and installed in an underground room of the building. From the earliest months of work, Bertelli observed a periodic pattern of the pendulum motions that led him, starting from August 1871, to repeat the observations several times a day. From 17th June 1872 he started some fully-fledged tromometric observations with the instrument he had himself devised, which allowed him to make a numeric evaluation of the breadth of the pendulum oscillation.

At the end of 1872, Bertelli was able to summarise the observations performed and formulate an initial explanation of the results obtained. He noted, in particular, that the tromometric movements very often accompanied a significant barometric lowering or, more generally, a rather rapid pressure variation; more seldom, there were strong instantaneous oscillations, of an irregular pattern, which occurred at the same time as close or distant earthquakes.

Soon afterwards, in order to add historical breadth to his research, Bertelli published a long and highly detailed essay on all his past experiences on spontaneous pendulum movements.

In spite of that his ideas were greeted coldly by some and openly attacked by others: the movements observed by Bertelli should have been traced back to causes that were completely different from those hypothesised: to the wind, which was thought to make buildings shake; to the currents generated by temperature disequilibria inside the pendulum covers; to the ground movements generated by mechanical, acoustic or thermal causes, even connected to human activities.

Bertelli replied by stating that he felt quite safe from such criticisms, having taken care to position his instruments upon a column isolated from the building and established directly in the ground at a depth of around one and a half metres as compared with the floor of the building. According to Bertelli, this excluded the influence of building or road traffic vibration, temperature, direct action of the wind upon the pendulums.

At that point a long scientific controversy was triggered off that lasted from 1874 to 1875 with numerous interventions, the substance of which is summarised by M.S. de Rossi on the pages of the newly-founded *Bullettino del Vulcanismo Italiano* (Bulletin of Italian Volcanism). De Rossi himself joined this endless debate seeking to create a sort of arbitration that ended up with his complete agreement with Bertelli's ideas.

The liveliness of the dispute attracted the attention of numerous scholars of seismology. The first of these was A.G. Malvasia in Bologna, followed by de Rossi in Rome and Rocca di Papa, I. Galli in Velletri and other scholars from different parts of Italy began regular microseismic observations between 1873 and 1875. It was then clear that in order to obtain homogeneous results it was necessary to standardise the instruments and the methods of research. For this purpose in 1875, Bertelli and de Rossi together devised a tromometer built more simply and economically that they called "normal tromometer", which allowed different observers to obtain comparable results.

In the meanwhile Bertelli continued with his systematic observations: by the end of 1875 he had collected over 18,000 measurements and the curve of the microseisms, traced on the basis of these data fully confirmed his earliest conclusions. The graph presented a maximum in the winter months and a minimum in the summer; the peaks very closely followed the barometric depressions. Bertelli called the movements most directly connected to the lowering in the pressure "baroseisms" in order to differentiate them from the strictly seismic movements.

Later on, once the observations had risen to about 50,000, he compared the trends with R. Mallet's curve of the monthly frequency of the earthquakes in our hemisphere, finding significant confirmation of the 'endogenous' origin of microseisms. He then articulated his pneumodynamic theory according to which the equilibrium of the earth's crust was modified by strictly endogenous causes (an enormous expansive force inside the earth's core) that is, by exogenous agents capable of adding to or subtracting themselves from the endogenous forces. These modifications could produce both macroseismic and microseismic phenomena.

The study of the tromometric movements had in the meantime significantly expanded, above all thanks to the work of proselytism performed by de Rossi's Bulletin. The Italian tromometric stations - 5 at the end of 1874 – soon became 10 in 1877, 14 in 1880, 24 in 1884, and 31 in 1886; they then started to drop progressively, along with the fading chances that the study of the microseismic movements could in some way help the forecasting of great earthquakes, the chimera of the 19th century scholars of seismology. Bertelli dedicated most of his scientific activity to the study of microseismic movements; the observations with the tromometer engaged nearly all of his time free from teaching. However, many other field fields also appealed to him. He was interested in electrotechnical studies, in particular capacitors, the multiple copper points systems, the pointed dischargers, the lighting-rod, an optical telegraphy method. For many years he dealt with historical-critical research into the invention of the compass and its first astronomical and nautical application, and the attribution of the discovery of magnetic declination. He also published some research into marine sounding studying various versions, both ancient and modern, of the instrument and proposing a new manometer version of his own invention.

In 1895 he was called to Rome to become the assistant of the General Father of the order as well as to occupy the position of director of the Vatican Specola, a position left vacant by the death of Francesco Denza. Upon returning to Florence in 1898, he went back to teaching and in 1903 was elected Chancellor of the «alla Querce» boarding school, where he died 2 years later.

Selected publications

Bertelli, T. (1872). Osservazioni sui piccoli movimenti dei pendoli in relazione ad alcuni fenomeni meteorologici, in *Bull. Meteor. Osser. Collegio Romano*, **11** (11).

Bertelli, T. (1873). Appunti storici intorno alle ricerche sui piccoli e spontanei moti dei pendoli fatte dal secolo XVII in poi, in *Bull. di Bibliogr. St. Sci. Mat. Fis.* **6**.

Bertelli, T. (1874). Tromometro a prisma proposto per le osservazioni microsismiche dal P. Timoteo Bertelli e dal cav. prof. Michele S. de Rossi, in *Bull. Meteor. Oss. R. Coll. Carlo Alberto in Moncalieri* **9** (1873-74), 145-148.

Bertelli, T. (1890). Delle vibrazioni sismiche e delle indicazioni sismometriche. Ricerche teorico sperimentali. Nota II, in *Mem. Pont. Acc. N. Lincei* **6**, 67-221.

Bertelli, T. (1892). Sulle indicazioni degli istrumenti sismici. *Bullettino Mensuale*, in *Bull. Mens. Oss. Centr. R. Coll. Carlo Alberto in Moncalieri* S. II, **12**, 79-80.

Bertelli, T. (1893). Di alcuni moti tromometrici osservati in Sicilia nelle eruzioni etnee del 1883, 1886, e 1892 e di quella sottomarina della Pantelleria nell'ottobre 1891. *Atti Pont. Acc. N. Lincei* **46** (1892-93), 17-29.

Bina, Andrea (Milan 1724 January 1 – Milan 1792 March 8)

After finishing his studies at the seminary of his native town, he studied rhetoric at the University of Brera.(Milan) In 1741 he became a member of the Congregation of the Cassino Benedictines undertaking at the same time elaborate studies in mathematics and physics. Deeply attracted by physics and especially electrology, Bina became part of the large number of scientists who were fascinated by the recent discoveries in electricity and thought they could explain a great number of natural phenomena with it. Among the first to do so in Italy and the world, the Cassino scholar tried to demonstrate experimentally his theoretical argumentations, publishing a study on this subject. For this purpose he suggested adopting a vertical seismoscopic pendulum which, by means of a needle inserted in the mass, would record the movements of the ground on the sand contained in a wooden box floating in a receptacle filled with water. He himself used a similar instrument to “record” the shakes of the seismic sequence in Umbria in 1751.

Selected publications

Bina, A. (1751). “Ragionamento sopra la cagione de' terremoti ed in particolare di quello della Terra di Gualdo di Nocera nell'Umbria seguito l'A[nno] 1751.” Costantini e Maurizj, Perugia.

Cacciatore, Niccolò (Casteltermeni, 1780 January 26 – Palermo, January 1841 January 28)

After a complex curriculum of literary and scientific studies Cacciatore, the encounter in 1798 with the worthy astronomer Piazzzi, director of the Specola Palermitana, represented the turning point in his scientific career. He dedicated himself to the observations and research into astronomy; in 1800 he became first assistant at the Specola; in 1811 professor of astronomy and geodesy, and in 1817 he took on the post of director of the Specola, keeping it until his death. Cacciatore marginally dealt with seismology, designing and using a mercury seismoscope, of which there still exist two specimens (one from 1818 and one from 1827), perhaps the most ancient seismic instruments existing in the world. With one of these instruments, which were based on a seismoscopes described by the French astronomer Jean de Hautefeuille (but we do not know if it was actually ever made), Cacciatore made observations on the occasion of the earthquake of the Madonie (Northern Sicily) on 8th September 1818. The role played by Cacciatore in the development and the experimentation of his seismoscopes highlights the influence of the astronomical observatory practice on the nascent experimental seismology.

Caloi, Pietro (Monforte d'Alpone (VR) 1907 February 22 – Rome 1978 February 13)

He graduated in 1929 in mathematics at the University of Padua; in the academic year 1929-1930 he specialised in physics and obtained a scholarship to study astronomy at the Astronomical Observatory of Padua. In 1931 he became assistant at the Geophysical Institute of Trieste, where he started his activities as a seismologist, collaborating in the installation of a new seismic station at the Institute with the seismographers Wiechert and Vicentini.

In 1937, following an invitation by A. Lo Surdo, founder of the National Institute of Geophysics, he joined the Institute as principal geophysicist. In 1948 he became chief geophysicist and in 1951 director of Observatory.

In 1937, by virtue of the chair in seismology he had obtained in 1935, he began his teaching activity which, over a thirty-year period at the University of Rome, would allow him to arouse an interest in his science on the part of hundreds of students, amongst whom some of the leading Italian geophysicists of the day.

Caloi was probably the major Italian seismologist of the 20th century, even if his reserved nature and his preference for publishing prevalently in the Italian-language *Annals of Geophysics* did not help much towards having his contribution to seismology better known and appreciated. He was among the promoters of the foundation of the European Seismological Commission from 1951, of which he was secretary; he was vice-president of the IASPEI from 1951 to 1954 and won numerous national as well as international awards.

Caloi's scientific interests were prevalently oriented towards seismology, but he was keen on many other fields of geophysics as well: the physics under the earth's crust, lakes and seas from their hydrodynamic and thermodynamic standpoints, the geodynamics of large dams and their control, the slow movements of the earth's crust, the interaction between atmosphere and hydrosphere with special regard to the 'high waters' of the Venice lagoon, the micro-seismicity provoked by severe ice, and the philosophy of science to which he dedicated the more profound part of his scientific passion.

In the field of theoretical and applied seismology he devoted long and thorough research to the waves of Rayleigh and Somigliana; and so his studies led him, in 1953, to submit the asthenosphere to the scientists' attention, as a layer inside the earth's surface responsible for the canalisation of the seismic energy, slowing down the velocity of propagation of the longitudinal and transversal waves.

Earth core, lower and upper mantle, and the crust are also the subject of detailed studies.

It should suffice to glance through his lengthy list of publications (over 200) to get some idea of the weighty scientific activity that characterised every moment of his life.

He reached the compulsory retirement age in 1972, but continued to work indefatigably afterwards as well, publishing the results of his studies on the transition zone between mantle and core; studies on the existence of guide-canals of shear waves in the upper mantle; on the micro-movements of a fault as the attenuation of local seismicity or on the micro-movements linked to the atmospheric pressure or those having an astronomical origin; on the variations of the vertical associated with the transit of the pressure variations and the geodynamic phenomena that preceded the Friuli earthquake on 6th May 1976.

Selected publications

Caloi, P. (1936). Due nuovi tipi di onde sismiche alla luce di una teoria di Somigliana. *R. Acc. dei Lincei*, **3**, 507-511.

- Caloi, P. (1953). Onde longitudinali e trasversali guidate dall'astenosfera. *Rend. Acc. Naz. Lincei* **15**, 352-357.
- Caloi P. (1954). L'astenosfera come canale-guida dell'energia sismica. *Ann. Geof.* **7**, 491-501.
- Caloi, P. (1958). About some phenomena preceding and following the seismic movements in the zone characterized by high seismicity. In: "Contribution in Geophysics in honour of Beno Gutenberg" (H. Benioff, M. Ewing, B.F. Howell Jr. and F. Press, Eds.), 44-56.
- Caloi, P. (1961). Seismic Waves from the Outer and the Inner Core. *Geoph. Journ. Roy. Astr. Soc.* **4**, 139-150.
- Caloi, P. (1964). On the canalization of seismic energy. *Ann. Geof.* **17**, 513-522.
- Caloi, P. (1967). "On the Upper Mantle." *Advances in Geophysics* **12**, Academic Press, New York.
- Caloi, P. (1972). From the Somigliana waves to the evanescent waves. *Ann. Geof.* **25**, 471-480.

Cancani, Adolfo (Rome, 1856 February 18 – Rome, 1904 May 28)

He graduated in physics in Rome in 1884 and dealt with climatological meteorology and atmospheric electricity at the University of Rome and the Central Office of Meteorology and Geodynamics. In 1892 he became assistant at the Geodynamic Observatory of Rocca di Papa where in the following seven years he applied the most modern scientific criteria to the observatory's observation activity. In his short but promising scientific career, Cancani contributed with over 30 papers to various aspects of seismology: he devised and built numerous seismic instruments and formulated the hypothesis of the propagation of earthquakes by means of two wave systems, longitudinal and transversal. This conjecture offered the stimulus for a fruitful debate among the seismologists of the day.

In 1903 Cancani, at the International Seismological Conference at Strasbourg, was appointed member of the Commission for the choice of the seismic apparatus to be installed in the observatories of the Association Internationale de Seismologie. On that occasion he presented his report on the degrees of the Mercalli scale and the corresponding acceleration ranges. The new scale, with the subsequent contributions from Sieberg in 1912 and in 1932, became the Mercalli-Cancani-Sieberg scale (MCS), still widely used in Italy.

A few months before his death he became visiting professor of geophysics at the University of Modena.

He was a member of the Italian Seismological Society ever since it was founded (1895).

Extended biography

He graduated in Physics in Rome in 1884 and was for four years pupil and assistant at the Practical School of the Physics Institute of Rome, directed by Pietro Blaserna, collaborating at the same time with Ciro Chistoni, first assistant of the Central Office of Meteorology, towards the installation and maintenance of the instrumentation for the observations on atmospheric electricity. In 1888, he joined the Central Office for Meteorology and Geodynamics (UCMG) as a member of the climatological meteorology section, which he left in 1892 in order to become assistant at the Geodynamic Observatory of Rocca di Papa, previously directed by M.S. de Rossi. He worked assiduously for seven years to reorganize, according to the new scientific criteria, the activity of research and observation. In 1899 he re-joined the UCMG as an assistant at the Geodynamics department.

He also distinguished himself for his teaching activities, achieving a few months before his death the status of visiting professor in geophysics at the Royal University of Modena.

It was seismology that drew the greatest benefits from the work of Cancani; he devised and built numerous seismic instruments. By applying to the earth the theory of elasticity, he formulated the hypothesis of the propagation of earthquakes by two wave systems, longitudinal and transversal ones. Such a conjecture offered the basis for a fruitful debate among the seismologists of the day and paved the way for a solution to the fundamental problem of being able to determine the hypocentral coordinates on the grounds of the recordings of longitudinal and transversal waves.

In 1903 Cancani participated at the International Seismological Conference in Strasbourg where he earned an appointment as member of the Commission given the task of studying the best choice of seismic instruments to be installed in the observatories of the International Seismological Association. On that occasion he presented his modifications to the Mercalli scale, in which he related the degrees of the scale with acceleration ranges that he had estimated, giving rise to subsequent studies which also a contribution by B. Gutenberg. This new formulation of the scale, following a contribution given by A. Sieberg in 1912 and in 1932, became the MCS scale – i.e. Mercalli-Cancani-Sieberg - still widely used in Italy today.

He was member of the Italian Seismological Society ever since its foundation (1895).

Selected publications

Cancani A. 1894, Sulle ondulazioni provenienti da centri sismici lontani, in *Ann. Uff. Centr. Meteor. Geodin.* **15**, p.I , 13-24.

Cancani, A. (1894). Sugli strumenti più adatti allo studio delle grandi ondulazioni provenienti da centri sismici lontani, in *Atti R. Acc. Lincei, Rend., Class. Sci. Mat. Fis. Natur.* S.V **3** (9), I sem., 551- 555.

Cancani, A. (1896). Osservazioni e risultati recenti sulla forma e sul modo di propagarsi delle ondulazioni sismiche, in *Boll. Soc. Sismol. Ital.* **2**, 125-139, Modena

Cancani, A. (1897). I pendoli orizzontali del R. Osservatorio Geodinamico di Rocca di Papa, ed Il terremoto indiano del 12 giugno 1897, in *Boll. Soc. Sismol. Ital.* **3**, 235-242.

Cancani, A. (1900). Sulla necessità e sulla scelta di apparecchi sismici paragonabili, in *Boll. Soc. Sismol. Ital.* **6**, 37-42, Modena.

Cavalleri, Giovanni Maria (Crema 1807 November 18 – Monza 1874 December 1)

He became a Barnabite father, teaching literature from 1835, and physics from 1849, at the high school of the College of Monza. His competence in this field was apparent, and in 1851 the Austrian government licensed him to teach physics. Cavalleri's studies of such aspects of science as optics, electrology, seismology and agronomy, led him to devise and construct precious instruments.

In seismology, Cavalleri was one of the first scholars to turn his attention to the inertia of pendulum masses and to the fact that these could be relevant to seismology.

In 1857 Cavalleri experimentally observed that apparatuses of equal mass and different length receiving the same impulse oscillated with different periods and frequencies. Among the different pendulum apparatuses the one whose period of oscillation coincides or is closer to the period of the impulse received will have larger oscillations. These important experimental

conclusions drawn by Cavalleri did not receive the attention that they really deserved for at least two more decades.

Cavalleri built a seismic instrument that was capable of providing the following information, either directly or indirectly: the time of the start of the earthquake, the prevalent direction of the first shake, the general direction of the horizontal waves, with their breadth and frequency, the strength of the vertical movements, the result of the vertical and horizontal movements, the inclination of result, the velocity or the duration of the wave and, lastly, the overall intensity. Although there are no direct witness reports, it is likely that L. Palmieri drew inspiration from the work of Cavalleri when he designed his famous electromagnetic seismograph, as certain design similarities lead us to suppose: the method to determine the temporal start of the earthquake recording (with the starting of a clock at the moment when the shake began) and the method to measure the intensity of the instrument's vertical oscillations.

Cavalleri was a member of several scientific societies, including the Italian Society for Natural Sciences and the Lombard Institute of Science Literature and Arts.

Selected publications

Cavalleri, G.M. (1857). Di un nuovo sismometro collocato nel collegio di Monza. *Atti Ist. Lombardo Sci., Lett. Arti* **1**.

Cavalli, Atanasio (Asti c.1717 – Rome? c.1798)

Cavalli first comes to our notice in 1764, the year when he published his book *Letters of Filaletes*, free academician. As Carmelite friar Cavalli took the name Atanasio di San Luigi in religion. He taught theology in a Carmelite convent in Turin, devoted himself to the study of spiritualism and the occult, and even wrote a book on this topic. His scientific activities were mainly based on astronomical, meteorological and natural observations.

In 1770 Cavalli abandoned religious life and moved to Rome where he taught physics and moral philosophy at the "Gregorian" university. In Rome he corresponded with Francesco Caetani, a duke who had set up an astronomical and meteorological observatory, which he co-directed with Eusebio dei Veiga.

In the wake of the flood of emotions following the disastrous seismic sequence in Calabria (5 quakes today estimated to have been in a magnitude range between 6.3 and 6.9, occurring between 5th February and 28th March 1783) and a more recent earthquake on 2nd October 1785, Cavalli contributed to the science of earthquakes by designing two seismoscopes. We know that the first and most elementary seismoscope used by Cavalli was the first one ever made.

Selected publications

Cavalli, A. (1785). Lettera del signor ab. Atanagio Cavalli a S.E. il Sig. Duca di Sermoneta. *Antologia Romana* **12** (16), 121-123.

Cavalli, A. (1785). Lettera seconda del signor ab. Atanagio Cavalli a S.E. il Sig. Duca Francesco Caetani di Sermoneta. *Antologia Romana* **12** (17), 129-131.

Cecchi, Filippo (Ponte Buggianese, 1822 May 31 – Florence, 1887 May 1)

In 1839 Cecchi entered the order of Scuole Pie, changing his layman's name, Giulio Isdegerde, to Filippo, after Saint Filippo Neri. He studied physics and mathematics at Florence in the boarding school of San Giovannino (location of the Ximenian observatory) and he was a contemporary of Alessandro Serpieri, another illustrious scolio seismologist. After two brief periods of teaching in Urbino and in Volterra, he became a physics teacher at San Giovannino. Cecchi devoted himself to the study of experimental sciences and in particular to the study of new apparatus and instruments of physics, meteorology and seismology.

From 1872 he directed the Ximenian observatory, until that time mostly dedicated to astronomical and meteorological observation. Under his management the observatory suspended its astronomical activity, by then impossible in a large city like Florence, in order to dedicate himself to meteorological and seismological observation. Cecchi was one of the most important inventors of seismic instruments of his times. He mainly designed 5 seismic instruments, amongst which the first ever device for continuous recordings on smoked paper, which also achieved moderate success at international level. Some of his instruments can even be found in Europe and as far away as in Asia: in Manila, for instance. The first and perhaps the most widespread instrument was the electrical seismograph with sliding smoked paper (1875) on which Cecchi separately recorded the three components of movement. The instrument was not very sensitive, but did record some earthquakes, including that of western Liguria (north-western Italy) on 23rd February 1887, published in various journals and books of the day.

Extended biography

On the 10th of November 1839, at the young age of 17 years, Cecchi entered the order of Pious Schools, changing his layman's name, Giulio Isdegerde, to Filippo, after Saint Filippo Neri. He studied physics and mathematics at Florence in the boarding school of San Giovannino under father Antonelli and he was a contemporary of Alessandro Serpieri. After two brief periods of teaching in Urbino and in Volterra, he succeeded his late father Tanzini as physics teacher at San Giovannino. Cecchi devoted himself to the study of experimental sciences and in particular to the study of new apparatus and instruments. During his first years of activity he significantly improved telegraphic equipment and in 1854 he invented and made a new and successful electromagnet. During the first Italian Exhibition (Florence, 1861), Cecchi produced a new electromagnetic motor; two years previously, upon the request of the Florentine authorities, he had constructed a thermometer and a barometer with a large-sized quadrant which had been placed under the porch of the Orgagna. He also restored the gnomon set up by Ximenes in Florence cathedral, during which time he repeated Foucault's scientific experiment. Cecchi, who was responsible for the erection of the lightning conductors, modified these devices, developing the traditional system and improving the protection of Florentine monuments from damage by lightning strikes.

From 1872, after Father Antonelli's death, Cecchi directed the Ximenian observatory. He immediately realised that it was impossible to continue his astronomical observations in the city centre, and therefore redirected its research towards meteorology. The institute was equipped with new scientific apparatus and Cecchi designed and made new meteorological instruments, such as the nephoscope and a simple meteorograph whose prototype was never, however, completed.

Cecchi's successful reorganisation of the observatory's activities, and his creation of a network of Tuscan meteorological stations, were particularly appreciated by the scientific elite; in 1879 he was invited to the International Congress of Meteorology at Rome and later helped Francesco Denza to set up the Italian Meteorological Society. Cecchi was one of the most important inventors of seismic instruments of his times. He mainly designed 5 seismic instruments, amongst which the first ever device for continuous recordings on smoked paper, which also achieved moderate success at international level. Some of his instruments can even be found in Europe and as far away as in Asia: in Manila, for instance. The first and perhaps the most widespread instrument was the electrical seismograph with sliding smoked paper (1875) on which Cecchi separately recorded the three components of movement. The instrument was not very sensitive, but did record some earthquakes, including that of western Liguria (north-western Italy) on 23rd February 1887, published in various journals and books of the day. In 1884 he was awarded the gold medal at the National Exhibition of Turin.

Selected publications

- Cecchi, F. (1876). Sismografo elettrico a carte affumicate scorrevoli, in *Atti Pontif. Acc. N. Lincei*, **29** (1875-76), 421-428.
- Cecchi, F. (1875). Sismografo elettrico a carte affumicate scorrevoli, in *Bull. Meteor. Osserv. R. Coll. Carlo Alberto in Moncalieri*, **9** (9) 30 September 1875.

De Rossi, Michele Stefano (Rome, 1834 October 30 – Rocca di Papa, on 1898 October 23)

Born in a noble Roman family, he graduated at the University of Rome in 1855. His first scientific work evolved from his collaboration with his brother Giovanni Battista, a famous archaeologist of the paleo-Christian era who studied subterranean Christian Rome. An earthquake in 1868 and the Vesuvius eruption in 1872 aroused the geophysical interests of M.S. de Rossi. He immediately understood the need for a network of seismographs located throughout the world capable of accurately recording any motion of the earth's crust, with its intensity, duration and direction. By 1873 he was already active in the study of several earthquakes and in 1874 he honed an intensity scale he had put forward himself, as well as perfecting the tromometer with T. Bertelli and in the organisation of the first Italian seismic network. In the same year he started with the publication of the *Bullettino del vulcanismo italiano* (Bulletin of Italian Volcanism), the first geodynamic journal in the world, which he almost completely funded for 23 years and the compilation of which he always took care of. Faced with the manifest anomaly of a seismic network on national scale, but of a private nature coordinated by de Rossi, the Italian government, before actually supporting de Rossi financially (from 1882) with his venture, only set up a geodynamic service at the Central Office of Meteorology in 1887. In 1883 the government set up the Geodynamical Committee, of which de Rossi was a member. The committee decided to set up a geodynamical service for the whole country and planned the establishment of three high-level observatories in Catania, Casamicciola and Rocca di Papa. De Rossi was given the task of finding a site and designing buildings for the observatory of Rocca di Papa; in 1889, when the station was nearly ready, the geodynamical service was separated from the geodynamical committee to become a branch of the Central Office of Meteorology. This fact implied de Rossi's dismissal as director. Although he was given the job of

managing the observatory of Rocca di Papa, where he brought all his instruments, he undoubtedly felt this to be an unfair removal from the direction of the organisation he had set up and to which he had devoted all his life. It is hardly surprising that de Rossi progressively abandoned his research.

De Rossi's contribution to the seismology of his day was extraordinary: the first seismological network ever created in Italy is thanks to him, his seismic scale being a model for the subsequent ones by Mercalli, the first journal of geodynamics and design and perfecting of dozens of instruments developed above all in the period 1874–1887. His work was highly appreciated in Europe, with a variety of acknowledgements at national and international level.

Extended biography

Michele de Rossi studied at the Collegio Romano and then at the University of Rome, where he graduated in 1855. His first scientific work evolved from his collaboration with his brother Giovanni Battista, a famous archaeologist of the Paleo-Christian era who studied subterranean Christian Rome. de Rossi's contribution concerned the mapping of topographical relief, and the level of the catacombs; in particular, he attempted to calculate their topography and length. For this, he had to take into consideration a number of known topographical problems. They could be solved thanks to de Rossi's invention of the so-called 'iconographical and orthographical machine', which was awarded a prize at the Universal Exhibitions of 1862 and 1867 in London and Paris, respectively. Between 1867 and 1871 his strong interest in palaeontology resulted in a number of surveys in the Roman countryside and of the volcanoes in the Lazio region.

de Rossi's geophysical interests date back to 1868 when, in a letter addressed to the Genoa Gazette regarding the earthquake which occurred in June, and which had been felt by de Rossi himself in Castelgandolfo, he set out some suggestions for a network to collect data concerning the extent and means of earthquake propagation. De Rossi wrote: "weak earthquakes are rarely felt as they often happen by night; consequently there is little knowledge of them and only poor scientific observations. Anyone can easily understand that science would be more advanced by comparing the data obtained with many seismographs located throughout the world and able to accurately record any motion of the earth's crust, its intensity, duration and direction".

The Vesuvian eruption of May 1872, the Lazio earthquakes of January 1873 and, above all, those on 12th March in Camerino and 29th June in Belluno, convinced him to collect a series of news accounts and observations published in 1874 in a memoir which presents his first version of an intensity scale. De Rossi was sure that subsurface phenomena, such as destructive earthquakes and the main volcanic eruptions, are not the telltale signs of a continuous activity which, on the contrary, is usually characterized by weak and often imperceptible manifestations. As a consequence, de Rossi thought that only by the systematic study of the whole process of this activity, made with suitable instruments and continuous observation, would chronological and topographical statistical examination of each phenomenon be possible, even minor ones such as variations in the levels of wells and temperatures of springs, escapes of gas from solfataras and "blazing fountains", eruption of springs, and perturbations of the magnetic field. But only an organisation similar to the meteorological one, which was characterised by an extensive network of observatories, could make the systematic collection of data possible. Since 1873 de Rossi himself began to organise this network; the following year he started publication of the *Bullettino del Vulcanismo Italiano* (Bulletin of Italian Volcanism), as the main medium for diffusion of data, discussion of the results and promotion of the organisation.

The bulletin was the first scientific review entirely devoted to earth sciences. A large part of it was written by de Rossi himself; during the period in which it was published there were no significant changes to its editorial style. It opened with one or more articles; there followed several pages of bibliography (originally with comments); then there was a section devoted to the correspondence from the observatories; the last section was represented by summaries of the observations made in the various stations. There were about twenty observatories in the original network, some of them directed by famous scientists such as T. Bertelli, D. Conti, F. Denza, I. Galli, A. Issel, A.G. Malvasia, L. Palmieri, A. Serpieri and O. Silvestri.

The first issues were devoted to the controversy between T. Bertelli and P. Monte on the nature of the tromometric motions. In 1874 de Rossi visited their respective observatories of Florence and Livorno; whilst checking to ensure that the pendulums in both establishments were properly positioned and sufficiently isolated, he realised that the significant differences in oscillations were due to the different environment. In order to solve the problem de Rossi decided on a personal experiment. In July he set up two pendulums in his summer cottage at Rocca di Papa: one was placed inside the cottage, the other in a tunnel which had been dug near the cottage beneath layers of lava. Later on he set up a tromometrical station in the cellars of his cottage, where he equipped a cave with a Bertelli-type tromometer and four seismometrical pendulums of different lengths. He subsequently set up other pendulums in his Rome home and in a gallery of the Saint Callistos catacombs.

In February 1875 de Rossi compared the results of his 7,500 observations with the simultaneous research led by Bertelli in Florence and Malvasia in Bologna and with the data obtained by the seismograph of the Vesuvian Observatory. Macroseismic motions had been detected by the subterranean instruments as well as by those placed on the ground, independent of weather conditions and building structures. Indeed, they bore some relation to variations of the barometer. Moreover, the periods of maximum agitations coincided in Rocca di Papa, Rome, Florence and Bologna; and they were approximately verified by the observations made on Vesuvius with a different instrument.

de Rossi concluded that pendulum oscillations are transmitted by the slightest motions of the earth's crust. A definitive result could have been achieved only with a larger spread of tromometrical stations and with the comparison of their observations: "Now the accumulation of data needed to obtain definitive laws and to identify the first cause depends on multiplying the number of observatories. The first cause undoubtedly appears to be seismic or related to seismic phenomena; consequently, it is our hope to identify this with an improvement in that obscure branch of earth dynamics called seismology". At this stage, de Rossi and Bertelli devised and made a simple cheap tromometer.

The production of simple and cheap instrumentation was one of de Rossi's main goals in order to facilitate the multiplication of observatories. In his words: "It is necessary for the progress of science that a knowledge of the methods of observation, cheap instruments and even apparatus which can substitute seismic instruments may be widespread". Furthermore: "Only a multiplicity of observatories will give science the necessary data for the exact study of the cause and the laws of earthquakes. There is a particular need for more observational apparatus which is cheap and simple to use, so the effort to invent such instruments is praiseworthy".

De Rossi himself devised various instruments, including a simple self-recording seismograph, and its derivations, the microseismograph and the protoseismograph; indeed, he always paid particular attention to simplicity of construction and low costs. In 1877 the success of the project he had started four years previously had become evident: he now had 105 correspondents, and

counted amongst the newcomers such scientists as G. Grablovitz, P. Monte, A. Stoppani and T. Taramelli. de Rossi could proudly announce "a sort of society or new school for the study of subsurface phenomena in Italy".

After the disastrous earthquake of the Isle of Ischia of 4th March 1881, the Geological Committee obtained authorization from the Ministry for Agriculture and Trade to partially finance de Rossi's organization. The following year the Geodynamical Observatory and Central Archives were officially inaugurated in the head office of the Committee, located in Santa Susanna road in Rome. De Rossi became its first director.

On 28th July 1883 another disastrous earthquake at Casamicciola (Isle of Ischia) convinced the government to intervene effectively with the institution of a Geodynamical Committee, of which de Rossi was a member. The committee decided to set up a geodynamical service for the whole country and planned the establishment of three top-level observatories in Catania, Casamicciola and Rocca di Papa.

De Rossi was given the task of detecting a site and designing buildings for the station of Rocca di Papa; in 1889, when the station was nearly ready, the geodynamical service was separated from the geodynamic committee to become a branch of the Central Office of Meteorology. This fact meant de Rossi's dismissal as director. Although he was made director of the observatory of Rocca di Papa, to which he brought all his instruments, he undoubtedly felt this to be an unfair removal from the direction of the organisation he had set up and to which he had devoted all his life.

Not surprisingly de Rossi progressively abandoned his research, and only with growing difficulty did he manage to complete the final issues of the bulletin. Family bereavements and the progression of the disease from which he later died forced him to retire. He eventually died on 23rd October 1898 at Rocca di Papa.

Selected publications

De Rossi, M.S. (1879-1882). "La meteorologia endogena.", 2 vols., Dumolard, Milan.

De Rossi, M.S. (ed.) (1874-1897). *Bullettino del Vulcanismo Italiano* 1-20 (Besides managing the publication of the contributions of Italian and foreign scholars, De Rossi published dozens of contributions and notes on it).

Grablovitz, Giulio (Trieste, 1846 – Casamicciola, 1928 September 19)

Born in 1846, in the Austrian-dominated Trieste, he privately developed an interest, from the early 1870s, in issues concerning seismology and the relationship between seismic phenomena and volcanic, meteorological and astronomical ones.

In 1885 Grablovitz was appointed a member of the Royal Geodynamical Commission which was set up after the earthquake of Casamicciola on 28 July 1883. His task was to establish and direct a geodynamical observatory in that town. Due to some difficulties, he had to set up a temporary seismic station in Porto d'Ischia, where he continued working even after the opening of the observatory of Casamicciola.

His research related in particular to seismometry, where his activities contributed significantly to the development of seismic instruments with more effective registration. Grablovitz devised a system for the scientific use of seismograms, applying astatization both upon horizontal

seismographs and vertical ones. Noteworthy is the system of astatization of the vertical seismograph in which the stationary mass, suspended from a spring inclined at 45° in relation to the vertical one, anticipated solutions introduced in modern seismographs.

His studies on the different velocities of seismic waves led him to propose certain instruments for the registration of slow waves, whereas he considered the short horizontal pendulums devised by Cecchi and the Brassarts best fitted for the registration of “rapid” seismic waves (p and s).

In the following years Grablovitz managed to make an instrument capable of registering seismic waves of differing periods. To this end he modified the horizontal pendulums of Rebeur-Paschwitz. All his subsequent projects were based on this modified instrument. He wrote various seismological papers, the majority relating to his instrumental projects, the rest relating to his ideas for setting up a seismic warning organisation for the whole of Italy whose coordination would have been managed by a central office.

His more effective researches were done in the observatories of the Isle of Ischia, where he worked until they closed down. For his seismic instruments, highly appreciated and also used outside Italy, he received the gold medal at the Milan Exhibition in 1906. He was adviser of the Directive Committee of Meteorology and Geodynamics, a founding member of the Italian Seismological Society (1895) and a member of the Society of Spectroscope Operators.

Extended biography

Born in Trieste in 1846 during the Austrian occupation, Grablovitz obtained Italian citizenship in 1876.

He was a scholar of earth physics and cosmic physics, and started earthly on in his life to deal with astronomy and tide-gauging. In 1874 he published his first astronomical work on the calculation of predictions of celestial phenomena recorded in Trieste and in Italy. The following year he published tables of tidal waves, proposing the use of new kinds of tidal gauges; he realised the tidal gauging programme of the Tyrennian sea entrusted to him by the Royal Talaxographic Committee, and he collaborated with the Royal Navy Hydrographic Institute.

He carried out studies into the frequency of earthquakes in relation to the time angle of the moon; he dealt with smoke holes and the thermo-mineral waters of the isle of Ischia, studying their characteristics in relation to the temperatures and the sea-level. In 1876 he published the “New Seismic Theory of the Tidal Waves” and in 1878 “Relations between the microseismic movements and the lunar-solar action of the tides”.

His activity as a seismologist started in 1885 when he was called to be part of the Royal Geodynamic Commission set up following the earthquake at Casamicciola on 28th July 1883. He was given the task of founding and directing the future Geodynamic Observatory of Casamicciola.

The period of the construction and the activation of the observatory was a particularly laboured one for Grablovitz. Owing to the poor quality of the work and the materials used the scientific activity was strongly hampered. The difficulties encountered convinced him to set up a temporary seismic station at Porto d’Ischia which, after the inauguration of the main observatory called The Great Sentinel of Casamicciola, was to remain his favourite place of work.

Grablovitz’s research activities focused mainly on the field of seismometry, with his theoretical studies and with the practical accomplishments meaning that the seismic instruments could evolve through the adoption of rigorous recording criteria. It was Grablovitz who developed a system for obtaining seismograms that could be used scientifically, by applying the astatization both to horizontal and vertical seismographs. Particularly worth mentioning is the astatization

system of the vertical seismograph in which the stationary mass, suspended from a spring inclined 45° as compared with the vertical (1889), anticipated solutions introduced in modern seismographs.

In the wake of studies relating to the different velocities of the seismic waves he indicated some existing instruments (Cecchi and Brassart short vertical pendulum models) as the most suitable for recording the 'rapid' seismic waves (p and s). He was a skilled designer and technician; he devised several instruments such as the geodynamic water levels and the seismic tank (1895) destined to recording the long-period waves.

Grablovitz managed to obtain with a single instrument the recording of seismic waves of different periods. For this purpose he modified the Rebeur-Paschwitz horizontal pendulums obtaining a new instrument, which constituted the starting point for the successive evolution of his seismic instrumentation.

Grablovitz's output of seismological writings is immense, many of which based on instruments he had himself developed; instead some take into consideration the idea of a seismic surveillance organisation distributed across the national territory and coordinated by a Central Office. Towards the end of his career Grablovitz thought of enlarging the seismic network and a consequent increase in funding that would allow him to organise his observatory and employ new staff. A government decree-law then determined the downsizing of the network nationwide and the closing down of several observatories, including that of Ischia. The transfer of the station and the instruments from Casamicciola to Trieste was decided under the supervision of Grablovitz himself, but a later decree obliged him to retire with the role of honorary director of the observatory. He spent the most fruitful years of his scientific activity in the observatories on the Isle of Ischia following their events and not surviving beyond their suppression.

For his seismic instruments, highly appreciated and used outside Italy as well, he received the gold medal at the Milan Exhibition of 1906. He was adviser of the Directive Committee of Meteorology and Geodynamics, a founding member of the Italian Seismological Society (1895) and a member of the Society of Spectroscopists.

Selected publications

Grablovitz, G. (1888). Sopra un nuovo principio per rendere astatico il punto neutro nei sismografi orizzontali. *Ann. Uff. Centr. Meteor. e Geodin. Ital.* S. II, **8**, pt. IV, (1886), 261-267.

Grablovitz, G. (1892). Funzionamento degli apparecchi in occasione di un terremoto nell'Isola d'Ischia. *Ann. Uff. Centr. Meteor. e Geodin. Ital.* S. II, **11**, p. III (1889), 177-180.

Grablovitz, G. (1896). Nuovi metodi per indagini geodinamiche. *Boll. Soc. Sismol. Ital.* **2**, 41-61.

Grablovitz, G. (1898). Sulla forma delle oscillazioni lente nei terremoti. *Boll. Soc. Sismol. Ital.* **4**, 192-201.

Grablovitz, G. (1913). Sulle varie fasi dei sismogrammi, *Boll. Soc. Sismol. Ital.* **17**, 218-244.

Guzzanti, Corrado (Mineo, 1852 June 2 – Mineo, 1934 March 19)

He trained at a technical college, with no university training. From 1882 Guzzanti started, at his own expense, a private observatory of meteorological and geodynamic phenomena. He put all his energy into the design of new seismic instruments and the study of all the natural phenomena

in some way correlated or thought to be correlated to seismic and volcanic events. He was the promoter of new observatories all over Sicily. He was a typical example of the vast array of observers, from the most varied social and cultural backgrounds, who formed the backbone of Italian seismological observation.

Extended Biography

After studying at a technical institute Guzzanti devoted himself to telegraphy and became director of the Post and Telegraph Office of his birthplace. His seismological activity dates to 1878, the year in which seismic activity occurred at Mineo. In fact, professor Orazio Silvestri, the famous geologist of the University of Catania who had the task of studying the earthquakes of October 1878, knew Guzzanti and soon employed him as his assistant in designing and constructing seismic instrumentation to record local tremors. Afterwards, Silvestri suggested that Guzzanti should establish a seismic observatory in Mineo, which he did in 1882, actually setting it up in his home. The observatory was originally equipped with seismoscopes, but in 1883 it became a seismological as well as a meteorological observatory, and in 1887 it was moved to a room that had been purpose-built and fitted out with instruments, some of which provided by the Italian Meteorological Society and by the Central Office of Meteorology, and some built by Guzzanti himself.

Guzzanti's cooperation with the Meteorological Society appears from his copious correspondence with Denza, the person who developed the first Italian meteorological network.

During the 1890s Guzzanti expanded his research, previously limited to the observation of the phenomena related to the geodynamical activity of the region around the Etna volcano. In 1892 he installed a puteometer in a well in order to record variations in the water-level related to geodynamical phenomena. These observations were compared with similar ones from Catania. Guzzanti made other important observations using a thermometrograph installed at the source of the Fiumecaldo river. He was helped in this by the launderers who washed clothes in the waters of the river. For several years, between the end of the 19th and the start of the 20th century, he collected these data together with tromometric measurements, and seismological and volcanic observations from Etna.

In 1911 Guzzanti studied telluric currents and he was awarded a prize for his scientific pictures. His marked sensitivity for the problems of seismological observation led him to promote various meteorological-seismological observatories in Sicily. This is documented by his correspondence with the "Pennisi" observatory of Acireali. He was one of the founders of the Italian Seismological Society, with eleven of his papers appearing in its Bulletin. He also contributed to important scientific Reviews and Journals, such as the "Atti dell'Accademia Gioenia di Catania", the "Atti e Rendiconti dell'Accademia Zelantea di Acireale", "Bollettino Mensuale di Moncalieri" and the "Rassegna delle Scienze Geologiche in Italia". In addition, he wrote several articles for regional Sicilian newspapers.

The instruments which Guzzanti designed and built were awarded major prizes. More significantly, they enjoyed a wide circulation, both in Italy and abroad. From 1895 till 1916 a 'Guzzanti' microseismoscope with double pendulum was operating in Bucharest where it recorded various local earthquakes. Some of his instruments are still kept in Italy. A microseismoscope with double pendulum which he had designed and which had been made at the Ufficio Centrale di Ecologia Agraria of Rome is kept at the Astronomical Observatory of Palermo. The largest collection of 'Guzzanti' instruments, coming from his personal estate, is now held, in bad conditions, by the municipality of Mineo.

During Guzzanti's half-century of scientific activity he was in touch with famous meteorologists and seismologists, such as Francesco Denza, Michele Stefano de Rossi, Pietro Tacchini, Timoteo Bertelli and Guido Alfani. These rapports are documented in various correspondences. He was a corresponding member of the Accademia di Scienze Lettere ed Arti degli Zelanti of Acireale, and of the Accademia Gioenia of Catania; he was also awarded important scientific prizes.

The relevance of Guzzanti's activity lies in the fact that he was one of the most important private seismological researchers in the whole of Italy. Moreover, he took part in the first Italian seismic network (1878-1879), which had been organised by de Rossi during the 1870s.

Unfortunately, his observatory was ignored when the national geodynamical network was founded; as a consequence it worked only until its founder's death. Furthermore, a large part of his instrumentation and documents have not yet been collected and their real worth has not hitherto been appreciated.

Mercalli, Giuseppe (Milan, 1850 May 21 – Naples, 1914 March 19)

Mercalli was ordained priest on Christmas day 1871. He then studied natural sciences at the polytechnic of Milan where he gained a diploma as a pupil of the abbot A. Stoppani. From that time he broadened his interest for scientific matters: in 1878 Stoppani gave him the task of editing the seismic and Volcanology section of his important work "La Geologia d'Italia" (The Geology of Italy). This was just the start of his extraordinary scientific activity, which may be seen as a successful match between practical and theoretical research; not surprisingly one of his most important works "Vulcani e fenomeni vulcanici d'Italia" (1883) results from the elaboration of the documents he had collected from hundreds of surveys across the whole of Italy.

Moreover, during his long years as a researcher he taught natural sciences, first in religious institutes and then, from 1888, in public schools. In 1892 he was moved to the Vittorio Emanuele school in Naples, where he worked until 1911, the year when he won the competitive examination for the post of director of the Vesuvian observatory. In 1892 he obtained a teaching post in Seismology and Volcanology at the University of Catania, then at the University of Naples.

Mercalli's first important research dates back to 1883, when, after the earthquake of Casamicciola on 28th July, he went to the isle of Ischia to study the phenomena which followed the tremor. His subsequent publication earned him fame among the scholars of Seismology and Volcanology. The following year, with Torquato Taramelli, he led a scientific survey in Andalusia (Spain) to study the effects of the earthquakes which had occurred there. In 1887, again with Taramelli, he surveyed the area damaged by the strong earthquake which occurred on 23rd February in Liguria.

His surveys continued in the subsequent years and covered the important period in the development of Italian and world seismology. From 1905 to 1908 the Ministry of National Education commissioned him to survey Calabria and the Messina area. The copious documentation he collected meant he could identify the proper building characteristics for the high seismic risk area. His name is linked to the macroseismic intensity scale he had invented and disseminated. Moreover, a significant part of his activity was directed to the study of the main Italian volcanoes, Vesuvius and the Phlaegrean area in particular.

As a result of the sheer size and originality of his contribution to a broad range of topics connected with geodynamic phenomena, Mercalli is rightly considered one of the Italian scholars who most of all contributed to seismology.

A good way to sum up his scientific career is in the opinion delivered by the committee which supported his candidature as director of the Vesuvian observatory: "Mercalli has collected such a large quantity of worthy observations, both in the field of volcanology and in that of seismology, and his unceasing activity in surveying all of the phenomena of Italian volcanoes, the Vesuvius in particular, is so worthy of praise, that the most influential Italian and foreign volcanologists undoubtedly consider him the greatest student of the volcano. In every respect he is the best candidate in this examination".

Extended biography

Mercalli was ordained priest on Christmas day 1871. He then studied natural sciences at the polytechnic of Milan where he gained a diploma as a student of the abbot Stoppani. From that time he broadened his interest in scientific topics: in 1876 he published some studies into the ice fields near Como; two years later Stoppani gave him the task of editing the seismic and volcanological section of his famous work "La Geologia d'Italia". This was just the beginning of his extraordinary scientific activity, which may be seen as a successful merging between practical and theoretical research; not surprisingly one of his most important works "Vulcani e fenomeni vulcanici d'Italia" (1883) results from the elaboration of the documents he collected in hundreds of surveys across the whole of Italy. The work is particularly interesting for several reasons. Besides summing up in one single work the various geodynamic phenomena of the Italian territory, as regards earthquakes Mercalli provides thematic cartography of seismicity, on the basis of the frequency and intensity of the earthquakes that had occurred in the various areas, subdivided into chronological ranges. This represents an important methodological step forward, revisited and in some way made official in 1886 by T. Taramelli in his map of the Italian seismic areas. He presented the a catalogue of the Italian earthquakes and main volcanic events.

During his long years as a researcher he taught natural sciences, first in religious institutes and then, from 1888, in public schools. In 1892 he was transferred to the Vittorio Emanuele school in Naples, where he worked until 1911, the year when he won post as director of the Vesuvian observatory. In 1892 he got a teaching post in Seismology and Volcanology at the University of Catania, and later on at the University of Naples.

Mercalli's first important research dates back to 1883, when, after the earthquake of Casamicciola on 28th July, he went to the isle of Ischia to study the phenomena which followed the tremor. His subsequent publication earned him some fame among all the scholars of Seismology and Volcanology. The following year, with Torquato Taramelli, he led a scientific survey in Andalusia (Spain) to study the effects of the earthquakes which had occurred there. In 1887, again with Taramelli, he surveyed the area damaged by the strong earthquake on 23rd February in Liguria.

On these last two occasions Mercalli and Taramelli performed two exemplary earthquake studies on the field that turned out to be fundamental contribution from the methodological standpoint and in the process of elaborating the first Mercalli seismic scale.

In particular, the report on the effects of the earthquake on 23rd February 1887, about 300 pages long, represents an unusually exhaustive and detailed monograph that deals with all the major aspects of the earthquake: the geology of the most shaken area, the effects (their nature, anomalous distribution etc.), the possible causes, the chronology and type of repetition, the

forerunning phenomena). Mercalli was also one of the few Italian seismologists to use, with some plausible results, the original method applied by R. Mallet in the earthquake in Basilicata in 1857, which consisted in using the direction of the fall and the rotation of walls, building elements or objects to graphically determine the epicentre and the hypocentre of the earthquake. His surveys continued in the following years and covered the important period of the development of Italian and world seismology. From 1905 to 1908 the Ministry of National Education commissioned him to survey Calabria and the area of Messina. The rich documentation he collected allowed him to identify the proper building typology for the areas with high seismic risk. His name is connected to the macroseismic intensity scale he had invented and diffused. Moreover a significant part of his activity was directed to the study of main Italian volcanoes, Vesuvius and the Phlaegrean area in particular.

As a result of the sheer size and originality of his contribution to a broad range of topics connected with geodynamic phenomena, Mercalli is rightly considered one of the Italian scholars who most of all contributed to seismology.

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Selected publications

Taramelli, T. and Mercalli, G. (1888). Il terremoto ligure del 23 febbraio 1887. *Ann. Uff. Centr. Meteor. e Geodin. Ital.* S. II, **8**, pt. IV (1886), 331-626 and 4 tables.

Taramelli, T. and Mercalli, G. (1886). I terremoti andalusi cominciati il 25 dicembre 1884. *Mem. R. Acc. Naz. Lincei. Classe Scienze Fisiche, Matematiche e Naturali* S. IV, **3**, 116-223 and 4 tables.

Mercalli, G. (1883). "Vulcani e fenomeni vulcanici in Italia." Vallardi, Milan, 376 and 13 tables, [anastatic reprint, Forni, Sala Bolognese 1981].

Mercalli, G. (1907). "I vulcani attivi della terra.", Hoepli, Milan, viii + 422

Oddone, Emilio (Baldissero Canavese, 1864 October 28 – Torrespaccata, 1940 August 26)

He was graduated in Physics in 1886 from the University of Turin. Between 1889 and 1890 he studied at the Universities of Berlin and Rome. From 1890 to 1892 he was assistant at the geodynamical observatory of Rocca di Papa (Rome), under the directorship of M.S. De Rossi, and from 1892 assistant at the Central Office for Meteorology and Geodynamics (UCMG). In the same year he was called to direct the geodynamical observatory of Pavia, where in 1892 he obtained a teaching post in experimental physics. In 1904 he moved back to the Office. In 1907 he cooperated with the Bureau Central de l'Association Seismologique Internationale of Strasbourg. In 1933 and until 1935, he succeeded Luigi Palazzo as director of the UCMG. He was a member of the Italian committee of Geodesy and Geophysics of CNR and was founder and member of the Italian Seismological Society. As vice-president of the seismological branch of

the International Association of Geodesy and Geophysics he took part in the conventions of Madrid (1924), Prague (1927) and as president, succeeding H.H. Turner who died in 1930, at Stockholm (1930), Lisbon (1933) and Edinburgh (1936).

Oddone was active in different sectors of seismology with several earthquakes studied both in the macroseismic and the seismometric fields. He was the father of several seismic instruments as well as instruments for the static control of structures. Some biographies acknowledge that he was the pioneer in introducing the concept of rock stiffness.

Selected publications

Oddone, E. (1923). Ricerche teorico sperimentali sulle vibrazioni meccaniche del sottosuolo. *Mem. R. Uff. Centr. Meteor. Geodin.* **1**.

Palmieri, Luigi (Faicchio, 1807 April 21– Naples, 1896 September 9)

In 1825 he graduated in Physics and Mathematics and after that in Philosophy from the University of Naples. For several years he taught privately, without being distracted from his experimental research in physics. In 1847 he obtained the chair in Logics and Mathematics at the Naples. Palmieri's first seismic studies date back to the 1850s. In 1851 he and the geologist Arcangelo Scacchi became members of a committee of the Academy of Sciences of Naples given the task of studying of the Melfi earthquake (August 14, 1851). In those years he was offered the directorship of the Vesuvian Observatory, the first geodynamic observatory in the world, but Palmieri only accepted the job in 1854, after the death of its designer and first director Macedonio Melloni.

In 1855, observing the lava erupting from an eruption of the Vesuvius from his observatory, he realised that eruptive activity was accompanied by a series of seismic tremors, some of which were so weak that they could hardly be perceived by a careful observer. He therefore devised an electromagnetic seismograph expressly to register these tremors.

The original concept required that the mercury, which was normally used in seismoscopes, was now crossed by an electric current, rendering the seismoscope far more sensitive; besides incorporating a means of automatically registering any soil motion. This device, the first seismic instrument with a sophisticated recording system, was made in 1856 in the physics laboratory of the University and set up in the 1857 at the Vesuvian Observatory. His systematic collection of seismographic data at the Vesuvian observatory allowed Palmieri to get valuable results concerning the progress of the volcano's activity. Moreover he argued that trembles and seismic tremors are significant forerunners of volcanic eruptions.

In 1864 a new version of the seismograph was set up in the University observatory. This device taught Palmieri that volcanic geological structure attenuate the propagation of seismic waves. Moreover he realised that a broad network of seismic stations equipped with seismographs was necessary in order to study both the speed of propagation of seismic waves and to predict earthquakes. His seismographs and above all the constructive solutions he adopted inspired numerous other scholars in the design of new instruments. Two specimens of his seismographs were requested in Japan and worked from 1874. For his great scientific prestige and his long scientific career, Palmieri was for about 40 years (1855-1896) an important point of reference for Italian and foreign earth scientists.

Extended biography

In 1825 Palmieri graduated in Physics and Mathematics and afterwards in Philosophy at the University of Naples. In 1831 he opened a private school of philosophy and physics which enjoyed a huge success, attracting each year some 400 students. After teaching at the Medical and Surgical College and at the Royal Naval College, in 1847 he obtained the chair of Logics and Mathematics at the Naples University.

Teaching never stopped Palmieri from pursuing his research in experimental physics. Between 1840 and 1845 he worked, both alone and with the cooperation of Linari, on “telluric induction”. In about 1859 he began his studies on atmospheric electricity, to which he devoted the remainder of his life. He published a number of works on this topic, giving valuable results of his research, made with instruments he had himself invented, amongst them his useful double-wire electrometer.

Palmieri’s first seismic studies date back to the 1850s. In 1851 he and the geologist Arcangelo Scacchi were members of a committee of the Academy of Sciences of Naples given the task of studying the Melfi earthquake (14th August, 1851). The survey resulted in the publication of a notable monograph. The following year Palmieri was authorised to study atmospheric electricity in the Vesuvian observatory, which at that time was closed.

The Observatory was inaugurated on 28th September 1845 but had yet to attain full operational standards when in 1849, as a reaction to the popular riots of the previous years, in which his director Macedonio Melloni was involved, King Ferdinand II dismissed him and cut off the funding to the Institute, which was subsequently closed. But Palmieri himself persuaded the King to save the Institute’s activities and reopen it. At the same time, he declined the appointment of director, accepting the post only after Melloni's death in 1854.

In 1855 he was given another task by the Academy of the Sciences: that of surveying, together with Scacchi and Guarini, the eruption of Vesuvius which had begun in May. It was probably during the eruption that Palmieri had the idea of making a seismograph. Observing the flow from the observatory, he realised that eruptive activity was accompanied by a series of seismic tremors, some of which were so weak that they could hardly be perceived by a careful observer. He therefore devised an electromagnetic seismograph expressly to record these tremors.

The original concept required that the mercury, which was normally used in seismoscopes, should now be crossed by an electric current, thereby making the seismoscope far more sensitive, besides incorporating a means of automatic ground motion recording. This device, the first seismic instrument with a sophisticated recording system, was made in 1856 in the physics laboratory of the University and set up in the 1857 at the Vesuvian Observatory.

After the kingdom was annexed to Piedmont, the university system was restructured and Palmieri left the teaching post of logics and mathematics, becoming professor of geophysics. This post involved management of both the Vesuvian and the university observatories. Since then the Institute of Earth Physics and the Vesuvian observatory represented the main institutions for theoretical and practical researches on volcanic and seismic phenomena. Palmieri considerably expanded the observatory's activities, regularly collected the daily files of meteorological, seismic and volcanic observations and began to publish the Annals.

The importance of an advanced observing station was demonstrated during the eruption of 1872, when for the first time a volcanic phenomenon could be directly observed close to its origin. The main phase of the eruption, which had started on 26th April, kept Palmieri isolated in the observatory for about a week. When on 4th May he could go back to Naples he was welcomed by the population as an hero; indeed, due to the exceptional crowds of people awaiting him at the

university, he could not give his planned lecture. His observations of the eruption were collected in a famous paper which was translated into German by Ramelsberg, and into English by R. Mallet.

His systematic collection of seismographic data at the Vesuvian observatory allowed Palmieri to get valuable results concerning the progress of the volcano's activity. He was the first scientist who observed and recorded the "continuous shiver" - later called "harmonic tremble" - which precedes and accompanies eruptions. Moreover, he argued that trembles and seismic tremors are significant forerunners to volcanic eruptions.

In 1864 a new version of the seismograph was set up in the University observatory. This device taught Palmieri that the volcanic geological structure attenuated the propagation of seismic waves. Also, he realised that a wide network of seismic stations equipped with seismographs was necessary in order to study both the velocity of the propagation of seismic waves and to predict earthquakes:

This probably led Palmieri to propose a lightweight model of the seismograph, produced in 1874. Two specimens of the Palmieri seismograph were requested in Japan, whose working was documented in 1874 at the Central Meteorological Observatory of Tokyo.

His seismographs, and above all the constructive solutions adopted, inspired numerous other scholars in the design of new instruments.

In the following years Palmieri's tireless activity generated numerous publications on Vesuvius - in particular chemical and spectroscopic analyses of lavas and fumaroles - on the Casamicciola (Isle of Ischia) earthquakes of 1881 and 1883, on atmospheric electricity and, at the end of his life, on telluric currents. He died on 9th September 1896, a few months after the publication of his last work. By then the Vesuvian observatory was the most important Institute for volcanological research and set the standard for similar institutions which were founded later around the world.

Selected publications

Palmieri, L. (1859). *Ann. del R. Osserv. Meteorol. Vesuviano*. **1**.

Palmieri, L. (1874). Il sismografo portatile, in *Atti Acc. Pontaniana Napoli*, Naples.

Serpieri, Alessandro (born in San Giovanni a Marignano, 1823 October 31 – Fiesole, 1885 February 2)

After brilliant secondary school studies and a period spent at the Ximenian observatory of Florence, where he devoted himself to the sciences, in 1843 he started his teaching activities first in Siena and then in Urbino, where he was appointed "public professor" of Physics in 1846, a post he held until 1885.

His literary and scientific publications include essays on pure physics, astronomy, meteorology and seismology. His first publication dates back to the Polverina (Macerata) earthquake on 12th March 1873 (Central Italy). On that occasion Serpieri studied the earthquake in a highly detailed way, collecting information from various Italian and foreign observatories and paying particular attention to the direction of the shaking and to the identification of the epicentral area, which he called the "seismic radiant". For the gathering of information on the earthquake he circulated a questionnaire, the forerunner of the subsequent macroseismic questionnaires. His research into

animals' capacity to forecast earthquakes was the first ever in this field; moreover, he developed the crucial hypothesis that earthquakes are preceded by electrical and magnetic disturbances. This gave him the idea of bringing telegraphic offices into seismic observatories. In 1873 this project resulted in the establishment of the first telegraphic transmission of seismic information. Serpieri also designed a seismic instrument and probably provides theoretical consulting to his own mechanic, A. Scateni, in the creation of two seismographs.

Teaching remained Serpieri's main activity however, at least until 1884, when the Italian government decided to make it a lay profession. Although he was offered the opportunity of keeping his post - with the new title of "professor" replacing the clerical one of "rector" - he refused to separate religious life from teaching. He then moved from Urbino to Badia Fiesolana (near Florence), where he was appointed rector of the religious college; he died only a few months later.

Tacchini, Pietro (Modena, 1838 March 21 - Spilamberto (Modena), 1905 March 24)

In 1857 Tacchini graduated at the University of Modena. Tacchini's scientific contribution was particularly relevant especially in the astronomical and the astrophysical fields, while in the seismological field his name is closely tied to the history of the foundation of the first official Italian geodynamic service.

After an intense research activity in the astronomical observatories of Modena, Padua and Palermo, in 1879 Tacchini moved from Palermo to Rome, where he was appointed director of the astronomical observatory of Collegio Romano, replacing the famous astronomer Father Angelo Secchi. In the same year he was appointed the job of directing the newly-established Ufficio Centrale di Meteorologia (Central Office of Meteorology). In 1887, under his direction, the office was renamed Ufficio Centrale di Meteorologia e Geodinamica (Central Office of Meteorology and Geodynamics, UCMG), a name which acknowledged the increasing attention to geodynamics.

His work was in particular aimed at giving Italy an efficient meteorological and seismic service. This was possible thanks to Tacchini's great capacity to combine his experience as organiser with his ability to obtain the involvement of the most responsive political offices in his objectives. This resulted in the foundation of various geodynamical observatories, in particular those of Rocca di Papa, Casamicciola, Pavia and Catania, and the geophysical and meteorological stations of Etna, Mt Cimone, Monte Rosa, Sestola (Modena), Tiriolo (Catanzaro) and Caggiano (Salerno).

Tacchini was soon aware of the relevance of promoting seismology and, to this end, he founded in April 1895 the Italian Seismological Society, organising its first congress at the exhibition held in Brescia in September 1902 of seismic instruments. Tacchini paid particular attention to history of seismometry, collecting for UCMG various ancient seismic instruments. This collection, enriched in the following decades, today constitutes one of the world's best-stocked museums on the history of seismology. In 1899, after 40 years' work, he resigned as director of UCMG; three years later, in early 1902, he also resigned as director of the observatory of Collegio Romano.

Taramelli, Torquato (Bergamo, 1845 October 15 – Pavia, 1922 March 31)

An eminent figure in 19th century Italian geology, considered to be the founding father of Italian geology following Italian unification, Taramelli left some important traces in the seismological field as well.

After his degree in natural sciences from Palermo, Taramelli became the Antonio Stoppani's assistant (one of the most illustrious 19th century Italian geologists) at the Milan polytechnic. Fundamental was the Taramelli's contribution to the geological survey and description of some Italian regions in particular the North-Eastern Italy.

He was a fellow of the Accademia Nazionale dei Lincei, of many scientific associations, and chaired the Italian Geological Society in 1890 and in 1905.

He was a founding member of the Italian Seismological Society, a member of the Royal Geodynamical Committee and from 1887 on the Directive Committee of Meteorology and Geodynamics at the Ministry of Agriculture.

In a number of precious studies Taramelli analysed macroseismic fields of some important earthquakes in Italy (e.g. Belluno area 1873, Western Liguria 1887) and abroad (Andalusia 1884).

In Andalusia and in Western Liguria, Taramelli and Mercalli performed two pioneering studies of earthquakes on the field that turned out to be fundamental contributions from the methodological standpoint and also in the process of elaborating the first Mercalli seismic scale.

In particular the report in the effects of the earthquake occurring on 23rd February 1887, about 300 pages long, represents an unusually exhaustive and detailed monograph that deals with all the aspects of the earthquake: the geology of the most shaken area, the effects (their characteristics, anomalous distribution, etc.) the possible causes, the chronology and type of repeat earthquake, the forerunning phenomena.

In 1885 he was invited to join the Geodynamic Commission having the task of developing the Italian network of geodynamical observatories of the Central Office of Meteorology and Geodynamics.

Thanks to his competence and prestige Taramelli was often given the job of coordinating inquiries into Italian seismicity, organising the geodynamic service and studying single earthquakes. In 1886, at the end of the inquiry commission's work towards defining the seismic areas of northern and central Italy, Taramelli elaborated a map of the Italian seismic areas that represents one of the earliest official documents of that kinds.

In the last few years of his life Taramelli suffered from near complete blindness: nevertheless he continued work until the end of his life.

Extended biography

An eminent figure in 19th century Italian geology, considered to be the founding father of Italian geology following Italian unification, Taramelli left some important traces in the seismological field as well. After his university studies in Pavia, his father's work commitments took him to Palermo where he graduated in natural sciences. At that age he had already earned himself special merits for patriotism: he had volunteered for the expedition of Giuseppe Garibaldi's Thousand, marching on southern Italy to conquer the Reign of the Two Sicilies, but a typhoid infection forced him to withdraw.

After his degree in natural sciences from Palermo, Taramelli became the Antonio Stoppani's assistant (one of the most illustrious 19th century Italian geologists) at the local polytechnic. He

then taught sciences at the technical institute of Udine, founded after the re-unification of the Veneto region to Italy, whilst performing an intense research activity on the field. An ardent patriot, in 1866 he took part with Garibaldi's volunteers in the third war of Italian independence, at the victorious battle of Bezzecca. In 1875 he was given the teaching post of geology and palaeontology at the University of Pavia. That same year he published the geological map of the province of Treviso, with its related description, that of Istria in 1878, Friuli in 1881 and the Belluno area in 1883. The great work of geological study performed in the region came to an end with the monograph entitled "Geology of the Venetian Provinces" which won the prize awarded by the Accademia dei Lincei. Upon invitation by the Swiss he published the geological map of the Ticino canton and was a member of the commission studying the boring for the construction of the Simplon tunnel; his reservations regarding the conclusions drawn by illustrious foreign experts later turned out to be tragically accurate

He skilfully illustrated his own scientific works, thanks to his natural gift for drawing, not only of a geological nature; he was one of the first geomorphologists.

He also dealt with hydrogeology, above all the water provision of many urban centres, railways tunnels and seismology. He was a fellow of the Accademia Nazionale dei Lincei, of many scientific associations, and chaired the Italian Geological Society in 1890 and in 1905.

He was a founding member of the Italian Seismological Society, a member of the Royal Geodynamical Committee and from 1887 on the Directive Committee of Meteorology and Geodynamics at the Ministry of Agriculture.

In a number of precious studies Taramelli analysed macroseismic fields of some important earthquakes in Italy (e.g. Belluno area 1873, Western Liguria 1887) and abroad (Andalusia 1884). Given the task of studying the earthquake occurring on 29th June 1873 in the Belluno area (Northern Italy) G.A. Pirona and T. Taramelli drafted an extremely detailed report on the earthquake effects, pausing to reflect on the effects as well as the causes of the earthquake. In the minutely detailed relief of the directions of the falls and the rotation of the walls, of the building components or objects, the two authors seem to draw upon the model applied by R. Mallet, in the 1857 Basilicata earthquake, and utilise such directions to graphically determine the epicentre and the hypocentre of the earthquake, in spite of the total absence in those years of analytical and instrumental methods to calculate these parameters.

In Andalusia and in Western Liguria, Taramelli and Mercalli performed two pioneering studies of earthquakes on the field that turned out to be fundamental contributions from the methodological standpoint and also in the process of elaborating the first Mercalli seismic scale.

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In the last few years of his life Taramelli suffered from near complete blindness: nevertheless he continued work until the end of his life, leaving a work he as writing unfinished.

Selected publications

Pirona, G.A. and Taramelli, T. (1873). Sul terremoto del Bellunese del 29 giugno 1873. *Atti del R. Ist. Veneto di Sci., Lett. Arti* S. IV, **2** (9), 1523-1574.

Taramelli, T. and Mercalli, G. (1888). Il terremoto ligure del 23 febbraio 1887. *Ann. Uff. Centr. Meteor. e Geodin. Ital.* S. II, **8**, pt. IV (1886), 331-626 and 4 tables.

Taramelli, T. and Mercalli, G. (1886). I terremoti andalusi cominciati il 25 dicembre 1884. *Mem. R. Acc. Naz. Lincei. Classe Scienze Fisiche, Matematiche e Naturali* S. IV, **3**, 116-223 and 4 tables.

Taramelli, T. (1909). Relazione all'On. Sen. P. Blaserna sull'operato della Sottocommissione incaricata di visitare i luoghi del terremoto calabro-siculo del 28 dicembre 1908. In: "Relazione della Commissione Reale incaricata di designare le zone più adatte per la ricostruzione degli abitati colpiti dal terremoto del 28 dicembre 1908 o da altri precedenti", 89 -112, Reale Accademia dei Lincei, Rome.

Vicentini, Giuseppe (Ala, 1860 November 2 - Ala, 1944 November 15)

Vicentini graduated in physics at Padua on 7th July 1882 and for the following six years he was the physics assistant at the Istituto Tecnico of Turin. In the academic year 1883-84 he undertook further studies in physics at the University of Turin and in 1885 he won the competitive examination for professor of Instrumental Physics at the University of Cagliari. Four years later he moved to the University of Siena, where he was appointed director of the physics laboratory and of the attached meteorological and geodynamical observatory. Here he installed an early version of his famous horizontal seismograph.

For some years Vicentini published his meteorological data, which are of particular importance for the study of the climate in Tuscany. In 1894 he moved to the University of Padua, where he was given the task of organising a special course in physics. He held this post until 1931, the year in which he retired. In 1895 he had set up a geodynamical observatory in the Institute of Physics of Padua, where he devoted himself to the design of new seismic instrumentation. He designed a highly sensitive seismic instrument based on the original structure of the pendulum used by the pioneers of seismology, namely, the microseismographs for the horizontal and vertical components. These device enjoyed a great huge success both in Italy and abroad. Wiechert himself, during the design phase of his seismographs, came to Italy in 1899 and, when he visited several Italian seismologists to study the instruments they had devised, he expressed his preference for Vicentini's microseismograph, which he defined as the most sensitive.

Unlike G. Agamennone, another great Italian designer of seismic instruments, Vicentini understood the importance of introducing systems of damping in earthquake recording, which he equipped several instruments with.

Extended biography

Vicentini graduated in physics at Padua on 7 July 1882 and for the following six years he was the physics assistant at the Istituto Tecnico of Turin. In the academic year 1883-84 he undertook further studies in physics at the University of Turin and in 1885 he won the competitive

examination for professor of Instrumental Physics at the University of Cagliari. Four years later he moved to the University of Siena, where he was appointed director of the physics laboratory and of the attached meteorological and geodynamical observatory. Here he installed an early version of his famous horizontal seismograph.

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During his long scientific career Vicentini studied electric resistance, Röntgen rays and the radioactivity of thermal springs. Nevertheless, his fame is mainly due to the design and construction of instruments for seismology, which he used for his own research.

Vicentini's studies on the elaboration and improvement of methods, on the correct determination of constants and his systematic researches on physical properties of bodies, were more effective than his work on the discovery of scientific laws and phenomena. In addition, he designed a highly sensitive seismic instrument based on the original structure of the pendulum used by the pioneers of seismology, namely, the microseismographs for the horizontal and vertical components. These devices were enormously successful both in Italy and abroad. At least 50 horizontal and 25 vertical ones were in use around the world from 1895 until the 1970s (in a few cases they are still working) some of these self-built at the observatories and/or modified. Between 1903 and 1905 Emil Wiechert created a series of highly sensitive seismographs for the horizontal and vertical components, which were extraordinarily successful and perhaps constituted the best instruments for mechanical recording ever before designed. In the design phase Wiechert came to Italy in 1899 and during his visits to various Italian seismologists to study the instruments they had devised, he expressed his preference for Vicentini's seismograph, which he defined as the most sensitive. Another important instrument, which he made in 1898 in cooperation with Pacher, was the microseismograph with a vertical component which was used for checking the stability of buildings and, during World War I, for sound-ranging observations. The seismographic station at Vicentini's institute of Physics was visited by a number of famous seismologists such as Milne, Omori and Wiechert.

Unlike G. Agamennone, another great Italian designer of seismic instruments, Vicentini understood the importance of introducing damping systems in earthquake recording, which he fitted to several specimens of his instruments. Especially valuable was the introduction of a magnetic kind of damping system onto his vertical microseismograph, with a water and alcohol-based thermal compensator. A specimen of this instrument, which still exists, worked from 1927 until 1992 in the observatory of Piacenza (Northern Italy).

Selected publications

Vicentini, G. (1895). Microsismografo a registrazione continua. *Boll. Soc. Sismol. Ital.* **1**, 66-72.

Vicentini, G. and Pacher, G. (1899). Microsismografo per la componente verticale descrizione e risultati. *Boll. Soc. Sismol. Ital.* **5**, 33-58.

PART TWO

Alfani, Guido (Florence, 1876 January 17 – Florence, 1940 November 20)

Son of a noble and well-educated Florentine family, Alfani's adolescence was riddled with health problems and strongly affected by his religious vocation. Eventually, in 1896, he found in the Gavi seminary of Livorno a healthier place for him to stay and the chance to combine his great interest in seismology and science in general, together with his religious calling. In the seminary he installed his first observatory which he equipped, at his own expense, with highly sophisticated instruments for those times, including a Vicentini microseismograph in 1898.

He worked at the Ximenian Observatory as assistant to the Director Giovanni Giovannozzi from 1900 until 1905, from whom he took over the management at the time of the latter's retirement.

On two occasions, as early as 1905, for the Indian earthquakes on 4th April 1905 and in Calabria (Southern Italy) on 8th September 1905, he published some good location reports, before direct information had arrived from the areas affected.

Between the end of 1908 and the early months of 1909, first when he was given the chair of visiting professor of seismology at the University of Florence, and then when he was invited to join a commission of inquiry analyzing the places most suited to reconstruction after the devastating earthquake in Messina on 28th December 1908.

Thanks to the enormous energy that Alfani dedicated to his scientific mission, in spite of his weak physical constitution, he was present at the sites of the worst Italian seismic disasters of the early decades of the 20th century (1908 Calabro-Messinese, 1915 Marsica, 1916 Riminese, 1919 Mugello), to study the effects of the earthquakes and to console the population affected.

Alfani was a clever and skilful designer of numerous scientific instruments, particularly meteorological and seismic ones. Helped by the specialized skills of mechanical craftsmen he equipped the Ximenian Observatory with many seismic instruments, and added the analysis of seismograms to the Observatory's Seismic Bulletin, the most important of which were reproduced.

With the intention of equipping the Observatory with increasingly sensitive and up-to-date seismic instrumentation, he initially used the Vicentini microseismograph and the Stiattesi horizontal pendulums, later replacing them with Omori-style instruments improved by himself (Omori-Alfani pendulums), equipping the geodynamic laboratory of the Ximenian with trometrographs, periodic instruments, orthoseismographs, inclinographs, all based on smokey paper recording. Alfani had a three-component Galitzin seismograph model built in the laboratory of the Ximenian Observatory, devising a variation that was less expensive than the original that he called photoseismograph. He studied the realization of the accelometric vibrograph, he dealt with antiseismic building, concentrating his attention also on the creation of meteorological instruments such as a large barometer in which he substituted mercury with gold, and a microbarograph.

He published about 70 works on seismology and, being a great populariser of science, he wrote over 4,000 newspaper articles on various topics in seismology, meteorology and physics. He was engaged in correspondence with over 1,000 correspondents, including the leading Italian and foreign seismologists of the day, receiving over 10,000 letters from them.

He was a member of the Italian Seismological Society from 1907, as well as being the member of numerous academies and national and international associations. He also won several honours.

Extended biography

Son of a noble and well-educated Florentine family, Alfani's adolescence was riddled with health problems and strongly affected by his religious vocation. Eventually, in 1896, he found in the Gavi seminary of Livorno a healthier place for him to stay and the chance to combine his great interest in seismology and science in general, together with his religious calling. In the seminary he installed his first observatory which he equipped, at his own expense, with highly sophisticated instruments for those times, including a Vicentini microseismograph in 1898. He fostered a close friendship, with mutual esteem, with the Barnabite scholars T. Bertelli and C. Melzi d'Eril of the Observatory "alla Querce" and G. Giovannozzi of the Ximenian Observatory, both of which Florentine observatories. Alfani was invited by these scholars to continue his research at their respective observatories. In 1899 Alfani chosen to join the Barnabites, but was refused by the superiors in Rome, and so accepted Giovannozzi's invitation to become **scolopio** and in 1900 became their assistant at the Ximenian Observatory . In those years Alfani was, although he was very young, already highly esteemed in the seismological and meteorological spheres for his scientific as well as religious vocation, and for his insightfulness. In 1905 Alfani took over from Giovannozzi in the management of the Observatory and showed, right from the beginning, his best qualities as an experimenter. On two occasions, as early as 1905, for the Indian earthquakes on 4th April 1905 and in Calabria (Southern Italy) on 8th September 1905, he published some good location reports, before direct information had arrived from the areas affected. Those were years when the ability to interpret the many strong earthquakes that occurred both in Italy and in the world enhanced Alfani's fame among public opinion and among the seismologist, not without causing some envy and displeasure, though. The seismic observations of the Ximenian Observatory, for example, did not find much space in the national seismic bulletins. After the Calabria earthquake in 1905, however, Alfani was called upon to give many interviews, to lecture all over Italy and to provide his expert advice for the setting up of seismic observatories. Alfani found in P. Tacchini, A. Cancani and G. Agamennone, some colleagues that were rather unfavourable towards him. In particular, Agamennone did not miss any opportunities to attack him in their correspondence, and also in the pages of newspapers, either directly or under pseudonyms.

Alfani got his real revenge over his critics between the end of 1908 and the early months of 1909, first when he was given the chair of visiting professor of seismology at the University of Florence, and then when he was invited to join a commission of inquiry analyzing the places most suited to reconstruction after the devastating earthquake in Messina on 28th December 1908.

Thanks to the enormous energy that Alfani dedicated to his scientific mission, in spite of his weak physical constitution, he was present at the sites of the worst Italian seismic disasters of the early decades of the 20th century (1908 Calabro-Messinese, 1915 Marsica, 1916 Riminese, 1919 Mugello), to study the effects of the earthquakes and to console the population affected. His great capacity to design increasingly sensitive seismic instruments allowed him to record a growing number of world earthquakes that he would give early warning of in the newspapers in seismic bulletins and scientific publications. In the 1920s and 1930s, besides his usual interest in the activities of seismology and meteorology, Alfani gave ample space to his qualities as a scientific populariser, with dozens of lectures all over Italy and hundreds of interviews in newspapers. He only slowed down his production in the last two years of his life, owing to health problems.

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He published about 70 works on seismology and, being a great populariser of science, he wrote over 4,000 newspaper articles on various topics in seismology, meteorology and physics. He was engaged in correspondence with over 1,000 correspondents, including the leading Italiana and foreign seismologists of the day, receiving over 10,000 letters from them.

He was a member of the Italian Seismological Society from 1907, as well as being the member of numerous academies and national and international associations. He also won several honours.

Selected publications

Alfani, G. (1905). Un perfezionamento ai pendoli orizzontali a registrazione meccanica, in *Rivista di Fisica, Matematica e Scienze Naturali* **71**, 405-409.

Alfani, G. (1932). Il fotosismografo Alfani, in *Bollettino del Comitato Nazionale per la Geodesia e la Geofisica*, S.II **2** (4), 1-4.

Cirillo, Nicola (Grumo Nevano, 1671 September 10 –Naples, 1735 July 2)

N. Cirillo, a typical exponent of 17th century Naturalism, was a physician and botanist, who studied earthquakes in an original manner, if only in part.

The occurrence of the March 1731 (Southern Italy) seismic sequence provided an opportunity to apply the Cartesian method which Cirillo keenly supported. This demanded that the scientist should "investigate with a continuous and uninterrupted movement of the mind all the data referring to our problem, considering each element of data in detail", so as then to be able to "embrace them in a sufficient and ordered enumeration". In the course of the period of seismic activity in Puglia, Cirillo, with the help of two collaborators, observed the oscillation of two pendulums, circa 26 cm in length, applied to a graduated semi-circle installed at Ascoli Satriano and at Giovinazzo. The choice of these two locations was not accidental: while the first was near the area most shaken by the earthquakes, the second was at four times the distance from the epicentre. The frequent agitations and the more substantial oscillations observed in the pendulum

at Ascoli Satriano compared to those for the similar instrument at Giovinazzo convinced Cirillo that he had found the experimental proof that would demonstrate beyond all doubt how the laws that govern the propagation of every type of movement also held good for seismic movements.

Extended biography

N. Cirillo, a typical exponent of 17th century Naturalism, was a physician and botanist, who studied earthquakes in an original manner, if only in part. Cirillo was born into an intellectual family. When he was orphaned at a very young age, he became a ward of his brother who sent him to the Jesuits' college in Naples. There he was strongly influenced by the mathematician N.P. Giannettasio. At the age of 16 he enrolled as a medical student at the university, where two of his teachers, Tozzi and Caloprese, encouraged him to study the theories and methods of Descartes and Galileo. Moreover, in order to master the vocabulary of science, he acquired a thorough knowledge of ancient Greek; he probably graduated in 1692. After that he privately taught scientific subjects and, at the same time, began his medical practice as Tozzi's assistant. He soon abandoned teaching, devoting himself to medicine, and caring for private patients and those in the public Hospital of the "Incurables".

In 1697 he took over from Tozzi, who had moved to Rome; between 1697 and 1704 he emerged as a brilliant intellectual in the cultural elite of Naples, and for this reason, retained his post when Tozzi returned to Naples.

In 1705 Cirillo won the chair as professor of physics; the following year he secured the second chair of practical medicine, and in 1717, when Tozzi died, he was given the first chair of theoretical medicine. In 1726, despite strong opposition, he was assigned to the most prestigious first chair of practical medicine, which he kept until his death.

Besides his teaching activity, Cirillo was interested in botany and natural history. Having little time for his own research, he concentrated on collecting the most effective research published in the most important scientific journals. He regularly received the Philosophical Transactions of the Royal Society. From 1718 he contributed to these Transactions by writing significant papers on the annual meteorological record, and he wrote two memoirs concerning the 1731 earthquake in southern Italy. Moreover, he became member of the Royal Society. He assembled a rich scientific library and created a botanical garden in which both Italian and foreign plants were cultivated.

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Selected publications

Cirillo, N. (1733). Historia terraemotus Apuliam et totum fere Neapolitanum regnum, anno 1731, vexantis. *Philosophical Transactions* **38**, 79-84.

Cirillo, N. (1747). The history of an earthquake, which shook Apulia, and almost the whole Kingdom of Naples, in 1731. *The Philosophical Transactions (from the year 1732, to the year 1744) abridged, and disposed under general heads* **8**, pt. II, 682-684.

Girlanda Antonino (Laureana di Borrello, 1913 August 28 – Messina, July 1988 July 13)

He graduated in Mathematics and Physics in 1941 at the University of Messina. He was assistant of Mathematical Analysis and soon developed an interest in seismological matters; in 1953 he won the chair of visiting professor of Earth Physics.

He was the senior professor of the physics degree courses. He was a lecturer in Earth Physics at the university, and visiting professor in seismology.

He was director for over 35 years (from 1947 to 1983) of the Geophysics and Geodesy Institute of the Faculty of Sciences of the University of Messina.

In the post-war years he dealt with modernising and enhancing the Seismological Observatory of the University of Messina which, in the early 1950s, had some of the best instruments in Italy, designed by Girlanda himself.

In those years a long collaboration began with the National Institute of Geophysics (today also including Volcanology), the journal called *Annali di Geofisica* and with Pietro Caloi.

In 1956 Girlanda was appointed member of the subcommission for the calibration of the seismographs of the European Seismological Commission, and he was also a member of the subcommission for the alpine explosions, again for the European Seismological Commission.

In 1960 he was invited to join an inquiry commissioned by the High Council for Public Works concerning the link between continental Italy and Sicily.

In 1978 he was named as an expert representative of the Sicilian Region in the work group examining the feasibility of the bridge crossing the strait.

During his career he received numerous awards and acknowledgement.

His most important seismological contributions regard the locating of earthquakes, the deep earthquakes in southern Tyrennian area, the 20° discontinuity. He was also particularly skilled in the design and creation of short-period seismographs, in the optical-galvanometric recordings, as he had monitored the microseismic activity induced by artificial barriers (i.e. dams) in some basins of the Alps.

Galli, Ignazio (Velletri, 1841 July 20 – Rome, 1920 February 10)

He graduated in Natural Sciences and taught for 45 years in the middle school of Velletri. There he founded an observatory in 1867.

The pupil of Arcangelo Secchi (-), the famous Italian astronomer, he took an interest in seismology with contributions related to the effects of earthquakes with particular regard for luminous phenomena. Part of his research and resulting scientific publications were also

dedicated to the phenomena correlated to atmospheric electricity, amongst which ball lightning which is still an important subject of study.

In the seismological field he concentrated his attention on the study and the realisation of new seismic instruments, rewarded with the gold medal at the National Exhibition of Turin in 1884. The technical solutions adopted by Galli to survey the horizontal and vertical movements caused by an earthquake were at the basis of the functioning of numerous seismoscopes built from 1884 by the Brassart brothers of Rome, on behalf of the Central Meteorology Office (and from 1887 also of Geodynamics).

With his writings, amongst which his report on the vibratory form of the seismic motion stand out, he actively took part in the scientific disputes that characterised the development of seismology towards the end of the 19th century. Particularly appreciated even today, as they are cited in present-day scientific literature, are his works on the luminous phenomena observed during the earthquakes, particularly a paper over 200 pages long published in the Bulletin of the Italian Seismological Society on the gathering and classification of the luminous phenomena observed during earthquakes.

Selected publications

Galli, I. (1906). Di alcuni rumori problematici nell'aria e nel suolo. *Atti della Pontificia Accademia Romana dei Nuovi Lincei* **59**, 239-262.

Galli, I. (1910). Raccolta e classificazione di fenomeni luminosi osservati nei terremoti. *Boll. Soc. Sismol. Ital.* **14**, 221-447.

Goiran, Agostino (Nice, 1835 – Nice, 1909)

A. Goiran obtained a teaching diploma in Physical and Mathematical Sciences at the University of Turin; he was later a teacher in Nice first, and later Lodi, Sanremo, Casale Monferrato and several other places.

In 1869 he came to Verona, where he taught physics and natural history at the Royal High School S. Maffei and at the Royal Female College named “degli Angeli”.

Goiran's scientific interests were partly addressed to seismology: most of his activities were, however, dedicated to studying the flora of Verona.

The first subject of observation by Goiran were the seismic phenomena that occurred at Monte Baldo between 1870 and 1876. Such activity earned him the appointment as leader of the commission given the task by the Prefect of Verona, in 1876, of performing an assessment and a thorough analysis of the seismic events at Monte Baldo.

After the publication of his *Seismic History of the Province of Verona* (1880) and definitely starting from 1881, Goiran started up a seismic observatory at the High School Maffei of Verona, equipping it with a seismoscope (in 1891 it was equipped with a Brassart seismoscope) as well as a tromometer, and magnets and a microphone. After 1891 Goiran's publications on the Verona earthquakes came to a halt. The Verona observatory, also thanks to the work of an assistant, nevertheless continued to work at least until 1896.

The documents and the research materials accumulated by Goiran were used, a few years later, by L. Sormani Moretti for the work entitled "La provincia di Verona" published in Florence in 1904.

In 1900 he left teaching and in 1904 he also left Verona in order to return to Nice where he died on 29th October 1909.

Extended biography

A. Goiran obtained a teaching diploma in Physical and Mathematical Sciences at the University of Turin; he was later a teacher in Nice first, and later Lodi, Sanremo, Casale Monferrato and several other places.

In 1869 he came to Verona, where he taught physics and natural history at the Royal High School S. Maffei and at the Royal Female College named “degli Angeli”.

In 1874 he became a full member of the Academy of Agriculture, Commerce and Arts (AACA) of Verona. Within the Academy he held various positions, including that of director of the Academic Museum (from 1878 to 1880) and spokesman for the Commission dealing with the reorganization of the Meteorological Observatory.

Goiran’s scientific interests were partly addressed to seismology: most of his activities were, however, dedicated to studying the flora of Verona.

Nevertheless, from 1869 Goiran was able to develop his seismology research, utilizing Foucault’s Pendulum functioning at the Gabinetto di Fisica of the Royal High School Maffei. The first subject of observation by Goiran were the seismic phenomena that occurred at Monte Baldo between 1870 and 1876. Such activity earned him the appointment as leader of the commission given the task by the Prefect of Verona, in 1876, of performing an assessment and a thorough analysis of the seismic events at Monte Baldo. Other members of the commission, apart from Goiran of course, were G. Pellegrini and G.B. Angelini.

Starting from 1876 Goiran’s research activity became more systematic: during his visit to Monte Baldo, accomplished in the summer of that year, he organised, in the absence of other surveyance instruments, his own network of correspondents. The official meteorologist of Verona, Bertocelli, actually refused in 1875, to position a seismograph at Malcesine, arguing that the phenomena of Monte Baldo had a strictly local interest. One seismoscope was, instead, working at the observatory of the AACA in 1878 and 1879.

After the publication of his *Seismic History of the Province of Verona* (1880) and definitely starting from 1881, Goiran started up a seismic observatory at the High School Maffei of Verona, equipping it with a seismoscope (in 1891 it was equipped with a Brassart seismoscope) as well as a tromometer, and magnets and a microphone. In the *Seismic Effemerides* published that year, Goiran clarified his own objectives: it was a question of starting up the research across the whole of the province, through 3 observatories. After 1891 Goiran’s publications on the Verona earthquakes came to a halt. The Verona observatory, also thanks to the work of an assistant, nevertheless continued to work at least until 1896.

The documents and the research materials accumulated by Goiran were used, a few years later, by L. Sormani Moretti for the work entitled “*La provincia di Verona*” published in Florence in 1904.

In 1900 he left teaching and in 1904 he also left Verona in order to return to Nice where he died.

Selected publications

Goiran, A. (1880). “*Storia sismica della provincia di Verona.*” G. Civelli, Verona.

Palazzo, Luigi (Turin, 1861 January 18 – Florence, 1933 June, 13)

In 1884 Palazzo graduated in physics at the University of Turin and, after having obtained various student grants in Italy and abroad, in 1888 he was appointed assistant physicist at the Central Office of Meteorology and Geodynamics (UCMG) of Rome. He studied terrestrial magnetism, concentrating on measurements, as demonstrated by his charts of magnetic declination and inclination of Italy (1902). In August 1901 Palazzo was appointed director of UCMG (after Pietro Tacchini); in this role he participated in a number of Italian and foreign conventions, while continuing with his research on magnetism. He was one of the Italian pioneers of flight and in 1903 he proposed in Rome the foundation of the Aeronautic Association.

Palazzo's contribution to seismology consisted mainly of his long-running and careful organisation of seismological research in Italy and the Italian colonies. For 30 years he was director of the Italian Seismological Society, having in 1903 succeeded its founder, professor P. Tacchini. Moreover during 1905-1907 he was president of the International Seismological Association.

In 1905 he was called in to join the commission studying the disastrous Calabria earthquake which happened on 8th September 1905, which C. Chistoni, G. Mercalli and T. Taramelli were members of as well.

From 1897 he taught geophysics and meteorology at the University of Rome. He was a member of various academies, including the Accademia Nazionale dei Lincei, the Pontificia Accademia delle Scienze dei Nuovi Lincei, the Accademia Gioenia di Scienze Naturali of Catania. He served on the Council of the Italian Geographical Society and as vice-president of the Italian Meteorological Society. In 1930 he was awarded a prize in Geophysics by the Italian Society for the Advancement of Science. In addition, he received numerous civil honours.

Riccò, Annibale (Modena, 1844 September 14 – Rome, 1919 September 23)

After his secondary schooling in a technical institute, Riccò graduated in natural sciences at the University of Modena in 1868 and, at the same time, gained a diploma in engineering in Milan. In 1871 he was appointed university teacher of geodesy and mineralogy, having meanwhile taught physics in a technical institute in Modena. In 1878 he won the competitive examination for a teaching post in technological physics at the Engineering School of Naples, where he became first astronomer at the observatory directed by Gaetano Cacciatore. After Cacciatore's death he was appointed director, a post which he held until 1890, moving that year to Catania where he had obtained a teaching post in astrophysics. Additionally he was responsible for organising and managing the observatories of Catania and Etna.

Riccò expanded and reorganised the seismic section of the observatory of Catania, where he set up a very important geodynamic station. He was director of the geodynamical service of Sicily and the Sicilian islands. He was a member of various national inquiries into volcanic and seismic phenomena, and in particular: with G. Gemellaro and M. Camerana on the inquiry commission studying the Calabria earthquake which occurred on 16th November 1894 and with C. Chistoni, G. Mercalli, L. Palazzo and T. Taramelli of the Commission studying the Calabria earthquake on 8th September 1905.

He studied the volcanic activity of Stromboli and Etna in great detail; moreover, he published various essays on astronomy and seismology, participated in a number of congresses and was a member of various associations and academies.

Among these was the Royal Academy of Science, Letters and Arts of Modena, where he was a corresponding member from 1882 and an honorary member from 1900.

Selected publications

Riccò, A., M. Camerana M. Baratta and G. Di Stefano (1907). Il terremoto del 16 novembre 1894 in Calabria e Sicilia. Relazione scientifica della Commissione incaricata degli studi dal R. Governo. Parte I - Relazione sismologica. *Ann. Uff. Centr. Meteor. Geodin. Ital.* S. II, **19**, pt. I (1897), 7-261.

Riccò, A. (1906). Sui metodi di costruzione in Calabria (nota preliminare). *Boll. Soc. Sismol. Ital.* **11**, 321-327.

Silvestri, Orazio (Florence, 1835 – Catania, 1890 August 17)

After graduating in philology, literature and natural sciences at the university of Pisa, Silvestri taught natural history at the local grammar school. In 1862 he moved to Naples where he had been appointed assistant of industrial chemistry at the University. During his brief residence at Naples Silvestri began physical-chemical, geological and mineralogical research applied to volcanology. In 1863 he obtained the teaching post of general chemistry at the University of Catania, where he immediately devoted himself to the organisation of the first chemical laboratory of that university. The eruption of Etna in 1865 and the related geodynamical events inspired him to turn his attention to his favourite studies: volcanology and seismology, topics in which he emerged as a careful observer of the progress of the principal active Italian volcanoes. For a brief period of three years, between 1874 and 1878, he temporarily abandoned these studies as he had been appointed full professor of applied chemistry at the industrial museum of Turin. Afterwards he moved back to Catania where he was appointed full professor of mineralogy and geology and professor of geophysics and volcanology. With this task he organised the Volcanological Institute of the university. As he was aware of the relevance of seismological observations for the study of the eruptions of Etna, he promoted the institution of a geodynamical service of Etna of which the Government appointed him director. Moreover he was a member of the main official committees of the second half of the 19th century which had been given the task of studying the eruptions of Etna and any related seismic events. This activity is testified to by the various memoirs he published in the main scientific Italian and foreign periodicals. As president of the Catania branch of the Italian Alpine Club, a branch he had himself founded, he supervised the project for a volcanological and geodynamic observatory placed on Mt Etna. He was, furthermore, a member of various academies and scientific associations, the General Secretary of the Accademia Gioenia di Scienze Naturali of Catania, and member of the Council of the Italian Meteorological Society and, from March 1885, of the Italian Royal Geological Committee.

Valle, Paolo Emilio (Rome, 1913 January 6 – Rome, 1970 November 15)

The life of P. E. Valle was not an easy one. After a labored career as a working student Valle got his degree in Physics at the University of Rome in 1940 with top marks. That same year he was hired as a geophysicist at the National Institute of Geophysics and in 1951 he was given the chair of visiting professor of Geophysics.

Valle, as a researcher, often chose the most difficult pathways: he would set aside tried and tested methods to give his work an original structure, the imprint of his personality. Unfortunately, the rigor that accompanied his approach has only returned a part of his original scientific contribution, through about forty publications that mainly appeared in Italian journals.

In the period from 1940 to 1951 his scientific activity focused upon the propagation of elastic waves in particular the calculation of the amplitude of the Love waves and the theory of the measurement of group velocity, constructed on the basis of the Fourier transform. The exceptional value of these studies was only recognized decades later.

From 1951 he was one of the first to deal with issues relating to the internal constitution of planets, and of the Earth in particular, with the methods of Atomic Physics. Some of his works concerned the determination of the adiabatic temperature gradient in the Earth's interior, which earned him the «Vercelli» prize from the Accademia dei Lincei. A work of great importance was on the use of solid state physics, and more precisely the theory of the Debye ideal solid, in which Valle arrives at an equation of state that is particularly suited to describing the behavior of matter under the thermodynamic conditions present in the Earth's interior. He deals with matters such as the evaluation of the temperature gradient, necessary for the formation of low-velocity layers; the evaluation of the pressure effect on the melting point of substances; the calculation of the melting temperature of iron under high pressures, which was important for the studies into the constitution of the Earth's core, etc. Some results anticipated the subsequent confirmations in the laboratory.

On 1961, after a long interruption due to illness (a heart attack that would eventually be his downfall), Valle resumed his scientific activity with research into seismometry, on the melting point as a function of pressure, on the effect of the zero-point energy on the elastic constants of a solid, on the equilibrium of self-gravitating bodies and, lastly, on the modeling of seismic sequences.

Physically weakened, embittered by his 'administrative' role unsuited to his worth and merits, P. E. Valle had by the end of life withdrawn to a form of stoicism. Hence little of the research mentioned here has actually been made public, except for three works, the last of which is an attempt to model the Sicilian seismic sequence, which started on 14th January 1968.

In this attempt, the question of modeling is faced with the intrinsic method, that consists in the study of a phenomenon per se, through the values of the sizes alone, of which phenomenon manifestations occur. Thus, the actual time of the phenomenon is assumed as an independent variable, operationally defined as the order number of the events. A similar approach has been more recently followed by well-known statisticians aiming to forecast strong aftershocks during ongoing seismic series.

Valle believed that further research performed in this direction could lead to even more important results. This was the reason that drove him to publish the results of such a precious, original piece of research.

Endowed with a rare mathematical gift, he transformed his works into sharp, clever, rigorous summaries that were not easily accessible to the uninitiated. For this reason, much of his research is still awaiting proper recognition, in line with its intrinsic avant-garde value.

Selected publications

Valle, P.E. (1953). An equation of state for solids. *Ann. Geofis.* **6**, 183-197.

Valle, P.E. (1960). Una stima del punto fusione nel mantello della Terra. *Ann. Geofis.* **13**, 79-84.

Valle, P.E. (1966). Il teorema del viriale e l'equilibrio di un sistema autogravitante isolato. *Ann. Geofis.* **19**, 361-364.

PART THREE

Somigliana, Carlo (Corno, 20th September 1860 – Casanova Lanza, on 20th June 1955)

Of noble origins, a relative of A. Volta, Carlo Somigliana was taught by some eminent teachers. He graduated at the Scuola Normale Superiore of Pisa in 1881, and from 1905 he was called to Turin to fill the chair of Mathematical Physics which he held until his retirement in 1935. His name is tied to important results, by now considered to be classical, concerning statics and elastic dynamics, and the potential theory. He is the father of the fundamental equation in elastostatics, known as Somigliana's tensor. The so-called formulae of Somigliana (1888) can be considered, within the scope of elasticity, the equivalent of those of Green for the harmonic functions.

His most important research also concern the propagation of the seismic waves and, in last years of his life, gravimetry: he was the first to observe that the form and the size of the geoids could, in theory, be extrapolated from gravity measures alone.

Pietro Caloi took up the topic of the superficial waves hypothesised by Somigliana (Somigliana waves), with whom he was in very close letter-writing contact, analysing them more deeply in many publications.

In the course of his long scientific career Somigliana held various institutional posts and was a fellow of numerous academies.

Selected papers:

Somigliana, C. (1917). Sulla propagazione delle onde sismiche. Nota I. *Atti della R. Accademia dei Lincei. Rendiconti della Classe di scienze fisiche, matematiche e naturali S. V*, **26**, 369-381.

Somigliana, C. (1917). Sulla propagazione delle onde sismiche. Nota II. *Atti della R. Accademia dei Lincei. Rendiconti della Classe di scienze fisiche, matematiche e naturali S. V*, **26**, 472-480.

Somigliana, C. (1918). Sulle onde di Rayleigh. *Atti della Reale Accademia delle Scienze di Torino* **53**, 618-628.

Somigliana, C. (1919). Sur la théorie des ondes sismiques. *Comptes Rendus des Séances de l'Académie des Sciences de Paris* **168**, 108-111.