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Between empiricism and tradition: reassessing Francesco Stelluti's Trattato del legno fossile (1637)

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ABSTRACT - This study provides the first comprehensive analysis of *Trattato del legno fossile* (1637), the only palaeontological work published by Francesco Stelluti, a founding member of the prestigious Accademia dei Lincei. The treatise offers a detailed description of fossil wood from the area of Todi (Umbria, central Italy) and represents an important document for understanding early seventeenth-century interpretations of fossils. Despite Stelluti's rigorous observational practice, expressed through meticulous descriptions, classification attempts, and extensive illustrations, he endorsed an inorganic origin for the fossil wood, attributing its formation to subterranean heat, mineral waters, and "transmutative" properties of clay. His interpretation reflects the theoretical pluralism of the early modern period, when traditional mineralogical explanations, emerging empirical approaches, and increasingly widespread organic interpretations coexisted. Stelluti's account reveals the tension between innovative Lincean methodologies, centred on observation and visual documentation, and the persistence of sixteenth-century natural-philosophical frameworks. The treatise, therefore, provides a crucial window into the pre-Stenonian phase of palaeontology, illustrating how careful empirical work could still operate within inadequate conceptual models. More broadly, Stelluti's work highlights the complex, non-linear development of Earth Sciences in early modern Italy, documenting the interplay between tradition and innovation at a time when the scientific understanding of fossils was undergoing profound transformation.

Keywords: Francesco Stelluti; History of Palaeontology; fossil wood; Accademia dei Lincei; Federico Cesi; Umbria.

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1. INTRODUCTION

In the broader context of the emerging Earth Sciences between the sixteenth and eighteenth centuries, one of the most intense debates concerned the true nature of fossils. These objects, characterised by peculiar shapes, often highly symmetrical and of remarkable beauty, and frequently found in great abundance within sedimentary deposits, had long attracted human attention since the Palaeolithic. They became integral components of the folklore of various cultures, fostering myths and legends, and were often employed as ingredients in medicinal practices (e.g., Skeat, 1912; Jones, 1942; Loomis, 1946; Kehoe, 1965; Oakley, 1965; Mayor, 2000, 2007; Lane and Ausich, 2001; Mayor and Sarjeant, 2001; Pull, 2003; Duffin, 2006, 2007, 2008, 2010, 2017; McNamara, 2007; Romano and Palombo, 2017; Romano and Avanzini, 2019; Romano, 2024b).

When fossils began to be investigated as natural objects to be interpreted, two opposing explanatory frameworks emerged: they were considered either the genuine remains of once-living organisms that had subsequently undergone lithification, or merely inorganic productions, *lusus naturae* or "sports of nature", formed directly within sediments (e.g., Rudwick, 1972; Accordi, 1978, 1981, 1984; Morello, 1979, 2003; Romano, 2014, 2015). Within the Italian context, some of the earliest scholars and naturalists to correctly interpret fossils as the remains of former living beings (*ex-vivi*) appeared as early as the fourteenth century. Among them were Ristoro d'Arezzo, followed by Ferrante Imperato, Leonardo da Vinci, Girolamo Fracastoro, Fabio Colonna, Niccolò Stenone (Danish by birth but Italian by adoption), Agostino Scilla, Paolo Boccone, Antonio Vallisneri, Anton Lazzaro Moro, and many others (e.g., Baratta, 1903; Accordi, 1975, 1978, 1981; Morello, 1979; Dominici, 2009; Baucon, 2010; Barras, 2012; Bek-Thomsen, 2013; Luzzini, 2013; Romano, 2014, 2018a, 2023, 2025a, 2025b; Pantaloni et al., 2017; Laurenza, 2018; Smith, 2018).

Their works not only advanced a correct interpretation of fossils but also introduced numerous innovative and foundational elements for the early development of the Earth Sciences, including: i) the first genuine experiments aimed at testing the organic nature of fossils; ii) the formulation of general principles of stratigraphy; iii) the understanding and application of the principle of actualism; iv) the establishment of the first public museum collections and the introduction of references specimens or "holotypes"; v) early insights into fossilization and taphonomic processes; vi) the introduction of concepts distinguishing internal and external moulds of fossils; vii) the first recognition of fossils as indicators of palaeoenvironmental and palaeoecological conditions (Rudwick, 1972; Morello, 1979, 2003; Vaccari, 1993, 2006; Vai, 2003; Vai and Cavazza, 2006; Romano, 2017a, 2018b, 2018c, 2014a, 2025b).

However, both in the Italian and in the broader European context, several authors, often figures of considerable and widely recognised intellectual stature, and in some cases members or founders of prestigious academies, continued, over the same centuries, to favour an inorganic interpretation of fossils. By doing so, they effectively precluded the entire cascade of potential inferences for the emerging Earth Sciences that would have derived from a correct reading of these natural objects. Among those supporting an inorganic origin were prominent figures such as Andrea Mattioli, Gabriele Falloppio, who attributed even the Roman ceramic fragments forming Monte Testaccio in Rome to "*scherzi di natura*" ("sports of nature"), Michele Mercati, Ulisse Aldrovandi (for some fossils), Benedetto Ceruti, and Filippo Bonanni. Included among the proponents of the inorganic hypothesis is also the author examined in the present contribution, Francesco Stelluti.

In the context of early seventeenth-century Italian science, Francesco Stelluti (Fig. 1) emerges as a significant figure for several reasons. These include his participation in the founding of the Accademia dei Lincei, his pioneering role in the use of the microscope as a new tool for naturalistic investigation, and his remarkable intellectual versatility, which ranged from law to mathematics, literature, and natural history. Born in Fabriano, probably on 12 or 29 January 1577, to Bernardino Stelluti and Lucrezia Corradini, he was initially directed toward legal studies in Rome. However, his intellectual trajectory soon broadened into a more interdisciplinary path.

Rome in the early seventeenth century was a vibrant centre for the arts and sciences, providing the ideal setting for the encounter between Stelluti, Prince Federico Cesi (Fig. 2), the Flemish scientist Johannes van Heeck, and the scholar and anatomist Anastasio de Filiis. From this fortunate meeting and subsequent collaboration arose, on 17 August 1603, the Accademia dei Lincei, one of the oldest and most prestigious academies in Europe, which adopted the lynx, an animal renowned for its exceptionally sharp vision, as its emblem, symbolising the rigorous and patient observation of nature *sensu lato*. It is noteworthy that at the time of its founding, Prince Federico Cesi was only 18 years old (Scott, 2001).

Within the renowned institution, Stelluti's interests extended far beyond law and mathematics, revealing from

Fig. 1 - Portrait of Francesco Stelluti (Public Domain/CC0).

Fig. 2 - Portrait of Prince Federico Cesi (Public Domain/CC0).

the outset a marked inclination towards astronomical instruments and the direct, empirical observation of natural phenomena. Within the Accademia dei Lincei, Stelluti was known by his academic name "*Tardigrado*", literally "slow-paced", and adopted the Latin motto "*Quo serius eo citius*", meaning "the slower, the faster". This self-ironic expression framed slowness not as a flaw but as a virtue, emphasising patience, methodological care, and deliberate reflection as essential qualities in serious scientific inquiry.

A decisive turning point in Stelluti's naturalistic research occurred with the introduction of the microscope into Italian scientific laboratories. The instrument, proposed and introduced into the Accademia by Galileo Galilei (Scott, 2001), enabled Stelluti to carry out unprecedented observations, as evidenced by the images of bees published in Federico Cesi's *Apiarium*, issued in 1625 (Fig. 3). The work was promoted by Cesi as a tribute to

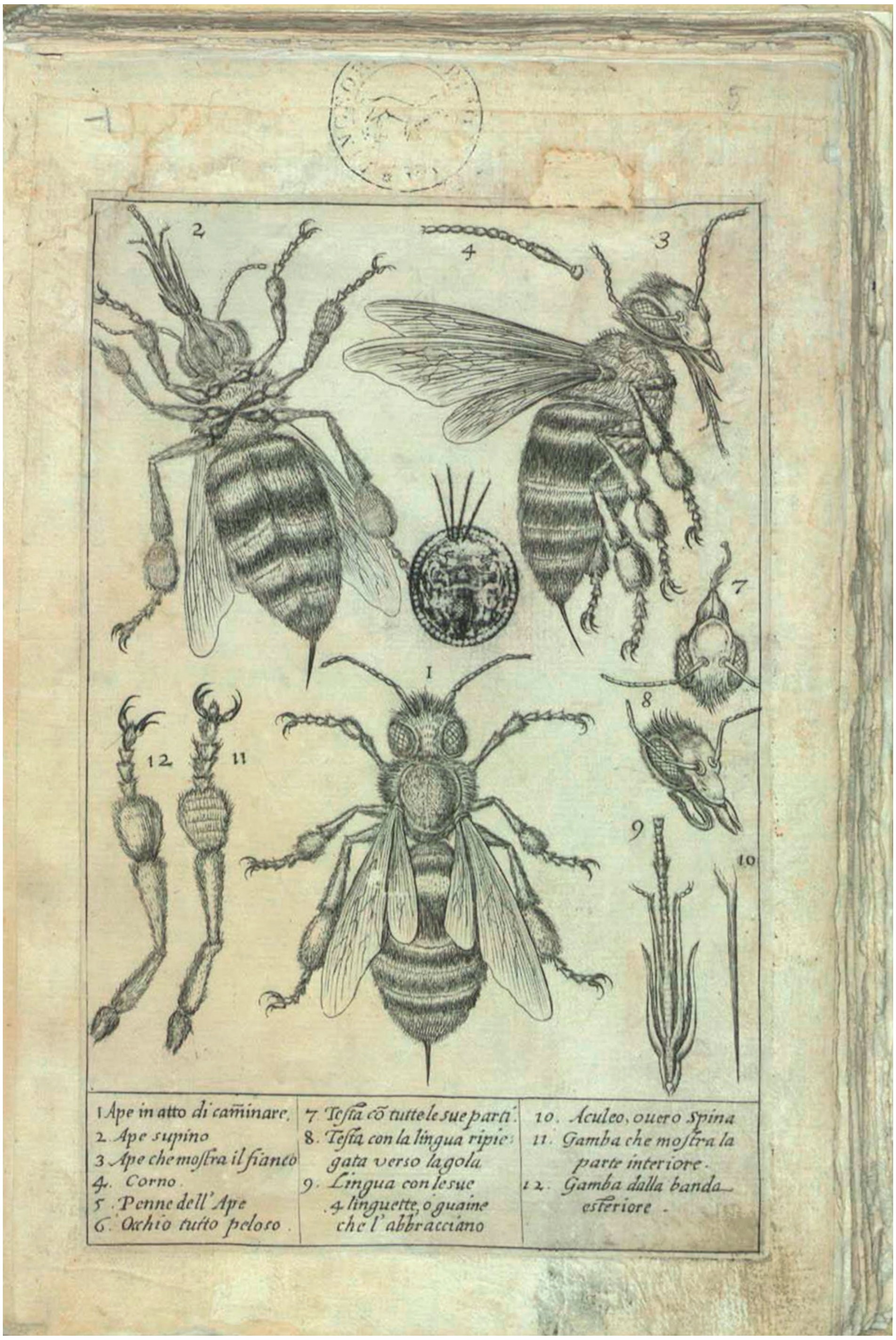

Fig. 3 - Illustrations of bees prepared for the *Apiarium*, representing the oldest known drawings made with a microscope, Rome, 1625 (Public Domain/CC0).

Pope Urban VIII, whose family emblem (the Barberini) prominently features three bees. In the treatise, bees were illustrated under magnification, allowing detailed observation and analysis of anatomical structures that had previously been inaccessible to scholars. *Apiarium* is therefore regarded as one of the earliest published examples of microscopic observations worldwide.

Remaining within the entomological domain and the use of the microscope, in 1630, Stelluti published his free-verse translation of the Satires of *Aulus Persius Flaccus*, into which he incorporated, an extraordinarily bold choice for the period, microscopic illustrations of bees and of a curculionid insect. This work most likely represents the first printed book containing images documented through microscopic observation.

The culmination of the editorial activities of the Accademia dei Lincei is represented by the 1651 publication of the *Rerum Medicarum Novae Hispaniae Thesaurus*, also known as the "*Tesoro Messicano*" (Fig. 4). On this occasion, Stelluti's contribution proved

Fig. 4 - Frontispiece of the work produced by the Accademia dei Lincei titled *Rerum Medicarum Novae Hispaniae Thesaurus* (also known as the "Tesoro Messicano"), published in 1651.

essential and decisive in bringing to completion the collective project of the Academy, which had begun several decades earlier. He played a crucial coordinating role in the final revision, organising the various sections and ensuring the coherence and reliability of the sources. Thus, at the critical moment of Prince Cesi's death in 1630, an event that plunged the Accademia into a period of crisis, it was Stelluti who preserved the memory and legacy of the academic endeavour. His organisational and scholarly commitment clearly transcended the sphere of individual research, demonstrating a level of dedication indispensable to the survival and completion of the Lincean enterprise.

In the present contribution, the only palaeontological work published by Francesco Stelluti is examined, dedicated to the description of the fossil wood found in abundance in Umbria near Todi. The work represents a kind of testament, albeit a partial one, to a major palaeontological project undertaken by Federico Cesi, yet not completed due to his death before publication. Owing to his landed properties in Umbria, Cesi was able to carry out a systematic investigation of the lithological and fossiliferous materials cropping out in the region, focusing his study on the fossil woods originating from the hills between Dunarobba, Rosaro, and Scismano (Scott, 2001). The original aim of Cesi was not simply to catalogue the natural productions of Umbria, but to attempt to understand the nature, origin, and transformation of fossils, questioning their formation through comparisons among locations, materials, modes of preservation, and possible mineralisation processes. To achieve this goal, Cesi combined field surveys, systematic sample collection, microscopic observations, and, above all, extraordinarily accurate drawings, often preparatory to later engravings (Scott, 2001). Many of the fossil woods initially studied by Cesi and subsequently by Stelluti appear with high probability to originate from the same stratigraphic section that would yield, in 1980, the famous Fossil Forest of Dunarobba, with dozens of large trunks preserved in an upright position. The work of Scott (2001) has, in fact, clearly demonstrated the correspondence between the seventeenth-century plates and recent photographs from the modern sites, featuring horizontal trunks, partially eroded trunks, clay-rich levels, elliptical sections due to compaction, and uprooted and transported trunks.

However, upon Cesi's death in 1630, Stelluti decided to carry forward the unfinished project by publishing a synthesis of the work, enriched with personal observations and with the conclusion that the fossil woods should not be interpreted as the remains of real organisms that had once lived. For Stelluti, in fact, these natural productions were nothing other than the result of mineral virtues of the earth capable of transforming clayey matter into wood. Most works on the history of palaeontology have traditionally focused on authors who, according to currently accepted knowledge, correctly interpreted the nature of fossils and the information they could provide to Earth scientists. However, in historical research, it is also of interest to examine works that proposed theories now considered erroneous and obsolete, to understand what drove authors toward such interpretations of nature and what limitations may have prevented the correct reading of natural phenomena. For this reason, in the present contribution, Stelluti's text on fossil wood is examined in full for the first time, also discussing subsequent interpretations and the reception of the original work in the following centuries.

2. THE TREATISE ON FOSSIL WOOD BY STELLUTI

The work examined in the present contribution was published in 1637 by Francesco Stelluti under the original title "*Trattato del legno fossile minerale nuovamente scoperto nel quale brevemente si accenna la varia e mutabil natura di detto Legno, rappresentandovi con alcune figure, che mostrano il luogo dove nasce, la diversità dell'onde, che in esso si vedono, e le sue così varie, e maravigliose forme*" ("Treatise on newly discovered mineral fossil wood in which the varied and mutable nature of said Wood is briefly mentioned, representing with some figures, which show the place where it is born, the diversity of the waves, which are seen in it, and it's so varied and marvelous forms"). The work, consisting of only 12 pages plus the plates, is dedicated by the author to Cardinal Francesco Barberini and was printed in Rome by the printer Vitale Mascardi (Fig. 5).

The text opens with an introductory discourse and dedication addressed to Cardinal Francesco Barberini, dated Rome, 8 May 1637, in which Stelluti reports that already the previous year he had sent the cardinal a brief handwritten treatise concerning the fossil wood in question. Since many people had subsequently asked for a copy of these observations on "that fossil wood, which is found in these parts of ours", Stelluti had resolved to publish a short treatise to satisfy the curiosity of the many "who desired to have a true and faithful account of such a strange wood". In the new treatise, Stelluti writes, in addition to further observations, numerous figures and plates were added so that, through the observation of the specimens, understanding of the text would be made easier for curious readers. The reason for the dedication, Stelluti explains, was due both to the fact that Cardinal Barberini was extremely interested in the "contemplation of the hidden parts of nature" and to the fact that the choice of so worthy and eminent a witness represented a guarantee for the curious reader of the seriousness and veracity of the information reported and commented upon, thus excluding fanciful accounts and observations.

The actual treatise begins on page 5 after the dedication, where Stelluti reports that although all natural productions are marvellous and worthy of study, those produced and found only rarely are even more interesting, since they are more unfamiliar to the naturalist. This latter case, the author writes, is precisely

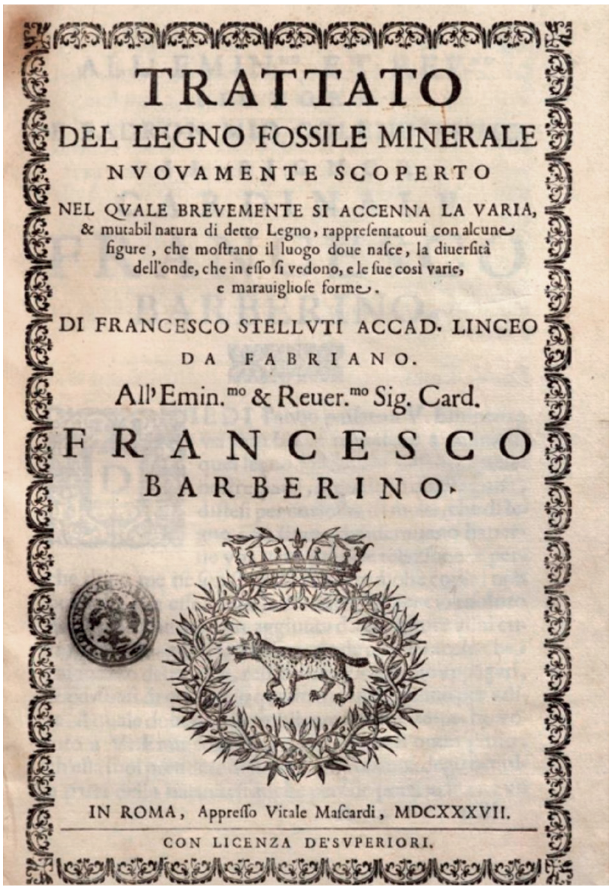
TRATTATO
DEL LEGNO FOSSILE MINERALE
NVOVAMENTE SCOPERTO
NEL QVALE BREVEMENTE SI ACCENNA LA VARIA, & mutabil natura di detto Legno, rappresentatoui con alcune figure, che mostrano il luogo doue nasce, la diuersità dell'onde, che in esso si vedono, e le sue così varie, e marauigliose forme.
DI FRANCESCO STELLVTI ACCAD. LINCEO DA FABRIANO.
All'Emin.mo & Reuer.mo Sig. Card.
FRANCESCO BARBERINO.
IN ROMA, Appresso Vitale Mascardi, MDCXXXVII.
CON LICENZA DE'SVPERIORI.

Fig. 5 - Frontispiece of Francesco Stelluti's *"Trattato del legno fossile minerale…"*, published in 1637 and the subject of the present contribution.

represented by "this fossil or subterranean wood", as defined by Federico Cesi himself, Prince of S. Angelo and second Duke of Acquasparta, who had had the merit of discovering it in previous years. Stelluti immediately refers to this particular wood as a "Metallophyte", to indicate that its nature and composition partake both of plant and of metal, although the plant-related component always appears to be the dominant one.

Stelluti again emphasises how this wood is worthy of study and admiration for its rarity, noting that in his time no report existed of it "arising" in other places, since no mention of it could be found in the writings of other authors who had dealt with "*fossilia*". He states, based on Pliny's Natural History, that even Theophrastus, who addressed many of the objects that today we call fossils and who also discussed "fossil ebony" and the bones that "are generated in the earth", makes no mention of this "wavy wood" that "arises" in our parts. And this wood discovered by Federico Cesi is noteworthy not only for its rarity but also for the "variety of the waves thus in it discovered", and for the many and different forms in which it appears. If compared to the wood of known trees, according to Stelluti, the closest resemblance would be to cedar, which grows in Mauritania on Mount Atlas", used by the ancients to make tables and beds of admirable craftsmanship.

Stelluti, before continuing with the description of the fossil wood, discusses the places where this natural curiosity is found. In particular, it was discovered in the Umbrian Province, in various localities within the territory of Todi, as shown in a map printed in the work (Fig. 6). However, the author reports that the area where it is found in the greatest quantity and variety lies between the two castles of Collesecco and Rosato, not far from the Roman road.

Stelluti then goes on to discuss the possible origin of this most unusual wood. The author states that, based on his observations in the field (Fig. 7), the production of this wood originates neither from seed nor from any type of plant root, but appears to arise from a kind of earth very similar to clay, which "little by little is transformed into wood". With the passage of time, therefore, nature slowly transforms this clay directly into wood. According to Stelluti, this process would be assisted by the presence, in the area where this peculiar type of wood is found, of "certain heats of subterranean fires" which, in those places, he writes, are distributed in the subsoil, "continuously sending out a very thick smoke" and at times even flames. These processes, the author reports, would be more intense and concentrated during rainy periods, and the formation of the wood under study would also proceed thanks to "the aid of sulphurous and mineral waters". If such heat subsequently becomes stronger, it will burn the wood itself, which will remain in the form of charcoal, as is often found on the ground. Conversely, Stelluti reports, if the sediment or clay has not yet been "transmuted" into wood, the action of the subterranean fires leads to the baking of these materials, which then assume the appearance of terracotta and of bricks fired in a kiln. This evidence, according to the author, would be further confirmation that the original material of this wood is none other than earth or hardened clay, whereas the portions already transformed into wood, as said above, burn and turn into charcoal.

Stelluti continues his reasoning concerning the nature of the wood by providing further evidence which, in his opinion, would support its fully inorganic origin. In particular, the absence in these natural objects of roots, branches or "nerves", as are observed in other woods and trees, being represented "only by simple trunks of different forms, and not upright as they grow in all plants, but lying stretched on the ground" (Fig. 8), would exclude that such trunks arise from seed or from root as observed in all other plants. Another element, according to the author, would be represented by the pattern of the "waves or veins" (Fig. 9), which do not continue with the same form throughout the wood as observed in living trees, but are "shaped differently, now long and straight, now narrow, now wide, now circular, now sinuous, and in a thousand other various forms". Conversely, Stelluti continues, in living wood knots are observed mostly in the area near the roots, and the "veins" continue with the same pattern along the full length or height of the

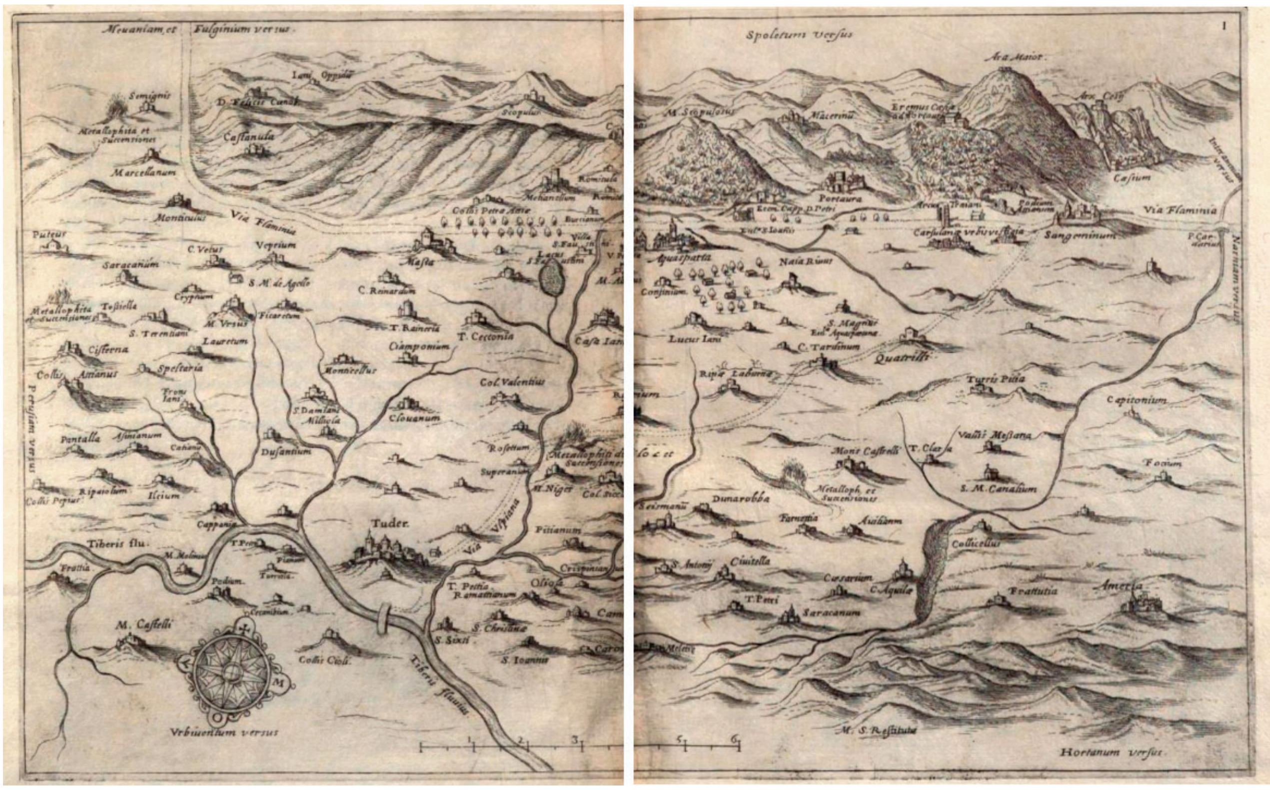

Fig. 6 - Map reproduced by Francesco Stelluti in his 1637 work to indicate the main localities in the territories of Todi and Acquasparta from which the fossil wood discussed in the treatise originated.

Fig. 7 - Original illustration from the 1637 work, depicting the original outcrop setting of the fossil wood near the castle of Rosaro, with stream incisions exposing the specimens and underground vapour emissions rising to the surface, interpreted as one of the generative causes of the objects described.

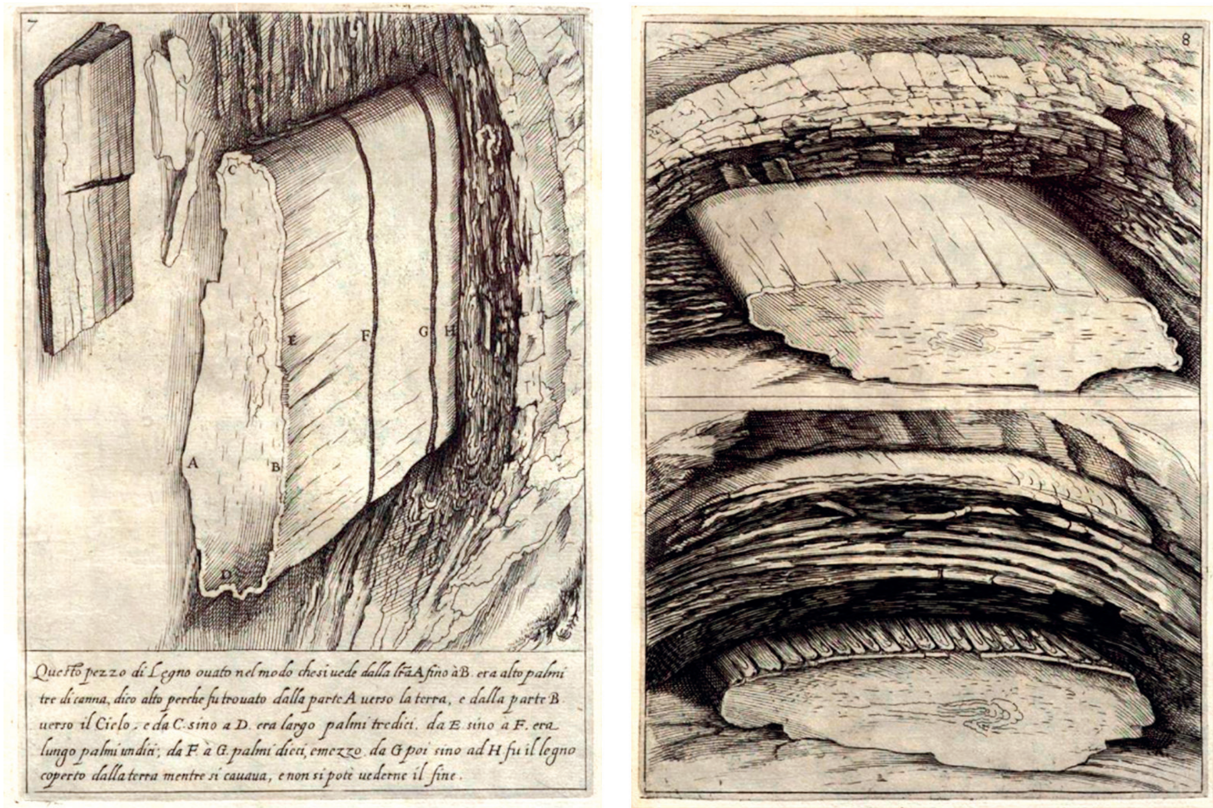

Fig. 8 - Illustration of fossil tree trunks in their original position within the sediments. As reported by Stelluti, the trunks, rather than being vertical as in living plants, are lying on their side and exhibit a flattened elliptical shape, which the author interpreted as resulting from the subterranean development of the material resembling wood.

Fig. 9 - Plates illustrating the different types of "waves" (wood grain patterns) observable in section after cutting and polishing the fossil wood specimens.

tree, “which from the roots has its nourishment”, and therefore the “nerves and veins” develop along the length of the plant. A completely different condition, however, is observable in the “mineral wood” he describes, since these trunks, being positioned horizontally, take “their nourishment” from every portion of the earth, thus producing irregular “waves” and forms of great variety.

According to Stelluti, the hypothesis should also be excluded that these trunks had been buried in the past or that, once fallen to the ground, they had been covered by earth and then shaped with those characteristic waves by the action of the mineral waters emerging in that place and by the subterranean fires described above. The author states that at first this latter interpretation appeared to him to be the most probable and correct one. However, the detailed study of this wood, according to Stelluti, finds no analogue in living trees with respect to the highly variable forms of the “waves” and structures observed. In particular, he cites two pieces of trunk illustrated in the plates, one of which is of large dimensions and was recovered from the sediments and is characterised by an oval section (Fig. 8). Stelluti explains that the deviation of this section from the typical circular section observed in the trunks of real trees is because, since this mineral wood lay horizontally and had the weight of the sediments above it, this prevented the wood from growing vertically, causing it instead to expand laterally. Such observations, the author continues, would represent a further confirmation that the original matter of this mineral wood must have been “a chalky substance” slowly transformed into mineral wood. Furthermore, the “waves” visible in it do not continue uniformly from one end of the trunk to the other as in real trees, but for each portion of wood that is removed, their form changes, “another form of wave appearing; and thus, this alteration continues up to the other part of the wood”.

Another noteworthy property of this wood, Stelluti continues, is that if it is worked while still fresh, immediately after being extracted and not left to season for years, it can be bent into an arc on the side where the “waves” are present, and it has been used to make crosses with boards only two or three fingers wide. If exposed to fire immediately after being taken from the ground, it burns slowly, emitting, in addition to a great deal of smoke, an unpleasant smell. Conversely, Stelluti writes, once dry it emits much more heat, to the point that “one cannot stay near it, as with the fire made from other wood”, and the duration of its combustion is also greater compared with any other type of combustible material. He reports, in fact, that when the wood has “already begun to turn to stone”, it can remain for two or three days exposed to the flame without being consumed.

Regarding the types in which this “mineral wood” occurs, Stelluti reports the following conditions: i) pieces, both large and small and of various shapes, completely turned to stone; ii) others in which it was impossible to decide whether they were composed of wood or stone, with an intermediate nature definable, according to the author, as “wood-stone”; iii) other trunks that had the appearance of wood but whose substance was entirely stone; iv) in other specimens the inner part was composed of wood while the outer part was of stone, and conversely in others the inner part had been changed into stone and the outer into wood (Fig. 10). Stelluti then continues by emphasising how nature, almost playfully, creates marvellous and rare works, such as certain pieces of wood found in various places and characterised by “splinters of metal” that showed a resemblance to marcasite. Among these, some appeared fragile and elongated like iron wire, positioned along the entire length of the “wood” and with a smooth and perfectly rounded finish, as in worked metals emerging from the turner’s lathe.

In some ditches, the author writes, watercourses have brought to light long trunks, where one part seems to be formed of pure clay, part of clay and wood, and part of wood alone. Moreover, many trunks are characterised by varied and unusual shapes, ranging from long forms with highly variable circumferences to turbinated, pyramidal, ovoid, globose, cylindrical shapes, and even forms “so extravagant that they can scarcely be described”. The hardness and consistency of the outer part of the trunks (he is probably referring to the bark) may also vary among specimens, Stelluti reports, with cases in which it is “fibrous and fragile”, in others very hard and wrinkled, and in others black in colour like charcoal.

Stelluti then reports an empirical experience which, in his opinion, should leave no further doubt concerning the inorganic nature of the fossil wood. He writes, in fact, that he had taken a portion of moist earth which, on the ground, surrounded one of these woods, and had placed it in a room of the palace at Acquasparta belonging to Duke Federico Cesi. After several months, Stelluti writes, the earth was found to be completely converted into wood, to the astonishment and wonder of the prince himself and of the other people who had the opportunity to observe the transmutation. From this evidence, Stelluti writes, “there is no longer any doubt whatsoever that the earth is the seed and mother of this wood”, with full power to generate it.

In the treatise, in addition to the fossil wood, Stelluti also discusses other fossils and, in particular, ammonites, fossils quite common in Umbria (Fig. 11). The author speaks of “forms carved in the rock” that recall the shape of snails and of serpents coiled upon themselves. Such objects, Stelluti continues, because of their form, similar to the horn of a ram, are called “horn of Ammon”, formed with this particular structure by nature itself. Stelluti states that these spirals are formed by spirals so perfect that he himself would have interpreted them as entirely artificial, had he not found them directly in the field, not only in the territory of Acquasparta but also near Fabriano, his place of origin, as we have already mentioned. Stelluti reports that several authors have already spoken in the past about the subject of ammonites, among them Gessner, Pliny, Agricola, Bellonio, Imperato, and Federico Cesi himself, who, as already stressed above, was preparing a treatise

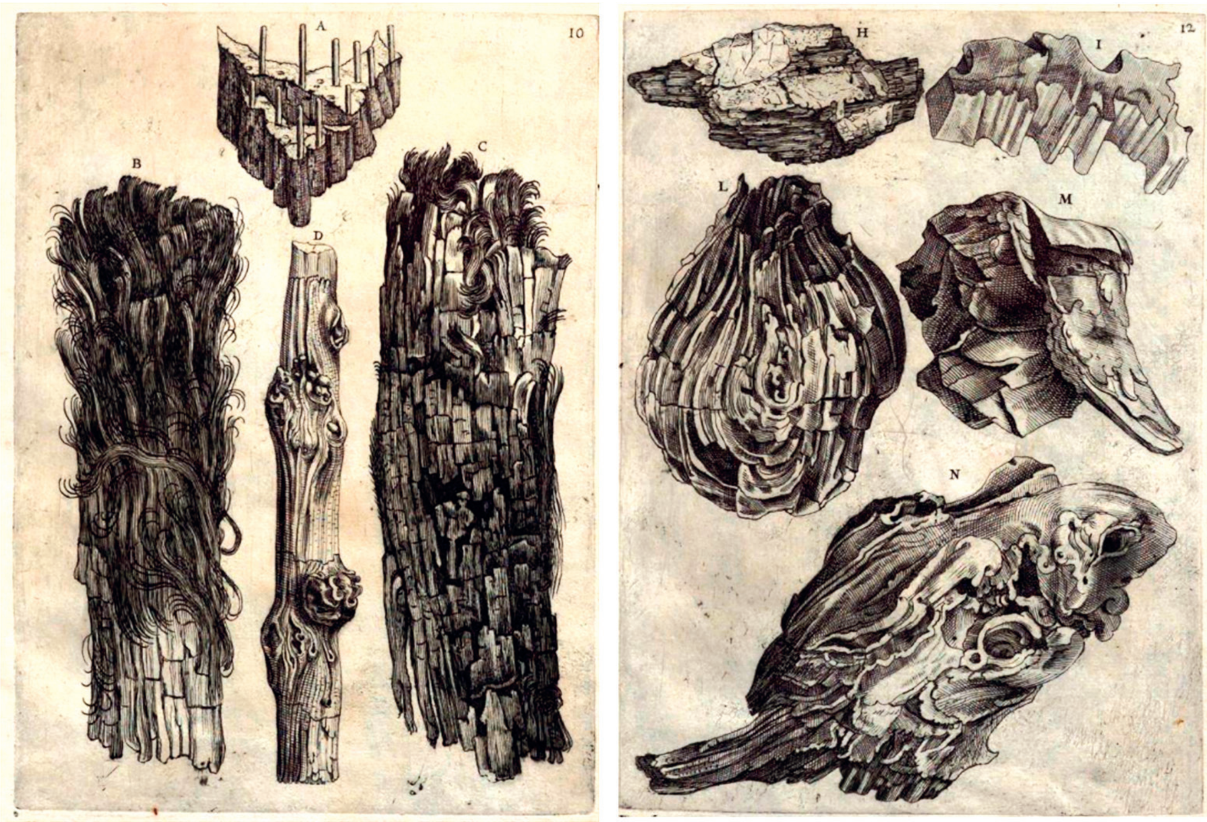

Fig. 10 - Plates illustrating the macroscopic appearance of different types of fossil wood from the deposits near Todi discussed in the 1637 treatise. The specimen marked with the letter A, in the author's words, represents "that kind of wood in which those long rows of metals we have mentioned are formed". The trunks B and C are described by Stelluti as "fibrous" or "capillary" because of their strong resemblance to hair. The trunk D is considered by Stelluti to be of particular interest, as its inner portion is reddish in colour and completely petrified, whereas the outer portion was "of barky and knotty wood" as shown in the illustration.

focused precisely on these topics, which, however, he was unable to complete because of his passing.

3. DISCUSSIONS AND CONCLUSIONS

In the present contribution, the work on fossil wood written by Francesco Stelluti, based on material found in abundance in Umbria near Todi, has been examined in detail for the first time. As already emphasised by Scott (2001), the fossil remains first observed by Federico Cesi, and later by Stelluti for the preparation of the treatise, can be considered essentially equivalent to those from Dunarobba, a well-known and extensively studied fossil forest (e.g., Ambrosetti, 1995; Staccioli et al., 1996, 2001; Palanti et al., 2004; Baldanza et al., 2009; Martinetto et al., 2014).

The figure of Francesco Stelluti must be contextualised within a crucial turning point of Italian scientific culture between the late Renaissance and the Early Modern Age, when the interpretation of fossils, and more generally of various phenomena of the natural world, was still the subject of heated debate and had not yet reached the conceptual form it would assume with Steno and with the naturalists of the late seventeenth century. His *Trattato del legno fossile* of 1637 constitutes a singular document, in which elements characteristic of the emerging empiricism promoted by the Lincei coexist with the clear persistence of mineralogical and philosophical traditions of the sixteenth century. According to such readings of the natural world, it was in fact legitimate to hypothesise processes of "transmutation" of matter, capable of forming in nature objects resembling wood but lacking a real organic origin. In this sense, Stelluti's text is emblematic of a transitional period, in which modern science was still in the process of constructing its own theoretical and methodological instruments.

As seen, Stelluti must be read and interpreted within the framework of the Accademia dei Lincei, an intellectual movement that was undoubtedly among the most advanced in early seventeenth-century Europe. His participation in the *Apiarium* of 1625, the first publication in the world to contain microscopic illustrations, demonstrates his full adherence to the Lincean programme, founded on the centrality of vision, on the systematic use of optical instruments, and on the visual reproduction of natural phenomena. However, the *Trattato del legno fossile* seems to show, quite surprisingly, a certain distance from the more modern and advanced interpretations of fossils as lithified remains of once-living organisms, already widespread in the Neapolitan context of Ferrante

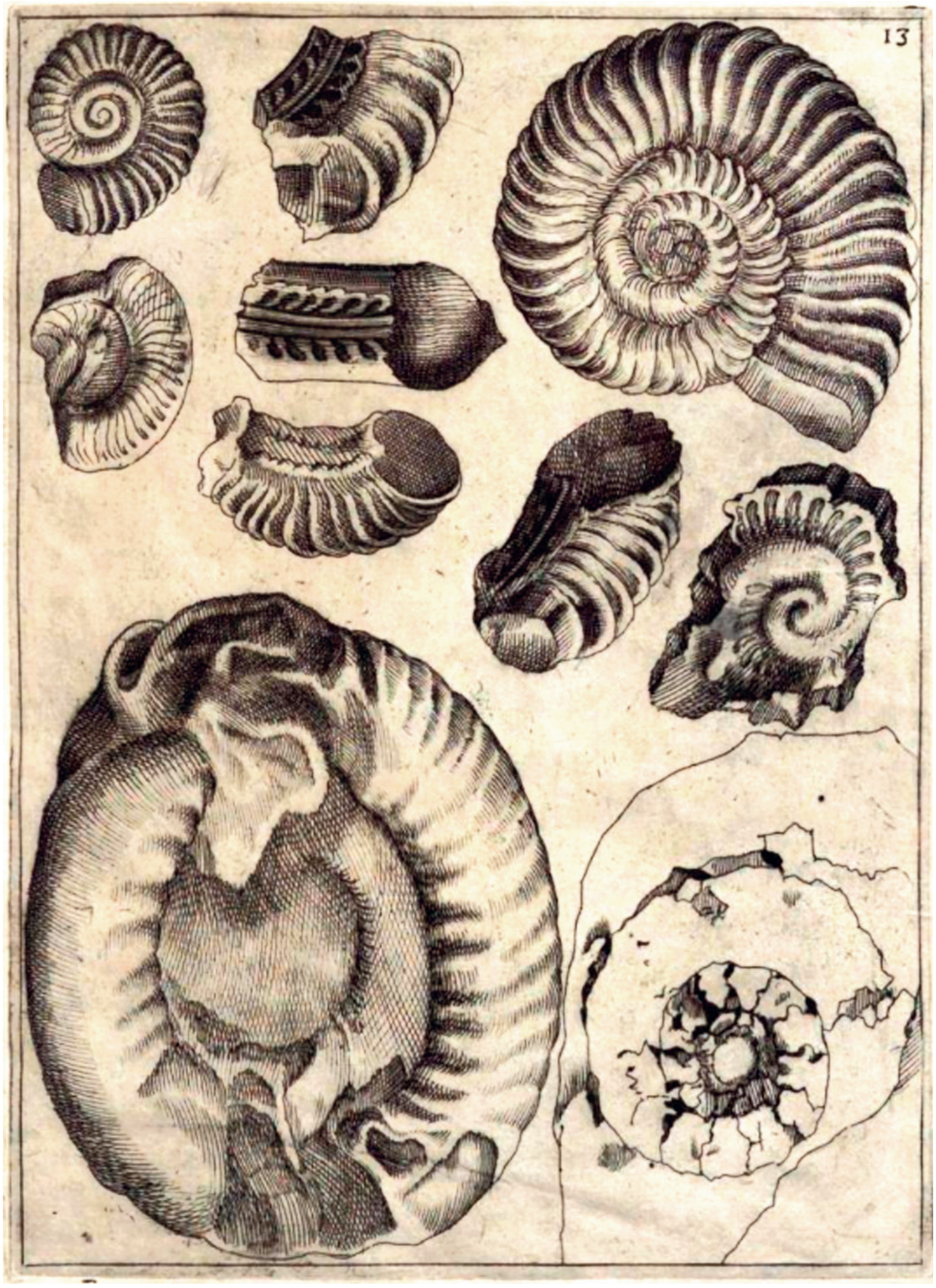

Fig. 11 - Plate depicting examples of ammonite fossils commonly found in several localities of Umbria and briefly mentioned by Stelluti in the treatise on fossil wood.

Imperato and, shortly thereafter, in the Ravenna circle of Fabio Colonna. Stelluti's inability to recognise the organic nature of the fossil wood from Todi, despite the fine and meticulous observation reported in the text, represents one of the key interpretative points of his work, and at the same time one of the most interesting aspects for the early history of palaeontology and geology *sensu lato*.

The treatise, as seen, describes in great detail the forms, the internal structures, and the modes of transition between apparently lignified trunks, carbonised portions, and completely petrified parts. Stelluti dwells on the variation in hardness, on the presence of "waves" and "veins", on the often oval geometry of the sections, and on the alternation of woody material and mineral material. All elements that today we know to be perfectly consistent with the processes of compression and deformation under simple lithostatic load. However, within Stelluti's conceptual framework, they become, on the contrary, clear indications of the inorganic nature of the material. The Lincean naturalist, in fact, interprets the structural irregularities as incompatible with a vegetal origin and as proof of the formation of the "fossil wood" starting from a "clay" transformed by mineral waters, by fumaroles and by subterranean heat, elements that he directly observed in the region near Todi. The presence of hydrothermal activity assumes in his reasoning a crucial role, because it provides a plausible physical agent capable of "cooking" and "modelling" the earthy matter until giving it the appearance, though not the substance, of wood.

This interpretative error, however, should not be read as simple naivety, but as a direct effect of a sort of theoretical pluralism characteristic of the early seventeenth century, when at least three major explanatory models coexisted: the traditional one, which regarded fossils as *lusus naturae* or mineral products endowed with formative virtues; the more modern one, which recognised their organic origin; and the intermediate one, which hypothesised a kind of "metallophyte" nature, that is, a hybrid capable of imitating living forms without deriving from them. Stelluti moves precisely within this third perspective, which was shared by many naturalists of the period, including Mattioli, Falloppio, Mercati, and Bonanni, who continued to interpret ammonites, *glossopetrae,* or lithified fish teeth as mineralogical phenomena or spontaneous petrifications of the earth. The fact that Stelluti, despite being a member of the Lincei, adopts such a conservative position with regard to fossils shows how the Italian scientific environment of the seventeenth century was still marked by deep tensions between old and new paradigms, and how the Lincean culture itself was not entirely homogeneous in its epistemological orientation.

A significant element of the treatise is undoubtedly the role and importance attributed to the illustrations. Stelluti accompanies his observations with plates depicting sections, deformed trunks, and variations in petrification. These images, similar in layout to those of the *Apiarium*, are not mere ornamental embellishments but genuine cognitive instruments. They represent an attempt to capture and convey to the reader the variety and complexity of the natural phenomenon under study and should be interpreted as evidence of the Lincean awareness of the value of images in the construction of natural knowledge. The plates give the treatise a modern character, in sharp contrast with the underlying theory, and make the work one of the earliest Italian examples of systematic iconographic documentation of fossil wood.

The reasons for Stelluti's error may have been multiple in nature. A first explanation may be linked to the absence of comparative models, considering that plant fossils were less widespread and less studied than animal fossils. The major Italian naturalistic works of the late Renaissance, from Ferrante Imperato's Historia Naturale to the collections of Aldrovandi, focused primarily on marine fossils, whose anatomical features were far more evident and comparable with living analogues. Fossil wood, by contrast, often appeared devoid of roots, bark, or recognisable growth rings, and was subject to intense deformation. Within an epistemological framework that was not yet stabilised, it might therefore have seemed more intuitive to interpret it as a product generated directly within the earth, shaped by subterranean vapours, rather than as a buried and mineralised plant organism.

A second element that very likely contributed decisively to Francesco Stelluti's erroneous interpretation regarding the inorganic nature of the fossil woods derives, as the re-examination of the materials and sites clearly shows (Scott, 2001), from the stratigraphic position of the levels he observed. Modern investigations, in fact, demonstrate that Cesi and Stelluti worked predominantly in the upper levels of the Pliocene successions of Dunarobba, Rosaro and Scoppieto, that is, in those horizons in which the trunks were transported and deposited horizontally within lacustrine clay sediments, often compressed and fragmented. The photographs and the direct comparisons between the present-day sites and the seventeenth-century drawings (as shown in the plates of horizontal trunks and in the reconstructions of the fossil-bearing fields) provided by Scott (2001) confirm that all the samples then available to the scholars were devoid of any evidence of physiological position. This circumstance, combined with the marked heterogeneity of the preservation states, from organic wood to fully mineralised specimens, favoured in Stelluti the idea of an "intermediate nature" between earth and mineral, rather than the organic interpretation that is obvious today.

The understanding of the vegetal origin would have been radically different if Cesi and Stelluti had had access to the lower stratigraphic level of the Fossil Forest of Dunarobba, revealed only in 1980, where more than forty trunks are preserved in an upright position, with diameters and heights compatible with real trees and lacking any evidence of transport. The presence of vertical trunks, rooted *in situ*, could in fact have provided an unequivocal argument for recognising these structures as the remains of trees that had once lived and were subsequently lithified, most likely directing the entire Lincean project towards a fully organic interpretation of the fossil woods.

Stelluti's treatise, therefore, seems to acquire a historical significance of considerable importance not so much as a contribution to the advancement of palaeontology, representing, as seen, perhaps a step in the wrong direction, but because it vividly documents the complexity of the construction of the science of palaeontology before the "Stenonian revolution". Stelluti's position demonstrates how, even within the scientifically most innovative group in Europe, it was still possible to maintain a traditional mineralogical interpretation, and how theories on the organic nature of fossils were not yet universally accepted even among the most up-to-date scholars. It should also be noted that, even after fossils had been accepted as the remains of once-living organisms, marine fossils continued for a long time to be regarded as demonstrative evidence of the Deluge, conceived as the sole major agent responsible for reshaping the Earth's surface after "Creation". Mountain building (orogenesis) itself was explained by several authors as a consequence of the Flood, and a mature understanding of Earth dynamics would only be reached with the revolution of plate tectonics in the second half of the twentieth century (e.g., Dickinson, 1971; Dietz and Holden, 1974; Hallam, 1974, 1975; Ippolito, 1974; Bosellini, 1978; Lewis, 2002; Romano and Cifelli, 2015a, 2015b; Romano et al., 2017; Le Pichon, 2019).

From the reconstruction of the manuscript, there also emerges an interesting parallelism between the progressive diversification of naturalistic approaches and the increasing attention paid, over the course of the seventeenth century, to the processes of formation and transformation of matter. Stelluti observes that fossil wood exists in various "degrees" of petrification and proposes a classification based on the relationship between woody parts and lithified parts. This distinction anticipates, albeit in a conceptually improper manner, modern interpretations of wood diagenesis, demonstrating how careful observation could yield useful insights even when guided by an incorrect theoretical framework. Likewise, his considerations on the regularity of the layers, on the horizontal distribution of the trunks, and on their mode of deposition document a sensitivity to themes of a sedimentological and even "taphonomic" nature that is remarkable for the time.

The value of the treatise can be fully understood only when it is interpreted within the cultural history of the Lincei. Stelluti was a leading figure in the most dynamic phase of the Academy, participated in Cesi's editorial project, and collaborated with Galileo and with many of the great intellectuals of the time. His interest in the "minor" or little-understood phenomena of nature fits within this tradition, which sought to construct a new body of knowledge based on the systematic description of the sensible world. The work on fossil wood, although not scientifically revolutionary, testifies to the intention to explore complex phenomena through the combined use of observation, illustration, and theoretical reflection. However, it also seems to reveal the difficulty encountered by the Lincei in fully freeing themselves from earlier naturalistic traditions, showing how modern empiricism still had to contend with deeply rooted interpretative frameworks.

If one considers the evolution of geology and palaeontology in the following decades, Stelluti's treatise appears as a valuable document for understanding the path that led to the modern definition of the fossil. On the one hand, it preserves the memory of the conceptual uncertainties of the early seventeenth century; on the other, it bears witness to the emergence of a descriptive, documentary mentality that would become central to modern science, with a centrality of naturalistic illustration which, as highlighted by several authors (Rudwick, 1972; Manucci and Romano, 2023), represented one of the necessary revolutions for the emergence of palaeontology. The treatise, therefore, does not belong to the canonical "winning line of palaeontology", but to the broader history of how nature was observed, described, and interpreted in an age of profound intellectual transformation. In this sense, it occupies a fundamental role in the history of Italian geological ideas, because it shows how the birth of modern palaeontology was not a linear process, but the result of a complex interplay between divergent interpretative traditions, between careful observation and inadequate theoretical models, between innovation and epistemic conservatism.

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