Luca Ciancio

THE CLUELESS SCIENCE OF EARTHQUAKES: SOCIAL HISTORY OF KNOWLEDGE AND INTELLECTUAL CHANGE

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Casa Editrice Leo S. Olschki
Casella postale 66, 50123 Firenze ⋆ Viuzzo del Pozzetto 8, 50126 Firenze
e-mail: periodici@olschki.it ⋆ Conto corrente postale 12.707.501
Tel. (+39) 055.65.30.684 ⋆ fax (+39) 055.65.30.214

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ESSAY REVIEWS

Luca Ciancio

THE CLUELESS SCIENCE OF EARTHQUAKES: SOCIAL HISTORY OF KNOWLEDGE AND INTELLECTUAL CHANGE

Rienk Vermij, *Thinking on Earthquakes in Early Modern Europe: Firm Beliefs on Shaky Ground*, London and New York, Routledge, 2021, 256 pp.

Because they are sudden traumatic events able to arouse powerful personal feelings and shake the most deeply rooted collective convictions, from the very earliest times severe earthquakes have raised unavoidable questions. It is not surprising that the societies gravitating around the Mediterranean – regions like Greece, Italy and Asia Minor 'infested' by earthquakes – were early to develop multifaceted thinking about these events.[1] Considering how frequently they are reported in the classical tradition, and that an interest in them persisted throughout late antiquity and the middle ages, it is quite astonishing that a rigorous and verifiable knowledge of such impressive phenomena was so late in coming about. Indeed, it was only at the end of the nineteenth century, with the construction of sophisticated seismometers, that it became possible to measure and compare on a large scale the energy, frequency and distribution of seismic events. Understanding of earthquakes improved during the first half of the twentieth century as a direct result of advances in geophysical research on the Earth's internal structure.[2] However, the now accepted explanation of earthquakes as the ultimate effects of the combined forces generated by tectonic movement and

Università di Verona: luca.ciancio@univr.it

[1] On geomythology in classical world see Salomon Kroonenberg, *Why Hell Stinks of Sulfur. Mythology and Geology of the Underworld*, London, Reaktion Books, 2013.

[2] David A. Valone, *Earthquakes, Theories since 1800*, in Gregory A. Good (ed.), *Sciences of the Earth. An Encyclopedia of Events, People, and Phenomena*, New York and London, Garland Publishing, 1998, 2 vols., I, A-G, pp. 214-219.

subcrustal convection has emerged only about fifty years ago with the theory of plate tectonics.[3]

Because of its characteristics as a sudden and unpredictable event, the phenomenon has had difficulty finding a proper place even in historical studies.[4] From the 1980s, a converging of seismology, archaeology and anthropology led to the creation of a new field of studies known as historical seismology, which saw historians, geophysicists, seismologists, computer experts and geologists engaged in a multidisciplinary effort to assess seismic hazards. The results obtained were more than expected, shedding light on a little known chapter of social, economic and cultural history.[5] In the case of the history of science, a disciplinary history of geology often biased by a retrospective approach meant that the early modern period was substantially unknown in its proper configuration. Even with the spread of more sophisticated approaches, earthquakes continued to receive less attention than 'classical' topics such as the origin of fossils, the genesis of mountains or the discovery of deep time.[6]

Vermij's book, the first comprehensive study of ideas on earthquakes before the epoch-making catastrophe of Lisbon in 1755, rises to meet a difficult challenge since if something like a science of earthquakes really did exist, it was hardly a discipline in itself. It would be more apt to define it as a discourse arising out of a concern shared by philosophers, scientists, historians, theologians, but also by ministers and laymen who had personally experienced earthquakes. As a result of this, along with treatises and essays, the book examines a variety of sources usually not considered by science historians such as private letters and diaries, chronicles, histories, academic disputations, pamphlets and sermons, newspaper articles.[7] Inevitably, *Thinking on Earthquakes*, instead

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[3] Homer E. Le Grand, *Drifting Continents and Shifting Theories*, Cambridge, Cambridge University Press, 1988, p. 233.

[4] In this regard see Grégory Quenet, *Les tremblements de Terre aux XVII^e^ et XVIII^e^ siècle*, Seyssel, Champ Vallon, 2005, pp. 45-73; Emanuela Guidoboni – Jean-Paul Poirier, *Storia culturale del terremoto*, Soveria Mannelli, Rubbettino, 2019.

[5] On the latest research methodologies see Emanuela Guidoboni – John E. Ebel, *Earthquakes and Tsunamis in the Past: a Guide to Techniques in Historical Seismology*, Cambridge, The Cambridge University Press, 2009.

[6] See, for example, François Ellenberger, *Histoire de la géologie. 1*, Paris, Technique et Documentation - Lavoisier, 1988, pp. 47-53.

[7] To gain a sense of the abundance and variety of the historical documentation see Emanuela Guidoboni *et alii*, *CFTI5Med. Catalogo dei Forti Terremoti in Italia (461 a.C.-1997) e nell'area Mediterranea (760 a.C.-1500), An Advanced Laboratory of Historical Seismology*, Istituto Nazionale di Geofisica e Vulcanologia (INGV) 2018, available at http://storing.ingv.it/cfti/cfti5/.

of being a traditional history of scientific ideas is more like a case study of the far reaching intellectual transformation traditionally referred to as the 'scientific revolution'.

In learned culture, the pertinent disciplinary field was that of meteorology, a province within natural philosophy, quite unfamiliar to historians until recently.[8] One peculiarity of this field is that from antiquity it hardly saw any theoretical advancement, anything like a discernible sequence of competing explanatory models. In early modern times, ancient and medieval interpretations continued to circulate in forms that were constantly being re-elaborated. Nevertheless, Renaissance meteorology was by no means static, especially given that a number of dramatic earthquakes hitting towns and regions all over Europe led to urgent demands for explanation. This means that historians need to take a broader look at the complex of intellectual changes of the period with the question of earthquakes becoming an opportunity to investigate the very processes of knowledge production.

Obviously, it isn't possible to give an account here of the extraordinary wealth of new materials examined by the author. Two substantial issues deserve to be addressed in that they offer insights that are generally useful. The first pertains to the role of religious forms of knowledge both in terms of response to earthquakes and how they were interpreted. In this regard, looking at the rise, establishment and decline of what he terms «confessionalized science» may offer a powerful and overarching perspective. Such an approach requires that we explore the subtle interplay between religious ideas and philosophical explanations and the changing demarcation between the natural and the supernatural. By so doing we can access knowledge about how the mental climate in Protestant Europe and in Catholic countries was evolving. The second issue has to do with the problem of identifying the processes and players who most influenced the formation of ideas during a period in which empirical investigation did not offer unequivocal answers in form of experimental data.

The first part of the book (chapters I to IV) provides an essential starting point and examines religious, philosophical, and 'scientific' ideas that early modern scholarship received from antiquity and the Middle Ages. Learned opinions as well as popular interpretations never ceased to be heavily conditioned by religious models which explained earthquakes as punishment for our sins or an announcement of the last Judgement.

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[8] The essential reading is Craig Martin, *Renaissance Meteorology. Pomponazzi to Descartes*, Baltimore, The Johns Hopkins University Press, 2011.

Though religion and theology became increasingly influential, humanist intellectuals in the Italian tradition, relying more on historical sources than on empirical investigation, took an independent position.[9] It was a man of letters, Filippo Beroaldo, who published in 1505 the first scholarly work on an earthquake, an account inspired by stoic ideals to explain what had happened in Bologna that year. Adopting an unmistakably naturalistic approach, learned physicians like Pietro da Toledo and Simone Porzio who were familiar with the volcanic areas in the surroundings of Naples became interested in the efficient causes of earthquakes. But it was the humanist physician Georg Agricola who first suggested, in 1546, that the Earth's internal fire could be the main cause of seismic events, a highly influential hypothesis that inspired philosophers like Cardano, Telesio and Della Porta in their efforts to lay the foundation for a new philosophy of nature, as an alternative to scholastic tradition.

Endeavors like these inspired by the perspective of naturalism were unsuccessful mainly because they continued to rely on a qualitative approach based on the old physiological analogy between the living body and the Earth. Quite obviously, they also failed because of what Vermij aptly defines as the «assault on naturalism» prompted by the new religious sensibilities that exploded during the Reformation. The second and main part of the book (chapters V to XI) traces the rise of a new science of earthquakes dominated by the anti-naturalistic discourse. The debate was centered in the German speaking world where radical thinkers like Luther and Paracelsus had stirred up apocalyptic fever and created an intellectual environment in which the Earth became a theatre for the supernatural manifestations of god or demons. Joachim Camerarius, Philippus Melanchthon and Caspar Peucer turned the study of prodigies, including earthquakes, into a new branch of scholarship.

A Catholic confessionalized meteorology only emerged in the early seventeenth century. Building on the Coimbra commentaries on Aristotle, Jesuits scholars like Libert Fromond, Niccolò Cabeo and, especially, Athanasius Kircher launched a tradition of sublunary physics that remained very influential until the early eighteenth century. In addition to confessional scholarship, popular reactions in Catholic Europe, especially in Italy, took the form of cults of Saints in public ceremonies like the blood of Saint Januarius carried in procession through the streets

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[9] Among Italian humanists, the Dominican theologian of the Venetian Academy Father Valerio Faenzi deserves to be mentioned for his views on earthquakes as a "primary" cause of the rising of mountains. See *De montium origine, Valerii Faventies, ordinis praedicatorum, dialogus*, [Venetiis], in Academia Veneta, 1561.

of Naples. Interestingly enough, Vermij suggests that whereas Protestants «for contemporary miracles had to have recourse to the world of nature», the Catholics, who embedded miracles into stories about saints and relics, «were more free to study nature on its own terms» (p. 112). Incidentally, a comprehensive study of the imagery of earthquakes including devotional iconography – sufficient material for another book – may also prove to be valuable for the history of people's sentiments.[10]

By adopting the category of «confessionalized science» Vermij makes the point that Protestant natural philosophy, Anglican physics, or the science developed by the Catholic orders, may be considered a single movement that shared many common characteristics and goals. Though it varied greatly depending on the region, confessionalized science was also unified by its strong opposition to heterodox and even atheist trends of thought. This program was largely successful, especially in Catholic countries where centralized institutions could effectively impose the orthodox view. Though not eradicated, sceptic, libertine and stoic tendencies were quickly and effectively marginalized.

All this happened long before the rise of a mechanistic view of nature, in a process that was far from linear and which constitutes the main topic of the third part (chapters XII to XV). By the middle of the seventeenth century many scholars began rejecting a confessional investigation of nature and deliberately reduced all phenomena to some universal law of nature. The proliferation of geographical reports arriving from all over the globe greatly stimulated the appreciation of volcanic phenomena, already heightened by the catastrophic eruption of Vesuvius in 1631 which had piqued the interest of Naudé and Peiresc's circle in Paris. The main development, however, was mechanical philosophy. A plethora of new suggestions came from natural philosophers, continental chemists and British experimentalists; but, as Vermij persuasively argues, such theories, including Descartes's theory of the Earth, contributed very little to a new comprehension of the phenomenon. Not surprisingly, the most influential earthquake theory was offered by the chemist Nicolas Lémery. That a fermentation of iron and sulphur could cause a vapour forcing a passage within rocks became a standard explanation of earthquakes and volcanoes, but it was «just a new dress for an old theory» (p. 180).

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[10] On the 'scientific' iconography of earthquakes Susanne B. Keller, *Naturgewalt im Bild. Strategien visuelle Naturneignung in Kunst und Wissenschaft 1750-1830*, Weimar, VDG, 2006, pp. 77-178.

Inspired by the providential view of the Earth system that Kircher developed in his *Mundus subterraneus* (1665), Christian confessions reacted against reducing all phenomena to some universal law and converged toward a view of nature as (mainly) an expression of God's benevolence. The Anglican John Ray and the Catholic Johann Jakob Scheuchzer were the most important representatives of this new empiricism which harmonized with the demands of religion and which began circulating in the second half of the seventeenth-century. This new physico-theology sought to bring about a synthesis but, as Vermij emphasizes, it could neither integrate nor replace the purely empirical work of scientists and the message of more orthodox preachers. Instead, these various tendencies existed side by side and increasingly began diverging from each other. Vermij concludes that, in the period of experimentation and uncertainty lasting from about 1680 to 1715, ideas on nature were no longer directed by a single dominant player.

So, how did thinking on earthquakes change? Though a full discussion is beyond the scope of the book, the author comes to the conclusion that changes in ideas were mainly a result of social and political demands (pp. 6-7, 221-222). Religious interpretations were imposed by ministers and theologians «to propagate piety and turn people into obedient Church members» (p. 128). What emerges here is a significant increase in the influence of religion on scientific and philosophical thinking, definitely not an autonomous process of secularization. When the crucial question is raised of how confessionalized science lost its dominance, Vermij argues convincingly that the older views gave way not because of new inventions and discoveries, but as a result of wider social and political innovations that occurred during the second half of the seventeenth century. The most important factors were improvements in the means of communication – academic journals and periodical newspapers – and the new standards for reporting all kinds of events. New groups of interest such as merchants, journalists and lay scholars seized these for their own purposes and helped to spread new ways of looking at the world. This «new empiricism», often practiced outside scientific circles, was decisive for promoting a revolution in science. In short, innovation was fostered not principally by new ideas, but by new social «engines of change» (p. 158).

Vermij's masterful history of the science of earthquakes is destined to become an invaluable source for scholars of the history of science. For its exemplary, nuanced reading of a large variety of sources, *Thinking on Earthquakes* will also become a work of reference in the history of ideas. However, if the author's aim was to focus «on the development

of learned theory» (p. 11) one wonders whether in concentrating on the processes of confessionalization and deconfessionalization inevitably he does not exaggerate the degree of fragmentation and marginality of dissenting views. The dominant new meteorology developed by pious natural philosophers certainly deserves to be studied in all its variations and manifestations. Perhaps, he could have dealt in more depth with the opposing side as well, whose ideas, after disappearing temporarily from the public debate, reemerged and became more and more persuasive. This might help explain how naturalism, in lingering among literate people, may have inspired lay philosophers in the second half of the seventeenth century and, later, enlightenment naturalists.

In this regard, it might still prove productive to persevere in a line of investigation that has been central to Vermij's research since 1999: the controversy over the nature and action of subterranean fire.[11] According to many natural philosophers, the fire produced by subterranean chemical fermentations – which for some was a single permanent central fire – constituted the planet's thermic generator and was also responsible for the physics of the atmosphere. In the early modern age, the growing relevance attributed to the action of fire or subterranean heat was associated with ancient philosophers such as Heraclitus, the Pythagoreans and the Stoics. In this regard it might also be profitable to consider the revival of ancient atomism, a sort of alternative paradigm whose struggle to develop a new corpuscular physics has been stressed by scholars. Among the primary sources of atomism, Lucretius' views on earthquakes included in his *De rerum natura* also warrant some attention.[12] Lucretius' poem began to circulate openly in Italian humanistic circles in the fifteenth century and, despite a growing opposition by religious authorities, was frequently printed, translated and discussed in the sixteenth and seventeenth centuries. Just to mention a few examples, Giovanni Nardi after publishing his *De igne subterraneo* (p. 173) put out a commented edition of Lucretius' poem in 1647. Between 1664 and 1669, Borelli's pupil, the mathematician Alessandro Marchetti produced a famous Italian translation printed in London some fifty years later.[13] Epicurus' physics was also widely circulated through the work of Pierre Gassendi who in 1649 published his *Epicuri Meteorologia*, as part of his at-

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[11] Rienk Vermij, *Subterranean Fire. Changing Theories of the Earth during the Renaissance*, «Early Science and Medicine», 3, 4, 1998, pp. 323-347.

[12] Titus Lucretius Carus, *De rerum natura*, Lib. VI, vv. 535-607. See the standard translation by W.H.D. Rouse, London, William Heinemann, 1924, pp. 480-487.

[13] Stuart Gillespie – Philip Hardie (eds.), *The Cambridge Companion to Lucretius*, Cambridge, Cambridge University Press, 2007, pp. 136-138, 215, 217-218.

tempt to christianize atomism. It is not unlikely that these were some of the «atheist» stances frequently evoked and strongly opposed by clerics and pious scientists (pp. 152, 216).

The persistence of the debate on subterranean fires suggests that it might also be worth exploring in more depth the connection between the new meteorology and the cosmological debate. After all, it was clear to many that an earthquake represented a dramatic denial of Earth's stillness. As an example, the attempt by Francesco Travagini to explain the motion of seismic waves by the daily rotation of the Earth (p. 174) is especially interesting in light of the Catholic condemnation of Copernicanism. The rising debate over the inner constitution of the Earth could in fact demolish the foundations of Aristotelian cosmology, in addition to his sublunary physics. If the body of the Earth was pierced by subterranean conducts and caves situated at great depth, the question inevitably arises whether its material composition may have an impact on its rotation around the Sun. Not only Renaissance philosophers like Bruno and Campanella, but also astronomers like Kepler speculated about the implications of the different densities of the Sun and the planets. From a cosmological perspective, Robert Hooke's influential *Lectures and Discourses of Earthquakes* could also regain its role. According to his theory of the earth, in fact, variations in the earth's axis and in terrestrial magnetism could change the composition of the planet and cause earthquakes.[14] Consequently, the learned discourse on earthquakes also needs to be seen as part of a wider debate on the inner constitution of the Earth which contributed to forging a proto-geophysics alternative to Aristotelianism.

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[14] Robert Hooke, *Concerning the Figure of the Earth and variations of the Earth's axis*, in Ellen Tan Drake, *Restless Genius. Robert Hooke and His Earthly Thoughts*, New York and Oxford, Oxford University Press, 1996, pp. 246-248.

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