

Alma Mater Studiorum - Università di Bologna

DOTTORATO DI RICERCA IN
PHILOSOPHY, SCIENCE, COGNITION, AND SEMIOTICS (PSCS)

Ciclo 34

Settore Concorsuale: 11/C2 - LOGICA, STORIA E FILOSOFIA DELLA SCIENZA.

Settore Scientifico Disciplinare: M-STO/05 - STORIA DELLA SCIENZA E DELLE TECNICHE

PLUTARCH'S CHEMISTRY OF STONES AND METALS: CONCEPTIONS AND
EXPLANATIONS. WITH AN APPENDIX ON THE THESU XML ANNOTATION
SCHEME

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Esame finale anno 2022



«Lysander has the walls of Athens destroyed».

In Langhorne, John, William Langhorne, eds., *Plutarch's Lives*, London; New York, Ward, Lock and Co., 1881.

Abstract

This dissertation presents a systematic and analytic overview of most of the information related to stones, minerals, and stone masonry which is found in the *corpus* of Plutarch of Chaeronea, combined with most of the information on metals and metalworking which is connected to the former. This survey is intended as a first step in the reconstruction of the full landscape of ‘chemical’ ideas occurring in Plutarch’s writings; accordingly, the exposition of the relevant passages, the assessment of their possible interpretations, the discussion on their implications, and their contextualization in the ancient traditions have been conducted with a special interest in the ‘mineralogical’ and ‘metallurgic’ themes developed in the frame of natural philosophy and meteorology. Although in this perspective physical etiology could have come to acquire central prominence, non-etiological information on Plutarch’s ideas on the nature and behaviour of stones and metals has been treated as equally relevant to reach a fuller understanding of how Plutarch conceptualized and visualized them in general, in- and outside the frame of philosophical explanation. Such extensive outline of Plutarch’s ideas on stones and metals is a prerequisite for an accurate inquiry into his use of the two in analogies, metaphors, and symbols: to predispose this kind of research was another aim of the present survey, and this aim has contributed to shape it; moreover, a special attention has been paid to the analysis of analogical and figurative speaking due to the nature itself of a large part of Plutarch’s references to stones and metals, which are either metaphorical, presented in close association with metaphors, or framed in analogies. Much of the information used for the present overview has been extracted —always with supporting argumentation— from the implications of such metaphors and analogies.

It is a guiding assumption of this research that inquiries such as the present and its planned developments would be significantly facilitated by the availability of a digital tool for the indexing and mapping of ideas and of their contexts of enunciation in the texts conveying them. *TheSu* (*Thesis-Support*) is an XML annotation scheme designed for this specific end, intended to be flexible enough to aid a large variety of research objectives in intellectual history. This tool is presented in the introduction to this dissertation along with examples of its possible utility, quantitative analyses, and visualizations of *TheSu*-encoded data extracted from an integral case annotation of Plutarch’s *Aquane an ignis utilior sit*. The appendix to this dissertation presents the human-readable definitions of all the elements and attributes of *TheSu*, exported from the digital documentation of its XML Schema Definition document (version 0.72).

Acknowledgements

Looking back at the last three years and a half from the vantage point of a finished dissertation, I can only confirm my persistent conviction that I have been extraordinarily lucky to find a home for my PhD project in the Department of Philosophy and Communication Studies of the University of Bologna, and I owe this positive feeling to quite a few people, to whom I want to show my gratitude. The greatest luck was to begin my PhD in the frame of the *AlchemEast* ERC project: not only did this allow me to come into contact with a variety of research methods which have left a deep influence on the way I now approach the ancient technical and scientific literature, but it also immediately provided me a friendly environment in which I could share my scholarly interests as well as the problems and joys of my research, and find company in Bologna after I had left in Rome almost the entirety of my network of acquaintances and friends. I am grateful to every past and present member of the *AlchemEast* team, but special thanks must go to the P.I. Matteo Martelli—in whom I found a remarkably supportive and resourceful supervisor, available to help me both in normal times and during crises—and to Lucia Raggetti, reliable advisor and sharer of most interesting bibliographic and manuscript material.

As my PhD proceeded, I began to feel more and more at home at via Zamboni 38, as a functional member of the larger group of historians of science with which I have shared (and will keep sharing) numerous academic activities and dinners; in this regard, a special thank must go to Marco Beretta, director of the OFFISS (Officina di storia delle scienze), a harbour in which I was allowed to work whenever I wanted in the company of like-minded colleagues of varying academic age. I was also lucky to find colleagues whom I could bother very often to discuss philological and philosophical problems related to my research, and with useful results: for their helpful suggestions and patience I must thank especially Marco Bellini, Giulio Iovine, Giorgia Pausillo, and Riccardo Zanichelli; I also thank Emiliano Papparazzo for our usual long-distance discussions on problematic passages in ancient physics. For what regards the scientific aspects of my research (in the current sense of “science”), I was also very lucky to benefit often from the ready consultation of Lucia Maini and Marianna Marchini—chemists in the *AlchemEast* team, whom I must also thank for the experiments we did to try and answer my own research questions—and of Paolo Macini—on issues of metallurgy. On the digital aspects of my research I have worked mostly alone, but I thank Riccardo Gianninoni for finding interest in *TheSu* and putting genuine effort in helping me find a developer to bring the project to the next level.

During the last year of my PhD, I have spent six months as a visiting scholar at KU Leuven, where above every expectation I found greatest interest in *TheSu*. For their outstanding academic welcome and friendliness, I thank especially Margherita Fantoli—I cannot wait to collaborate again with her in the frame of digital humanities—and Jan Opsomer, who, together with Pieter d’Hoine, made me feel like a long-time member of the research family at the DWMC and greeted my project with interest and

appreciation. I am also grateful to Jan for taking time to review and evaluate my dissertation; the second reviewer was Francesco Fronterotta, whom I must thank for the immensely gratifying words of endorsement: I owe to him much of the originality of my research, as he allowed me to experiment freely with both my bachelor's and master's thesis when he was my supervisor in Rome, while being always available for suggestions.

I also thank Vincenzo Carlotta, Nicola Polloni, and Giulia De Cesaris for helping me settle in Leuven, while the social and academic life was significantly limited due to Corona safety measures. In these three years I have gone through many difficult periods, mostly following the Covid-19 outbreak but also affecting my first year of PhD, while I was still getting acquainted with Bologna. In this regard, I want to also thank the many friends with whom I could relax and have fun, and in whom I was able to find ready listeners and emotional support in moments of greatest distress, often linked to academic worries and self-inflicted overwork. In a loose chronological order —based on when I needed them most or when our friendship began—, I send my special thanks to the following people (I cannot avoid repeating some of these names, already mentioned above): Federico Pierucci, Giorgia Pausillo, Luigi Lobaccaro, Emiliano Paparazzo, Angela Riccardi, Marcantonio Bracale, Noemi Di Tommaso, Francesca Antonelli, Riccardo Zanichelli, Marco Bellini, Giulio Iovine, Monica Santomartino, Ben Rees, Mariestella Heejeong Ko, and Elena Danieli. An obvious thanks goes to my friends in *Costine*, persistently on background of my daily life and reliable platform of vulnerable sharing, political discussion, and squabbling: I thank you all, Lorenzo Anzuini, Michele Cogliano, Andrea Fortunato, Mario Gioia, Giorgio Inchingolo, Flavio Macci, and (again) Federico Pierucci.

A Federico Pierucci
e Marcantonio Bracale

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Introduction

This research started as an inquiry into the medical and ‘chemical’ themes in the metaphors and analogies used by Plutarch of Chaeronea in his works. A twofold aim guided my investigation: first, to get a better understanding of the varying functions of these themes in the argumentative, descriptive, and narrative contexts which include them; then, to elaborate a well-founded judgement on the extent to which metaphorical or analogical reasoning (of medical or ‘chemical’ themes) exercised an influence on Plutarch’s thought and written argumentation. In this epistemological attitude, my research, which falls into the broader field of intellectual history or history of ideas, has its clear inspiration in G. E. R. Lloyd’s 1966 monograph *Polarity and Analogy*¹, which pioneeringly showed how central was the role of analogies and comparisons in the development of ancient philosophy and science. I argue that a full fine-grained analysis of Plutarch’s metaphors and analogies would be an interesting addition to this strand of research, considering their large and conspicuous presence in his *corpus*². The first step in this direction is a critical selection of the main medical and ‘chemical’ themes in this corpus (a study which in its own can also contribute to the history of ancient medicine and natural philosophy). In fact, it is a prerequisite for the conduction of such analysis to ground it in an optimal understanding of Plutarch’s medical and ‘chemical’ views, without which it is impossible both to delimit the semantic areas of interest in a historically faithful way, and to interpret which properties are exactly projected from the *comparans* onto the *comparandum* in each metaphor and analogy³: if we do not know, for instance, that the term *οἶλος* (“compact”) is more properly used for textiles and fibres, we have no way of identifying it as a possible ‘botanical’, ‘anatomical’, or ‘textile’ metaphor, nor can we infer that its use for “water” might imply a visualization of the watery texture as a net of fine parts drawn close to one another without their individual density being increased — we would simply consider it a synonym of *πυκνός* (“dense”)⁴.

Since it is clearly important to begin every research of this kind with a full study of the author’s views on the selected themes, I have done this with Plutarch’s medicine and ‘chemistry’, while also collecting all the passages of potential metaphorical or analogical interest I was able to notice in my close reading of his *corpus*, and while working, at the same time, on the design of my theoretical and methodological framework. As my research progressed, I started to see that the reconstruction of Plutarch’s ‘chemical’ thought was more problematic than expected, and consequently restricted my scope to only this area, deciding to leave aside the

¹ LLOYD 1966.

² General studies on Plutarch’s imagery are FUHRMANN 1964; HIRSCH-LUIPOLD 2002. On the symbolism in Plutarch’s myths focuses VERNIERE 1977.

³ On the ‘transferral’ model of metaphors and analogies I follow PERELMAN AND OLBRECHTS-TYTECA [1958] 2013, 433–34. For a more recent treatment, with an overview of the earlier literature, see MONNERET 2018.

⁴ See my analysis of Plutarch, *Frig.* 21 955^B below, sec. 6.

medical and physiological domain for future investigation. After all, the presence of medical themes in Plutarch's *corpus* has already been the object of specific scholarly treatment⁵, even with a focus on metaphorical and analogical projections⁶, while the spectrum of Plutarch's 'chemical' ideas is comparably unexplored⁷. I therefore proceeded to analyze all the relevant information on minerals, metals and dyes — selecting these to begin with a thematic subfield which would also be of interest to the history of alchemy⁸— with the aim of reconstructing in the most possibly accurate way Plutarch's conception of these three materials and of their 'chemical' behaviours, which also entailed a proper understanding of their treatment in the context of physical etiology. Since most of the information on these themes is embedded in analogies and metaphors, which are scattered throughout Plutarch's *corpus* in even unexpected contexts, it was necessary to confer primary importance to their analysis, but with the new objective of extracting all the 'chemical' ideas embedded in their use. In this thesis, I have included some of the results of my investigation, deciding to attribute primary relevance to stones (chapters 1–8). Of my analyses of Plutarch's views on metals, only the sections dealing with lead and iron were added (chapters 9–10), as they perfectly complement the 'mineralogical' account. Indeed, Plutarch's 'chemistry' of stones is very often intertwined with that of these two metals, either concretely or in analogies (see chapters 5, 6, 7.1, and 8 especially).

I have mentioned that as part of my research I have also worked on my theoretical and methodological framework: more specifically, I have engaged in theoretical modelling and digital coding to design a tool that would be useful for my contextual analysis of metaphors and analogies. As a result, I have completed the design of the first version of *TheSu* (*Thesis-Support*) that may be publicly released (v. 0.72). This is an XML annotation scheme for the digital indexing and mapping of ideas and of their contexts of enunciation in any text, which I plan on using for my future fine-grained epistemological analysis of Plutarch's argumentative and expository metaphors and analogies. Rather than completing writing the code and directly proceeding to the digital annotation of the metaphors and analogies in my *corpus*, I decided to first provide *TheSu* with a polished documentation including human-readable definitions of all its elements and attributes. This will allow for its adoption in other projects, opening the possibility that it will be accepted as a new standard. In completing the code, I was not only guided by theoretical modelling, but I also tested it on an integral annotation of Plutarch's *Aquane an ignis utilior sit*, which allowed me to better calibrate the model on the actual needs of text and argumentation analysis. As an appendix to this thesis, I include the human-readable definitions of all the elements and attributes of *TheSu* 0.72, extracted from the digital documentation of the XSD, which will soon be published online.

⁵ See *e.g.* BOULOGNE 1996.

⁶ See PLATI 2020; KOWALSKI 2019; SACCO 2017; VAMVOURI RUFFY 2012.

⁷ I cite the relevant bibliography in the following section. On 'chemical' analogies, we may refer to SANSONE 1980 (whom I criticize below, p. 76 n. 304) and GARCÍA LÓPEZ 1991, both unsatisfying. Much of the imagery is of course listed in FUHRMANN 1964.

⁸ Early Greek alchemy, as firstly appears in the four alchemical books (I cent. CE) ascribed to Democritus, is concerned with the making of silver and gold, the making of precious stones, and the purple dying of wool: see *e.g.* MARTELLI 2014, 5–7.

Plutarch's 'chemistry' and 'mineralogy'

In Plutarch's time, 'chemistry' did not exist as an individual field, which makes this thematic delimitation of the subject arbitrary, or rather a convenient way to refer to a bundle of individually distinct topics. In relation to Plutarch's thought, it is intuitive that the term should apply to his views on matter, on physical bodies, on the elements, on these latter's qualities, movements and interactions, and on the explanation of natural phenomena, when centred on thermic and elementary alterations. Most of these topics are included in the ancient domain of "meteorology" —their most notable appearance is in the IV book of Aristotle's *Meteorologica*—, and the focus of this thesis is surely "meteorological" in the ancient sense.

In Plutarch's *corpus*, we do find an explicit delimitation of a 'chemical' subfield in the expression τὰ περὶ στοιχείων ("the [doctrines] on the elements"), applied to a part of the Stoics' physics (*Comm. not.* 37 1077^E), but this seems to only refer to the study of «first» causes such as corporeality, mixture, and movement in themselves (see 37-50, 1077^E-1086^B), leaving outside the meteorological domain of «last» causes and observable natural dynamics. Of «first» and «last» causes Plutarch writes in his *De primo frigido* (8-9 948^{A-C}), when he acknowledges that a «philosopher», as opposed to a «technician», should not be content with the «closest» causes (e.g. «that fever is brought about by exertion or an overflow of blood»)⁹, but to use them as starting-points to proceed to the «highest», adding that «this is the reason why Plato and Democritus, when they were inquiring into the causes of heat and heaviness, were right not to stop their investigation with earth and fire, but to go on carrying back sensible phenomena (τὰ αἰσθητά) to rational origins (αἰνοηταὶ ἀρχαί) until they reached, as it were, the minimum number of seeds». After this declaration, Plutarch begins an inquiry into the nature of cold which he conducts on merely meteorological grounds, because «it is better to also examine, first, the sensible phenomena». As we see, it is his deliberate choice to give priority to the 'macro-chemical' investigation —let us call it this way— over the 'micro-chemical', which encompasses both Democritus's theory of atoms and Plato's doctrine of elementary triangles as expounded in *Timaeus* (48^{B-E}, 53^C-57^B). Being a Platonist, Plutarch probably held that Plato's account of the elementary geometry was convincing¹⁰, which may explain why he does not seem to have built a doctrine of his own for the 'micro-chemical' level of physics: Plato's polyhedra and their geometrical rules of interaction may be given for granted, and the discourse conveniently conducted on the macroscopic level of supervenient qualities.

A model for such inquiry, after all, could be found in the very same *Timaeus*, whose account of the elementary polyhedra, after the intermission of a few remarks on the non-existence of emptiness and stillness in the world (57^C-58^B), was followed by a genuinely "meteorological" section on the properties of the

⁹ Transl. Helmbold in CHERNISS AND HELMBOLD 1957, also in the following quotation.

¹⁰ The fullest account on Plutarch's views on the geometry of elements and 'micro-chemical' level is in OPSOMER 2015. Cf. his remark on p. 32: «As a Platonist who considers the *Timaeus* a more or less sacred text, Plutarch is committed to geometric atomism».

elements' «genera» (γένη) and «forms» (εἶδη), with the inclusion of metals and stones (58^C-61^C)¹¹. It is not clear whether Plutarch committed to this section of the *Timaeus* in his own meteorology: while stones, as I will show in chapter 2, are unambiguously “earthy” as in the Platonic doctrine (60^{B-C}), no reference can be found in Plutarch's *corpus* to a “watery” constitution of metals, which were identified by Plato as a «fusible» (χυτόν) genus of water (58^D-59^C). The only general remark on the nature of the content of «mines» (μετάλλα) is made by Plutarch's brother Lamprias in *De defectu oraculorum*, after the mention of three mines which have depleted in the past —the silver mine in Attica, the copper ore mine in Euboea¹², and an asbestos mine in the same region—, and it is framed as an indirect quotation: «indeed, the followers of Aristotle declare that the artisan of all these is the exhalation (ἀναθυμίασις) inside the earth» (44 434^B). This is an allusion to Aristotle's doctrine of «minerals» (lit. «diggables», ὀρυκτά) and «metals» (μεταλλευτά) as presented in his *Meteorologica* (III 6 378^A12-^B4), and it does not imply any endorsement on Plutarch's part. Aristotle's theory may be considered a development of Plato's account, as the two materials are distinguished by the «dry» or «moist» quality of the exhalation which produced them: while the minerals are the product of the «smoky» (καπνώδης) exhalation, the metals are originated by the «vaporous» (ἀτμιδώδης), and these can qualify as water only «in potentiality» (δυνάμει), as they all form before the exhalation has the chance to become water. There is indeed a sign that Plutarch may have been receptive to Aristotle's terminological distinction of the metals as μεταλλευτά (an original Aristotelian contribution)¹³, as he once happens to refer to iron, which surely has better acoustics than a rock, as «the most noiseless of the *metalliká*» (*QConv.* VIII 3.2-3 721^F), but it is unclear whether he used this term with coherence and precision. In another place, in fact, this seems to occur in its more general sense for any product of the earth, to refer, together with *botaniká* and *thēriaká*, to the full spectrum of materials used in medicine (*QConv.* IV 1.3 663^C); not even its variant *metalleuómena* appears to disambiguate, as it is used as well for materials of medical use, but in the indeterminate syntagm «many of the *metalleuómena*» and in reference to only those of earthy constitution, all having condensing and cooling properties (*Frig.* 21 954^D). We can at least be sure that bronze «rust» (ἰός), *i.e.* verdigris, is presented by Theon to be «earthy» (γεώδης) in *De Pythiae oraculis* (3 396^A), which might imply the assumption of a different elementary constitution of the metal: this would be coherent both with Plato's specific description of verdigris in *Timaeus* (69^C) and with Aristotle's remark that every metal «has earth» due to having a share of the dry exhalation in *Meteorologica* III (378^B3-4), but a specific textual derivation is impossible to prove¹⁴.

¹¹ This section was dubbed as «meteorological» by VIANO 2003.

¹² On this I will comment below, p. 174-6.

¹³ See HALLEUX 1974, chap. 2.

¹⁴ Cf. POUILLOUX 1965, 61–62, who overstates the terminological connections between the passage in *Pyth.* and Plato's *Tim.*, without considering the Aristotelian elaborations or the possible influence of any other philosophical school.

Plutarch's natural philosophy, to be sure, was influenced by the centuries of scientific and cultural developments following the doctrinal expositions of Plato and Aristotle, of which the medical tradition on the *metalleuómena* was only a small part. Indeed, most themes of meteorological interest show up in the context of physical etiology and as part of *quaestiones* with multiple answers, most notably in the *Aetia physika* and in the *Quaestiones convivales*. In the genre of *problémata phusikà*, Aristotelian in origin, much Peripatetic literature was available in Plutarch's days (often falsely ascribed to the founding master), and a regular interlocutor and source of inspiration—as we will see—is undeniably such composite 'Aristotle'¹⁵, very often flanked by Theophrastus¹⁶. If anything of Plutarch's dialogues and *Quaestiones convivales* can be trusted, it is safe to assume that he engaged frequently in philosophical conversations with people of any doctrinal allegiance and scientific expertise, which is a sufficient reason to suppose that his meteorological views were exposed to many further influences, perhaps even including those of his main antagonists, *i.e.* the Stoics and the Epicureans: that he read some of their works is evident in his polemical texts against them, and it cannot be excluded that he may have accepted some of their etiologies not touching on «first» causes. In this thesis, albeit acknowledging all the notable textual parallels, I try to remain coherent with my assumption that the largest part of the influences on Plutarch's thought cannot be fully reconstructed, and that in most cases it is not possible to pinpoint specific passages in literature to attribute them the role of 'sources'; for this reason, I generally refer to "traditions" rather than texts: if a Plutarchan etiology has close parallels with another in an earlier text (*e.g.* Aristotelian), I normally do not assume that such text directly influenced Plutarch's elaboration, but that they were somehow in contact with a common tradition, whether literary, oral, or both (*e.g.* of Aristotelian character).

Plutarch's 'chemistry' has not received much attention in the scholarly literature. His cosmological views on matter, its animation, and its rational arrangement—a level of analysis we may refer to as 'meta-chemical'—has attracted most of the interest, due to the relevance of Plutarch's exegesis and elaboration of Platonic themes (especially in works such as *De animae procreatione in Timaeo*, *De Iside et Osiride*, and *De defectu oraculorum*) to the history of Platonism, of which he represented the "Middle" strand¹⁷; the few scattered information, in his *corpus*, on quantitative and geometric 'micro-chemistry' have only recently been collected and analyzed by J. Opsomer¹⁸; and the only general work on Plutarch's 'macro-chemistry' is a 1948 posthumous article by E. O. von Lippmann, which collects the interesting information without offering interpretations¹⁹. This does not mean that Plutarch's meteorology is completely unexplored: in fact, a huge

¹⁵ On the relationship between Plutarch's *quaestiones* and the Aristotelian *problémata*-literature see MICHIEL MEEUSEN 2015, spec. p. 61-109.

¹⁶ On the presence of Theophrastus in Plutarch's *corpus* see BOULOGNE 2005.

¹⁷ The classic is FERRARI 1995. For a discussion of the bibliography on the topic see BOYS-STONES 2018, 113–15. On the label "Middle Platonism" see *ib.*, p. 1-23.

¹⁸ In OPSOMER 2015.

¹⁹ VON LIPPMANN 1948.

amount of scholarly elaboration on the topic can be found in the commentaries to Plutarch's etiological works, especially those to the *Aetia physika* written by F. H. Sandbach, L. Senzasono, and M. Meeusen²⁰, and in S.-T. Teodorsson's three-volume commentary to the *Quaestiones convivales*²¹; studies on specific subjects of 'macro-chemical' interest are very few but not lacking²², as well as discussions on some metallurgic passages²³, which in contexts of mythic symbolism have been connected with ancient alchemical theory²⁴, but overall treatments of the subject, with an attention to the whole of Plutarch's *corpus*, do not exist. I hope that this thesis will be able to fill the 'mineralogical' gap in the Plutarchan scholarship.

The *TheSu* XML annotation scheme

The aim of the *TheSu* (*Thesis-Support*) annotation scheme is to provide the possibility of easily navigating through enunciates (*Theses*) contained in written texts and all their linked explanations, justifications and refutations (*Supports*), each indexed as a node in an abstract network defined as "Argumentative-Expository System" (AE System), which is stored in a database. Focusing on argumentative relations of whatever rhetorical nature, *TheSu* can be likened to the various annotation schemes that are being proposed in the field of Argumentation Mining²⁵, albeit it not sharing their common objective of digitally automatizing argument extraction from texts. *TheSu*, although similar to these approaches, is different from them for two main reasons:

First, it builds its system on theses abstracted from the texts by human interpreters, which can then be linked to their possible textual supports (if there are any). Argumentation mining approaches influenced by S. E. Toulmin and D. N. Walton²⁶ tend to directly search the texts for premise–conclusion enunciative pairs to tag them under schemes such as Walton's "argumentation schemes"²⁷; approaches based on Rhetorical Structure

²⁰ PEARSON AND SANDBACH 1965; SENZASONO 2011; MEEUSEN 2017a.

²¹ Teodorsson 1989. Other useful commentaries to the single books of *QConv.*, not always original with respect to Teodorsson's earlier treatment, are SCARCELLA 1998; CAIAZZA 2001; CHIRICO 2001; SCARCELLA 2001; BRACCINI AND PELLIZER 2014. Also useful is the commentary to *Frig.* and *Aq.* in D'IPPOLITO AND NUZZO 2012.

²² Possible examples are SANSONE 1980; LOPEZ FERREZ 1991; CABALLERO SANCHEZ 1992; OPSOMER 1999; BOULOGNE 2007.

²³ On the chapters in *Pyth.* concerning the blue bronze patina of the statues in the Delphic precinct (2-4 395^A-396^C) see POUILLOUX 1965; JOUANNA 1975; from the point of view of archaeometallurgy, P. CRADDOCK AND GIUMLIA-MAIR 1993; of the history of art FALASCHI 2017; of present-day chemistry (with an unconvincing attempt at a scientific explanation) FRANKE AND MIRCEA 2005. On the vinegar quenching of the Spartan iron money (*Lyc.* 9.2-3, *Lys.* 17.4, which I discuss below, p. 183-6) see HALLEUX 1987. On the cold liquefaction of lead (*Frig.* 11 949^{B-C}, which I discuss below, sec. 10) see VOLPE CACCIATORE 2007.

²⁴ Specifically, the quenching of the souls of the greedy in metallic lakes in the myth of Thespesius (*Vind.* 30 567^{C-D}): see BOULOGNE 1994; PÉREZ-JIMÉNEZ 1996. Both these analyses are unconvincing and mistranslate crucial elements in the text. Despite referring to alchemy in its title, ADORNO 1992 has almost nothing to do with alchemy.

²⁵ See LIPPI AND TORRONI 2016; STEDE AND SCHNEIDER 2019.

²⁶ See TOULMIN [1958] 2003; WALTON 1998; WALTON, REED, AND MACAGNO 2008.

²⁷ See e.g. LAUSCHER, GLAVAŠ, AND PONZETTO 2018; MOCHALES PALAU AND MOENS 2009; ROCHA, LOPES CARDOSO, AND TEIXEIRA 2016; GREEN 2018a.

Theory (RST)²⁸, on the other hand, select their elements through objective textual markers (e.g. EDUs, “Elementary Discourse Units”)²⁹, and as a consequence segment the text into discrete —albeit interconnected— non-overlapping units³⁰. Taking a different route, *TheSu* focuses first on the indexing of individual theses, i.e. treating every single declarative sentence as a “claim”, and then on their connection with supportive spans of text: the latter can be contiguous to their targeted theses or very far away in the text, as well as in other works from the same author or from different authors too (as will become clearer below).

Second, while Argumentation Mining methods are generally concerned with *textual* cohesion and natural argumentation patterns, *TheSu* is interested in the coherence and justification of the authors’ ideas in their *thought*, inasmuch as it is exhibited in their textual production. This also differentiates *TheSu* from annotation schemes in Argumentation Mining that seem to be more independent from Walton’s and RST’s influence³¹. An intellectual historian, while researching on an author’s thought, usually tries to reach a comprehensive view of it in order to identify trends and elements of cohesion, incompatibility, and evolution. When the

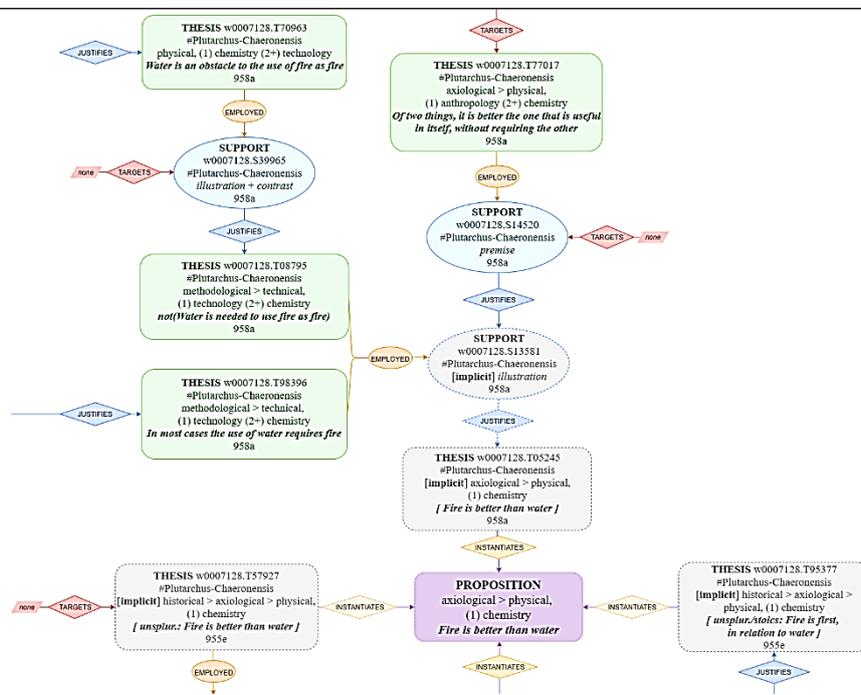


Figure 1. Fragment of a concept visualization of a *TheSu* map: Argumentative-Expository contexts linked to the theses in *Aquane an ignis utilior sit* instantiating the proposition ‘Fire is better than water’. Every **THESES** and **SUPPORT** that does not receive justifications or explanations is highlighted by the indicator “none –targets→”: it is desirable to be able to notice them at a glance, because it can be proof that their speaker considered them clear and non-controversial enough not to spend more (supportive) words on their presentation, opening to the possibility of identifying them as the ideological ‘building-blocks’ of the argumentative discourse.

²⁸ See MANN AND THOMPSON 1987; TABOADA AND MANN 2006, sec. 2.4, A.2.

²⁹ See the definitions in e.g. CARLSON, MARCU, AND OKUROWSKI 2001; MARCU, AMORRORTU, AND TAJAHUERCE ROMERA 1999.

³⁰ On the undesirable aspects of these approaches see GREEN 2018b; PELDSZUS AND STEDE 2013, 15–19.

³¹ E.g. PELDSZUS AND STEDE 2013.

historian extends the scope of the research to include texts from different authors, the aim is usually to be able to discover traces of historical influences or innovations based on independent reasoning. Attempts might be made to elucidate the author's texts by putting them in relation to others pertaining to the same culture or current of thought: when certain ideas are presented synthetically and without explanation, it is always possible to look at works from different authors —culturally and philosophically close to the first— to find their plausible sense and justifications³². *TheSu* is intended as a tool to help the historian reach these aims, by providing databases for generating maps of the networks of ideas conveyed by texts, and arrange and filter them according to varying interests (see Figure 1).

TheSu is thus distinguished from the other annotation schemes in a way that can be summarized as follows: although it always starts from a text containing natural argumentation, it only uses it as a proof for the existence of a *scientific discourse* that the text's author intends to convey. The "discourse" is composed of both explicitly formulated statements and their implicit assumptions and alluded consequences, and of all the explicit and implicit argumentative links between them. These are only "scientific" in the sense that they are to be 'taken seriously' by the interpreter, who must always start by assuming the hypothesis that the author has legitimate reasons to believe in and present all of them: to test this hypothesis, the interpreter must thus try to find in the text all the supports that might qualify the claims as *well founded* and *adopted critically* by the author, and so "scientifically" legit (in the context of their existence). In so doing, the interpreter cannot but be guided by a strong principle of charity³³, and in this way detach the scientific discourse from the text up above a certain degree of 'charitable' arbitrariness. The structure of the scientific discourse, then, not always corresponds to the structure of the text, and the latter is only used as grounding for the reconstruction of the former.

TheSu annotations, in addition, can serve the purpose of gathering organized data as a basis for logical and epistemological evaluations of an author's style of reasoning. To make these further analyses possible, the interpreter must be as non-judgemental as possible in the annotation phase: weird and weak as they may seem, every extra-logical "argumentation" practice deserves the same space as the actual "demonstrations" —adopting Perleman and Olbrecht-Tyteca's distinction—³⁴ in the network of ideas. This also distinguishes *TheSu* from more 'normative', logically rigid, approaches in Argumentation Mining³⁵.

Plutarch's *Aquane an ignis utilior sit* has been chosen as a case study because of its short length and its elaborate, though very clear, argumentative structure³⁶. It is a rhetorical exercise where both the superiority of water and the superiority of fire are argued for in persuasive speeches that are symmetrical in extension as

³² On current research practices in the History of Ideas cf. e.g. VAN DEN BERG ET AL. 2014, sec. 3.

³³ See Davidson's "Principle of Coherence" in DAVIDSON 1991.

³⁴ PERELMAN AND OLBRECHTS-TYTECA [1958] 2013.

³⁵ E.g. GREEN 2018a.

³⁶ The digital edition used is the XML/TEI edition published at PerseusDL/canonical-greekLit (CERRATO *et al.* 2019), which corresponds to Bernardakis's critical edition of the work (BERNARDAKIS 1895).

well as in cogency, and wherein no final solution is provided to the controversy. It contains much more “argumentation” than “demonstration”, and its interesting rhetorical features have already been analysed by A. M. Milazzo, although with a different approach³⁷. In this introductory section, its theses will only be quoted by their annotated paraphrases in English, which is the standard language for the *TheSu* documents: considering that all the theses have been extracted from the original Greek text, in this case every paraphrase is also a translation, original to this annotation and sometimes diverging from the previous, to improve on clarity and faithfulness. The original (pre-annotated) text will be quoted in translation as well.

Every *TheSu* XML document corresponds to at least one work to be annotated. Considering the general need for historians to keep track of the textual *locus* of every passage that they analyse and quote, it is better for the annotator to work on already-existing XML/TEI editions of the texts, if suitably provided with milestone elements with IDs corresponding to the desired reference system. This has been the case with the adopted digital edition of *Aq*. Often, *TheSu* elements need to include non-contiguous spans of text. These, in turn, can often be interpreted as composing multiple theses or supports (explicit or implicit) cumulatively, sometimes leading to the problem of overlapping hierarchies. For these two reasons, stand-off markup has been chosen as the annotation method for *TheSu*: each of its elements has to refer to a span of text in another document, linked through xLink and xPointer.

Every *TheSu* sheet contains an Argumentative-Espository System (AE System), that is theoretically defined as a set containing theses, their argumentative and expository supports, and the functional relations between the two. As will be shown below, this also needs to include a few more elements in its digital implementation.

A “**thesis**” is an instantiation of a declarative proposition at a certain point of the text representing the stance of its speaker. It can be explicit in the form of an enunciative sentence (*e.g.* ‘Putrefaction is the decay of liquids in the flesh’, *Aq*. 957^E) or implicit, *e.g.* in the form of a rhetorical question (*e.g.* ‘[Water is more useful to humans than fire]’ in «how, then, should water not be more useful... ?», 957^B).

A “**support**” is a segment of text that is presented by its speaker *in function of* a part of the scientific discourse conveyed by the same text. A “support” can:

1. provide justifications for the acceptance or refusal of a thesis or of another support (*argumentative support*): *e.g.* «In most cases, it is not possible to use water without fire: in fact, it is more useful when it is heated, otherwise it is harmful» (958^A).
2. explain more clearly, stylistically, or in depth the meaning of another segment of text containing theses or supports (*expository support*): *e.g.* «Is it not more helpful what we always and continuously stand in need of, like a tool and an instrument, ...?» (955^F);
3. expand on an information conveyed by a thesis, favouring a more complete knowledge and understanding of it (*expansive support* or *excursus*): «... and (do you not see) that every sense

³⁷ See MILAZZO 1991.

partakes of fire, as it fabricates the vital principle, and especially sight, which is the keenest of the bodily senses, being an ignition of fire... ?» (958^E);

4. contextualize the interpretation and reception of another segment of text containing theses or supports (*contextualizing support*): «In fact, (about) the saying that sometimes humans exist without fire: humans cannot exist at all (without it)» (958^B).

The reader here may notice that in *TheSu*'s annotation scheme the “support” elements, having four distinct functions, include rhetorical uses that do not correspond directly to argumentative and expository aims. One can still speak of “Argumentative-Expository Systems”, though, because careful consideration of both the expansive and contextualizing supports is needed for a complete understanding of the argumentative and expository roles of the theses surrounding them, and of their linked segments of text.

“Theses” and “supports” are encoded as `THESIS` and `SUPPORT` XML elements, both children of an `AEsystem`, which is in turn child of a work. *Aq.*'s `AE System`, in its current version, contains 259 manually annotated `THESIS` elements (corresponding to 334 theses, 56 of which are implicit) and 216 `SUPPORT` elements (121 implicit). These numbers are striking if the very short nature of the text is considered (1627 words in total). It is clear that a high amount of information on an author's thought and on its cultural context can always be extracted from even relatively small bits of text: mapping it in detail can be crucial to avoiding misinterpretations and misattributions.

Every `THESIS` and `SUPPORT` must have its own ID, so that each can be targeted by `SUPPORT` elements through hyperlinks. The IDs of `THESIS` elements are also necessary for the most original feature of the *TheSu* annotation scheme. Absent, to the best of my knowledge, from current Argumentation Mining techniques is the possibility of linking together unrelated argumentative-expository chains when converging towards the same idea. It is a need for the historian, when studying the thought of a certain author, to have a clear view of how the same theses are presented and argued for in different contexts, even when unrelated. For example, if the author does not provide supports for a judgement in a certain work or paragraph, it does not necessarily mean that it is not argued for or better explained elsewhere. To have a map where all its occurrences in different *loci*, with all their corresponding argumentative-expository apparatuses, are linked together, would naturally be helpful to the researcher. This is made possible, in *TheSu*, through the creation of a “propositions” document (or section) containing only `PROPOSITION` elements (a different version of `THESIS` for the annotation of non-textual declarative sentences), and by linking to their IDs all the textual `THESIS` elements instantiating them. In *Aq.*, the proposition *e.g.* ‘{ Water is more useful than fire }’ is repeatedly argued for in different manners, and implicitly conveyed by the words in [a] 955^F-956^A, [b] 956^C and [c] 957^B. The thesis at [a] is the target of 5 supports, the one at [b] of 5 more, and the one at [c] of only 2. It is undesirable to keep these 12 supports fragmented in their respective rhetorical chains, as they all converge towards the same idea. Indeed, it is interesting to see how this proposition is argued for in *all* of its enunciative occurrences. Accordingly, it is preferable to connect each of the textual theses to their common abstract proposition within

the same network. The usefulness of such a connection becomes even clearer if one imagines its extension to the whole textual production of an author, as well as to works from different authors.

What follows is a non-exhaustive presentation of some of the required or optional attributes and children elements of the `THESIS` and `SUPPORT` elements: all the others can be found in the in the appendix.

Every **THESIS** has an `@id`, a `@polarity` (affirmative or negative) and a `@quantity`. It can sometimes be `@implicit` (boolean), as has been explained above. Every non-propositional `THESIS` can have one or more children elements `matchingPropositionsGroup`, including `matchingProposition` elements each with a `@propRef` pointing to the corresponding `PROPOSITION` elements. A required child element is the `speakersGroup`, containing at least one `speaker`, corresponding to the person, group or entity the thesis is interpreted to be ‘pronounced’ by, with a `@ref` pointing to their name in an authority sheet. The `THESIS`’s child element `assent` is used to specify whether the thesis is shared, unaccepted or actively attacked by its speaker (sub-element `assentSpeaker` with its `@assentValue`), or by the author of the work (`assentAuthor`). The child element `thesisType` mainly serves indexing purposes, including among its children elements: `macroThemesGroup` (to specify the ‘macroscopic’ theme(s) of the thesis, e.g. “physical”, “historical”, “axiological”), `microThemesGroup` (for the ‘microscopic’ theme(s) of the thesis, e.g. “physiology”, “cosmology”, “dialectic”), and `keywordsGroup` (to point through `keywordRef` elements to the textual or implicit keyword(s) corresponding to the object(s) of the thesis).

Note that each `keywordRef`’s `@ref` links to the ID of a **keyword** that is a child of `AEsystem`. Separating the keywords from the theses becomes necessary due to the possibility of different theses including the same keywords: in 957^C («but, in general, water (τὸ ὕδωρ) is so far away from being self-sufficient for self-preservation or the bringing-forth of other things that lack of fire, for it, is even destruction») the theses ‘not(Water is self-sufficient for self-preservation)’, ‘not(Water is self-sufficient for the bringing-forth of other things)’ and ‘Without fire, water is destroyed’ all share the textual keyword τὸ ὕδωρ. Each keyword can point to a segment of the annotated text or be ‘implicit’, and must always be tagged semantically through an attribute `@namely`, pointing to a class in a vocabulary sheet (e.g. “water”). Although the choice of the controlled vocabulary can be left to the interpreter, all new exhaustive *TheSu* annotations should consider the keyword classes already used in the previous ones, to facilitate the linking of the novel theses to all the corresponding previous propositions. It is better not to refer to an ontology of real-world entities, both to free the classification from the need of specifying vague or untranslatable terms, and to avoid projecting alien categories of thought to different cultural and scientific contexts. More freedom can be granted in the choice of the classes for the “macro-” and “micro-themes”, as coherent keywords give sufficient help for the discovery and aggregation of (quasi-)synonymous theses. Each of the `microTheme` and `keywordRef` elements also has an attribute `@focus` to specify, by order of rank, their relative prominence in the thesis: the one just quoted, ‘Without fire, water is destroyed’, is about “water” and “fire” and includes both as its keywords, but it is more relevant to an understanding of Plutarch’s ideas on water than those on fire. The `keywordRef` linked to it has thus been

given `@focus = 1`, and the other `@focus = 2`. `keywordRef` can be used as grounding for visualizable analyses such as the one in Figure 2, where fire- and water-related keywords have been assigned a score (“Epistemic relevance”) based on the quantity of `THESIS` elements containing them at different points of the text, weighted on the basis of their `@focus`. One can learn from such a graph that a comparative style is maintained (almost) throughout the text, instead of it featuring two ‘separate’ speeches on the individual excellence of each element: such an analysis can lead to interesting findings if compared to similar analyses of other works of the same genre.

Other child elements of `THESIS` are `paraphrasis` and `text`. The former contains a short paraphrasis in English of the thesis as it has been interpreted and annotated: no logical formalization is required, as the annotation process must remain accessible to interpreters untrained in logic. The same goes for the paraphrasis of `PROPOSITION` elements: avoiding a strict logical formalization of the propositions allows the interpreter to consider as their instances theses that are not quite logically equivalent, but that can count as *synonymous enough* for the History of Ideas, as is the case with the thesis in the bottom-right corner of Figure 1 (quoting ‘Fire is first, in relation to water’) with respect to ‘Fire is better than water’. Finally, `text` points through its children elements `textRef` (referring to one text segment via `@from` and `@to`) to the textual proof of the existence of the thesis at a certain point of the discourse.

`SUPPORT` elements share with `THESIS` the attributes `@id` and `@implicit`. The children elements `speakersGroup`, `assent`, `paraphrasis` and `text` are present here as well. The first unique child element of the `SUPPORT` is `targetsGroup`, containing at least one target pointing through `@ref` to the ID of a supported element. Very useful is `employedElements`, including one or more `elementRef` (with `@ref`) to link to the theses or supports in the textual span of the `SUPPORT` that are actually used by this in support of the targeted element(s), e.g. as premises, discriminating between them and other non-relevant elements possibly annotated in the same text, thus solving ambiguities.

For mainly indexing purposes, as with `thesisType`, each `SUPPORT` element contains a `supportType`, also necessary for the analysis of the reasoning styles of the discourses they are part of. This includes the children elements `supportFunction` and `supportForm`. The children elements of a `supportFunctionsGroup` included in a `supportFunction` are `argumentation`, `exposition`, `expansion` and `contextualization`, each with a `@rank` (default = 4) representing their relative centrality

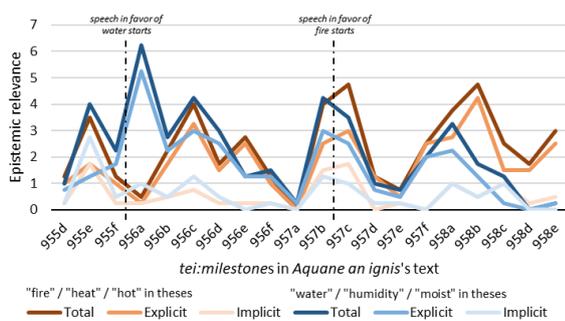


Figure 2. Relevance of fire- and water-related keywords to the theses conveyed by different contiguous spans of *Aquane an ignis*'s text.

Use in SUPPORTS	Form of SUPPORT	Justified?	THESIS quantity	Total	Justified / Total
	as premises	yes	36	74	49%
		no	38		
Employed in justifications	as illustrations	yes	65	140	46%
	in other forms	yes	9		
		no	41		
	Employed in explanations	yes	9		
no		21			
Employed in jstf./expl.?	as examples	yes	0	1	0%
	no	1			
Unused		yes	19	83	23%
		no	64		
All THESES		yes	208	334	62%
		no	126		

Table 1. Theses in *Aquane an ignis* in relation to supports: ² by how many and in which forms they are employed, and by how many they are targeted.

to the support (most central = 1). The idea is that every support, as everything else in a cohesive discourse, is always at the same time argumentative, expository, expansive and contextualizing of its surroundings to a certain degree³⁸, and that its speaker, in order to achieve different rhetorical effects, simply chooses to make one or another of these functions more prominent than the others. The possibility of ranking the functions solves the problems that would come from having to choose *only one* of them even in cases where there is enough ambiguity to make it seem impossible. For the annotation of whether the support, when “justifying”, serves the purpose of arguing *for* or *against* its target(s), `argumentation` has been given the attribute `@for` (= “acceptance”, “refutation” or “mix”). Finally, using the element `supportForm` the interpreter can classify the support by its rhetorical type, referring through `@formTag` to any class in a typology contained in an authority sheet. The *TheSu* standard typology of supportive forms is meant to be very simple and intuitive for intellectual historians: among the “argumentative” forms, the “deductive premise” is one or more statements from which the supported target can be inferred by deduction, the “illustration” is a particular case from which the conclusion can be derived by induction, the “authority” is an appeal to an authoritative figure that adheres to the targeted idea, etc. Table 1 illustrates a quantitative analysis strictly dependent on the elements `SUPPORT`, `supportFunction` and `supportForm`: it is not surprising that in a rhetorical work such as *Aquane an ignis* a very high amount of theses are given argumentative support (62%), but it is not necessarily expected that “illustrative” supports are twice the deductive “premises” (140 to 74), characterizing the speech as scarcely “logical” in tone and much more “exemplary”. It is also interesting that theses employed in supports tend here to attract further argumentation, especially the “premises” (49% justified) and “illustrations” (46%), in contrast with the theses not used in supports (23%). This breakdown is only a small tile of the mosaic that is Plutarch’s personal argumentation style, waiting for further analyses to be combined with and compared to.

This exposition has focused on the methodological usefulness of this kind of argumentation and exposition mapping for historians working on a text, but *TheSu* can also be helpful for an optimal, *transparent* and *reusable*, exposition of the basis and results of their research: a historian’s ‘secondary’ interpretation of a certain text —e.g. its ideas’ dependency from the ones in a contemporary philosophical current, or their ideological or popular nature— always depend on a ‘primary’ interpretation of the argumentative and expository chains it is composed of. Storing these primary interpretations in easily-accessible *TheSu* databases would help with the evaluation of the secondary interpretations proposed by the historian, and would facilitate the work of future researchers who wish to build upon the former’s research and generate new interpretations from the argumentative-expository material. This is only possible thanks to digital interfaces and database interrogation techniques, and would otherwise be too difficult or time consuming using traditional, non-digital methods.

³⁸ cf. PERELMAN AND OLBRECHTS-TYTECA [1958] 2013, 203.

Conceptions and explanations

1. Using stones in life and speech: stone's most intuitive properties

1.1. Ballasts and thought experiments (weight).

Among the first properties we find intuitively associated with stones is that of weight. Stones tend to be heavier than other substances we commonly interact with, so we should not be surprised to see them used or mentioned as paradigmatic heavy objects, *i.e.* for no other reason than their heaviness. There are a few examples in the anecdotes told by the characters of *Sollert*. In chap. 12, Aristotimus, quoting Hagnon³⁹, mentions two instances of fraudulent behaviour in the context of the economy of barley, both exposed by the intervention of a domesticated elephant (968^D). The first is not of interest here, as it concerns a regular, unduly appropriation of half a measure (μέτρον) of barley by an elephant's keeper, who was exposed when the elephant, spontaneously, split in half a measure of barley in presence of his keeper's master. The second, on the other hand, is about raising the weight of a measure of barley, probably for the aim of subtracting a part for one's own and compensating the loss of weight with valueless substances. An elephant's keeper, we are told, obtained this by «intermixing» the stocks «with stones and earth» (λίθους και γῆν... καταμιγνύοντος). The elephant's reaction, described in the following lines, might also be a hint of a perceived close association between the mentioned stones and earth and ash (τέφρα), as the deceit was allegedly exposed when the elephant, reflecting his keeper's behaviour, decided to throw ashes in his pot while he was cooking meat⁴⁰: the underlying analogy must be that stones and earth are here to barley as ash is here to meat, and such analogical connection can only be traced intuitively if a certain familiarity is perceived between the ashes and the stones and earth, just like meat is an easy analogue of barley (*e.g.* for their both being food). This would indeed be consistent with Plutarch's "earthy" conception of ash (as manifested in *QConv.* VI 1 687^A and *Frig.* 21 954^{E-F}).

Stones and earth are also mentioned together for their heaviness in *Ad princ. ind.* 2, this time with the addition of lead (μόλιβδος): another substance which unsurprisingly figures as paradigmatic weight. In this passage, Plutarch assimilates some rulers' empty, ostentatious gravity with the unskilful sculptors' habit of modelling their colossi outstretched and with their mouth wide open to make them appear bigger and more majestic (779^F-780^A). Expanding on the theme, Plutarch states that «with their heaviness of voice» (βαρύτητι φωνῆς), along with their rough glance and unsociability, these rulers seem to only imitate the «bulk and dignity of ruling» (ἄγκον ἡγεμονίας και σημνότητα). Taking cue from the lexicalized 'mechanical' metaphor of βαρύτης, whose association with the equally lexicalized, metaphorical ἄγκος suggests a conscious activation of both

³⁹ BOUFFARTIGUE 2012, n. 148 hypothetically identifies him with the Academic philosopher who was one of Carneades's disciples (II cent. BCE).

⁴⁰ The anecdote is also told by Aelian in *NA* VI 52, where he substitutes ash with «dust» (ἄμμος) and interprets the elephant's reaction as a revenge against its owner.

terms' literal meaning⁴¹, he then develops the analogy by comparing the mentioned, metaphorical, weights with the quite literal «earth⁴², stone and lead» of which colossi are filled for their stabilization. It is implicit that the perceived value of these substances is low, as they are used for an effective contrast with the «heroic and godlike» form that the colossi show on the outside; these materials are, indeed, arguably affordable and not particularly impressive, but while «these weights» (ταῦτα τὰ βάρη) do at least provide a stable upright stance to the colossi, excessive strictness, on the contrary, often makes the rulers «swing and tumble down» from their faulty foundation. It is clear that stones, earth, and lead are only used for filling the colossi in reason of their heaviness and no other intrinsic qualities, so much that they are explicitly referred to, collectively, as “weights”⁴³.

Going back to *Sollert.*'s anecdotes on the animal world, we find other mentions of the use of stones as weights, this time without association with earth or lead. Aristotimus, for instance, reports that cranes habitually sleep while keeping a stone in one foot to avoid remaining asleep—and thus exposed to dangers—for too long (10 967^C, referred to by Phaedimus in 20 979^D). The «tension of the grasp» (ὁ τῆς ἀφῆς τόνος) is what prevents the crane from falling into a deep sleep: if the tension ceases, in fact, the stone instantly wakes the crane by colliding with the ground⁴⁴. Stones can serve as weights even when they are minuscule: according to Aristotimus, Cretan bees «ballast themselves with very little stones» (ἐρματίζουσιν αὐτάς... μικροῖς λιθιδίοις)

⁴¹ Ref. on the *ónkos*'s relation with the property of weight (earlier chemical mechanics section). Cf. TIRELLI 2005, n. 9, who, although commenting on the analogy of this passage, does not seem to notice any metaphoricity in *ῥγκος*; however, he usefully expands on Plutarch's moral attitude towards “solemnity”, quoting other relevant passages.

⁴² There is no reason to translate γῆ as «clay», as done by FOWLER 1936.

⁴³ Originally, though, stone was among the basic component materials of the *kolossoi*, when these were only straight «statue-pilliers» of stone and iron with a covering of bronze, as remarked by CUVIGNY 1984, n. 1 *ad loc.*, who refers to ROUX 1960. See also Pisani in LELLI, PISANI, ET AL. 2017, n. 3 *ad loc.*, according to whom the leg spread was introduced as a result of the colossi's increasing growth in height, «per comprensibili esigenze di statica».

⁴⁴ A similar behaviour is reported by Pliny in *HN* X 59 immediately after his description of how the cranes' (*grūes*) flocks are organized, paralleling the thematic succession in Aristotimus's speech although differing in the information. In Pliny's version, as highlighted by BOUFFARTIGUE 2012, n. 131 (who identifies the *géranos* with the *Grus grus* or common crane, with reference to Aristotle, *HA* III 12 519^A2-3), not every sleeping crane holds a stone in its foot, but only the «sentries» (*excubiae*) that should stay awake to alert the others in case of dangers, as the stone's fall would signal (to the others) their nightly *indiligentia* (on the sentries cf. Aristotle, *HA* IX 9 614^B23-6, where there is no mention of the stone). Aelian writes of cranes' behaviours in *NA* III 13 in the same succession as Plutarch and Plinius, but with more detail («un luxe de details», in the words of BOUFFARTIGUE 2012, XLVI); he does not mention «sentries», and his version of the stone-grasping corresponds to that of Aristotimus, with the added clarification that the fallen stone would wake «by making a crashing noise» (ὑποκτυπήσα); on Plutarch's and Aelian's direct or indirect reliance on a common source see BOUFFARTIGUE 2012, XXXVI–LII and cf. below, n. 45, 49, 50. Aelian also reports that the stone which cranes eat to ballast themselves during flights (see my text, immediately after, for Plutarch's examples of ballasting), is a «touchstone of gold» (χρῶσου βάσανος) after being regurgitated. Helmbold, in CHERNISS AND HELMBOLD 1957, n. e *ad loc.*, cites Ammianus Marcellinus XVI 5.4 and Diogenes Laertius V 16, where similar sleeping behaviours, with the substitution of a copper sphere for the stone, are told of Alexander (in the former) and Aristotle (in the latter).

when rounding a windy peak, to avoid being carried away by the wind's force (10 967^{AB})⁴⁵. Sea urchins⁴⁶ are equally resourceful, Phaedimus implicitly replies (28 979^B), as they can manage to stay fixated to their «small sea-rocks» (τοῖς πετριδίοις) during storms, and to not be swiped away «due to their lightness» (διὰ κουφότητα), by «ballasting themselves with little stones» (ἐρματιζομένοις λιθιδίοις)⁴⁷. In *Pyr.* 3 (6), a stone is also used as a ballast for a ballistic end, being tied to an oak bark (inscribed with a message) and thrown from one side of a river to the other.

Another interesting use of the small stones' weight is to raise a liquid's level inside a container. It is again Aristotimus who reports that Libyan crows, when in need of a drink, fill the water with stones to make it rise and so be able to reach it (10 967^A)⁴⁸. He frames the information as something which seems like a tale (μῦθος), the phenomenon being absent from our everyday experience⁴⁹: although he was himself skeptical about it in the past, as he states, he changed his mind when he saw a dog on board a ship throwing «pebbles» (χάλικες) into a half-empty jar of oil: he «was amazed» (ἐθαύμασα) how the dog understood «the squeezing out brought about by «the heavier substances» (τὰ βαρύτερα) depositing under «the lighter» (τὰ κουφότερα)»⁵⁰. In this mechanism, stone only plays the part of a generic weightier substance⁵¹, and this qualification is so intuitive that also animals can naturally make it.

⁴⁵ As remarked by BOUFFARTIGUE 2012, n. 129, it is implausible that bees would round a «peak» by any means, so much that Plutarch's term *akrōtērion* «pourrait provenir d'une confusion lors de la copie de l'anecdote»: comparing this passage with the parallel one in Aelianus, *NA* V 13, where the little stones are described as gathered ἄκροις τοῖς ποσί, he therefore proposes that in the common source (on Plutarch's and Aelian's common source see above, n. 44 and cf. below, n. 49, 50) there might have been an original τοῖς ἀκρωτηρίοις referring to the «extremities» of the bees' feet. On this ballasting cf. also Aristotle, *NA* IX 626^B24-6; Pliny, *HN* XI 24; and Dio Chrysostom, XLIV.7. The toponym «Cretan», as well as the *akrōtērion*, is only present in Plutarch. According to Lelli, in LELLI, PISANI, ET AL. 2017, n. 34 *ad loc.*, «la credenza è sorprendentemente testimoniata ancora oggi in Sicilia».

⁴⁶ The term used is *ekhinos thalattios*, meaning «sea hedgehog», which would not surprise any Italian speaker («riccio di mare»). Cf. also the present scientific name of the urchins' biological class, *Echinoidea* («hedgehog-like»).

⁴⁷ The same information is reported by Pliny, *HN* IX 100; Oppian, *H.* II 225-31; and Aelian, *NA* VII 33. It is indeed true that one often finds «graviers entre les piquants des oursins», as remarked by BOUFFARTIGUE 2012, n. 335.

⁴⁸ Cf. the very similar phrasing in *Frig.* 21 955^B, where the context is different; I quote this passage below, p. 88.

⁴⁹ The same behaviour is reported in greater detail by Aelian in *NA* VII 48, where he explains the water's elevation as an effect of it «being squeezed out» while the pebbles «are pushed down and settle on the bottom due to their weight (ἐκ τοῦ βάρους)», and he credits Egyptian crows with a spontaneous (φύσει) understanding that «a single place does not accept two bodies». Cf. Aristotimus's anecdote of the dog, which I mention in my text immediately after (on Plutarch's and Aelian's common source see above, n. 44 and cf. above, n. 45 and the following footnote). Cf. also *AP*, IX 272 [Bianor] and Pliny, *HN* X 125, where there is no reference to Lybia and the nautical setting is substituted with a sepulchral one. For more information on the tradition of this anecdote, in later times transformed into a fable, see HANSEN 2019.

⁵⁰ Commentators cite no parallels for this report. It might be possible that Plutarch fabricated it to introduce more variation in the original anecdote on crows and make it more believable by cumulation (cf. Aelian's creative concealment of his sources as discussed by BOUFFARTIGUE 2012, XXXVI–VII, XLVII–VIII): in fact, the «mechanical» explanation of water's elevation resembles closely the one used by Aelian in the parallel passage on crows, which is believed to stem from a common source; see above, n. 44 and cf. n. 45 and the preceding footnote.

⁵¹ Cf. *Sollert.* 17 972^B, where although the stones' weight has little relevance, there is mention of a container getting filled with stones so that a certain surface can raise. Here Aristotimus reports, quoting Juba (= *FGrH* III 275 F 51a; I cent. BCE-I CE), that when

A more interesting case, for the interpretation issues that it raised, is that of the “extra-cosmic stone” (ἔξω τοῦ κόσμου λίθος) appearing in Lamprias’s speech in *Def. orac.* 28 (425^{C-E}), whose only role in the argumentation, I mean to show, is exemplifying intuitively a generic weight, if not a weight *par excellence*. The context is that of Lamprias’s defence of the possibility, and even probability, of the existence of a plurality of worlds (κόσμοι, chapters 24-30). While turning his attention to Aristotle’s cosmological views—which only allow for existence of a single world—he brings into discussion the idea of an absolute cosmic centre as a point of direction for all the bodies (chapter 25). Lamprias rejects this as absurd, opting for a relative understanding of the centre, to be defined through the bodies’ movements: these, in turn, are varied as they depend on the bodies’ different substances (chapter 26). To hypothesize a multiplicity of worlds, Lamprias continues, is thus not really unreasonable, as every world would be provided with its own centre and harmonic disposition: the existence of each world could neither be contradicted by referring to an external centre identified as a point of direction for bodies—in the void it could not logically exist, not being there any moving body to define it—, nor by electing only one of the existing centres as the absolute direction point for the bodies of every world—as it would make no sense and would be akin to denying the existence of any harmonious order (chapter 27). After concluding that «each of the worlds has its above and below and its round about and its centre, not with reference to another world on the outside, but in itself and with reference to itself» (27 425^C)⁵², Lamprias starts by easily dismissing a possible rebuttal, after which he turns to an attack of the Epicurean and Stoic cosmologies (28 425^{C-E})⁵³:

ὄν μὲν γὰρ ἔξω τοῦ κόσμου λίθον ὑποτίθενται τινες οὔτε μονῆς εὐπόρως παρέχει νόησιν οὔτε κινήσεως. πῶς γὰρ ἢ μενεῖ βάρος ἔχων ἢ κινήσεται πρὸς τὸν κόσμον, ὥσπερ τὰ λοιπὰ βάρη, μήτε μέρος ὦν αὐτοῦ μήτε συντεταγμένος εἰς τὴν οὐσίαν;

γῆν δ’ ἐν ἐτέρῳ κόσμῳ περιεχομένην καὶ συνδεδεμένην οὐκ ἔδει διαπορεῖν ὅπως οὐκ ἐνταῦθα μεταχωρεῖ διὰ βάρος ἀπορραγεῖσα τοῦ ὄλου, τὴν φύσιν ὀρώντας καὶ τὸν τόνον ὑφ’ οὗ συνέχεται τῶν μερῶν ἕκαστον.

ἐπεὶ μὴ πρὸς τὸν κόσμον ἀλλ’ ἐκτὸς αὐτοῦ τὸ κάτω καὶ ἄνω λαμβάνοντες, ἐν ταῖς αὐταῖς ἀπορίαις Ἐπικούρῳ γενησόμεθα κινεῖν τὰς ἀτόμους ἀπάσας εἰς τοὺς ὑπὸ πόδας τόπους, ὥσπερ ἢ τοῦ κενοῦ πόδας ἔχοντος ἢ τῆς ἀπειρίας ἐν αὐτῇ κάτω τε καὶ ἄνω νοῆσαι διδούσης, διὸ καὶ Χρῦσιππον ἔστι θαυμάζειν, μᾶλλον

an elephant falls into a hunter’s trap, namely a large dug hole, the rest of its herd throw in “vegetation and stones” (ῥῆγν καὶ λίθους) to fill it up and provide to the fallen an easy escape (cf. Pliny, *HN* VIII 24 and Aelian, *NA* VI 61 and VIII 15, who do not mention Juba; on Aelian’s silence on Juba see BOUFFARTIGUE 2012, XLVI–XLVII). The stones here only function as walkable ground, and one can argue that they would not be so adequate were they not harder than the «thin (λεπτοί) twigs and light (κοῦφος!) rubbish» that were used by the hunters to cover the trap: on the hardness of stone see below, sec. 1.3. The report is derisively dismissed by Phaedimus in 25 977^{D-E}.

⁵² Transl. BABBITT 1936B.

⁵³ Paraphrasing mine. The translation draws *passim* from BABBITT 1936B.

δ' ἄλλως διαπορεῖν, ὅ τι δὴ παθῶν τὸν κόσμον ἐν μέσῳ φησὶν ἰδρῦσθαι, καὶ τὴν οὐσίαν αὐτοῦ τὸν μέσον τόπον ἀιδίως κατελληφυῖαν, οὐχ ἤκιστα τούτῳ συνείργεσθαι πρὸς διαμονὴν καὶ οἰονεὶ ἀφθαρσίαν.

In fact, that stone outside the world which some take as a hypothesis (to exist) does not easily provide a thought of either stillness or movement. How, in fact, would it either remain still, while having weight, or move towards the world —just like the other weights—, while not being part of it nor having been arranged into its substance?

Earth encompassed and bound up together in another world, on the other hand, would not raise problems on how (lit. it would not be necessary to wonder how) it manages not to migrate here, broken off from the whole due to its heaviness, if we consider the nature and tension by which each of that world's parts is kept together.

Because, if we understand the 'below' and the 'above' not in relation to the world but to the outside, we will fall into the same problems as Epicurus, who moves all the atoms towards the places under the feet, as if either the void had feet or infinity gave the possibility of thinking of a below and above within itself. One should therefore be amazed at Chrysippus too, or rather be in complete bewilderment as to what was happening to him, when he said that the world settled in the centre and that, having its substance seized the central place eternally, it was not least because of this that the world became fastened up towards its permanence and its, as it were, incorruptibility.

As noticed by Cavalli⁵⁴, this is the only passage in the preserved ancient literature informing on the argument of the “extra-cosmic stone”. Although we can easily discern the protagonist of the argument (*i.e.* the stone), as well as the relevance of its behaviour as a weight in relation to the world(s), it is however left unclear what the argument should even be⁵⁵. We have no elements to identify the *τίνες* mentioned here by Lamprias, nor can we infer with certainty which position they meant to attack by using this rebuttal⁵⁶. It is only certain that

⁵⁴ In CAVALLI AND LOZZA [1983] 2013, n. 95 *ad loc.*

⁵⁵ Cf. Lelli in LELLI, PISANI, ET AL. 2017, n. 45 *ad loc.*: «non è chiaro a quale pietra si riferisca Plutarco, né a quali teorie faccia riferimento».

⁵⁶ My interpretation of the “extra-cosmic stone” scenario as a dialectical rebuttal, rather than as a tenet in a philosophical theory, relies on my understanding of the verb *ὑποτίθεσθαι* as meaning “advance as a *hypothesis*”, that is, as an undemonstrated assumption —whether true or not— to be used as a premise in an inference, also for dialectical purposes; see WYTENBACH 1796 (*ὑποτίθενται*: «pro argumento adhibent» and RESCIGNO 1995 («immaginano»), with n. 252 («teorizzavano per assurdo [*sic!*]»); and then «obiettavano per mezzo d'aporia», «l'ipotesi aporetica»). For rather ambiguous translations of *hypotithentai* cf. BABBITT 1936B («assume»), FLACELIÈRE 1947 and 1984 («supposent»), ILDEFONSE 2006 («supposent»). For decidedly incompatible translations cf. Cavalli in CAVALLI AND LOZZA [1983] 2013 («che a detta di alcuni esisterebbe») and Lelli in LELLI, PISANI, ET AL. 2017 («che, alcuni dicono, sarebbe»), with the preceding footnote. The non-dialectical interpretation allows Del Corno to open his introduction to CAVALLI AND LOZZA [1983] 2013 with a comparison between the “extra-cosmic stone” and Kubrick's monolith in *2001: A Space Odyssey*, since the

it does not represent a threat to Lamprias's stance, who easily rejects its premise due to its inconceivability. To see this, one has to assume a relative understanding of the centre or 'below', as Lamprias does: if a centre or 'below' only exists in relation to a world, and it is only defined by that world's parts' convergent or divergent motions, it is logically impossible for any object not included in a world to move towards a centre or 'below'. If we imagine a stone to exist without any relation to a world's system of centripetal and centrifugal motion, and therefore —using contemporary terminology— to be free from its mechanical laws, we will not be able to conceive it as a moving (falling) object. Now, the stone, being a weight, has to fall by definition (*i.e.* move towards a centre or a bottom), and it is only ever still when interrupted in its fall by an obstacle (or when it has finally reached the centre or ultimate bottom). Given these assumptions, an "extra-cosmic" stone cannot exist, because a stone, like every weight, is required to either fall or stay still, and both its falling and its stillness, outside of a world, are inconceivable (their «thought», νόησις, is not «easily» compatible with the conditions)⁵⁷. If the subject of the hypothesis were not external to every world —Lamprias adds in contrast, both to show the reasonability of his own position and to prevent another possible objection—, but it were instead an earth included into another world (notice here again the coupling of "stones and earth" as two paradigmatic weights), the problem would not exist: that earth's mechanical behaviour, it is implied, would be related to that other world's centre or 'below'. If someone pointed to an alleged difficulty of explaining why that earth stays in its world instead of falling in our own, it would be because of their misconception of the centre as an absolute direction point, rather than a relative and multipliable one: every world, in fact, without having to relate to an external centre, is kept together by its own «nature» (φύσις) and «tension» (τόνος), that is to say, by the natural tension that regulates the well-arranged movements of its own bodies⁵⁸. Although the centre or 'below' is not mentioned explicitly in the remarks on the "extra-cosmic stone" and "otherworldly earth", it is clear that it is still at the core of the argument, as it was in the preceding lines. This is also shown by the fact that these remarks are followed by a sharp attack on the Epicurean and Stoic conceptions of an absolute 'below' or centre, which indeed become absurd if Lamprias's relativism is assumed. Now that the argumentation of this passage is clear, I can argue with some confidence that the stone's sole role in it is that of a generic weight, or of an intuitively and non-controversially weighty object. It is selected as an instance

former, as we read, allegedly represents our impossibility of understanding the world's structure (p. 11). This interpretation is clearly wrong, but RESCIGNO 1995, n. 252 is too harsh in dismissing it as an "aberrant" interpretative hypothesis, since its rhetorical framing makes it clear that the remark was not meant to be read as a scientific commentary. For the extension of Rescigno's disdain to Flacelière's view see below, p. 23 n. 62.

⁵⁷ With ILDEFONSE 2006, n. 14, cf. the way Aristotle dismisses the hypothesis of a body existing outside of the world in *Cael.* I 9, 278^B22-279^A11. He also uses kinematic arguments, but does not refer to weight nor uses stone as an example.

⁵⁸ Xylander's conjecture τόπον in the place of τόνον (1599, sec. "In Plutarchi Moralia, annotationes interpretis", 17) is superfluous and less «consentanea disputatione institutae» than he supposes, because Lamprias, here, is not attributing the cause of the mechanical arrangement of the bodies to "natural places", but to the «worlds». It is true that the concept of τόνος is (more) easily associated with Stoic cosmology, as noticed by ILDEFONSE 2006, n. 15 *ad loc.*, but Plutarch also used it in *Lun.* and *Lys.* to describe the motion of heavenly bodies: see below, p. 52-3.

of a simple object with the simplest mechanical behaviour because it is hard to think of it has something that could remain still in mid-air: as a stone, it clearly has to fall. It seems plausible that the argument of the “extra-cosmic stone”, in its original formulation, was used to problematize, and so refute, the idea of a plurality of worlds (as such, it might have been equally advanced by Aristotelians, Epicureans and Stoics, all explicitly mentioned by Lamprias). If it was, it might have sounded like this: “Let us assume that there are more worlds, each with its own centre: towards which would a stone fall, if it is external to every world?”, forcing the opponent to the acceptance of an absolute, ‘superior’ centre⁵⁹, namely the one which gets to attract the stone⁶⁰. This scenario, Lamprias simply replies, is not (easily) conceivable. Other interpretations focusing on the stone’s incompatibility with the world’s harmonic structure, on its separation from the world’s constituting matter, or on its (absence of) relation to the world in terms of (Stoic!) *oikeiōsis*, *sumpátheia* and *koinōnía*, therefore, seem to only miss the point and overcomplicate the matter⁶¹. The stone’s constitution and the

⁵⁹ Cf. *Def. orac.* 27, 425^{A-B}: «anyone who insists that, while there are many centres, the heavy substances are impelled from all sides towards one only, does not differ at all from him who insists that, while there are many men, the blood from all shall flow together into a single vein [...]» (transl. BABBITT 1936B).

⁶⁰ Cf. the reconstruction in RESCIGNO 1995, n. 252: «se qualche realtà vi fosse stata [all’esterno del mondo], essa avrebbe arrecato danno alla sua struttura, sia che rispetto ad esso fosse stata congenere, sia che fosse stata allogena. Se gli fosse stata congenere [...] avrebbe teso verso il centro di quel mondo e [...] distrutto l’analogia simmetrica del κόσμος platonico. Se invece fosse stata alcunché di aliotrio ne avrebbe, naturalmente [...], causato la dissoluzione». Rescigno’s interpretation, apparently, relies completely on the one Apuleian passage that he gathers for comparison —*Plat.* I 7.197-8—, which to me does not really seem relevant to our case.

⁶¹ See the preceding footnote and RESCIGNO 1995, n. 252, who attributes to Plutarch (through Lamprias) a definitely Stoic cosmology: the “extra-cosmic stone” cannot move towards our world as it is «privata di οικειωσις in rapporto ad esso. Ciò solo a cui può pensarsi è un agglomerato autonomo, capace, cioè, di σύστασις e di τόνος autonomi. In altre parole non mi pare vi possano essere dubbi circa la relazione tra il λίθος di Plutarco e la teoria della συμπάθεια, della κοινωνία, della οικειωσις tra ciascun singolo elemento e l’insieme strutturale dell’universo di cui è parte». He rightly quotes in his note *Lun.* 924^D as a parallel passage, but he is wrong in declaring that «[vi] è cenno, per l’appunto, della συμπάθεια delle parti rispetto all’insieme», since the verb that Lamprias uses there is not a cognate of συμπάθεια, but οικειοῦν, which is of course related to οικειωσις. It is true that this is still a Stoic concept (see POHLENZ 1948, 227–34; in Plutarch, *Stoic. rep.* 12 1038^B), but the focus of Lamprias’s remark, arguably, is much less on how the earth «will appropriate» (οικειώσεται) her parts than on these parts’ belonging to a whole. I can easily agree with Cherniss on the idea that Lamprias, by using this word, «turns against the Stoics their own doctrine of οικειωσις» (CHERNISS AND HELMBOLD 1957, n. c *ad loc.*, followed by LERNOULD 2013, n. 91), *i.e.* that he simply uses it dialectically, possibly with a hint of irony; see also DONINI 2011, n. 89 (who is content to recognize the “Stoic vocabulary” and cite, like Cherniss, *Stoic. rep.* 12 1038^{B-C} = SVF III 179). Rescigno’s error is probably dependent on THEILER 1982, 174, whom he cites, for Theiler writes, commenting on *Lun.* 924^E, that «ein Sympathieverhältnis besteht nicht, wenn etwas nie zu einem Ganzen gehörte und nicht abgespalten (ἀπεσπασμένον) ist». Curiously, RAINGEARD 1935, 79 (who is neither cited by Theiler nor by Rescigno) had already explained this passage by referring to *sumpátheia* before them: «la pesanteur s’explique donc par la “sympathie” qui règne entre les semblables». Now, Raingear’s, Theiler’s and Rescigno’s interpretation might indeed be supported by the presence of the term τόνος in our passage, but Lamprias’s use of the word does not necessarily imply on his part an assumption of the tenets that only the Stoics associated with it (see above, p. 20 n. 58). Another relevant factor is the ambiguity of the term οὐσία in the syntagm *συντεταγμένος εἰς τὴν οὐσίαν*, as the term “substance” can be interpreted either as a synonym for “matter” or as a substantive designation of an object’s “self” or “identity”, *i.e.* as its “being”; while in my translation I focus on the term *συντεταγμένος* to stress its reference to an orderly arrangement (it is in fact a composite of *τάττειν*), leaving οὐσία ambiguous, Rescigno’s translation seems to focus more on a kind of material unity («ne sia costrutturata alla sostanza»; see also *e.g.* FLACELIÈRE 1947: «n’entre pas dans la composition de sa substance»). The parallel *loci* Rescigno gathers as proof of his interpretation are not even applicable to his version, in addition to being external to Plutarch’s *corpus*: *e.g.* Cicero in *Nat. deor.* II.82 only uses the terms *natura*, *mundus* and *cohaerēre* to refer to a non-disorganized cosmos, and Philo, likewise, uses in *Aet.* 75 the concepts of κόσμος, φύσις, ἔνωσις, and ἕξις to refer to the eternal organization of our world.

relationship between this and a material whole are here irrelevant: the stone is nothing more, and nothing less, than a perfect token of a falling object, which can only exist in a system which, providing ‘mechanical laws’, allows its weighty entities to fall⁶².

Analogous considerations can be made on a similar passage in *Lun.* 7, in which Lamprias’s argumentative efforts are again focused on dismissing the idea of an absolute centre as a direction point for all the bodies in the world, this time through its derision by a list of *reductiones ad absurdum*. One of these, as pointed out by Görgemanns, is a “thought experiment” without parallel in ancient literature⁶³, just like the argument, as we might add, of the “extra-cosmic stone”. Its protagonist is also a weight —a very significant one—, and the theme is still that of a hardly conceivable (although not logically impossible)⁶⁴ mechanical behaviour. As to the identification of the weight itself, the scholars’ opinions are varied, since the term which Lamprias uses for it may be ambiguous, at least for us (924^{A-B}):

[...] ὡσπερ οὗτοι τὴν ἐπὶ τὸ μέσον φορὰν εἰσάγουσιν. ἢ τί παράδοξον οὐκ ἔνεστιν; [...] οὐ μύδρους χιλιοταλάντους διὰ βάθους τῆς γῆς φερομένους, ὅταν ἐξίκωνται πρὸς τὸ μέσον, ἴστασθαι, μηδενὸς ἀπαντῶντος μηδ’ ὑπερείδοντος· εἰ δὲ ρύμη κάτω φερόμενοι τὸ μέσον ὑπερβάλλοιεν, αὐθις ὀπίσω στρέφεσθαι καὶ ἀνακάμπτειν ἀφ’ αὐτῶν;

[...] just like these people introduce the motion towards the centre. What paradox is not implied by it? [...] Is it not true that lumps of a thousand talents (*i.e.* ca. 4 tons) moving through the depths of earth, when they reach the centre, would stop still without anything opposing or sustaining them? And that if they went past the centre, moving downwards due to their impetus, they would turn back again and return all on their own?

⁶² FLACELIÈRE 1947, n. 185, in connecting the “extra-cosmic stone” with the Epicurean argument of an arrow that is thrown outside of a limited world’s boundaries (Lucretius, *Rer. nat.* I 968-979), which «ne peut ni atteindre un but quelconque ni être arrêtée par aucun obstacle», at least captures the ‘mechanical’ core of Lamprias’s argument, and therefore does not deserve the bitter criticism of RESCIGNO 1995, n. 252: cf. above, p. 19-20 n. 56. As was also true for Del Corno, Flacelière’s simple parallelism (although in the commentary’s introduction it turns into something more: «Lamprias semble bien employer un argument épicurien», p. 68) is not to be understood as an interpretative hypothesis: Flacelière wants to suggest a dialectical line of influence at most. It also makes no sense to present the Epicurean arrow, as Rescigno does, as a «simbolo del traversamento dello spazio». Probably, also ILDEFONSE 2006, n. 14 *ad loc.* wanted to allude to the Epicurean argument, when he wrote of «la flèche dans l’histoire stoïcienne» without citing any passage.

⁶³ GÖRGEMANNNS 1970, 94. Cf. RAINGEARD 1935, 76, who already noted that the arguments consist of «expériences theoriques et du domaine de la fiction», although his quotation of the term ψευδῶς in 7 924^B as proof of his interpretation is rather far-fetched (since Lamprias uses it to refer to the absurd consequences of the fictional scenarios; not to the scenarios themselves).

⁶⁴ As GÖRGEMANNNS 1970, 94 puts it, «das widerspricht jeder Vorstellungsmöglichkeit».

The term *múdro*, which I have simply translated as “lump”⁶⁵, is used by ancient Greek authors to refer to blocks of metal or stone, which in certain contexts are also described as, or implied to be, incandescent⁶⁶. The ‘metallic’ or ‘mineral’ constitution of the hypothesized boulders⁶⁷ —which I have hidden in my translation for lack of an appropriately ambiguous word in English— makes of this passage another possible candidate as a testimony of the ancient exemplarity of stones as weights. The boulders’ weight is in fact their only relevant quality in this thought experiment, so much that Lamprias underlines it by a considerable amplification (“of a thousand talents”); this is used, rhetorically, to emphasize the perceived absurdity of a body stopping automatically (or reversing its motion) at an immaterial centre: the heavier the boulder is imagined, the weaker the centre will seem in its mechanical (non-)opposition⁶⁸. Naturally, this thought experiment requires the earth’s interior to be hollow in some degree⁶⁹, but the dialectical nature of the argument spares it from a necessary inclusion of actual geographical assumptions: it is true that the mythical cosmology described by Socrates in *Phaedo* (111^C -112^E) would add a degree of plausibility to Lampria’s scenario; however, this scenario is clearly not meant to be received as plausible⁷⁰. H. Cherniss, therefore, may be right in supposing that «Plutarch probably had in mind a subterranean geography such as that of *Phaedo*»⁷¹, but he has no convincing reasons to try and interpret the reference to *múdroi* in light of actual meteorological phenomena. There is no need for these *múdroi* to be «incandescent boulders such as are thrown up by vulcanoes»⁷²; as also noted by P. Donini⁷³ (who nonetheless translates the term as «massi incandescenti»), the absurd mechanical absurdity would follow to occur whether the boulders are conceived as being red-hot or not. I would suggest that the term is only chosen to evoke a bigger and heavier stone block than the one we would imagine reading λίθος (possibly as a variant of πέτρος, another term which is quite rare in Plutarch’s

⁶⁵ Cf. KEPLER 1634: «massas millenorum talentorum»; PRICKARD 1918: «masses of a thousand talents».

⁶⁶ Hesychius reports for *múdro* three definitions: «raw iron (ἀργός σίδηρος)», «mighty stone (κραταιός λίθος)» —metaphorically also used for «a dumb person (ἀναίσθητος)»—, and «iron made incandescent (σίδηρος πεπυρ(ακτ)ωμένος)»; he also defines the otherwise unattested word σμύδροσ as «incandescent iron (διάπυρος σίδηρος)». On *múdro*s see KAGAROW 1928, who remains very faithful to the ambiguity of the term. See also LSJ for the best list of relevant *loci* (although their interpretation of the word as “anvil” in Aeschylus, Fr. 307 appears to me to be wrong); CHANTRAINE (who focuses too much on fire and incandescence, maybe relying excessively on the scholium to Callimachus, *H.* III 49 that he quotes, as well as on the uncertain etymology of μύδροσ from μυδάω: “I am damp”); BEEKES (according to whom «the technical meaning rather suggests a Pre-Greek word. This is confirmed by the variant σμύδροσ»).

⁶⁷ On the distinction between minerals and metals see above, p. 3-4.

⁶⁸ Cf. Phaedimus’s argument of the falling sphere in *Comm. not.* 40 1081^B (which I discuss below, p. 33-4) and the Epicurean argument of the arrow in Lucretius, *Rer. nat.* I 968-979 (see above, p. 22 n. 62).

⁶⁹ Cf. RAINGEARD 1935, 76 nn. *ad loc.*, who interprets *múdro*us as an allusion to «bolides» and points out, on their alleged arrival to the earth’s centre, that «une pareille force de penetration est invraisemblable».

⁷⁰ See above, p. 22 n. 63.

⁷¹ CHERNISS AND HELMBOLD 1957, n. b to *Lun.* 7 924^A.

⁷² Cherniss in CHERNISS AND HELMBOLD 1957, n. b to *Lun.* 7 924^A, citing «for *múdroi* in this sense»: Pseudo-Aristotle, *Mund.* 4 395^B22-23 (where the incandescence is specified by the use of διάπυρος and the probably generic μύδροσ —not explicitly defined— can only be understood to designate volcanic boulders as it appears in connection with streams of lava); Strabo, VI 2.8, 2.10 and XIII 4.11 (where no incandescence is specified, and the μύδροι —term which might be used again in its generic sense— are blown upwards by craters and flames).

⁷³ DONINI 2011, n. 81.

*corpus*⁷⁴), but an equally plausible hypothesis would be that the falling mass is in fact imagined as a block of metal, since in this case *múdroi* would be, to my knowledge, the only available Greek term to refer to it⁷⁵. Raingeard’s and Cherniss’s efforts to identify which specific object hides behind the word *múdroi* — Raingeard thinks of meteors, while Cherniss, dismissing the former’s proposal with no explicit reason, decides in favour of his own volcanic boulders⁷⁶— are therefore excessive and miss the focal point of this *reductio ad absurdum*, which simply is the mechanical behaviour of a considerably weighty body⁷⁷. It is only uncertain whether this should be imagined as metallic or mineral in constitution; in the latter case, this passage would fit perfectly among the other instances of stones as stock examples for generic weights.

Shortly after listing these paradoxes, Lamprias turns to a defence of the theory that the moon’s constitution is earthy, opposing the (implicitly) Stoic counterargument that it is absurd for an earth to stay up ‘above’ despite not occupying the world’s central position (8 924^{D-F}). Since this passage concerns the idea of an absolute cosmic centre and its substitution with a relativistic view, and its argumentation focuses on the behaviour of weights, we can consider it to have been written in the same spirit of the polemic in *Def. orac.* 28, and some scholars have in fact treated these two as *loci paralleli*, although sometimes disregarding their individual features⁷⁸. Considering their similarities, then, we might be unsurprised to also find here a reference to stones as weighty objects, and a close association of these stones with earth (*Lun.* 8 924^{D-E}):

τεκμήριον <τὸ κατωφερές>⁷⁹ ἔσται τῶν ῥεπόντων οὐ τῆ γῆ μεσότητος πρὸς τὸν κόσμον, ἀλλὰ πρὸς τὴν γῆν κοινωνίας τινὸς καὶ συμφυΐας τοῖς ἀπωσμένοις αὐτῆς εἶτα πάλιν καταφερομένοις. ὡς γὰρ ὁ ἥλιος εἰς ἑαυτὸν

⁷⁴ In Plutarch’s works, *múdroi* are only mentioned again in *Arist.* 25.1 —still without their material constitution being clarified—, again in a context where their only relevant property seems to be their weight (see below, n. 77). The *πέτρος*, which in Plutarch’s *corpus* is only mentioned four times (two of these inside the proverb quoted in *Profect.* 2 75^F, that I quote below, p. 62), curiously appears in the very same *Arist.* (17.3) as part of a symbolic gesture, *i.e.* as a metaphoric amplification (in size and weight, and arguably in injuring power — cf. below, p. 34-5 on the use of stones as weapons) of Amompharetus’s *ψῆφος* in favour of a battle (the word meaning both “vote” and “pebble”, see FLACELIÈRE AND CHAMBRY 1969, n. 3 *ad loc.*). The other occurrence of the term is in *Per.* 31.3, where Plutarch describes the sculptor Pheidias as being accused of representing himself on his shield of Athena as a bald old man lifting a *πέτρος* with his bare hands (notice here, again, the implicit focus on the stone’s weight).

⁷⁵ Cf. also below, p. 46-8 on the oscillation in the doxographical tradition between the terms *λίθος* and *μύδρος* to refer to Anaxagoras’s conception of the sun, which might be a hint of some authors’ specifically ‘metallic’ understanding of the word *múdroi*.

⁷⁶ Raingeard: «nous ne pouvons penser qu’à des bolides» (in which case we could consider the *múdroi* to be stony-iron meteorites, see below, p. 46 n. 171); Cherniss: «probably not aeroliths, as Raingeard supposes, but [...]». See also above, p. 23 n. 69 and 72.

⁷⁷ Cf. the plunging of a *múdroi* in the sea as part of a sacred oath, as reported by *e.g.* Herodotus, I 165.3 and Aristotle, *Ath.* 23.5 ≈ Plutarch, *Arist.* 25.1. The plunging was accompanied by the declaration that the sworn behaviour would last until the *múdroi* would return to surface, *i.e.* by the invocation of «conditions irréalisables qui servent de garantie symbolique de la fermeté du voeu» (KAGAROW 1928, 197). In this ancient practice too, as we can see, the *múdroi*’s only relevant property was its remarkable weight. Cf. *Sul.* 10.7 for an oath involving the throw of a stone and based on the principle of analogy.

⁷⁸ See ADLER 1910, 133; RAINGEARD 1935, 80; THEILER 1982, 174, RESCIGNO 1995, n. 252. See also GÖRGEMANN 1970, 111–12, who, following Adler, parallels *Def. orac.* 26-28 with *Fac. lun.* 8-15.

⁷⁹ Suppl. Cherniss in CHERNISS AND HELMBOLD 1957, whom I decided to follow in my quotation. The transmitted *lacuna* —as reported by Ingekamp in INGENKAMP AND BERNARDAKIS 2013— is of 11 letters in ms. E (Par. Gr. 1672, beginning of XIV cent.) and

ἐπιστρέφει τὰ μέρη ἐξ ὧν συνέστηκε, καὶ ἡ γῆ τὸν λίθον ὡσπερ <αὐτῇ>⁸⁰ προσήκοντα δέχεται κατωφερῆ πρὸς οἰκεῖον⁸¹. ὅθεν ἐνοῦται τῷ χρόνῳ καὶ συμφύεται πρὸς αὐτὴν τῶν τοιούτων ἕκαστον.

The <downward motion>⁷⁹ of the falling bodies will not be a sign of the earth's centrality in the world, but of a kind of association and original communion of earth, instead, with the objects which move back down after being thrust away from her. In fact, just like the sun turns back into itself the parts out of which it was constituted, the earth too welcomes the stone as befitting <to herself>⁸⁰, brought down to something which is its own⁸¹; hence each of such objects, with time, unites with her and stays in communion with her.

Any body, Lamprias continues, not partaking in this original communion with (our) earth, is thus not required to fall to it, and an originally earthy and separate moon would not have problems surviving in its unity. The stone is clearly used to exemplify an earthy weight: this time, it is not only chosen as a paradigmatic heavy object (*i.e.* something that falls), but as a weight which can be easily understood as an object proper to earth and conspecific with it (*i.e.* something that falls into earth as its cosmological relative). It might not be a coincidence that Lamprias, a few lines below, when he decides to show his Stoic opponent (represented by Pharnaces) how his criticism can backfire on his own theories, he refers to him as «that who drives together every earthy (γεώδη) and heavy (βαρέα) thing into a single space and makes them parts of a single body»

14 letters in ms. B (Par. Gr. 1675, XV cent.; 16 letters according to GÁRRIGA 2021). Cherniss's solution is accepted by LEHNUS [1991] 2013, DONINI 2011, LERNOULD 2013, Castello in LELLI, PISANI, ET AL. 2017, n. 18 *ad loc.* Cf. WYTTENBACH 1797C (suggests to rephrase as τεκμήριον τοῦ ἀνάγκη γίνεσθαι, τὴν ῥοπήν αὐτοῖς οὐ etc.); BERNARDAKIS 1893 (ἐκ τῶν βαρέων). Cf. also KEPLER 1634, who in his translation uses “proportio” without signalling an insertion.

⁸⁰ Suppl. Cherniss in CHERNISS AND HELMBOLD 1957, whom I decided to follow in my quotation. The transmitted *lacuna* —as reported by Ingekamp in INGENKAMP AND BERNARDAKIS 2013— is of 5 letters in ms. E (Par. Gr. 1672, beginning of XIV cent.) and 8 letters in ms. B (Par. Gr. 1675, XV cent.). Cherniss's solution is accepted by LEHNUS [1991] 2013, DONINI 2011, LERNOULD 2013, Castello in LELLI, PISANI, ET AL. 2017, GÁRRIGA 2021. Cf. WYTTENBACH 1797C (ἴδιον καὶ), followed by BERNARDAKIS 1893; ADLER 1910, 133, n. 1; RAINGEARD 1935, 79 n. *ad loc.* (proposes to delete the *lacuna*); HUBERT, POHLENZ, AND DREXLER [1955] 1960 (οἰκεῖον καὶ). Cf. also KEPLER 1634, who inserts in his translation «[sinui suo]».

⁸¹ The transmitted text is καὶ φέρει πρὸς ἐκεῖνον: notice that this way it would be the earth (like the sun in the preceding sentence) to actively move the stone, if the verb φέρειν is interpreted as transitive, but the masculine demonstrative ἐκεῖνον could only refer to the stone itself, and this way the sentence would make no sense; RAINGEARD 1935 keeps the transmitted text and gives an intransitive meaning to φέρειν (transl. «la terre [...] se porte vers cette masse», see n. *ad loc.*); cf. KEPLER 1634, who already translated «et fert ad illum», and ADLER 1910, 133, n. 1, who quoted the transmitted text without modifications. Cherniss in CHERNISS AND HELMBOLD 1957, instead, whom I decided to follow in my quotation, accepts the conjecture κατωφερῆ from WYTTENBACH 1797C (the full conjecture was κατωφερῆ πρὸς ἐκεῖνην; as an alternative, καὶ φέρει πρὸς ἐκεῖνον was also proposed) and takes πρὸς οἰκεῖον from EMPERIUS 1847, 289 (who had proposed καταφερῆ πρὸς τὸ οἰκεῖον, endorsed doubtfully by BERNARDAKIS 1893 and Ingekamp in INGENKAMP AND BERNARDAKIS 2013). Cherniss's solution is accepted by LEHNUS [1991] 2013 (although the «verso di essa» in his translation seems to depend on Wyttenbach's πρὸς ἐκεῖνην), LERNOULD 2013. Cf. also KRONENBERG 1941, 41 (προσκειμένον), followed by GÖRGEMANN 1970, 95, n. 23, DONINI 2011 and Castello in LELLI, PISANI, ET AL. 2017. And GÁRRIGA 2021 (καὶ προσφέρει ἐκεῖνον, taken from Amyot; it is clear from her commentary at p. 131 that she does not mind about the strong philosophical implication of this variant, identical to that of the manuscripts' καὶ φέρει πρὸς ἐκεῖνον).

(924^F): in this passage, it is clear, the stone’s only function is that of a γεῶδες βάρος. Below I will come back to the analysis of Plutarch’s views on stone’s material composition⁸²; now, it is only important to stress that the illustrative function of the stone does not require it in this passage to be of any specific kind. This time, it is not even important to imagine the stone as being particularly heavy. H. Cherniss is therefore right in opposing both Raingeard’s confident identification of the stone with a meteor⁸³ (which is also his understanding, as I have shown above, of the term *múdroi* in 7 924^A) and M. Adler’s unjustified connection with the argument of the “extra-cosmic stone” in *Def. orac.* 28 (425^C)⁸⁴: the reference is in fact «to any γεῶδες τι ὑπὸ βίας ἀναρριφέν, in the words of Pharnaces [in 6 923^F]»⁸⁵, *i.e.* to any earthy object that after being thrown upwards from the soil falls back to it. This mechanical behaviour was understood by the Stoic Pharnaces to be caused by the weights’ inclination (ῥοπὴ) towards the centre, as he had explained during the discussion, and precisely his statements on the subject were what prompted Lamprias’s bitter list of *reductiones ad absurdum*. Being it part of that same polemical answer, it is then reasonable to see in the present reference to the stone an allusion to Pharnaces’s own example, although made more concrete by the explicit, mineral instantiation of his earlier, more generic term γεῶδες⁸⁶.

One last association of stones with the property of weight can be found in *Comm. Not.* 30, where Phaedimus is intent on showing the absurdities entailed by the Stoic thesis that “the everything” (or “sum of things”, as Cherniss translates⁸⁷ τὸ πᾶν) does not exist. One of these is centred on the thesis’s inherent contradiction with the belief that all the existing objects —*i.e.* the parts of “the everything” itself— have a bodily nature, contradiction given by the fact that a non-existing object is certainly not regarded as a body⁸⁸. Deciding to proceed with a rhetorical accumulation, Phaedimus selects his illustrative instances in a way that is clearly meant to encompass, by allusion, everything in the world that the Stoics conceive as bodily (1074^{A-B}): since “the everything” is not a body, we read, «but heaven and earth and animals and plants and humans and stones are body, that which is not body will have bodies as its parts [...], and what is not heavy will possess heavy members, and what is not light light ones»⁸⁹. Phaedimus, clearly not satisfied with the single, although logically sufficient, reference to corporeity, has expanded on the absurdity by also mentioning the properties

⁸² See below, sec. 2.

⁸³ RAINGEARD 1935, 79 n. *ad loc.* («Lamprias à n’en guère douter parle des bolides»). Cherniss also targets KRONENBERG 1941, 41, n. *ad loc.* («meteoroliet Lysand. 12»).

⁸⁴ ADLER 1910, 133, who does not refer to the “extra-cosmic stone” itself, but to its implicit counterpart which is part of the world (though not of earth, which is what he writes): «eandem sententiam Lamprias in dialogo *de def. orac.* profert, cum 425^C implicate concedat, fore, ut lapis extra terram situs ad eam deferretur, si pars terrae esset»).

⁸⁵ Cherniss in CHERNISS AND HELMBOLD 1957, n. c to 924E. Cf. LEHNUS [1991] 2013, n. 69, who invites the reader to compare this passage with what he writes in his previous n. 62, where he follows Cherniss in identifying the *múdroi* of 7 924^A as volcanic boulders (see above, p. 25 with n. 72): does he mean that the present λιθος is to be interpreted as a volcanic boulder too?

⁸⁶ In accordance with DONINI 2011, n. 92.

⁸⁷ CHERNISS 1976b.

⁸⁸ See CASEVITZ AND BABUT 2002, n. 436 for a detailed explanation of the argument.

⁸⁹ Transl. CHERNISS 1976b, with slight adjustments.

of heaviness and lightness. The reason why they are relevant to the argument is that weight is one of the main qualities of all corporeal beings *qua* corporeal, hence it is also inseparable from stones. Although it is intuitive to associate the present reference to stones with the mentioned heaviness rather than with lightness, we can see that in this passage their close association with weight is shared with every other existing bodily entity. The stones' stock exemplarity as weights, then, is not rhetorically exploited in this argument, if not in a vague and partial manner: this distinguishes this passage from the others discussed above.

1.2. Tightly packed perceptual barriers (density)

During the discussion, the mechanical connection between the weight (βάρος) and bulk (ὄγκος) of a substance has interestingly turned up in a metaphorical frame⁹⁰. Reflecting on the connection between these two properties, we might not be wrong in suggesting the stones' paradigmatic βαρύτης to be correlated with a peculiar constitutive ὄγκος distinguishing the stones from the other, lighter bodies: a particularly high amount of (heavy) matter might be intuitively imagined to be fitted into each stone's boundaries, and this density (πυκνότης) of bulk might be regarded to be the cause of stone's higher weight. Whether our supposition is true or not, there are indeed a few passages attesting to a conception of stone as a particularly dense substance, although only one of these can be reasonably interpreted to report Plutarch's own belief. In *QConv.* VI 5 — a *quaestio* that will turn up again repeatedly in the following sections⁹¹— Plutarch's own character is the only one expressing his opinion, and since it closes the discussion while remaining undisputed, it is safe to assume that Plutarch, here, wrote sincerely about his own take on the Aristotelian *problēma* under discussion, *i.e.* that on how does it happen that «pebbles» (χάλικες) and leaden *ákmones*⁹² refrigerate the water they are plunged in, proposing a tentative solution in accordance with his own ideas⁹³. The first part of his explanation connects the two objects' cooling effect with the action of cool air, and grounds the differences in its intensity into a concrete dynamic of mechanical opposition and letting-through (690^F-691^A):

πρῶτον οὐ δοκεῖ σοι περιψύχεσθαι⁹⁴ μὲν ὑπὸ τοῦ ἀέρος τὸ ὕδωρ ἔξωθεν ἐμπίπτοντος⁹⁵, ὁ δ' ἀήρ μᾶλλον ἰσχύειν πρὸς τοὺς λίθους καὶ τοὺς ἄκμονας ἀπεριδόμενος; οὐ γὰρ ἔωσιν αὐτόν, ὥσπερ τὰ χαλκᾶ καὶ τὰ

⁹⁰ See above, p. 15-6 on *Ad princ. ind.* 2 779^F-780^A.

⁹¹ I will focus on it especially in sec. 6.

⁹² I discuss the meaning of this term (lit. “anvils”) below, p. 97.

⁹³ TEODORSSON 1989b, n. to 690 F points out that «the conductivity of lead and silicon is very low; hence lumps of these materials, if cold when dropped into the water, may cool it or keep it cool through the slow emission of cold».

⁹⁴ Περιψύχεσθαι: conjectured by Reiske and accepted by all following editors. In the manuscripts we read προψύχεσθαι (“be pre-cooled”).

⁹⁵ Ἐμπίπτοντος: anonymous correction of the ἐκπίπτοντος (“falling out”) in the manuscripts, accepted by all modern editors. As reported by Ingenkamp in INGENKAMP AND BERNARDAKIS 2011, the correction was maybe already in ms. g (Palat. (Vat.) *Gr.* 170, XV cent.), but the letter is not written clearly enough to be discernable. FUHRMANN 1978 credits Turnèbe.

κεραμεῶ τῶν ἀγγείων, διεκπίπτειν, ἀλλὰ τῇ πυκνότητι στέγοντες ἀνακλώσιν εἰς τὸ ὕδωρ ἀπ' αὐτῶν, ὥστε δι' ὄλου καὶ ἰσχυρὰν γίγνεσθαι τὴν περίψυξιν.

First, does it not seem to you that water is cooled by the air falling upon it from the external surroundings^{94,95}, and that air is more effective when opposed by the stones and the *ákmones*? Because these do not allow it to pass through and escape, like copper (or bronze, *khalkós*) and earthenware vessels [do], but holding it with their density they reflect it from themselves into the water, so that the cooling becomes thorough and intense.

It is precisely the stones' superior «density» (πυκνότης), greater than that of both copper and earthenware — *i.e.* the materials of the vessels storing the lukewarm water in need of a refresh—, that bars the air from running through the stones without an impactful action on themselves and on the water which surrounds them⁹⁶: the stones are so compact that not even air is able to seep through them. In fact, a few lines below, after repeating that it is with their density that the «pebbles» (χάλικες) «produce the cold in the [water's] depths», Plutarch supports the statement with a quite strong assumption, of specific interest here: «for every stone is a solid mass (*págos*) of earth that was cooled and condensed by intense cold, and the more so for the more condensed [stone]» (691^B). I will comment on this passage (and on Plutarch's wordplay on the term *págos*) later, while discussing the stones' earthy composition⁹⁷; for the moment, it is only important to take it as a proof of a very tight constitution associated with the stones' bulk. This denseness, clearly, is both related to coldness and conceived, in a way, to be hostile towards air. This last detail is curious, because air—as we will see—will keep showing up, in a way or another, in relation to each of the passages associating density with stone which remain to be examined; in none of these can the association be directly and uncontroversially attributed to Plutarch himself.

The most relevant passage is in *QConv.* VIII 3.2, in the context of Boethus's defence of an atomistic stance on the mechanisms of sound propagation: this relies explicitly on the assumption of the existence of the void, which he accepts as “previously demonstrated” by Epicurus (720^F-721^A). After introducing the opinion that sounds are muffled or silenced altogether when they encounter material obstacles—namely, atomic aggregations intercepting their trajectories to the ears through empty space and deviating it—, he proceeds to illustrate the thesis through empirical phenomena. In so doing, he first refers to the different acoustics of the empty against filled vessels (the former, when smitten, give back a much louder and more lingering sound

⁹⁶ Cf. *Lun.* 25 939^{B-C} for a similar dynamic of heat refraction and intensification (note the partial correspondence between the term *συνεπερείδοντος* in that passage and the *ἀπερειδόμενος* used here).

⁹⁷ See below, p. 40-2.

than the latter)⁹⁸, and then moves away from containers to focus on «the bodies themselves», differentiated by each own's degree of material density (721^C):

[...] αὐτῶν δὲ τῶν σωμάτων χρυσὸς μὲν καὶ λίθος ὑπὸ πληρότητος ἰσχνόφωνα καὶ δυσηχῆ καὶ ταχὺ κατασβέννυσι τοὺς φθόγγους ἐν αὐτοῖς εὐφῶνος δὲ καὶ ἀλλος ὁ χαλκός, ἢ πολύκενος καὶ ὄγκον ἑλαφρὸς καὶ λεπτός, [...]

[...] and among the bodies themselves, on one hand gold and stone, due to their fullness, [are] thin-voiced and ill-resounding, and quickly extinguish the noises inside them, while on the other copper (or bronze, *khalkós*) [is] good-sounding and talky, as it contains much void and [is] light and thin in bulk [...]

We can see that stone, together with gold, is explicitly opposed to the acoustic capabilities of copper on the grounds of the latter's different *ónkos*. Although Boethus says nothing on the bulk and density of stone and gold, it is clearly implied by the context that these are assumed to be far from *πολύκενοι*, having an *ὄγκος* that is the opposite of «light and thin». In this illustration, they play the same role as the filled vessels mentioned in the previous phrase, 'containing' in themselves (notice the term *πληρότης*) many more atoms than «talky» copper⁹⁹. Naturally, it is not possible for us to directly assign to Plutarch this assumption, contained in such an Epicurean physical explanation, but his in-character immediate reply to Boethus might give us a hint that he agreed with him on the differences in *ὄγκος* between the mentioned substances (3 721^{D-F}). Plutarch's character, in fact, does not oppose Boethus's statements on the varied lightness and bulk of these bodies, but only dismisses his view on emptiness as the specific carrier of sound, substituting it with air. As he specifies, «copper partakes of no emptiness, but having intermixed in it an even and smooth air (*pneûma*) it is

⁹⁸ With Braccini in BRACCINI AND PELLIZER 2014, n. 92, I don't really see why «this example, and the entire argument that follows» should be, as TEODORSSON 1989c, n. to 721^B declares, «strangely irrelevant and misleading». He argues that «Boethus seems suddenly to have forgotten that his argumentation has so far been founded upon the difference between more or less equally dispersed molecules of air offering a more or less easy free passage to the atoms of air [?] carrying the sound», but, although Boethus did mention the *τοῦ ἀέρος ἄτομοι* at the beginning of his reply (720^F), it is clear that in so doing he did not mean to restrict the scope of all possible atomic obstacles to only airy substances: they are a subset of all material obstacles, and are only mentioned explicitly because the *quaestio* is about the mechanisms of sound propagation through the atmosphere at night. Teodorsson becomes strangely offensive towards Boethus, calling him «muddle-headed» and introducing his next example (which I quote immediately below) with the formula «as if this were not enough», but his inductive reasoning does not seem to me to be that far-fetched, if his Epicurean atomism is assumed. See also the following footnote.

⁹⁹ I again agree with Braccini in BRACCINI AND PELLIZER 2014, n. 93 on the fact that TEODORSSON 1989c, n. to 721^C has no reason to state that «if the sound can only move through the void, this implies that propagation through solid matter, albeit *πολύκενος*, would be practically impossible», since solid matter, if not too densely packed, is clearly conceived to contain enough void for sound to be propagated in it. Boethus's reasoning is not «highly bizarre»: after all, he is in no way comparing copper's conductivity with that of air (which is obviously much higher), but corroborating his acoustic theory through induction. See also *ib.*, 189, n. to 721^{CD} («as a matter of fact, the Atomist theory of acoustics could not account for propagation of sound in solid matter») and the preceding footnote.

soundingly-receptive of strikes and resonant»¹⁰⁰. His correction does not affect copper's superior lightness and lesser ὄγκος, but only grounds it in a specific elementary composition, in which air occupies a bigger part, it might be implied, than in those of stone and gold, whose heavier element(s) make up their bulk in greater density¹⁰¹.

It is interesting to contrast this negative correlation —between the participation of air in a body's composition and the latter's resulting bulk— with Plutarch's report (and ridicule) of Chrysippus's views on how the bodies acquire their permanent states (or essential arrangements of properties, *héxeis*)¹⁰² in *Stoic. rep.* 43. Here, air appears as the central object of the dispute (1053^F-1054^A). In his books *On permanent states* (*Peri héxeōn*), as Plutarch writes, Chrysippus «says that these (*i.e.* the permanent states) are nothing but airs (ἀέροι)», and that bodies are held together (συνέχεται) by these, so that these bodies' «being each of a certain quality» (τὸ ποιὸν ἕκαστον εἶναι) depends on the air holding each of them together: air, Chrysippus illustrates, «that is called hardness in iron, denseness (πυκνότης) in stone and whiteness in silver». If we maintain that Plutarch associated air with lighter ὄγκοι, it might have seemed particularly paradoxical to him to posit it as the specific cause of the stones' density, insofar as it was to be understood as one of stone's fundamental elements (see Plutarch's reformulation in terms of μίγνυσθαι and κεράννυσθαι in the same passage)¹⁰³, rather

¹⁰⁰ There is no reason to identify this air with the Stoic *pneūma* permeating everything (see in my text, immediately below), as done by TEODORSSON 1989c, n. to 721^E. Braccini in BRACCINI AND PELLIZER 2014, n. 104 cites Theophrastus, *Ign.* 17 as an example of a non-Stoic reference to *pneūma* inside *khalkós*, but the «particolari condizioni» of its presence in the metal are only temporary and quite short-lived, and thus not really comparable with Plutarch's character's account; on this passage see below, p. 192-4.

¹⁰¹ The corrections and additions that we find in the prosecution of the *quaestio* —even those in Ammonius's authoritative reply— do not tackle Boethus's and Plutarch's remarks on the bodies' density and admixture with air. There is indeed another passage hinting that Plutarch regarded stones to also contain air: see *Lun.* 5 922^C, which I analyze below in sec. 5. On the stones' minimal resonance cf. *An. procr.* 33 1029^F, where Plutarch mentions λίθοι as an instance of «the most noiseless bodies» (τὰ κωφότατα σώματα), alongside woods and barks as well as bones and rennets, which provide, when mixed in good proportions, «astonishing sights of sculptures, and and drugs (or pigments? – φάρμακα) and [musical] instruments of astonishing effects». It is unclear whether Plutarch here intends the term κωφός to be understood more literally in its acoustic sense (considering this passage's musical theme, also developed in the following lines) or metaphorically (cf. CHERNISS 1976a: «senseless» and Ferrari in FERRARI AND BALDI 2002: «inerti»). Concerning the acoustic behaviour of stone, also consider that in *Def. orac.* 8 414^A it is «rocks» (πέτραι) to give back echoes (but mountains are the most frequent subject of this action: see *Ar.* 22.4, *Sul.* 19.4, *Mar.* 20.2).

¹⁰² Stoic technical term with no exact correspondent in modern languages. It refers here to the set of qualities defining the categories or species that include their subjects; *héxeis* differ from *skhéseis* (“dispositions”) as the latter are affected by variations in the circumstances, whereas the former are permanent and independent. On this concept see Babut in CASEVITZ AND BABUT 2002, n. 530.

¹⁰³ ZANATTA [1993] 2018, n. 7 *ad loc.* rightly points out that Plutarch, by paraphrasing this way, distorts Stoic physics (the *pneūma* does not mix into the bodies, carrying its own properties against them, but determines the bodies' properties by its movement: see Babut in CASEVITZ AND BABUT 2002, n. 532). It is also true, however, that Plutarch's attack is grounded in Chrysippus's wording, because this, if taken literally, can seem to establish a relation of identity between the «airs» and *héxeis*: if the density of an object «is» air, then air or *pneūma* (with its own physical properties) will have to inhere to the object in the same way as its density, which is difficult to imagine in different terms than those of mixture and physical unity. It is not necessary to suppose that Plutarch manipulated Chrysippus's text, as stated (without arguments) by MEIJER 2003, n. 221: he probably just misinterpreted it (whether voluntarily or not). On Chrysippus's use of ἀήρ to refer to *pneūma* (identified with the bodies' qualities shortly after in 1054^B) see Babut in CASEVITZ AND BABUT 2002, n. 531. This ambiguous wording, again, lends itself to Plutarch's subtle counter-arguments: see *ib.*, n. 537 («P. néglige en effet derechef [...] la nature mixte du *pneūma*, compose d'air et de feu»).

than as a merely external agent of densification¹⁰⁴. His refutation, though, does not focus on the thesis's chemical unlikelihood, but on the logical absurdities that it entails in the system of Chrysippus's physical thought, as is to be expected in a work on the Stoics' self-contradictions. Chrysippus himself, it is implied, regards air as a particularly loose substance¹⁰⁵: how can it happen, then, that «the loose becomes denseness in that which is not dense?», *i.e.* that air's loose quality turns into a dense *héxis*—when holding together a dense object— while not being air itself dense? Plutarch develops the paradox in the following lines, to show that there is no escape from the incongruity, but, in these developments, the stone's 'aerial' denseness is not mentioned again¹⁰⁶. What is interesting here about this passage is that it attests of a use of stone as a paradigmatic «dense» object, namely in Chrysippus's intuitive list of illustrations, but nothing allows us to suppose that also Plutarch employed them as such.

This might also have been a traditional association, of course, and in this case it would be unlikely for Plutarch to differ significantly from his culture on this specific tendency, especially if we accept that in *QConv.* VI 5 he did express his own views through his character's mouth. Remaining in the 'perceptological' sphere, in fact, but turning to optics from the acoustics we have touched above, we might find a faint clue of this traditional character in the way Plutarch phrases his references to Lyncaeus's mythical, extraordinary sight. As Phaedimus states in *Comm. not.* 44 (1083^D), «they say that the famous Lyncaeus would see through rock and through an oak (διὰ πέτρας και διὰ δρυός)», and Plutarch also writes in *Util.* 3 (87^{B-C}) that Lyncaeus could see both «through an oak» (διὰ δρυός) and «through stones and shells» (διὰ λίθων και όστράκων)¹⁰⁷. Now, oaks

¹⁰⁴ On air as an external agent of mineral hardening cf. my discussion of *QConv.* VII 2.3 701^{B-C} below, in sec. 4.

¹⁰⁵ See Babut in CASEVITZ AND BABUT 2002, n. 534: «P. se réfère naturellement ici à certaines des caractéristiques reconnues à l'air par la physique stoïcienne [...]»; he reports parallel *loci* for each.

¹⁰⁶ See Babut in CASEVITZ AND BABUT 2002, nn. 535, 537 for the most detailed explanation of Plutarch's arguments and of their faults.

¹⁰⁷ Cf. *Cypr.* 15 (Bernabé) and Pindar, *N. X* 62-3, where Lyncaeus is narrated to have spotted Castor hiding inside an oak's stump by sighting from the distant mount Taygetus. Pindar's verses might be the ones that Plutarch had in mind while writing this passage (see CANNATÀ FERA 2020, n. to *N. X* 62-3), but the details of rocks, stones and *όστρακα* are absent from both these and the ones in *Cypr.* Klaerr, in KLAERR, PHILIPPON, AND SIRINELLI 1989, n. 5 to *Util.* 87^C, quotes a scholium to Pindar's passage informing that Lyncaeus could see through stone, earth and the oak, but the scholiast is not immediately trustworthy, as he might have lived much later than both Pindar and Plutarch. While Hartcliffe simply ignores the term in its translation in GOODWIN [1874D] 1878, BABBITT 1928 decides to translate *όστρακα* as «tiles» instead of «shells», partially followed by Klaerr («briques»), who in turn surely influenced Pisani in LELLI, PISANI, ET AL. 2017 («mattoni»). Their 'artisanal' and 'architectural' interpretation is in accordance with a few variant readings appearing in the manuscript tradition: as reported by Ingenkamp in INGENKAMP AND BERNARDAKIS 2008, the syntagm *λίθων και όστράκων* is substituted in ms. G (*Barb. Gr.* 182, XI cent. and before 1350) with *πλίνθων και λίθων* ("bricks and stones") and corrected *in margine* in both ms. X (*Marc. Gr.* 250, XI/XIV cent.) and F (*Par. Gr.* 1957, XI cent.) as *πλίνθων και όστράκων*. Klaerr, defending this interpretation in his note *ad loc.*, finds support both in Pindar's scholium (whose mention of *γή*, however, does not necessarily imply a reference to «terre cuite») and in the divergent copyists, but such evidence is arguably unconvincing. Moreover, as pointed out by Klaerr himself, the pair *λίθοι και όστρακα* shows up another time in *Util.*, «comme une espèce de locution toute faite», just a few lines above our passage (87^B), there unambiguously referring to «coquilles». He also cites Plato, who in *Rp.* X 611^{D-E} «associe plusieurs fois *πέτρας* et *όστρα*, au sens de cailloux et coquillages» in an underwater setting. Considering these unambiguous uses, I argue that it is slightly more probable that, at least in Plutarch's understanding of the locution, the term *όστρακα* referred to

and shells tend to turn up in Plutarch's *corpus* rather as paradigms of hardness than as particularly dense objects, but their high resistance to the visual ray, which is required to be assumed for Lyncaeus's sight to be perceived as exceptional, is hardly accounted for in terms of hardness. In fact, there is a passage in *Frig.* 13 where Plutarch connects the oil's great transparency with its high content of air, and this latter with the oil's weight (950^B): «and among the other liquids oil is transparent above all, having the greatest share of air: sign of this is [its] lightness (κουφότης), due to which it surfaces above everything, moved upwards by [its] air»; and it «peculiarly provides luminosity and transparency in the [water's] depths, as the liquid parts (τὰ ὑγρά) are divided (διαστελλόμενα) by the air». Moving from our hypothesis, then, that Plutarch's rejection of Boethus's atomistic explanation did not also involve copper's lesser ὄγκος, but only re-interpreted its density in terms of element proportions, substituting all the Epicurean "empty spaces" with air, we might suggest that also here the stones' abysmal quality as a medium for perception would be explained by Plutarch through their insufficient share of air¹⁰⁸: if they contained more air, they would also turn out to be lighter, looser, and more transparent. This hypothesis seems to be confirmed by the optical considerations made by Lucius in *Lun.* 18: after declaring that «whatever is to cause a repercussion or a reflection must be compact and solid, in order that it may stop a blow and repel it», he explicitly refers to the «sunlight that the air lets pass without impediment or resistance», and, concerning the earth's reflectivity, he illustrates that earth «does not let the light penetrate its depths as water does or pervade it through and through as air does» (931^{B-C})¹⁰⁹. This is all compatible with Plutarch's character's statements on the density of stones in *QConv.* VI 5: if stone is too tight to let air pass through, we can infer, it is also unlikely for it to contain more than a little share of air, and its interception of the visual ray finds an easy parallel in its interception of propagating air, which we have seen being a result of the stone's denseness.

1.3. Unyielding crushing tools (hardness)

Unsurprisingly, we also find some passages associating stones with a peculiar hardness. The most eloquent of these is in *Exil.* 2, in which Plutarch mentions stone as a substance with an unquestionable natural property to compare it with the sorrows or joys conveyed by different happenings in our lives, whose positive or negative character is only assigned to them by our judgement (599^D): «the stone is by nature hard (σκληρός), the ice is by nature cold; they do not add at random these mechanical resistances (ἀντιπνίαι) and freezings

shells rather than tiles. Because of the outdoors and mountainous scenery of the description of Lyncaeus's sighting, it is likely that the word «stone» was meant to allude at rocky cliffs rather than walls; it would still remain unclear, however, what the «shell»'s role in the setting should be. There might be an allusion (although this is admittedly a leap) to the shells (κογχύλια) which Plutarch describes in *Isid.* 40 367^A to be contained «in the mines and in the mountains», sign of the previous presence of the sea: in this interpretation, Lyncaeus's sight can pierce through the stone of a mountain, but to get to the other side it also has to pierce through the ὄστρακα that it contains.

¹⁰⁸ Air which they nonetheless include in some degree: see my discussion of *Lun.* 5 922^C below, in sec. 5.

¹⁰⁹ Transl. Cherniss in CHERNISS AND HELMBOLD 1957.

from the outside». These qualities are not given to them by an external agent, “in addition” and fortuitously (just like our judgement does with honors and disgraces), but are central to the nature of both stone and ice¹¹⁰. Stone’s paradigmatic hardness also has an implicit role in *Comm. not.* 40, as part of a thought experiment brought forward by Phaedimus in his *reductio ad absurdum* of the Stoic tenet that «nothing touches anything». Since this is dependent on the theory of an incorporeal “limit” (πέρας), Phaedimus can visualize the absurdity in a way that is akin to Lamprias’s reference to falling *múdroi*¹¹¹, contrasting a strong mechanical effect with the absolute weakness of a bodiless entity¹¹² (1081^B):

ἂν δὲ δὴ κεραμεῶν ἢ κρυσταλλίνην σφαῖραν εἰς ἐπίπεδον φερομένην λίθινον ἀφ’ ὕψους νοήσωμεν, ἄλογον εἰ μὴ συντριβήσεται, πληγῆς πρὸς ἀντίτυπον γενομένης, ἀτοπώτερον δὲ τὸ συντριβῆναι κατὰ πέρας καὶ σημείον ἀσώματον προσπεσοῦσαν.

And if we thought of an earthenware or ice sphere moving from above into a stone surface, it would be absurd if it did not shatter due to the occurring impact with something resistant, but its shattering for falling on a ‘limit’ and an ‘incorporeal sign’ would be even stranger.

Just like terracotta and ice are chosen by Phaedimus for their being conceived as particularly fragile substances, stone is chosen as an undoubtedly resistant (ἀντίτυπος) surface of impact, so that it would be hard to imagine such delicate objects not shattering in their collision with it. This would be easier to imagine if the surface were *e.g.* that of an earthy soil due to its softness, as this quality would correspond to a lesser

¹¹⁰ Cf. the different interpretation of the mentioned properties and of the verb ἐπιφερεῖν (which I have translated as «add») in DE LACY AND EINARSON 1959 (followed by Pisani in LELLI, PISANI, ET AL. 2017): by writing that «it is not from outside that they convey (ἐπιφέροντες) the sensation of rigidity and freezing», the two scholars present the ἀντιτυπία and πήξεις as externalized effects of stone and ice, rather than as these latter’s intrinsic qualities. Their interpretation is as adequate as mine and arguably much more coherent with the analogy in the passage, but is syntactically less defensible. In fact, it simply ignores the demonstrative ταῦτα («these»), which could very well be just rhetorical and meaningless, but is more probably referred to the preceding adjectives σκληρός and ψυχρός as qualifiers of stone and ice: in being recalled, these are assimilated to their substantive correlates of ἀντιτυπία and πήξις, implying that stone is hard inasmuch as it is mechanically resistant, and ice is cold inasmuch as it is frozen. This is how the passage is also understood by DÜBNER 1868 and by Patrick in GOODWIN [1874b] 1878 (but their translations do really fall short of literality). Cf. also the translation in CABALLERO AND VIANINO 1995, which seems puzzlingly informed by a middle ground between my interpretation and that of De Lacy and Einarson: «non è che apportano dall’esterno casualmente questa loro capacità di resistenza e di coagulazione» («apportano» to whom or what?). They moreover seem to miss the point of the rhetorical contrast in our passage, commenting on Plutarch’s use of the expression φύσει that «è quello che conta per i Cinici (= 600^D; 601^B e ^D), al cui stile si riconduce l’anafora» (n. 20); the parallel passages they cite do not seem to be related to the present argument.

¹¹¹ See above, p. 23-6.

¹¹² See Babut in CASEVITZ AND BABUT 2002, n. 627, who writes of «l’idée du “choc sur un objet résistant”» and mentions «un choc brutal entre deux corps»: this is not conceivable, «si le seul contact possible entre ces deux corps est un point immatériel». He notes that ἀντιτυπία is among the main properties attributed to bodies by the Stoics, citing Pseudo-Galen, *Qual. inc.* IX p. 483 Kühn (= p. 26 Giusta) (= SVF II 381).

ἀντιτυπία¹¹³: stone, by contrast, is intuitively a hard enough substance to break any fragile object falling on it. It is also hard enough, in fact, to be mentioned as a paradigmatic tool for breaking objects open. It appears, together with iron¹¹⁴, in both *Am. prol.* and *Sollert.* in the same context, as a substance that —exceptionally— would struggle to cut into a halcyon’s nest: when this is completed, Plutarch writes, the nest’s «compactness of surface [...] becomes difficult to divide (δυσδιαίρετον) with iron or stone» (*Am. prol.* 2 494^B), and the halcyon «so tautens and secures the joints that it is difficult even for stones or iron to break or pierce it (δυσδιάλυτον εἶναι καὶ δύστροπον)» (*Sollert.* 35 983^D)¹¹⁵. Now, although the association is not explicit, we can imagine that it is still thanks their hardness that stones can also be used as improvised weapons: Plutarch highlights this function in *TG et CG* 19 (10), where, describing the tumult at the Capitol in which Tiberius and more than three hundred Roman citizens lost their lives, he specifies that everyone stroke to kill by the use of sticks and stones, «and no one by iron» (*i.e.* by using proper weapons). That hardness suffices for a stone to be injurious and lethal is evident from a scene in *Art.*, describing Cyrus’s death as a result of a fall from his horse, which made him strike his wounded temple against a stone implied to lay immobile on the ground (11.10). In the same *Vita* we also read of the Persian way of killing poisoners, exploiting the hardness of stone for lethal results: «there is a broad (πλατύς) stone, and on this the head of the culprit is placed; and then with another stone they smite and pound until they crush the face and head to pulp» (19.9)¹¹⁶. The specification about the size of the inferior stone (see πλατύς) is here superfluous, but in other passages this property is clearly stressed to indicate a superior damaging power: this applies both to the succinct μέγας («large») referred to the dreamt stone in *Arist.* 19 (2) and to the amplifying ὑπέρογκα μεγέθη (lit. «sizes of extreme bulks») of the stones thrown by Archimedes’s machines in *Marc.* 15 (2; see also 16.1). The use of the adjective ὑπέρογκος, with its reference to «bulk» (ὄγκος), may suggest the trivial notion that the larger is a stone the higher is its weight¹¹⁷. Stones, after all, can be also harmful due to their weight, and this property is exploited independently from both size and hardness in a capital punishment described in *Galb.* 8 (7), where one of Nero’s informers is killed by being thrown onto the ground and having «carts loaded with stones»

¹¹³ See *e.g.* Diadoumenos’s report that turtles bury their eggs in sand with the smoothest (λειότατον) and softest (μαλακώτατον) part of the dune (*Sollert.* 33 982^B): they obviously choose it to spare the eggs from crushing accidentally.

¹¹⁴ On iron in this paradigmatic role see below, p. 180-1.

¹¹⁵ Transl. Helmbold in CHERNISS AND HELMBOLD 1957. It is possible that Plutarch simply copied the information from his source: as BOUFFARTIGUE 2012, XL–XLIII notes, the description of the halcyon’s nest became a literary theme after the one in Aristotle, *HA IX* 14 616^A19-32, and Plutarch’s account shows massive similarities with that of Aelian in *NA IX* 17, including the detail that the nest is «impossible à briser». The stone is not mentioned by Aristotle, who only writes of an «iron tool» (σίγηριον), but stone does appear together with iron in Aelian’s passage: «if you strike with a stone the parts which have been closely fitted, you will not pierce (διατρήσειας) them. And if you try to cut them (διακόψαι) with iron, so well and truly have they been interwoven that they will not yield [...]» (transl. SCHOLFIELD 1959, with a slight adjustment). On Plutarch’s and Aelian’s probable reliance on a common source see above, p. 16 n. 44.

¹¹⁶ Transl. PERRIN 1926.

¹¹⁷ On the connection between “bulk” and “weight” see above, p. 15-6. Cf. *Mar.* 23.4, where «large weights» (βάρη μεγάλα) are described to be thrown into a river to have them strike a bridge and damage it.

(ἄμαξαι λιθοφόροι) being dragged over his body. Plutarch's *corpus* also contains scattered references to harming stones not further specified¹¹⁸; in some of these passages, the stones are associated with analogously injurious earthy weights, *i.e.* βῶλοι (“lumps [of earth]”)¹¹⁹, πῆλος (“mud” or “clay”)¹²⁰ and κέραμος (“earthenware”)¹²¹. Interestingly, Plutarch's *Aet. phys.* 37 is specifically dedicated to the dogs' puzzling behaviour of pursuing and biting the stones that are thrown at them, rather than the men who threw them¹²².

Stone's hardness might also be among the significant factors in the natural degradation of animal nails over time. Plutarch reports on the habit of both lions and eagles¹²³ of keeping their nails (or talons) turned inwards while they are walking, to prevent them from losing their edge and sharpness by abrasion (*Curios.* 11 520^F); stone, however, is not necessarily the main responsible of this consumption, as the soil, of course, is also made of earth and vegetation. In fact, the parallel passage of Aristotimus's speech in *Sollert.* (which only refers to lions, and not eagles) comes immediately after his report that the elephants' tusks are dulled by the vegetation (ῥλη) that they uproot or cut down (ὀρύττοντες ἢ κείροντες) to eat, and there are evident terminological correspondences between the two sentences (10 966^C)¹²⁴, lowering the chances the Plutarch thought specifically of stones when writing down this information.

Stones, in turn, are also quite difficult to break, and this is certainly a merit of their hardness. I will comment later on a passage which shows how this has repercussions on stonemasonry¹²⁵; for the moment, it is sufficient to consider Plutarch's report in *Util.* that «there are some [animals] that even feed on stones and shells, and transform [the food] through [their] breath's strength (or good tension, εὐτονία) and hotness» (2 87^{A-B}). This

¹¹⁸ See *e.g.* *CMA.* 14.1; *Nic.* 25.3; *CMi.* 28.3; *Eum.* 10.8; *Alex.* 12.3 and 45.5; *Ar.* 48.6; *Sul.* 6.16. For “stonings” referred to by the verb καταλέγειν see *e.g.* *Alex.* 55.7 and *Sul.* 17.11.

¹¹⁹ See *Alex.* 31.3 (cf. 25.4).

¹²⁰ See *Cic.* 30.7.

¹²¹ See *Sul.* 9.11 (cf. *Pyr.* 34.2, with κεράμις, *i.e.* “roof-tile”).

¹²² As noted by MEEUSEN 2017a, 482: «for a good understanding of the *quaestio*, one should note that the stone is thrown at the animal in order to injure it, and not simply thrown away so that the dog should fetch it». Sandbach, in PEARSON AND SANDBACH 1965, n. c *ad loc.*, already connected this passage with that in Plato, *Rep.* V 469^E, where the same phenomenon is mentioned in an analogy (and the term that is used for “stones” is λίθοι). Cf. the symbolic throw of a *múdro*s in *Arist.* 17.3, which I have shortly commented on above, p. 24 n. 74. Cf. also *Demetr.* 28.5, where the metaphorical reference to the «single stone and noise» which would suffice to cause tumult in a congregation just as it would do to a concourse of birds pecking seeds probably does not imply that the stone is thrown to harm.

¹²³ The reference to eagles is puzzling. This is what led Pohlenz, in PATON, POHLENZ, AND SIEVEKING [1929] 2001, to print a *crux* before αἰτοί and suggest the conjecture οὔλουροι («cats») in its place. For a short discussion of the textual problem see INGLESE 1996, n. 4 *ad loc.* See also Ingenkamp's proposal in INGENKAMP AND BERNARDAKIS 2010 (βαλταί λύγκες, «spotted lynxes», from a semi-parallel *locus* in Euripides, *Alc.* 579-80).

¹²⁴ Compare τῆς ῥλης [...] ἀμβλύν τὸν ὀδόντα ποιούσης ἀποτριβόμενον (*Sollert.*) with ἐντὸς ἀποκρύπτων τοὺς ὄνυχας, ἵνα μὴ τριβόμενοι τὴν ἀκμὴν ἀπαμβλύνωσι (*Curios.*). The terms τριβόμενοι and ἀπαμβλύνωσι in the second passage reverse the order of the succession ἀμβλύν and ἀποτριβόμενον in the first, and the prefix ἀπο- might have been transferred from the root τριβο- to ἀμβλυ- (or the other way around) for *variatio*.

¹²⁵ See my discussion of *QConv.* VII 2.3 701^{B-C} below, in sec. 4.

is implied to be unusual for animals¹²⁶, and the reference to breath's heat and εὔτονια suggests that a particularly intense softening is regarded to be a prerequisite for the stones' dissolution and assimilation into the body¹²⁷. We should also notice here the coupling of stones with shells, which have already turned up above together as paradigmatic (dense?) obstructions to the visual ray, overcome by Lyncaeus's sight¹²⁸. Density does not seem to be a relevant property in the present context, but it is easy to imagine it being positively correlated with hardness¹²⁹.

There are also other animals exhibiting the behaviour of taking stones into their mouth, but without swallowing them afterwards. This is the case, as Plutarch writes in *Garr.*, of geese, «of whom they relate that when from Cilicia they cross Mt. Taurus, which is full of eagles, they take a great stone (εὐμεγέθης λίθος) in their mouths to serve as a bolt or bridle for their scream, and pass over at night unobserved» (14 510^{A-B})¹³⁰. The curious specification on the stone's size implies that a small stone would not suffice to achieve the desired constraint, not keeping the mouth of the geese both gaping and blocked enough to suffocate their voice. The adjective εὐμεγέθης is also used by Aristotimus in a parallel passage in *Sollert.* 10 (967^B)¹³¹: since this passage is slightly different from the former in the rest of its phrasing, the correspondence of the term might corroborate that the stone's largeness was perceived by Plutarch as a relevant detail in the phenomenon¹³². A great size, indeed, seems to be the main requisite for the stone to stop the voice, and although size is easily associated with weight, the latter seems to have no relevance in this context. A certain mechanical resistance, however, is required for the stones not to be crushed or deformed by the geese beaks' grip: this, we can infer, might be understood to be provided by their hardness. Such features of stones, in a similar way, were also exploited by Demosthenes for the end of perfecting his pronunciation of words: as Plutarch reports, «he used to correct and drive away the indistinctness and lisping in his speech by taking pebbles (ψῆφοι) in his mouth and then reciting speeches» (*Demosth.* 11.1)¹³³.

¹²⁶ Cf. *Praec.* 4 801^A, where stones are described as nauseating to human beings and essentially not edible: pregnant women do desire to eat them when they have cravings, but reject them in disgust shortly after putting them in their mouth. This is also reported in *Aet. phys.* 26 918^D, more concisely but with an additional reference to earth (in the pair λίθος καὶ γῆν).

¹²⁷ Compare with Chrysippus's idea that *pneūma* «is» the density in stones as well as the hardness in iron, as reported in *Stoic. rep.* 43 (on which I comment above, p. 30-1). Heat is explicitly associated with a softening action on stones in *QConv.* VII 2.3 701^{B-C}, as I will show below in sec. 4.

¹²⁸ See above, p. 31-2.

¹²⁹ It surely is in the context of iron quenching and softening: see below, p. 102, 182.

¹³⁰ Transl. HELMBOLD 1939. See the following footnote.

¹³¹ On the identification of the mentioned *khēnes* see BOUFFARTIGUE 2012, n. 130: «il s'agit naturellement des oies dites "sauvages"». According to Lelli, in LELLI, PISANI, ET AL. 2017, n. 35 *ad loc.*, «anche questa credenza è sorprendentemente viva nel folklore sabino (La)».

¹³² It is also possible that Plutarch simply copied the detail from his source, but it is interesting to note that the adjective is absent from Aelian's parallel *locus* in *NA* V 29 (on the hypothesis of Plutarch's and Aelian's common source see above, p. 16 n. 44). It is remarkable that Ammianus Marcellinus used the term *lapilli* («pebbles») in XVIII 3.9, showing an opposite understanding of the stones' size in the phenomenon.

¹³³ Transl. PERRIN 1919, slightly modified.

2. Stone's material composition

Before expanding on the stone's connection with earth, which I have occasionally touched upon in the previous section¹³⁴, it is better to deal with Plutarch's only micro-chemical sentence where the mentioned stone is interchangeable with any other physical entity. This is part of Plutarch's (imaginary opponent's) remark in *Col.* 9: «What then? Did it not happen to Plato too and Aristotle and Xenocrates to generate gold from something not gold, stone from something not stone, and all the other things, everything from four simple and primary [components]?» (1111^DPlutarch has no conceptual reason here to mention precisely gold and stone as instances of micro-chemically supervenient bodies, just before the extension of the judgement's scope to «all the other things»). We can interpret the two to have been chosen randomly as physical substances, with the sole aim of giving more concreteness to the statement. For gold we might also guess that its connotations of purity¹³⁵ are meant to clash rhetorically with the extraneous nature of its matter, but the same cannot be said for stone. However, considering that Plato is mentioned first, we can also suppose that Plutarch meant the succession of the two to allude to Plato's treatment of the elements' *génē* in the *Timaeus* (58^C-61^C), a section which would surely spring to mind to any reader as the canonical reference text on the Platonic theory of elementary structures¹³⁶. There, among the other substances, gold is in fact mentioned before stone; the former as an eminent *génos* of water and the latter as the first (and probably the most intuitive) of earth. Resulting both from a primary element, it is true that Plato “generated” them from something which was not logically identical with them, and Plutarch's illustrations, if they are indeed grounded in the *Timaeus*, are therefore correct.

Plato himself, then, already presented stone as an earthy substance, and Plutarch clearly agreed with him on the matter. We already know that Lamprias mentions stone in *Lun.* as an instance of «earthy weight» (γεῶδες βᾶρος), “welcomed” in its fall to earth as by «something which is its own» (οἰκεῖον) due to their «association (κοινωνία) and original communion (συμφυΐα)» in their allotted cosmic region (8 924^{E-F}). Expanding on this

¹³⁴ See above, p. 15 on *Sollert.* 12 968^D and p. 18-22 on *Def. orac.* 28 425^{C-E} for passages where the connection may be implied without it being thematized.

¹³⁵ See Plato's description of gold as a *μονοειδές γένος* of water, *i.e.* not combined with other elements (such as earth, as is the case for copper), in *Tim.* 59^B (cf. above, p. 3-4). Aristotle briefly states in *Meteor.* III 378^{B4} that gold is the only metal that «is not set to fire» (οὐ πυροῦται, *i.e.*, probably, does not get incandescent nor loses a part of itself in the separated slag: see HALLEUX 1974, 64–65 with n. 26, quoting Alexander of Aphrodisias, in *Meteor.* 178 1-7 Hayduck); since Aristotle gives this detail immediately after connecting the other metals' reactivity towards fire with the ‘earth’ (*i.e.* dry exhalation) that is present in them, it is reasonable to suppose that he regarded gold as the only one made of pure ‘water’ (*i.e.* moist exhalation).

¹³⁶ As pointed out by BOYS-STONES 2018, 66–67, the *Timaeus* is the most frequently referenced Platonic dialogue in Plutarch, Alcinoüs and Plotinus, as well as the one that was the object of the highest number of ancient commentaries. The celebrity of Plato's *Timaeus* is also shown by the fact that it was «read by the Stoics as the basis for their cosmology» in the Hellenistic period (*ib.*, p. 25, 27).

earthy nature, we should then consider, again¹³⁷, the view expressed by Plutarch's character in *QConv.* VI 5, since it specifies the conditions under which the process of earth's petrification occurs (691^B):

οἱ τε χάλικες πυκνότητι τὸ ψυχρὸν διὰ βάθους ποιοῦσιν· πᾶς μὲν γὰρ λίθος κατεψυγμένης καὶ πεπιλημένης ὑπὸ κρύου γῆς πάγος ἐστί, μᾶλλον δ' ὁ μᾶλλον πεπυκνωμένος [...]

And the pebbles with [their] density produce the cold in the [water's] depths, for every stone is a solid mass of earth which has been cooled down and compressed by freezing cold, and the more so for the more condensed [stone] [...]

This passage provides a very clear, although concise, etiology of the genesis of stone, but is a bit difficult to translate. Its last phrase, *μᾶλλον δ' ὁ μᾶλλον πεπυκνωμένος*, may raise a problem of interpretation, since it is not evident what state, process or quality the first *μᾶλλον* is intended to refer to: what exactly should we associate «more» with «the more condensed» stones? The most recent interpreters do not comment on the possible ambiguity, and they apparently follow Hoffleit with variations of his translation «the denser the colder»¹³⁸. This is neither a literal translation nor a perfectly faithful one, but has the merit of capturing the focal point of the argument and making it evident. The most literal translation is the one proposed by Creech («though some more or less than others»¹³⁹), but it provides no disambiguation to the reader. The most likely candidate as the reference of *μᾶλλον*, in my view, is not an implicit degree of coldness, as in Hoffleit's translation, but instead the entire sentence that precedes it, describing the (completed) process¹⁴⁰ of the earth's cold condensation¹⁴¹. The phrase may be redundantly paraphrased this way: “the stones which have been condensed more are more than the others a solid mass of earth which has been cooled and condensed by freezing cold”, which means that the stones which are now denser are ‘more intensely’ cooled-earth *págoi* than the stones which have remained looser in their texture. The message is still convoluted, but its sense seems to be that the stones which are now more compact are so as a result of a stronger, and possibly longer, exposition of their earth to freezing cold. This idea can find easy corroborations in everyday phenomena. For instance, the longer and more intensely a quantity of water is exposed to cold, the denser (*i.e.* the more solid

¹³⁷ See above, p. 27-8.

¹³⁸ See FUHRMANN 1978 («la plus dense étant la plus froide»); Montalbano in LELLI, PISANI, ET AL. 2017 («e più è densa più è fredda»). TEODORSSON 1989b does not comment on the expression.

¹³⁹ In GOODWIN [1874b] 1878.

¹⁴⁰ The constant processual focus of the passage is expressed by the perfect tense form of its verbs *καταψύχειν*, *πυλεῖν* and then *πυκνοῦν*; the verb *πεπυκνωμένος* («condensed») is different from the adjective *πυκνός* («dense»).

¹⁴¹ Cf. the translation in WYTTENBACH 1797B («omnis lapis nihil est quam e frige factae et gelu adstrictae terrae concretum quippiam: tanto quisque magis, quanto est densior») and the identical in DÜBNER 1877. Another possible choice for the reference of *μᾶλλον* is the first sentence *οἱ τε χάλικες [...]* *ποιοῦσιν*; this is unlikely, as the passage is syntactically divided in two semantic blocks by the use of *γὰρ* and of the *μὲν... δὲ* structure, but if true it would mean that pebbles, by their density, produce more coldness in the water's depth the more they have been condensed (by freezing cold) during their formation.

and less liquid, but actually more thorough) a block of ice it becomes; observations such as this might have served as inspiration for Plutarch's take on mineral formation, but there are indications that this view was also shared by some of his predecessors, whose transmitted opinions are likely to have influenced his thought¹⁴². We have seen that this passage, then, does not immediately associate a higher cold quality with the stones' density, as Hoffleit understood, but in the argumentative context it does serve the function of pointing at such

¹⁴² As already noted by FUHRMANN 1978, n. 2 *ad loc.*, Theophrastus reports this position as a (non-incompatible) alternative to the idea that stones solidify as an effect of heat: «some things are solidified through heat, others through cold. And probably there is nothing to prevent some kinds of stones being formed by either of these two methods, although it would seem that all the types of earth are produced by fire [...]» (*Lap.* 3, transl. RICHARDS AND CALEY 1956). The 'cold' take on mineral formation also appears in the second answer to a Pseudo-Aristotelian *quaestio*, namely, «why are stones solidified by hot water more than by cold?» in *Pr.* XXIV 11: «or does heat petrify (*ἀπολιθοῖ*), but there is also petrification (*λιθοῦται*) under the influence of cold because the excess (*ὑπερβολή*) of freezing cold (*πάγος!*) uses up the moisture and hardens it?» (937^A17-19, transl. Mayhew in MAYHEW AND MIRHADY 2011, slightly modified; the following sentence, *δῆλον οὖν ἐκ τῆς ὑπερβολῆς καὶ τὸ ἀπλῶς*, is of uncertain translation: in addition to Mayhew see LOUIS 1993); the wording closely resembles the one used by Plutarch in the passages under discussion: see especially *Frig.* 19 953^{E-F}, which I examine immediately below. Fuhrmann's statement that «la théorie de la pétrification par le froid dans les entrailles de la terre [...] était également enseignée par Anaxagore» in DK 59 B16 (= Simplicius, *in Phys.* 155.21-23) is slightly inaccurate: the philosopher did present stone formation as a product of earth's cold condensation (*ἐκ δὲ τῆς γῆς λίθοι συμπιγνυται ὑπὸ τοῦ ψυχροῦ*), but without mentioning (although possibly implying, as I will now show) the underground setting. He describes earth's petrification as a final phase in a large-scale process of elemental "separation" (the verb is *ἀποκρίνεσθαι*), based on the substances' different degrees of density (see B12 = Simplicius, *in Phys.*, n. to 187^A21, IX p. 156.13-157.1 Diels: *καὶ ἀποκρίνεται ἀπὸ τε τοῦ ἀραιοῦ τὸ πυκνόν*; B15 = *ib.*, n. to 188^A17, IX p. 179.3-10 Diels): he shows that earth «is solidified» out of the «separated» (denser) substances by illustrating that, after water is separated from clouds, earth is separated from water, and only afterwards stones are solidified from earth (by cold), thus moving farther away from water (as a result of their higher density — the verb is *ἐκχωρεῖν*, "move out from", "withdraw": in this interpretation, the prefix *ἐκ-* connects with the genitive *ὑδατος*, in a way that is rare but later attested in Polybius I 15.7, as cited by LSJ, *s.v.*, I.3, in the literal spatial sense; in this case, the adverb *μᾶλλον* would be lacking of a term of comparison, possibly implicitly referring to unpetrified earth; in contrast, the standard interpretation, which is more syntactically defensible but less meaningful, wants the *ἐκχωρεῖν* to be absolute and the *μᾶλλον* to be connected with *ὑδατος*, *e.g.* «the stones move further out than the water» in CURD 2007; in fact, comparing the present occurrence of the verb with the *ἐξεχώρησεν* in B15 = Simplicius, *in Phys.* 179.3-6, where it is associated with *εἰς τὸ πρόσω τοῦ αἰθέρος*, one can also suppose that Anaxagoras consistently used *ἐκχωρεῖν* to refer to the outward motion of the bodies during the cosmogenesis, centrifugally expelled from the central mass into the sky, as done *e.g.* by SIDER [1980] 2005, nn. 4 to Fr. 6 and 2 to Fr. 15 and maybe by TORRIOS-CASTRILLEJOS 2014, 118, but the evidence is too scarce for a conclusive judgement). Commentators (*e.g.* CURD 2007, 72 n. *ad loc.*) are still puzzled by the last detail as it is not clear why the stones are regarded by Anaxagoras to drift away: after BURNET 1892, 269, the interpreters tend to connect the fragment with the testimony in A71 (= Aëtius II 13.3) and suppose that it refers to the stones' «snatching up» towards the sky and transformation into stars (cf. Plutarch, *Lys.* 12.2 = A12, which I discuss below, in sec. 3.1), and see TORRIOS-CASTRILLEJOS 2014, 124–26 with n. 81); however, if we assume that the Anaxagorean fragment is cosmogonical rather than meteorological, and interpret the verb *ἐκχωρεῖν* as I did, we may also suppose —taking inspiration from Plutarch's mineralogy— that the "further separation" of stone from water is meant to allude to the formation of the denser, rocky depths of earth, which are obviously farther away from superficial bodies of water than the earthy soil (this latter being hotter and looser than the underlying rocks, and thus closer to water's degree of density); STOKES 1965 argued that there are insufficient reasons to interpret the fragment as a cosmogonical (*i.e.* past, rather than present) description, but his whole argumentation strictly relies on the "upwards" (or "outwards") understanding of the stones' drifting. Going back to Plutarch's passage, TEODORSSON 1989b, n. *ad loc.* adds a reference to Anaximenes, DK 13 A7 (= Hippolytus, *Haer.* I 7) as «the earliest indication of this idea of petrification as being due to cold», but this is arguably a stretch, since in Anaximenes's cosmology, as presented in the very same testimony, every kind of condensation is due to cold, and every compacted body—including clouds, water and earth (notice the progression, interestingly paralleled in the Anaxagorean fragment)— is described as a state of air (*i.e.* the *arkhē*) passing through different degrees of density. Both Fuhrmann and Teodorsson also point for comparison to the Empedoclean testimony DK 31 A69 as an exemplary indication of an opposite, 'hot' account of mineral formation: it is composed of Pseudo-Aristotle, *Pr.* XXIV 11 (on part of which I have commented above in this footnote — nor in Fuhrmann nor in Teodorsson we find mention of the second answer to the *quaestio*) and a segment of Plutarch, *Frig.* 19 953^E.

higher coldness. In fact, it seems that Plutarch's main aim with this sentence is to give proof that stones can also make the water colder on their own —*i.e.* not only by reflecting the cool air—, due to their density (but there might be more to it, as I will show later)¹⁴³: grounding their denseness in a process of deep freezing is instrumental in evoking an intuitive correlation between the stones' final, stable, density and their active coldness. After all, we can agree that a more thoroughly frozen mass of water is in its whole colder (beside denser) than a half-frozen one: this should also be the case for Plutarch's "frozen" earth. Lastly, the analogy with ice is not extrinsic to this passage, but is implied by Plutarch's choice of the word *págos*, which has no perfect correspondent in English. Being a derivate of the verb *pégnumi* ("I fix", or "solidify"), it can indeed be neutrally translated as "solid mass", as I have done above, but it is more commonly used in the sense of either "rock" (*i.e.* rock structure, cliff) or, precisely, "ice" (or "frost")¹⁴⁴. By using the term, Plutarch clearly intends to play on its simultaneous connotations of density and coldness, and by activating its full semantic ambiguity he deliberately suggests an analogical connection between minerals and frozen water¹⁴⁵.

The wordplay emerges much more clearly from the expressions of a parallel passage¹⁴⁶ in *Frig.* 19. Plutarch here wants to provide another proof that earth should be regarded as the primarily cold element, and decides to find support for this hypothesis in the persuasive assumption that what is «completely» (κομιδῆ) cooled necessarily transforms into «that which is primarily cold» (953^{E-F}):

ἔστι δ' ὑπερβολὴ ψύξεως πῆξις, πῆξις δ' εἰς ἀγνωσίαν¹⁴⁷ τελευτᾷ καὶ λίθωσιν, ὅταν, παντάπασι τοῦ ψυχροῦ κρατήσαντος, ἐκπαγῆ μὲν τὸ ὑγρὸν ἐκθλιβῆ δὲ τὸ θερμόν. ὅθεν ἢ μὲν ἐν βάθει γῆ πάγος ἐστὶν ὡς εἰπεῖν καὶ

¹⁴³ On the first answer to the *quaestio* see above, p. 28. This further explanation, apparently centred on a direct cooling of the water exercised by the pebbles' density, may be accounted for either as a third distinct answer to the *quaestio* or as a cohesive addition to the second (which describes an indirect refrigeration following a water's "thinning"); this is possible as the two explanations are interspersed by the ambiguous formula *καὶ μὴν*. I will discuss the matter in detail below, in sec. 6.

¹⁴⁴ Another meaning, which is the most common in Aristotelian natural science, is "freezing cold": see *e.g.* Pseudo-Aristotle, *Pr.* XXIV 11 937^A17-19 (quoted above, p. 39 n. 142), and Theophrastus, *Ign.* 17 (which I examine below, p. 192-4). I thank Emiliano Papparazzo for the resolutive discussion we have had on this term. This use was probably originated by a metonymic extension of the original concrete meaning, as "freezing" cold is that which is strong enough to produce *págos* (*i.e.* frost or ice). The term is apparently never used by Plutarch in this sense, for which he seems to prefer *κρύος*.

¹⁴⁵ Cf. the translations of *págos* by WYTTEBACH 1797B («concretum quippiam»; identical in DÜBNER 1877), Creech in GOODWIN [1874b] 1878 («congealed lump»), Hoffleit in CLEMENT AND HOFFLEIT 1969 («compact solid»), FUHRMANN 1978 («masse compacte»), VOLPE CACCIATORE 2007, 100 («roccia»), Montalbano in LELLI, PISANI, ET AL. 2017 («coagulo»). The wordplay is only vaguely represented in Creech's translation and not highlighted in any commentary. However, Fuhrmann does connect the passage with *Frig.* 19 953^E, where «la theorie de la petrification par le froid dans les entrailles de la terre est développée» (n. 2 to *QConv.* VI 5 691^B) and the term *págos*, as I immediately show below, receives specific attention; the two passages are also connected, the other way around, by Nuzzo in D'IPPOLITO AND NUZZO 2012, n. 89 and VOLPE CACCIATORE 2007, but only the former seem to have noticed Plutarch's deliberate ambiguity (see their translation of *págoi* in *Frig.* 19 as «ghiacci»).

¹⁴⁶ As I show in the preceding footnote, the two passages have already been connected by FUHRMANN 1978, n. 2 to *QConv.* VI 5 691B, VOLPE CACCIATORE 2007, and Nuzzo in D'IPPOLITO AND NUZZO 2012, n. 89. There is no need to engage in the relative chronology of *QConv.* VI and *Frig.*, as done by Volpe Cacciatore. According to her, Plutarch in *QConv.* VI 5 «riprende in modo più discorsivo quanto enunciato nel *De primo frigido*» (p. 100), and she asks the questions «qual è il motivo per il quale egli ritorna anche nelle *quaestiones* sul medesimo argomento? Per desiderio di ribadire la sua ipotesi? E quale dei due testi scrisse prima? [!]» (p. 101).

κρύσταλλος ἄπασα· τὸ γὰρ ψυχρὸν ἄκρατον οἰκουρεῖ καὶ ἀμάλακτον ἀπεωσμένον ἐκεῖ τοῦ αἰθέρος ἀπωτάτω
[...]

And the apex of cooling is solidification, and solidification culminates in unrecognizableness¹⁴⁷ and petrification, when, having the cold acquired a thorough dominance, what is moist is solidified and the heat is squeezed out. The earth into the depths is therefore all, so to speak, *págos* and ice: in fact, the cold dwells there, keeping guard, unmixed and unsoftened, thrust away in the farthest place from aether.

In the following lines, after applying this consideration to rock formations such as promontories and sea-rocks, Plutarch grounds the ambivalence of the word *págos* in a paretymology, stating that «all the things from which the heat was squeezed out and through which it has flown [out] are thoroughly solidified (or frozen, παγήναι) by the cold, hence they are also called *págoi*» (953^F)¹⁴⁸. Plutarch, who just before these lines, as we have read, has signalled his metaphorical use of *págos* as “ice” by coupling it with the unambiguous synonym κρύσταλλος and using the formula «so to speak» (ὡς εἶπεῖν), proceeds here to present the term’s metaphorical ambivalence as justified by a rational, and physically aware, etymology; his etymological reasoning, in turn, serves the function of persuading the reader that his ‘cold’ take on the etiology of mineral formation is traditional and (therefore) probably true¹⁴⁹. Petrification (λίθωσις), then, must be regarded as a perfect analogue of freezing, and the more intensely and unmixedly the cold seizes the earth —with extremes reached in the

¹⁴⁷ See Nuzzo in D’IPPOLITO AND NUZZO 2012: «finisce col diventare irrecognoscibile». The puzzling manuscript variant ἀγνωσίαν, as reported by Ingenkamp in INGENKAMP AND BERNARDAKIS 2013, is the one that is found in ms. J (Ambros. *Gr.* 881, XIII cent.) and ms. g (Palat. (Vat.) *Gr.* 170, XV cent.), preferred by BERNARDAKIS 1893, Hubert in HUBERT, POHLENZ, AND DREXLER [1955] 1960, and D’Ippolito in D’IPPOLITO AND NUZZO 2012. Ms. J also reports *in margine* the correction ἀλλοίωσιν («alteration»): this is the one transmitted in all the other manuscripts, and preferred by WYTTEBACH 1797c, DÜBNER 1877 and Helmbold in CHERNISS AND HELMBOLD 1957. Ingenkamp opts for ἀγνωσίαν with a *crux*. Although ἀγνωσίαν is difficult to justify in the context (it might refer to a non-visual unrecognizableness, *e.g.* in terms of softness, but the problem remains that the term is normally attested in the sense of “ignorance”, and would be a *hapax* in Plutarch’s corpus), ἀλλοίωσιν would probably be incompatible with τελευτᾶ, since the alteration, arguably, happens throughout the solidification process, and not only during its culmination. For other tentative conjectures (namely, synonyms of ἀκίνησια, “stillness”, or ἀγλωττία, “muteness”) see Pohlenz’s apparatus, which is also reported in more detail in Ingenkamp’s.

¹⁴⁸ The etymology is correct insofar as it connects the noun *págos* with the verb *pégnumi*, as noted by Helmbold in CHERNISS AND HELMBOLD 1957, n. c *ad loc.*, and by Nuzzo in D’IPPOLITO AND NUZZO 2012, n. 89 («l’etimologia proposta da Plutarco è del tutto fondata»). However, it is more likely that the quite early use of *págoi* for “rocks” (already in Homer) originated from the more general meaning of *pégnumi* “to fix” or “to fasten”, as the unambiguous meaning “to freeze” seems to be attested only later (LSJ, *s.v.*, III, cite Aeschylus, *Pers.* 496); see LSJ, *s.v.* πάγος («that which is fixed or firmly set»), CHANTRAINE, *s.v.* πήγνυμι, B.2 (πάγος as «“ce qui est fixé, dur”; autre sens après Hom. “gel, froid”»), BEEKES, *s.v.* πάγη («verbal nouns in *ph₂g-h₂/o/i- of πήγνυμι ‘to fasten, attach’»).

¹⁴⁹ Cf. Helmbold in CHERNISS AND HELMBOLD 1957, according to whom Plutarch uses the etymology «to confute Empedocles», *i.e.* the mentioned representant of a ‘hot’ account of mineral formation.

deepest underground settings¹⁵⁰—, the colder and more solid an ice-like stone the earth is regarded to become: this corresponds exactly to Plutarch’s character’s statements in *QConv.* VI 5, if the interpretation which I have defended above is correct.

It is now interesting to contrast these coherent etiologies with the few other passages where, although petrification is mentioned, cold is not taken into account. In one of these, stone is at least still considered earthy in its origin. In Pheidolaus’s¹⁵¹ report of the opening of Alcmena’s tomb in *Gen. Socr.* 5, in particular, it is possible to extract a minimal etiology of petrification from his passing remark that two amphoras were also found in the tomb, which he describes to have had «earth in themselves already petrified (λελιθωμένη) and fixed together (συμπεπηγυῖα) by time (ὑπὸ χρόνου)» (577^E-578^A). After so long a discussion on cold’s solidifying action, it might be surprising for us to see time mentioned here as the only agent of petrification. This is not necessarily in contrast with the other statements, though, for we can easily imagine something buried as undergoing a constant (downwards) pressure exercised by the earth and by the other materials used to cover up the tomb¹⁵², progressively pushing the enclosed earth into a solid, stony condensation. Considering Plutarch’s ideas on the coldness of earth’s depths, which we have already seen above, we might also suppose that a tomb, being the underground colder than the surface, could be thought of as a particularly suitable place for petrification, given enough time for it to occur¹⁵³. This hypothesis, however, in addition to assimilating,

¹⁵⁰ Cf. *Aem.* 14.3-11, where Plutarch discusses an etiology of spring formation which relies on the «density and coldness» of the earth in the underground: coherently with the Aristotelian theory (see Aristotle, *Meteor.* I 13 349^B23-350^A13), this is supposed to compress the moist exhalation thereby turning it into water (ἐξυγραίνεσθαι). For an akin etiology—in which the spring is formed on surface— see Plutarch, *Cr.* 4.6-7.

¹⁵¹ «Pheidolaus of Haliartus» only appears in Plutarch’s *Gen. Socr.*, and would be «otherwise unknown» (DE LACY AND EINARSON 1959, n. b to 577D; repeated by CORLU 1970, 16, Nesselrath in NESSELRATH AND RUSSELL 2010, n. 47, and DONINI 2017, n. 39. According to CORLU 1970, 16 he seems to be an imaginary figure, «imaginé par Plutarque pour que son pays d’origine suscît le premier débat collectif [...] sur les trouvailles faites au tombeau d’Alcmène» (repeated by Del Corno in GUIDORIZZI AND ALONI [1982] 2011, 54). No elements can justify us in treating him as a faithful spokesperson of Plutarch’s ideas, but it would be equally unjustified to disregard his passing physical remarks as non-Plutarchan: in fact, he never personally engages in proposing full etiologies or strong philosophical opinions, possibly incompatible with those of the other characters, and his main role is that of a narrator, probably describing the setting of his reported events in a non-controversial way; he does state to only have a second-hand knowledge of the story that he tells (οὐ γὰρ [...] παρετύχον), and may thus be representing, in his word choices, more his informers than himself (on the wording and the possibility of unreliable narration, also remember that the entire dialogue is framed by Plutarch as narrated by Caphisias, who was physically present when it occurred, to his interlocutor Archedamus), but it seems unlikely that this impersonality would also affect small descriptive remarks such as the one that I am discussing here. It is also a relevant detail that Pheideolaus shows in 12 581^{E-F} to have only a superficial understanding of divinatory practices, remarking that the «sneezes and voices» that have just been described by his interlocutors to guide Socrates in his various exhibitions of foreknowledge «are also used by the mass (οἱ πολλοὶ καὶ ἰδιῶται) for trivial matters and jokingly», but are avoided in more serious circumstances due to their intuitive inadequacy, and seem thus to not fit well with Socrates’s intellectual superiority. He, whose stepping forward as a naïf “non-philosopher” (DONINI 2017, n. 94) is clearly used by Plutarch as a narrative device to develop the philosophical discussion on divination, is immediately refuted by Galaxidorus through epistemological remarks on the possibility of inferring ‘big things from small signs’, starting with an analogy with medical semeiotics.

¹⁵² For minimal references to the earth covering buried bodies see *Flam.* 20.6 and *Alex.* 77.6.

¹⁵³ This would also corroborate my partly ‘temporal’ interpretation of the μᾶλλον in *QConv.* VI 5 (see above, p. 38-40), in the sense that the most condensed stones might not exclusively be regarded to result from a more intensely seizing cold, but also from a longer exposition to it.

possibly unduly, the extreme depths of earth with comparatively superficial dug graves¹⁵⁴, cannot find confirmation in the text, which nonetheless raises no issues of coherence with the others that I have discussed above, also considering that there is no reason to assume that Pheidolaus's physical ideas should correspond directly with those of Plutarch. A decidedly incompatible view on the subject, instead, could be read in *QConv.* VII 1, where it is Plutarch's character to state that «no gallstone (λίθος) has ever formed (συνέστη) in the belly; yet it would have sense for the fluid (τὸ ὑγρὸν) to collect and solidify (συνίστασθαι καὶ πήγνυσθαι) not less [here] than in the bladder, if really all that is drunk proceeded through the esophagus into the belly» (3 700^A). As much as it would seem paradoxical, given our premises, to think of stone as a collection of solidified liquids, we might easily explain the inconsistency by assuming that the gallstone is not supposed to be formed by the moist part of the fluids, but by their deposits, as in the Hippocratic treatise *Morb.* IV¹⁵⁵. A mythical petrification is also mentioned briefly by Autoboulos in *Amat.* 20, when he compares the sad fate of Gorgo with that of the so-called Parakúptousa (“she who stoops sideways”), who «was petrified (ἀπελιθώθη) after stooping [at her window] to see her lover being carried out [during his funeral]» (766^{C-D}), but this petrification was certainly understood as supernatural¹⁵⁶, and in the text, unsurprisingly, is not followed by a physical explanation.

On the subject of stone's earthy constitution, it is also useful to look closely at the way Plutarch introduces his third solution to the problem in *Aet. phys.* 19—that on why and how the squid alters its colour imitating those of the sea-rocks—, as his phrasing establishes an opposition between earth and stones. This follows his quotation of Empedocles on the theory of universal effluvia¹⁵⁷: «“there are effluvia (ἀπορροαί) from all the things that were ever generated (ἐγένοντο)”; in fact,» Plutarch adds, «it is not only from animals and plants and earth and sea, but also from stones that many fluxes constantly depart, as well as from copper (or bronze, *khalkós*) and iron» (916^D). If stones were considered to be a kind of earth, there would be no reason to present the two here in the opposing structure of «not only... but also» (οὐ μόνον... ἀλλὰ καί). Indeed, it would be logical that effluvia were diffused also by stones, being the information on their behaviour entailed by the

¹⁵⁴ As I will discuss below in sec. 4, Plutarch's character in *QConv.* VII 2.3 701^{B-C} actually presents soil as an active agent in the heating and softening of buried stones, rather than as a hardening cold *milieu*.

¹⁵⁵ See below, p. 133 n. 537.

¹⁵⁶ After Flacelière in CUVIGNY AND FLACELIÈRE 1980, n. 2 *ad loc.*, Görgemanns in GÖRGEMANN ET AL. 2006, n. 351 connects this passage with the myth of Arkeophon and Arsinoe told by Hermesianax in *Leontion*, Fr. 4 (Powell), on which we are informed by Antoninus Liberalis, 39 and Ovid, *Met.* XIV 698-761 (where the names are Iphis and Anaxaretes). As the story goes, the Phoenician Arkeophon was violently rejected in Salamis in Cyprus by the king's daughter Arsinoe, whom he loved, and her rejection led him to commit suicide. It was when Arsinoe looked scornfully out of her window to see his body carried in his funeral that Aphrodite punished the woman by turning her into stone. On the possible historical origins of this myth, Görgemanns remarks that παρακύπτειν from the window «ist ein typischer Gestus der Prostituierten», and that apparently there was a stone image of a woman in such a pose in Salamis, in connection with the cult of Astarte-Aphrodite: the Hellenistic Greeks might have invented an etiology for it.

¹⁵⁷ On the reception of this theory in post-classical philosophy see DÖRRIE 1965. On Plutarch's adoption of the effluvia see p. 133-5, where he notes that Plutarch made considerable use of the notion «in niederen Physik», but avoided it «in philosophisch-theologischen Zusammenhängen», differently from later Platonists.

general statement on earth. This should be even more obvious if the rhetorical function of the mention of «earth and sea» in the passage is considered, since Plutarch probably refers to the two in order to encompass all the ‘material’ geographic world, after having evoked all the ‘biological’ world through the comprehensive pair «animals and plants»¹⁵⁸: if «earth» is mentioned to refer to all the (lifeless) entities on earth, why present the stones and metals as an addition? Probably, the syntactic opposition is not to be taken literally, and Plutarch is only using it as a rhetorical device to guide the reader’s attention from the general and indeterminate —the «everything that was generated» of Empedocles’s quote— to the particular of specific interest here —the stones—, passing through an intermediary instantiation of the Empedoclean theory into the sublunary world (which in itself prepares the reader to agree on its application to the realm of minerals and metals).

Lastly, it should be also noted that the stones, as densely packed in heavy matter as Plutarch presents them to be¹⁵⁹, are not enough so for their earthy constitution to be considered pure, and just like most other concrete bodies they also include the other elements in varying degrees. This is shown by one of Lamprias’s remarks in *Lun.* 5, that very same Lamprias who after a few pages in the same dialogue —as I have reminded above— will also refer to stone as a *γεώδες βάρος*. In providing counterarguments to the Stoic theory of the moon’s constitution, which they allegedly described as a mix of «coaly fire» and «murky air» (922^A), he also points out that such air could not persist into a body moving at the moon’s speed, because, as he says, «impetus combusts both the air which is in stones and that which is in cold lead¹⁶⁰, not to speak of that contained in a fire whirling at such speed (*i.e.* the Stoic moon)» (922^C). It is already interesting to see stone and lead presented now again in pair as remarkably cold substances¹⁶¹ (their high coldness is implicitly contrasted by Lamprias with their almost paradoxical combustion, less easily believable than the one which would occur into a whirling mass of fire), but the important information here is that both stone and lead contain a share of air: this not only adds a layer of complexity to Plutarch’s idea of the stones’ earthiness, but is also coherent with his conception of stone’s density, as I understood it and presented it above¹⁶², inasmuch as it has to be correlated with a very low —and yet still present— content of air.

¹⁵⁸ Another possible interpretation of the pair «earth and sea» is that it functions as a metonymic repetition, and spatial specification, of the preceding ‘biological’ pair, in accordance with the traditional division of animal and plant life between the earth’s and the sea’s realm (see the Greek title and subject of *Sollert.*: «Whether land or sea animals are cleverer»). In this case, a semantic opposition between earth and stone would not exist, since the specification «but also» would indeed mark the extension of the effluvia theory’s scope from only living to also lifeless entities. The other interpreters do not seem to consider this option, but I find it as likely as the one which I assume in my text (following them), since the term *ἐγένοντο* (“were generated”) in Empedocles’s quote could always be understood by a Greek reader in a strictly ‘biological’ sense (“were born and grew”, rather than “were subject to generative alteration”). Therefore, the reason and aim of Plutarch’s phrasing might also be one of disambiguation.

¹⁵⁹ See above, sec. 1.2.

¹⁶⁰ I will discuss this phenomenon in detail below, in sec. 5.

¹⁶¹ Cf. RAINGEARD 1935, n. ad loc.: «le plomb fournit un exemple d’autant plus intéressant que c’est le métal froid par excellence». See also *QConv.* VI 5 690^F-691^B, of which especially the part I quote below, p. 171.

¹⁶² See sec. 1.2.

3. Stone as material, in nature and art

Remaining on the topic of constitutive matter, we can now go one step further and look at the cases in which stone is explicitly regarded as a material component of an object, be it natural or artificial. For the natural world, if we except rocks formations and crags, we do not have many examples to refer to, which is probably unsurprising: it is hard to think of many natural entities one may regard as ‘stony’, outside of the individual stones and gems themselves. It might be of particular interest, then, that Lamprias explicitly presents the tortoise’s shell to be λιθῶδες («stony») in *Lun.* 14 (927^F-928^A), taking indeed inspiration from an Empedoclean verse he quotes («and of trumpet shells and stone-skinned tortoises», *ναὶ μὴν κηρύκων τε λιθορρίνων χελύων τε*, in DK 31 B76), but attributing enough plausibility to the idea to use it as a rhetorical argument for the providential, organic arrangement of all the elements in the world, even in spite of their natural motions. The shell never squashes the turtle —«the stony [matter] does not press (πιέζει) nor squeezes down (καταθλιβει) the constitution (ἔξις) underlying [it]»—, but it should be a physical necessity for it to fall to earth: paradoxically, as Empedocles wrote, «there you will see soil (χθών) dwelling on the top of skin». Lamprias uses the same florid and unconvincing argument with similar argumentative ends, and with the same quotations, also in *QConv.* I 2 (618^B), but in both contexts he associates it with additional proofs (equally rhetorical in *QConv.*, more serious in *Lun.*), also taken from the sphere of productive arts (on one of these I will comment later, as it concerns stone masonry and architecture)¹⁶³. The crucial point of the ‘discursive’ part of *Lun.* is to show the superior likelihood of an earthy constitution of the moon¹⁶⁴, which is related to the defense of a teleological arrangement of the cosmos: if the Stoic —and originally Aristotelian— physics of “natural places” with an absolute centre were accepted (we have already seen these repeatedly being contrasted by Lamprias above, in *Def. orac.* too)¹⁶⁵, an earthy mass could never remain suspended in the air, and there would remain no space for the providential care of the demiurge and for an organic structuring of the world or of its individual constituents (see *e.g.* *Lun.* 13 927^A). It will be interesting, then, to see that in the very few places outside of *Lun.* in which Plutarch dedicates some words to the material constitution of celestial bodies, he appears to endorse or at least appreciate their ‘stony’ conception, emblematically associated with Anaxagoras, against its exclusively ‘fiery’ and ‘aerial’ alternatives. Before coming to the passages attesting to the use of different rocks and stones in art, then, it will be useful to discuss in detail Plutarch’s references to stars as “stones”.

¹⁶³ See below, p. 60-1.

¹⁶⁴ See below, p. 57.

¹⁶⁵ See above, p. 18-26.

3.1 Heavenly stones

In *Superst.*, Plutarch mentions that Anaxagoras «was brought to trial for impiety on the ground that he had said the sun is a stone (λίθος)» (10 169^F, not in DK)¹⁶⁶. He might have drawn the information from Plato's *Apologia*¹⁶⁷, where the theory that «the sun is stone (λίθος) and the moon earth (γῆ)» (26^D = DK 59 A35) is explicitly attributed to the natural philosopher. An unambiguously stony constitution is well attested in the tradition on the Anaxagorean sun¹⁶⁸, but according to a parallel strand, whose earliest testimonies are the grammarian Harpocration and Diogenes Laertius (who both wrote after Plutarch)¹⁶⁹, the sun was instead described as a *múδros diápurros*, *i.e.* as an «incandescent lump» of either metallic or mineral composition (as I have shown earlier in my discussion of the term¹⁷⁰). Maybe this doxographical tradition preferred this expression to accentuate the metallic nature of the sun as opposed to a mineral one, possibly in an attempt to justify its shining through incandescence in a more 'chemically' grounded and intuitive way (since a red-hot lump of iron can be more intuitively visualized than an incandescent stone); in this case, it would be clear that for these authors the term *múδros* had a preferential metallic meaning¹⁷¹, but we would still have no elements to attribute this tendency to Plutarch himself. There is actually a single manuscript exhibiting in our passage of *Superst.* (169^F) the variant *μύδρον* in place of *λίθον*¹⁷², but this was clearly a correction from a second reader

¹⁶⁶ Transl. BABBITT 1928.

¹⁶⁷ According to BABBITT 1928, n. 3 *ad loc.*, and LAURENTI AND SANTANIELLO 2007, n. 125.

¹⁶⁸ See *μύλος διάπυρος* («incandescent millstone») in Flavius Josephus, *Ap.* II 265 (= DK59 A19; this might have come from a deformation of the term *μύδρος*, on which see below, n. 169, but the reverse might also be true); *λίθος ἔμπυρος* in Hippolytus, *Haer.* I 8.6 (in DK 59 A42); *πέτροι*, of stars, *i.e.* rocks that were originally raised from earth by aether and then inflamed by it (the verb is *καταφλέγειν*), in Pseudo-Plutarch, *Plac.* II 13.3 888^D (= A71); Aëtius, *Plac.* II 20.6 (in A72), quoted in the following footnote.

¹⁶⁹ Diogenes Laertius II 8 (in DK 59 A1); Harpocration Gramm. 33, *s.v.* (= A2); Achilles Tatius Astr., *Intr. Arat.* 11 (not in DK). See also Olympiodorus, *In meteor.* p. 17.19-21 Stüve (in A19); and Aëtius, *Plac.* II 20.6 (in A72), who reports both variants (connecting the incandescence with both): *μύδρον ἢ πέτρον διάπυρον εἶναι τὸν ἥλιον*.

¹⁷⁰ See above, p. 23-4.

¹⁷¹ This is explicit in Olympiodorus, *In meteor.* p. 17.19-21 Stüve (in DK 59 A19): *μύδρος γάρ ἐστιν ὁ πεπυρακτωμένος σίδηρος*. Notice, however, that Diogenes Laertius (in A1, see above, n. 169) calls the Anaxagorean sun a *μύδρος διάπυρος* (II 12) while also writing of a *λίθος* (*i.e.* a meteorite) that fell off from it, whose fall was wondrously predicted by the philosopher (II 10). On this regard, a possibly conciliating, albeit speculative, alternative explanation to the oscillation between “stones” and *múδroi* may be that Anaxagoras conceived (or was believed to conceive) the stars as large stony-iron meteorites. The predicted meteorite is in fact referred to by also other sources as a «stone» —among these we find Plutarch's current passage (*ἐξ οὐρανοῦ παμμεγέθης λίθος*)—, and the detail that it fell directly from the sun is also reported by Pliny, *NH* II 149 (in A11; *saxum [...] casurum esset e sole*) and John Lydus, *Ost.* 7.3-7 (not in DK; *λίθον μέγιστον ἐκ τοῦ ἡλίου ἐκπεσεῖν*). Stony-iron meteorites have always been a potential source of iron, and it is generally agreed that “meteoric iron” was «the earliest form of iron used by mankind» (FORBES 1964D, 198); in Greco-Roman times, naturally, meteoric iron ores were still well known (*ib.*, p. 180, but with reference to an unreliable *mirabile* in Pliny, *NH* II 147). If this connection is reasonable, it is possible that Anaxagoras based his idea of the sun's and the stars' composition on his knowledge of the stony-iron meteorites, since they surely had to fall from something which had the same constitution as theirs. A stony-iron sun, then, would both be a “stone” and a *múδros* in the metallic sense, *i.e.*, more specifically, “unwrought iron”: see Hesychius's definition *ἀργός σίδηρος* («raw iron»), which I quoted above, p. 23 n. 66.

¹⁷² According to Ingenkamp in INGENKAMP AND BERNARDAKIS 2008, second correcting hand on top of an erasure in M (Mosc. SS. *Syn. Gr.* 501, XII cent.). Another variant is *λίθρον*, from a second hand in J (Ambros. *Gr.* 881, XIII cent.).

of the manuscript, which he probably based on his knowledge of the alternative tradition¹⁷³. Indeed, Anaxagoras's astronomical theories are also described by Plutarch in *Lys.* 12.3-4 (= DK 59 A12), where he presents stars (ἀστρα) as bodies that are not, according to the philosopher, in their natural place: «in fact, inasmuch as these are stony (λιθώδη) and heavy (βαρέα), they shine due to the opposition (ἀντέρσεις) and circular refraction (περίκλασις) of the aether» (notice here the merely 'optical' explanation of the sun's shining, as opposed to that centred on its incandescence)¹⁷⁴, and only as a result of their forced motion due to the

¹⁷³ In accordance with BABBITT 1928, n. 3 *ad loc.*, although he exaggerates in calling μύθος «the traditional word». This variant is only preferred by LOZZA 1980, n. *ad loc.* as *lectio difficilior*, without consideration of the fact that it was a later correction; in addition, he does not connect the passage with Plato's *Ap.*, he disregards the dating of the testimonies he cites from DK, and the same Plutarchan *loci* he gathers for comparison insist on the stars' stony constitution (rather than mentioning *múdroi*): I discuss *Lys.* 12.1-4 immediately below.

¹⁷⁴ The term *περίκλασις* may be ambiguous. In this interpretation, it is assumed to be a 'circular' variation (*περι-*) of *ἀνάκλασις*, from the verb *ἀνακλάω*, *i.e.* "I bend back", hence "reflect". There is no doubt that Plutarch understood the couple *ἀνάκλασις* και *ἀντέρσεις* —almost an exact parallel of the Anaxagorean *ἀντέρσεις* και *περίκλασις* (on the variation in the prefixes *ἀνα-* and *περι-* in an optical context compare with the expression *ἀντιλάμπεις* και *περιλάμπεις* in *Lun.* 18 931^C)— to refer to such a refraction, as he uses it unambiguously with this meaning in *Pyth.* 3 396^A, to describe the reflection of air onto the mountains surrounding Delphi, resulting in a higher concentration of air in the sanctuary's environment (see the terminological considerations by ILDEFONSE 2006, n. 37 *ad loc.*). Since, however, the noun *κλάσις* (from *κλάω*), does designate a "breaking" or "fracturing", scholars who are unfamiliar with Plutarch's physical language may also be led to interpret *περίκλασις* literally, *i.e.* as referred to a "circular breaking" (either transitive, or intransitive such as in LSJ, *s.v.* 2: «breaking round or on something»), and thus to a "corrosion" happening through "friction". In translating «circular refraction», as reflexively referred to aether (*i.e.* to the subjective genitive *τοῦ αἰθέρος*), I follow FLACELIÈRE AND CHAMBRY 1971 (*ἀντέρσει και περικλάσει*: «par la réflexion et la refraction») and Pisani in ANGELI BERTINELLI ET AL. 1997. If this is the correct explanation (which is very likely, also considering Plutarch's insistence on the mineral cold quality of the stars, as well as the absence of explicit references to a penetrating effect of aether or to his presence inside the lifted stones), this passage is an interesting testimony on an Anaxagorean explanation of astral brilliancy not relying on the concept of incandescence, which instead pervades the other sources, mostly later than Plutarch (on the explanation of sun and stars, the only preceding testimonies seem to be Plato, Pliny, and maybe the almost-contemporary Flavius Josephus: only this latter mentions the incandescence; see above, p. 46 n. 168). LANZA 1966, n. *ad loc.* argues that Plutarch's source was likely to be Peripatetic (see below, p. 49): this would do no less than connect him more tightly with the earliest testimonies of Anaxagoras's thought, and Aristotle himself—it is worth noticing—denied the possibility of the stars' ignition in his physics (see below, p. 76-8). The term *περίκλασις*, combined with *ἀντέρσεις*, is translated as «friction» by PERRIN 1916 («their shining light is caused by friction with the revolving aether»: notice that *τοῦ αἰθέρος* is here an objective genitive), and he is followed by *e.g.*: STOKES 1965, 10; Laurenti in GIANNANTONI 1969 («offrono resistenza e si sfregano contro l'etere»); MONTANARI, *s.v.* *περίκλασις* («per resistenza e attrito con l'aria»); Muccioli in MUCCIOLI AND GHILLI 2001; GRAHAM 2013, 184. If the correct interpretation were this, Anaxagoras, in explaining the star's brilliancy, might have relied on an analogical frame of reference with fire-starters such as flint (for a similar explanation of a stone's ignition through reference to friction see below, p. 76-7): this might seem to corroborate the 'mineral' interpretation of the Anaxagorean stars and *múdroi*, but the inference would be actually unjustified, since also iron can send sparks, *e.g.* when smitten by a hammer. Another interpretation is that proposed by TIGNER 1979, 330 (followed by CURD 2007, 212), according to whom the Anaxagorean stars are stones heated to incandescence by the aether. Another is that by TORRIJOS-CASTRILLEJOS 2014, 124–28 with n. 82, who argues that there is no friction between aether and the revolving stars, and that these shine as a result of the continuous separation of light and heavy elements due to the whirl: since the lifted stars (still) contain a part of aether, their fiery part must constantly depart from the earthy, hence originating brilliancy. Of an «earth-trapped aether» had already written SIDER [1980] 2005, n. 4 to Fr. 16, supposing that Anaxagoras used it as an explanation to why the stars can occupy the astral region, *i.e.* due to their inferior density (as conferred to them by their aethereal part) to that of the earth which gathered at the centre of the whirl (on this cosmological dynamic see above, p. 39 n. 142); he had also added that it was this aether to be regarded «to keep them burning», which allowed Anaxagoras to «describe the stars, sun and moon as red-hot stones». Sider's interpretation (albeit short on evidence) may be attractive, but the terms *ἀντέρσεις* and *περίκλασις* can hardly be supposed, as Torrijos-Castrillejos does, to refer to a «desprenderse y desgajarse» of the aether from the stones, arguably too distant an interpretation from the couple's literal (and Plutarchan) meaning.

«whirl» (δίνη) and the «intensity (or tension) of [their] revolution» (τόνος τῆς περιφορᾶς) that «they were also constricted not to fall down here (δεῦρο) originally, when the cold and heavy bodies were being separated from the whole». There can be no doubt, then, that Plutarch believed Anaxagoras to conceive the stars as mineral bodies, so much that the fact that they did not fall to earth —we know that for Plutarch too, intuitively, every stone should¹⁷⁵— had to be explained by the philosopher through their circular motion; it is also worth noticing that their dissociation from a natural, internal heat parallels Plutarch’s ‘cold’ views on stone formation and on their properties¹⁷⁶.

Now, Anaxagoras is repeatedly mentioned in Plutarch’s *corpus* as a paradigm of scientific rationalism, opposed to that superstitious attitude towards certain natural occurrences which manifests when people consider them as terrifying portents¹⁷⁷. In *Per.* 6, he is presented as the crucial intellectual influence that saved Pericles from the risk of «superstition» (δεισιδαιμονία) towards celestial phenomena (a praise immediately counterbalanced by Plutarch’s mediating exposition of his ‘double’ model of causality, 4-5)¹⁷⁸, conferring to the leader that «physical» attitude (see ὁ φυσικός λόγος) which gave its fruits, for instance, when he came to show utter disregard for the occurrence of an eclipse as he was going to set sail with his army (see 35.1-2). For his bold explanation of eclipses Anaxagoras is also celebrated in *Nic.* 23, in opposition with the terror that impeded Nicias to set sail —surely antithetical to Pericles’s indifference—, and it is likely that in *Lys.* 12 too, in expounding the philosopher’s physical theories on the stars, Plutarch was allowing himself a small *excursus* to instruct us with an example of the right approach to keep when dealing with astonishing celestial events. In fact, Plutarch begins the digression just after reporting that Lysander’s definitive victory against the Athenians at Aegospotami was held by some people to be the result of a “gods’ work” (11.13); that some even claimed that the Dioscuri had started to shine as «stars» on both sides of Lysander’s ship as he was leaving the dock (12.1)¹⁷⁹; and that some interpreted the (famous) fall of the «giant stone» (παμμεγέθης λίθος) into the river as a «sign» (σημεῖον) of the incoming calamity (2) — a meteorite which must have fallen, then, around 480/470 BCE (or believed to in later times). It is here, after noting that the stone is still venerated by the Chersonesians in his days, that Plutarch introduces the astrometeorological doctrine of Anaxagoras, while crediting him for an exceptional prediction: «and they say that Anaxagoras had anticipated that there would be, as a result of some slipping (ὀλισθημα) or agitation (σάλος) along the sky of the fixed bodies (ὁ οὐρανὸς ἐνδεδεμένων σωμάτων), a throw (ῥίψις) and fall (καὶ πτώσις) of one [of these bodies], broken away (ἀπορραγέντος) [from its seat]» (3);

¹⁷⁵ See above, sec. 1.1.

¹⁷⁶ See above, sec. 2. On Anaxagoras as a precursor in the ‘cold’ explanation of mineral formation see above, p. 39 n. 142.

¹⁷⁷ See especially BRENK 1977, 38–45.

¹⁷⁸ This allows for the co-existence of higher, teleological motives subject to divine rationality with natural, contingent causes (a development of Plato, *Tim.* 46^D–48^A): see also Plutarch, *Cor.* 38.1-2, but especially *Def. orac.* 436^{D-E}, with MEEUSEN 2021. See also the classic article by DONINI [1992] 2011.

¹⁷⁹ For an introduction to the Dioscuri, here manifesting as St. Elmo’s fire —as in Pliny, *NH* II 101—, see Piccirilli in ANGELI BERTINELLI ET AL. 1997, n. *ad loc.*

a prediction which is also reported, with additional rhetorical flourish, by Pliny (*NH* II 149-50), who presents the aerolith as a large «stone» (*lapis*) with a «burned colour» (*color adustus*) that can be still witnessed in his days, like three others that he mentions to confer more credibility to the phenomenon (one of which he reports to have seen in person, not long after the fall). It has been rightly pointed out that the reference to the «sky of the fixed bodies» is probably a sign of some Aristotelian contamination (see the expression ἄστρα ἐνδεδεμένα, *i.e.* «fixed stars», in *Cael.* II 8 289^B32-3) in Plutarch’s understanding of Anaxagoras’s theory, which does not seem to include the concept of such a spherical seat for the upper bodies¹⁸⁰.

In any case, the introduction of this doctrine is what prompts Plutarch’s decision to provide minimal details on Anaxagoras’s astronomy (including the theory of astral shining seen above), and —more interestingly for us— to start an etiological discussion on the best explanation for the meteorite’s fall¹⁸¹. Plutarch makes a conscious effort to keep it as short as possible, in fact concluding it with the expression «these things, now, are to be discussed minutely in another kind of writing (γένος γραφῆς)» (*Lys.* 12.7), which can be taken as a hint that he regarded such a critical etiology to pertain rather, perhaps, to the genre of *problémata*-literature¹⁸², but surely not to biography¹⁸³. In presenting his preferred explanation, Plutarch does not mean to offer an alternative to Anaxagoras’s ‘stony’ conception of the stars —he shows no doubts about it—, but only to suggest a more convincing account of the immediate cause of their fall; in doing this, most interestingly, he also assimilates meteorites to meteors, suggesting that the theory he tended to prefer offered a unified account for both (5):

Ἔστι δέ τις πιθανωτέρα δόξα ταύτης, εἰρηκότων ἐνίων ὡς οἱ διαττοντες ἀστέρες οὐ ρύσις εἰσὶν οὐδ’ ἐπινέμησις αἰθερίου πυρὸς ἐν ἀέρι κατασβεννυμένου περὶ τὴν ἕξαψιν αὐτήν, οὐδὲ ἀέρος εἰς τὴν ἄνω χῶραν πλήθει λυθέντος ἔκπρησις καὶ ἀνάφλεξις, ῥίψις δὲ καὶ πτώσις οὐρανίων σωμάτων οἷον ἐνδόσει τινὶ τόνου καὶ παρατροπῆ¹⁸⁴ κινήσεως ἐκπαλῶν φερομένων οὐ πρὸς τὸν οἰκούμενον τόπον τῆς γῆς, ἀλλὰ τῶν πλείστων ἐκτὸς εἰς τὴν μεγάλην ἐκπιπτόντων θάλατταν· διὸ καὶ λανθάνουσι.

¹⁸⁰ This is pointed out by LANZA 1966, n. to A12.

¹⁸¹ This was accounted for as one of the *Vitae*’s “meteorological” digressions by BOULOGNE 2008, 739–40, who only summarized it.

¹⁸² This is argued for by MEEUSEN 2017a, 145, 148–49.

¹⁸³ BOULOGNE 2008, 746 with n. 36 counts eight digressions in the *Vitae* associated with such “formulas of closure”.

¹⁸⁴ The conjecture παρατροπῆ, proposed by REISKE 1775, has been accepted by ZIEGLER [1926] 1973, FLACELIÈRE AND CHAMBRY 1971, and Manfredini in ANGELI BERTINELLI ET AL. 1997 in place of the manuscripts’ παρατρόπου, which as an adjective, referred to κινήσεως, would contribute to an unlikely meaning: «[...] shaken out [from their course] as if for some relaxation of tension and of deviating movement». The conjecture περιτρόπου proposed by KORAES 1812 is unsatisfying («[...] for some relaxation of tension and of circular motion»); he was followed by PERRIN 1916, who translated «[...] by some relaxation in the tension of their circular motion» (notice the disappearance of the καί).

But there exists a more convincing opinion than this, as some have claimed that shooting stars are neither a ‘flow’ nor a ‘distribution’ of aethereal fire extinguishing in air on the perimeter of the ‘lighting up’ itself¹⁸⁵, nor even a ‘catching fire’ and ‘flaring up’ of air which has broken free into the higher region due to [its] abundance¹⁸⁶, but rather a throw and fall of celestial bodies, shaken out [from their course] as if for some relaxation in intensity (lit. tension) and deviation¹⁷⁴ of [their] movement, carried [down] not onto the inhabited region of earth, but most of them falling out into the great sea; which is also why they escape notice.

We can see that Plutarch, in explaining the phenomenon of falling aeroliths, nonchalantly switches to the topic of *διάπττοντες ἀστέρες* («shooting stars»), manifesting that at least for the ends of this etiology he is willing to consider them as one and the same with meteorites; the *λανθάνουσι* («escape notice») with which he closes the explanation, coherently with this assimilation, might not only be meant to allude to the apparent infrequency of the phenomenon —implying that people would sight meteors much more often if also the sea were inhabited—¹⁸⁷, but perhaps also to the extreme rarity of ‘meteors’ falling in our regions and remaining on the ground as observable aeroliths: they would «escape notice» in the sense that even when people see a shooting star they rarely see the end of its trajectory, and are generally unable to find it somewhere on the ground, in the form of a stone.

Before presenting his preferred option (which he attributes to unnamed *ἔνοι*, perhaps hiding his own intuition under an authoritative plurality)¹⁸⁸, he refers to two alternative explanations which seem to be

¹⁸⁵ Cf. the translations by PERRIN 1916: «[...] are not a flow or emanation of aetherial fire, which the lower air quenches at the very moment of its kindling»; and by FLACELIÈRE AND CHAMBRÉ 1971: «[...] ne sont pas des émanations ni des parcelles du feu de l’*éther*, qui s’*éteignent* dans l’air au moment même où elles s’allument», followed closely by Pisani in ANGELI BERTINELLI ET AL. 1997 and Muccioli in MUCCIOLI AND GHILLI 2001.

¹⁸⁶ I do not understand which function PERRIN 1916 attributes to the dative *πλήθει*, translating: «nor are they an ignition and blazing up of a quantity of lower air which has made its escape into the upper regions»; he is followed by FLACELIÈRE AND CHAMBRÉ 1971 and Pisani in ANGELI BERTINELLI ET AL. 1997. I agree with Muccioli in MUCCIOLI AND GHILLI 2001: «né si tratta di una combustione e di un’inflammation dell’aria che si sprigiona per eccesso di quantità nella zona alta del Cielo», but I also consider a different interpretation below, p. 52 n. 196.

¹⁸⁷ Plutarch mentions the *κομήται* among the examples of phenomena causing astonishment due to their rarity in *Aet. phys.* 29 919^B. The rarity of *cometae* is also stressed by Seneca in *Nat.* VII: in 1.5 he connects it with the people’s common puzzlement about the phenomenon, which leaves them uncertain as to whether interpret it as a portent or not; in 3.1 he presents it as the reason why it has been impossible up to his days to fully comprehend the comets’ *cursus* («trajectory»); so again in 25.3, as the reason why a predictive system on their movements has not yet been discovered.

¹⁸⁸ This is only speculation. Plutarch might be implicitly referring to indeterminate «astronomers» such as the *mathēmatikoi* mentioned by Lucius in *Lun.* 6 932^{A-B}, whom he credits with the calculation of the moon’s size during its eclipses (note that two *mathēmatikoi* participate as characters in the dialogue, *i.e.* Apollonius and Menelaus; *mathēmatikoi* are also mentioned in 9 925^B, 17 930^A, 21 933^F-924^A—here associated with the couple *φυσικῶς καὶ μαθηματικῶς*—, 21 934^C, and 24 937^F, although never in connection with theories on meteors or on other phenomena of ‘lower’ meteorology). Lucius names them for the first time just a few lines after claiming that he and his fellow Academicians do not “say” anything by themselves (*i.e.* do not assert any dogmatic truth on astronomical phenomena), then referring to «those who assume that the moon is earth» (*οἱ δὲ γῆν ὑποτιθέμενοι τὴν σελήνην*), opposed

unattested in other texts, but whose terminology is of evident Aristotelian inspiration (and it is not to be excluded that Plutarch invented them, as garbled parodies of Peripatetic meteorology). In the first, a stream of fire of the aethereal kind —probably bursting down from the upper region— is described to “distribute” in the air and to be associated with a «lighting up» (ἔξαψις), clearly of the air itself (compatibly with similar Aristotelian explanations)¹⁸⁹; the “extinction” of the fire (see κατασβενημένου) described to occur «around» (περὶ) such ἔξαψις, perhaps, is due to the transfer of heat from the aethereal fire to the igniting air, which stops the fire from flaming (but not necessarily the air now encompassed by it). It is unclear how such “extinction” should have any role in the phenomenon¹⁹⁰, but a reference to a σβέσις, although of lightning bolts, can indeed be found in Aristotle’s *Meteor.* II, as something which some philosophers proposed to be the cause of thunders (9 370^A24). It seems in fact that in the Aristotelian tradition such a concept of “extinction” came to be employed in the etiology of lightnings, from which we may presume that it was also extended to the explanation of comets (assumed to be comparable phenomena)¹⁹¹. In Theophrastus’s *Metarsiologiká* (“Meteorological [books]”, as named by Diogenes Laertius in *VP* V 2 44) —which have remained preserved only in Arabic and Syriac translations and have been edited by H. Daiber in 1992¹⁹²— we can read of an «extinction» of fire interacting with a humid cloud as one of the possible causes of lightning, presented in analogy with iron quenching (since this allegedly produces fire at the moment of the immersion, 2.10-2); in Daiber’s translation: «when fire is extinguished in a humid cloud, the thin (part) of (the cloud) is ignited». If we correctly assume the «humid cloud» to be moist air, we have found a close parallel to Plutarch’s rejected etiology of meteors. It is both possible, then, that he intended to refer to a genuinely Theophrastean explanation (described in one of his meteorological books that have not survived up to our days, like the «fourth book on the *metársia*» Plutarch quotes in *Aet. Gr.* 7 292^{C-D})¹⁹³, and that he took inspiration from later Peripatetic elaborations, either written down as *problémata* or spread orally in the context of philosophical discussion. In the second dismissed explanation —Aristotelian-sounding as well, and like the first assuming

to the Stoics (see below). Here, like in our passage in *Lys.* 12, Plutarch prefers to ‘outsource’ the responsibility of strong claims about celestial bodies (perhaps with an implicit reference to Presocratic philosophers, or Plato and Socrates themselves, cf. DONINI 2011, 37–40 and n. 61), but this does not impede him from manifesting his predilection for the «most convincing δόξα».

¹⁸⁹ See Aristotle, *Meteor.* 4-7 341^B1-345^A10, where it is more properly the dry exhalation to ignite.

¹⁹⁰ It might be meant to explain the shape and visibility of the comet, according to the Theophrastean principle of *periōtheîn* I will discuss below: the afflux of surrounding air following the extinction of the fire onto the perimeter of the burst, perhaps, would help to contain the flare inside its boundaries, not allowing it to immediately expand into the atmosphere and dissipate.

¹⁹¹ Aristotle does associate them in *Meteor.* as phenomena which are explained with reference to the same causes, *i.e.* the interaction between the dry exhalation and the moist. Cf. below, p. 54 with n. 203.

¹⁹² DAIBER 1992, with translation and commentary. He believes that the text, as transmitted by his sources, has not been epitomized.

¹⁹³ DAIBER 1992, 277, 286 proposes an identification of the cited work with the lost *Peri hudátōn* («On waters») named by Diogenes Laertius in *VP* V 2 46 (who however associates it with «three» books, leaving Plutarch’s reference to a fourth problematic) and probably used by Olympiodorus in his commentary to Aristotle’s *Meteor.* Since Plutarch quotes an extract on the formation of a certain kind of clouds (the «floating»), it is not impossible that the work also contained some claims on meteors originating in “humid clouds”, like the lightnings in *Metars.* 2.10 Daiber. However, note that KIDD 1992, 297–98 remarks that «we know nothing at all about whether Theophrastus had any views on comets», collecting the possible evidence.

a concentric disposition of the elements in their ‘natural regions’—, the sense of aether and air’s interaction is reversed, and it is the latter to invade the upper sphere. This scenario is considered in a dialectical context by Lamprias in *Lun.* 5, to argue against the Stoic conception of an airy moon (in the same streak of counter-arguments that also includes the reference to the air’s “combustion” in moving stones and in «cold lead»)¹⁹⁴: he remarks that in the hypothetical case air managed somehow to reach the upper region it should necessarily «depart, changing into another shape (μεταβάλλων εἰς ἕτερον εἶδος), made into aether (ἐξαιθερωθεῖς) by the fire»¹⁹⁵ due to the fact that the «superior (and stronger, κρείττων) substance» occupying the region has the «nature of thinning and kindling with itself (λεπτύνειν καὶ συνεξάπτειν) everything» (922^B). This is something, incidentally, which is also coherent with the ‘micro-chemistry’ expounded by Plato in *Tim.* (56^D-57^B)¹⁹⁶. Plutarch, then, would probably agree that a mass of air invading the aethereal sphere would instantly ‘flare up’ (not necessarily in a visible way), but he does not think it is good explanation for the phenomenon of shooting stars and meteorites.

In the option he prefers, there is no reference to ignitions and moving airs: everything is explained by the simple movement of solid bodies. To present his etiology as a development of Anaxagoras’s, he repeats the syntagm ῥίψις καὶ πτώσις («throw and fall») he had earlier associated with his theory, and strips it from its reliance on a “break”: there is nothing “fixing” the celestial bodies in their place; they simply “move” (see κινήσεως), and their movement can sometimes be altered by a loss of τόνος («intensity» or «tension»), disrupting the harmony of their rotation and inducing them to fall¹⁹⁷. The implicit frame of reference, in the conception of such mechanics, might be the rotating motion of a sling bullet before the throw: if a thrower suddenly relaxes the sling’s tension while taking aim, the bullet’s circular motion cannot help but being

¹⁹⁴ See above, p. 44 and below, sec. 5.

¹⁹⁵ On air’s susceptibility to rarefaction and burning (proclaimed as well in this passage, 922^{B-C}) I will return below, in sec. 5.

¹⁹⁶ It is natural for the element composed of polyhedra with the sharper edges, given a critical quantity, to always “dissolve” (διαλύειν or λύειν) the element with the more obtuse. This is the case for fire and air, whose interaction leads to the decomposition of single airy octahedra into two fiery tetrahedra (56^E). The dodecahedron Plato assigns to a fifth element (55^C), identified in the Platonist tradition as aether (see BOYS-STONES 2018, 197), has actually more obtuse edges than the octahedron (see BRUINS 1951, 270), which implies that it should be air to decompose the Platonist aether. Either Plutarch did not make this association, or he tended to imagine the aether in the upper sphere to be a form of fire, which is more likely, considering his terminological insistence on «fire». This Platonic connection might allow us to propose a different translation of the phrase ἀέρος εἰς τὴν ἄνω χώραν πλῆθει λυθέντος ἔκπρησις καὶ ἀνάφλεξις in *Lys.* 12.5, assuming an indirect allusion to Plato’s language of elemental prevarication in *Tim.* 57^A (see «for all the time a weaker [element], finding itself into a stronger (κρείττον!), fights, it does not stop being dissolved (λυόμενον!)», *i.e.* decomposing its polyhedra into the shapes of the stronger’s). In this sense, the air entering the upper sphere might start its combustion due to the aethereal fire’s superior strength and overwhelming mass: «a ‘catching fire’ and ‘flaring up’ of air [moving] into the higher region, dissolved (λυθέντος) due to the [aether’s] abundance (πλήθει)». I do not opt for this translation for two reasons: first, the use of the accusative with εἰς would be less justified if it were not connected with the verb λυθέντος; second, it seems unlikely that Plutarch would want to dismiss so quickly a Platonically-reasonable theory.

¹⁹⁷ Compare with Seneca, *NH* VII 24.1, who after opting for the Stoic theory of comets as actual stars, *i.e.* divine masses of ignited, compacted air, he answers some possible objections, including the counter-argument that they, as stars, should not have different orbits than all the others: «why, then, should there not be other [stars] which have parted (*secesserint*) on their own route far removed from them?».

deviated, and the bullet «shaken out» onto a different trajectory¹⁹⁸. There is indeed evidence that Plutarch thought of this analogy, as he made it explicit in *Lun.* 6, in the words of Lucius: «yet the moon is saved from falling by its very motion (κίνησις) and the rapidity (lit. whizzing character, τὸ ροιζῶδες) of its revolution, just as missiles placed in slings are kept from falling by being whirled around in a circle (ἢ κύκλῳ περιδίνησις). For each thing is governed by its natural motion unless it be diverted (ἀποστρέφεται) by something else. That is why the moon is not governed by its weight: the weight has its influence (ῥοπή) frustrated (ἐκκρουόμενον) by the rotatory motion» (923^{C-D})¹⁹⁹. Plutarch, perhaps, prefers this explanation as it is more consistent with Anaxagoras’s concept of the «whirl» and «intensity (τόνος!) of the revolution» we have seen above —which he endorses and employs in *Lun.*— than the Presocratic’s very own meteorology (as Plutarch understood it). We may notice, on our part, that this etiology is incomplete to say the least, not only as it does not suggest any possible reason for the sudden «relaxation» of the motion of the celestial bodies —perhaps a deliberate indeterminacy, to allow for the god to loosen at his will the tension of their revolution²⁰⁰—, but also because it does not seem to take into consideration the ‘flaming’ trail following meteors and aeroliths, possibly incompatible with such a ‘stony’ and merely mechanical view on their manifestations. I will return later on this latter point²⁰¹.

Now, it is worth considering that, well before Plutarch tried to explain it, the aerolith’s fall at Aegospotami had received some hurried commentary from Aristotle in *Meteor.* I 7 (344^B31-6), at the end of a long

¹⁹⁸ On the metaphorical frame of τόνος see also below, p. 123-4 (for its application to heat and cold).

¹⁹⁹ Transl. Cherniss in CHERNISS AND HELMBOLD 1957. He had already connected this passage with *Lys.* 12 (see n. d to 923^{C-D}), without however referring to Plutarch’s favoured explanation (only to his testimony of the Anaxagorean astronomy in 12.3-4). He also pointed for comparison to Aristotle, *Cael.* II 1 284^A24-26, and 13 295^A16-21 (= DK 20 A67), where similar mechanics are attributed to Empedocles. The former passage interestingly attributes to him a concept of δίνησις («whirling»), and the latter an analogy involving lifted and rotating ladles filled with water, which do not allow the water to spill during their motion.

²⁰⁰ In *Lun.*, Lamprias argues for a providential arrangement of all the elements in the world, often contradicting their “natural” motions, on which see especially 13 927^{A-D}: if the moon is «caught» (περιληφθεῖσα) in her position and trajectory «by the bond that follows reason» (τῷ κατὰ λόγον δεσμῷ), perhaps her motion and that of the other celestial bodies may be subject to change for a development in divine «reason». An explanation of the natural structure of the phenomenon of shooting stars not including an immediate cause for their manifestations seems to be particularly fitting to Plutarch’s ‘double’ model of causality, which we have seen being introduced in *Per.* 6.4-5 in association with Anaxagoras (see above, p. 48 with n. 178): in the case of a meteor, the ‘natural’ cause of its “fall” would correspond to the «relaxation» of the revolution’s τόνος, and the ‘rational’ to the god’s intention to use it as a «sign» (σημεῖον) for something. If Plutarch did accept the meteors to act as signs of the god’s will, not only would he prove to agree with the people who interpreted the fallen aerolith at Aegospotami to be a divine σημεῖον (not necessarily of a disaster, yet possibly «a sort of fanfare announcing the inception of great events», as BRENK 1977, 187–88 proposed to interpret the great omens based on *Sul.* 7 — note that Sullas’s biography is coupled with *Lys.*), but we would also have a further reason to interpret the λαυθάνουσι in *Lys.* 12.5 to refer to the stones’ “evasiveness” after their fall, rather than before: if the god wants to use them as signs, we can expect him to make sure that his intended audience is always able to observe their course. The mathematical regularity of eclipses does not lend itself to the ‘double’ model of causality like the anomalous occurrences of meteors, which might have been the reason why Plutarch’s scorn for their superstitious interpretations was complete and constant: see again BRENK 1977, 38–45 (on this subject already cited above, p. 48 n. 177). On eclipses in the *Vitae* see also, more recently, FERREIRA 2015 and LESAGE GÁRRIGA 2015, 146–48, in which F. Brenk’s treatment still figures as an authoritative work. On meteorological omens cf. *Def. orac.* 18 419^E, quoted with some commentary below, p. 59-60 n. 227.

²⁰¹ See below, p. 83-5.

discussion on meteors which the philosopher all explained to be dependent on the ignition of the dry exhalation²⁰². His treatment of the meteorite could hardly be considered satisfying, as he simply presented it as a «stone» which happened to be lifted and let fall «by a wind» at the same time a comet appeared in the west, proving a causal relation between the two phenomena (since alterations in the dry exhalation are associated with changes in winds)²⁰³. He gave to it the consideration one can give to a rare anomaly, not requiring a specific theory like Plutarch's, and was content with merely placing it into the chain of reactions coming with the lighting up of a meteor in the sky, without even inquiring into the stone's original location. Theophrastus seems to have followed his master, as no single reference to aeroliths can be found in his *Metarsiologiká*²⁰⁴. Plutarch, who in contrast did provide a unified explanation, could however recognize that it did not take into account the problem of the meteor's concurrent manifestation²⁰⁵. For this reason, he deals with the problem in the prosecution of his digression, in spite of the fact that it might prove to invalidate his theory (*Lys.* 12.6-9). He starts with a citation of the historian Daimachus of Platea (IV BCE)²⁰⁶, who reported of a detail —if we are indulgent and assume his honesty (8)— which «bears favourable witness (*μαρτυρεῖ*) to Anaxagoras» (6): before the fall of the stone, in fact, it was allegedly possible to observe «a giant igneous body, similar to a flame-like cloud» (*πύρινον σῶμα παμμέγεθες, ὥσπερ νέφος φλογοειδές*) moving frantically into the sky for seventy-five straight days, with such a movement «as to carry in many places fiery shreds (*πυροειδῆ σπάσματα*) broken away (*ἀπορρηγνύμενα*) by [its] agitation (*σάλος*) and roaming, and flash (*ἀστράπτειν*) like the shooting stars». When this spectacle had ended, and the aerolith had fallen, this latter bore no trace of the fiery manifestation that preceded it, but was witnessed by the people, terrified and puzzled, to be merely a «stone», however «big» (7). If this phenomenon attests to Anaxagoras's explanation against Plutarch's it simply because it offers an immediate cause for the «throw and fall» of the star from its seat, «broken away» by the «agitation» (*σάλος*, remember the «slipping or agitation» mentioned in 3) of the fiery cloud; in Plutarch's exclusively 'kinetic' theory, indeed, the stars' revolution would remain indifferent to such a turbulence. He proceeds to discuss this heavenly occurrence for a few final lines, after which he concludes his digression (8-9)²⁰⁷:

²⁰² Cf. below, p. 78.

²⁰³ Cf. WILSON 2013, 142–43: «phenomena of his predecessors that Aristotle cannot fit into subordinate species, he sometimes turns into attendant circumstances. He mentions the rock that fell at Aigospotamoi at the same time as a comet appeared [...]. This meteorite, perhaps the most challenging evidence against Aristotle's whole theory, is safely deposited here as a footnote at the end of his discussion».

²⁰⁴ See again KIDD 1992, 297–98, quoted above, p. 51 n. 193.

²⁰⁵ It was also mentioned by Pliny in *NH* II 149, who wrote of a *cometes conflagrans*.

²⁰⁶ On this author, not to be confused with the homonymous author of the *Indiká* (who lived a century later), see Piccirilli in ANGELI BERTINELLI ET AL. 1997, n. *ad loc.*

²⁰⁷ Transl. based on PERRIN 1916, modified.

ὅτι μὲν οὖν εὐγνώμωνων ὁ Δαίμαχος ἀκροατῶν δεῖται δῆλός ἐστιν· εἰ δὲ ἀληθὴς ὁ λόγος, ἐξελέγχει κατὰ κράτος τοὺς φάσκοντας ἕκ τινος ἀκρωρείας ἀποκοπεῖσαν πνεύμασι καὶ ζάλαις πέτρων, ὑποληφθεῖσαν δ' ὥσπερ οἱ στρόβιλοι, καὶ φερομένην, ἣ πρῶτον ἐνέδωκε καὶ διελύθη τὸ περιδινησαν, ἐκριφῆναι καὶ πεσεῖν. εἰ μὴ νῆ Δία πῦρ μὲν ἦν ὄντως τὸ φαινόμενον ἐπὶ πολλὰς ἡμέρας, σβέσις δὲ καὶ φθορὰ μεταβολὴν ἀέρι παρέσχεν εἰς πνεύματα βιαιότερα καὶ κινήσεις, ὑφ' ὧν συνέτυχε καὶ τὸν λίθον ἐκριφῆναι. ταῦτα μὲν οὖν ἐτέρω γένει γραφῆς διακριβωτέον.

Well, then, that Daimachus needs indulgent readers, is clear; but if the story is true, he refutes by force those who affirm that a rock, which winds and hurricanes had cut away from some mountain top, was caught up and borne along like the spinning tops, and that at the point where the whirling impetus given to it first relaxed and ceased, there it was thrown, and fell. Unless, by Zeus, what appeared for many days was really fire, and [its] extinction and destruction brought air a transformation into stronger winds and movements, by reason of which it also happened to the stone to be thrown out. But these things, now, are to be discussed minutely in another kind of writing.

Plutarch here focuses on yet another alternative theory, different both from Anaxagoras's and from his own, and sharing some similarities with Aristotle's short remark in *Meteor.* I 7. According to this theory, the fallen stone is not to be considered a celestial body, but a «rock» (πέτρα) of terrestrial origin cut from a mountain by a strong wind and “thrown” and made to “fall” (notice that the couple ῥίψις καὶ πτώσις returns here in the syntagm ἐκριφῆναι καὶ πεσεῖν) when the whirling has “relaxed” (compare ἐνέδωκε with Plutarch's earlier ἐνδοσις of τόνος). This explanation, like Plutarch's, relies on mere mechanics; if it risks being invalidated by the co-occurrence of the meteor it is because it leaves no space for the occurrence of igneous bursts, and also ignores the «fiery shreds» that seemingly kept scattering in the sky for seventy-five days. Due to the risk of such a κατὰ κράτος confutation—which would also target Plutarch's favoured theory—, another possibility is considered, which would save the explanation of the wind-lifted rock as an indirect effect of the meteor's combustion (in a similar spirit to that shown by Aristotle in *Meteor.* I 7). The theory could stand, «by Zeus», if the shooting star were indeed associated with an «extinction» (σβέσις), as was assumed in the first explanation Plutarch had dismissed (in *Lys.* 12.5); differently than there, however, the fire's σβέσις would not have to be intended here as a partial cause for the shooting star's manifestation, but as the ending event of the phenomenon: after the «fire»—*i.e.* the comet itself— has extinguished, a strong alteration in winds would have to follow, strong enough to rip a rock from off a mountain. Such a reaction does not seem to be compatible with the Aristotelian meteorological views exposed in *Meteor.* (on winds see especially II 4-5 359^B27-363^A20), but it may find an interesting parallel, again, in Theophrastus's *Metarsiologiká*. At the core of its etiology of the motion of winds (13.7-21), we read that they move «because the air compacts and is

compressed [...]: whenever the air compacts at that place and is compressed so that there is no empty place left, the air moves from <one side to> the other since it is forced by the vacuum [...], so that there is no longer a vacuum»²⁰⁸, after which we find an analogy with the experience of sucking water from a surface with a tube by means of sucking the air which is inside the tube. In a similar way to what determines Plato's *periōtheîn*²⁰⁹, Theophrastus's air is compelled by a kind of *horror vacui* to fill in the places which without its presence would be empty, according to a dynamic known as *antapódosis*²¹⁰. Plutarch, then, might have wanted to refer to such a dynamic, because just like heating and burning, in his own understanding, causes any kind of matter including air to rarefy and dilate (see e.g. *QPlat.* 7.3 1004^F), any fall in heat, accordingly, induces it —like active cooling²¹¹— to condense and shrink: this is why Lamprias in *Lun.* 20 can imagine the «dark air» (σκοτώδης ἀήρ) of a «shadowy place» (τόπος σκιερός) to have such a «thickness» (παχύτης) as to be able to «contain in itself (συνέχοντος ἐν ταύτῳ) and close (σφίγγοντος)» even the radiance of a fire burning inside it, thus contributing to a crisper perception of the light for those observing it (933^C); i.e., because the «dark air» has not been rarified by sunshine or by any concurrence of strong sources of heat²¹². After the «extinction» of a huge celestial fire, then, one can only expect the air remaining in its place to condense drastically (which would be also presupposed by a Platonically imagined combination of the fire's tetrahedra into airy octahedra)²¹³, and, assuming the Theophrastean *antapódosis*, a large suction to be suddenly exercised on all contiguous masses of air, triggering a chain reaction that involves the energetic motion, in all directions, of enormous winds.

This all attests to the validity of the theory of the wind-lifted rock, but is irrelevant to Plutarch's favoured explanation (supposing individually distinct motions for independent celestial bodies). Its main effect is demonstrating that an alternative to Anaxagoras's (alleged) reliance on a “breaking away” of stars from a binding heaven is possible, but it also contributes to the persuasiveness, in general, of all explanations not considering «shooting stars» to be ignited streams of air, but rather solid “stones”. The intent to defend the ‘stony’ option in the account of meteors might have been the drive inducing Plutarch to the expand the *excursus* in such a hurried form, surely in response to current philosophical debates he did not want to withdraw from (and in anticipation of possible objections from his readers). Although he does concede to Daimachus —with manifest indulgence— that there might have been an actual «igneous body» agitating in the sky at the time of the meteorite's fall (after all, Plutarch conceives at least lightning bolts and flashes to be

²⁰⁸ Transl. DAIBER 1992.

²⁰⁹ On this mechanism, expounded in *Tim.* 79^A-80^C, see below, p. 80-1 and especially p. 161-6.

²¹⁰ On this concept see DAIBER 1992, n. to 13.7-17 and p. 283, 288.

²¹¹ Cf. e.g. above, p. 38-40.

²¹² I agree, therefore, with DONINI 2011, n. 236: «ci si può domandare perché mai una massa d'aria oscura dovrebbe essere più densa di se stessa quando è illuminata e quale fisica della luce sarebbe implicita in questa assunzione. [...] Forse l'assunzione implicita è appunto che una luce riscalda comunque e renda più rarefatta l'aria, che sarebbe invece più densa perché più fredda nell'oscurità».

²¹³ See above, p. 52 n. 196.

forms of blazing fire)²¹⁴, he does not accept their direct identification with the «shooting stars», which can still be supposed to be of a stony constitution like the aerolith: the Aristotelian-Theophrastean take on meteors as ἔξαψις or ἔκπρησις of air, maintaining Plutarch’s assimilation between meteors and meteorites, is the only theory he fully rejects. This is coherent, we may note, with Plutarch’s insistence in *Lun.* on the superior likelihood of an earthy constitution for the moon, which I have already mentioned in the introduction to this section (see especially 6-8 922^E-924^F, 15 928^A-928^D, and 21 934^F-935^C), and which is presented in the dialogue as a necessary assumption in the explanation of eclipses (see 19-21 931^D-934^F), boldly explained as a physical phenomenon for the first time —we have seen this above on *Nic.* 23— by none other than Anaxagoras. Since *Lun.* is also the dialogue in which Lucius argues that the moon’s rotating motion is a sufficient cause for her fall to be impeded (see 6 923^{C-D}, quoted above), we appear to have quite a few reasons to suppose this work and the digression in *Lys.* 12 to have stemmed from a common philosophical agenda, or at least to share some crucial cosmological preoccupations. Now, because the Stoics are the main polemical target of the discussion in *Lun.*²¹⁵ —the Aristotelians are indeed attacked, and openly in 16 (928^F-929^B), but their presence is secondary—, we might suppose that Plutarch might have wanted in the *excursus* of *Lys.* 12 to oppose the Stoics as well. This cannot be demonstrated, but it is true that Diogenes Laertius attributed to the Stoics a theory of *komētai* —not meteorites— as «fires (πυρά) lifted when thick air (παχύς ἀήρ) has been carried up to the aethereal place (ὁ αἰθερώδης τόπος)» (VII 1 152 = *SVF* 692), and that Seneca defended in *NH* VII a conception of *cometae* as actual stars, composed like all the others of compacted, blazing air²¹⁶; the technical term ἔξαψις («lighting up») —as I will show below²¹⁷— seems to have been also used by Stoics in the explanation of sky flashes (ἀστραπαί or σέλα). It is not unreasonable, then, to suppose that Plutarch also intended to contrast the Stoic aerial meteorology of celestial bodies, and oppose to it his preferred ‘stony’ alternative.

The problem remains that Plutarch does not seem to offer an explanation for the meteors’ flaming trail (but, again, I will return on this subject later)²¹⁸, and in the very few other places in his *corpus* in which he refers to shooting stars he dedicates no words to their alleged stony constitution, yet never openly contradicting his etiology. These references, always framed as second-hand reports, can be found in *Lucullus* —which K. Ziegler supposed, based on Plutarch’s self-citations, to have been composed, like *Lysander*, earlier than *Pericles*—, and in *Pompeius* and *Caesar* — which he instead supposed to be posterior to *Pericles*.²¹⁹ In the latter two, Plutarch reports of a portent allegedly witnessed by Caesar in the night (or morning) before he

²¹⁴ See below, p. 81-2.

²¹⁵ See e.g. DONINI 2011, 40–58.

²¹⁶ See above, p. 52 n. 197.

²¹⁷ See below, p. 57.

²¹⁸ See below, p. 81-3.

²¹⁹ See ZIEGLER [1951] 1965, 315.

fought the battle against Pompey at Pharsalus (9 August 48 BCE), which marked Pompey's final defeat and the beginning of Caesar's supremacy (notice the evident parallelism with the Spartans' victory at Aegospotami)²²⁰. In *Caes.* 43, Plutarch narrates that while «Caesar was making the round of his sentries about midnight, a torch of celestial fire (λαμπάς οὐρανόυ πυρός) was observed (ὠφθη), which seemed (ἔδοξε) to be carried over his camp in a bright and flamelike state (λαμπράν καὶ φλογώδη γενομένην), and then to fall (καταπεσεῖν) into Pompey's», and that «during the morning watch it was noticed that there was actually a panic confusion among the enemy» (5-6)²²¹. Although the reference to this confusion might be taken to imply that Caesar's army interpreted the meteor to have fallen in Pompey's camp as an aerolith, such an inference would not be confirmed by a reading of *Pomp.* 68, where the tumult is mentioned without direct association with the meteor (3), though immediately before its presentation: «furthermore, during the morning watch a great light (μέγα φῶς) shone out (ἐξέλαμψε) above the camp of Caesar, which was perfectly quiet, and a flamelike torch (λαμπάς... φλογοειδής) rose from it and darted down upon the camp of Pompey; Caesar himself says he saw (ιδεῖν) this as he was visiting the watches» (4)²²². No reference is made to the finding of a stone on the ground. Plutarch, here, merely acts as an informer on Caesar's own claim (despite it not appearing anywhere in his *BC*), but if he believed in the occurrence of such a celestial phenomenon, and maintained his 'stony' conception of shooting stars, it is likely he would suppose the stone to have fallen into the sea (as explained in *Lys.* 5), and that its distant trajectory simply intersected on the horizon with the sight of the much closer camp of Pompey. This, of course, is mere speculation: in the text, Plutarch is only explicit about a «light» and a «celestial fire», and never about a solid body. The meteor is consistently associated with actual fire, and in both the passages it is referred to as a *lampás* («torch»). This term is probably a variant of the technical *dālós* («firebrand») used by Aristotle to refer to a comet of a specific shape (see *Meteor.* I 4 341^B24-35), apparently referred to by the Stoics as *lampadiās* (see Diogenes Laertius, *VP* VII 152 = *SVF* 692, but also Pliny, *NH* II 90), and then listed as *lampás* (matching Plutarch's choice) in the Pseudo-Aristotelian *De mundo* (14 395^B12)²²³. Plutarch simply uses the appropriate term to refer to a specific kind of celestial phenomenon, and it is unlikely he meant to imply an analogical assimilation of the comet with a torch suggesting anything beyond a common shape (*e.g.* the common need for fuel akin to a wooden stick — surely not alluded to).

An analogy of the same kind is used by Plutarch in *Luc.* 8 in an explicit form, when he describes the sudden apparition of a meteor at Otrya (in Phrygia) between two armies on the verge of a battle: that led by Lucullus, and that led by Mithridates, with the addition of the just-arrived reinforcements brought by Marius (74 BCE). The battle does not begin, as the portent terrifies both armies, leading to Lucullus's decision to procrastinate

²²⁰ See my quotation of BRENK 1977, 187–88 above, p. 53 n. 200; in Brenk's monograph, see also p. 191, 205, and 211.

²²¹ Transl. based on PERRIN 1919, modified.

²²² Transl. PERRIN 1917, slightly modified.

²²³ I quote this passage below, p. 59 n. 225. On the *De mundo* I will return below, p. 82.

for insufficiency of provisions. The description of the meteor is prominent: «with no manifest change [of weather], but rather all of a sudden, the sky was cleft beneath (τοῦ ἀέρος ὑπορραγέντος) and a huge, flame-like body (σῶμα φλογοειδές) was seen (ὠφθη) moving down (καταφερόμενον) between the two armies. In shape (σχῆμα), it was most like a wine-jar (πίθος), and in colour, similar to incandescent silver (ἄργυρος διάπυρος)» (5)²²⁴. In these lines, the meteor, again presented as something which was “sighted” (ὠφθη, matching formally the ὠφθη in *Caes.* 43.5 and semantically the ἰδεῖν in *Pomp.* 68.4) rather than in absolute terms of occurrence (e.g. with γίνεσθαι), arguably, is here provided with the connotations of a solid body. It is not explicitly a “fire” as the *lampás* in *Caes.* and *Pomp.*, but only a σῶμα φλογοειδές, i.e. a «body resembling a flame»: while the adjective φλογοειδής was associated, already, with the meteor in *Pomp.* 68.4, and its synonym φλογώδης in *Caes.* 43.5 to signify a high degree of flaring luminosity (in *Caes.* increasing right before the passage over Caesar’s camp), it is here the only marker of a ‘fiery’ character of the meteor, thus completely framed in an analogy; the “incandescence” of silver, in fact, is simply evoked as *comparans* for the bright-orange look of the descending mass. The mass is depicted during its fall (notice the present tense of καταφερόμενον), and is not implied to reach the ground: if Plutarch believed it to be a stony body, again, he should have assumed it fell into the sea beyond the horizon, which implies that its descent «between the two armies» could only be observed from a panoramic point of view, allowing to see both armies at the opposite ends of a horizontal line. The term *píthos* used in the description of its shape will return in Pseudo-Aristotle’s *De mundo* (together with *lampás*, in 14 395^B13) as a technical term for a kind of meteor, later referred to by John Philoponus as *pithías* (in *Meteor.* p. 95.35 Hayduck)²²⁵. I will later mention that Plutarch manifested some disapproval towards meteorological explanations relying on the occurrence of «clefts» (ρήξεις) into the air²²⁶; his use in our passage of the verb ὑπορρηγνύειν (“cleave beneath”) in reference to «air» does not seem to contradict this disapproval, not only because it might be a mere *verbatim* quotation from Plutarch’s source, but also because it is a clear Homeric reminiscence of the formula οὐρανόθεν δ’ ἄρ’ ὑπερράγη ἄσπετος αἰθήρ («and from heaven immense aether was cleft beneath»), occurring two times in *Ilias* (VIII 558 and XVI 300) to describe thunderstorms started by Zeus. If the Homeric allusion were not intended, it would be hard to justify the prefix ὑπο-²²⁷. Plutarch wanted this description of the meteor to be more astonishing and entertaining than scientific,

²²⁴ Transl. based on PERRIN 1917, modified.

²²⁵ Cf. Scardigli in FUSCAGNI, SCARDIGLI, AND MUGELLI 1989, n. 102: «il termine *pytha* [*sic!*] significa botte (lat. *dolium*) e viene applicato a tutti gli oggetti simili alla botte [?] (come in Aristotele, *De mundo* 14: botti di fuoco, dette *pytheiai* [*sic!*])». Her paraphrasis of the line in *Mund.* 14 395^B13 is remarkably inaccurate: πολλὰ δὲ καὶ ἄλλαι φαντασμάτων ἰδέαι θεωροῦνται, λαμπάδες τε καλοῦμεναι καὶ δοκίδες καὶ πίθοι καὶ βόθωνοι, κατὰ τὴν πρὸς ταῦτα ὁμοιότητα ὧδε προσαγορευθεῖσαι.

²²⁶ See below, p. 83-4.

²²⁷ Cf. καταρραγέειν (“break downwards”) used for «winds» (πνεύματα) in *Def. orac.* 18 419^E, again in a context of meteorological portents, i.e. the omens that allegedly welcomed Demetrius as he landed in one of the sacred, almost-deserted islands of Britannia:

which makes it unsurprising that he gave no details on its physical explanation. It remains remarkable, though, that in none of the expressions used is a ‘fiery’ constitution literally associated with the meteor, which might thus be still perceived by Plutarch as a ‘stony’ meteorite.

3.2 Stone masonry

Moving, now, to artificial objects, stone is obviously much used in craftsmanship, not only because of its hardness, weight and affordability²²⁸, but also because of its durability. As Plutarch writes in *Aet. Rom.* 37, «those who first erected a trophy of stone (λίθινον) or of bronze [do not] stand in good repute» among the Greeks, because «time makes dim the memorials of dissension with enemies», so that it is «invidious and malicious» not to let them fade away with it (273^D)²²⁹. The substitution of trophies of stone for the previously used «impromptu suit of armour, set on a stake»²³⁰ was clearly instrumental in making the trophies more resistant to time’s consuming action²³¹. It is surely for qualities such as this, then, as is also true in other crafts, that stone must be selected, and definitely not for some extrinsic values: according to Lamprias, the οἰκοδόμος (“builder”), «does not value Attic or Laconian stone more highly because of its noble origin (εὐγένεια) than he does foreign (βαρβαρικός) stone», and so in a symposium, analogously, «it is not prestige (τὸ ἔνδοξον), but pleasantness (τὸ ἡδὺ) that must determine the placing of guests; it is not the rank (ἄξια) of each that must be considered, but the affinity (σχέσις) and suitability (ἄρμονία) of each to each, as is done when other things are associated for a common purpose» (*QConv.* I 2.5 618^A)²³². Commentators, after Abramowiczówna, tend to assume that Lamprias refers here to types of marble, but he might as well refer to any other kind of stone, since he only uses the toponyms «Attic» and «Laconian» to exemplify two of the most famous and praised

«shortly after his arrival there occurred a great confusion (σύγχυσις) in the air (περὶ τὸν ἀέρα) and many portents (διοσημῖαι); violent winds suddenly broke down (καταρραγέναι) and flashing hurricanes (πρηστῆρες) fell (πεσεῖν) to earth. When these abated, the people of the island said that the passing of someone of the mightier [souls] (*scil.* demons) had befallen» (transl. BABBITT 1936B, slightly modified). Naturally, it is not Plutarch speaking in this passage, and the context of supernatural reports requires a rhetoric of mystification rather than of physical accuracy. For recent commentary on this passage and on its context see SIMONETTI 2017, 68–69; see also BRENK 1977, 96–97: «these stories are somewhat inconsequential, even if interesting. Moreover, they are difficult to reconcile with Plutarch’s eschatological myths. [...] It is hard to believe that Plutarch is doing anything but spoofing here».

²²⁸ See how their use for the stabilization of colossi is presented by Plutarch in *Ad princ. ind.* 2 779^F-780^A, as discussed above, p. 15-6.

²²⁹ Transl. BABBITT 1936A, with slight adjustments.

²³⁰ BABBITT 1936A, n. a *ad loc.*

²³¹ According to BABBITT 1936A, n. a *ad loc.*, who cites Cicero, *Inv.* II 69 and Diodorus Siculus XIII 24.5-6, this was done by the Boeotians after their victory at Leuctra. BOULOGNE 2002, n. 195 adds a few details: he argues that Plutarch probably avoided an explicit mention of the Boeotian «par égard pour ses compatriotes, mais plus encore parce qu’existait déjà à la fin du V^e siècle l’habitude d’élever dans le sanctuaire de Delphes des monuments commémorant des guerres fratricides entre Grecs» (with reference to *Pyth.* 15 401^{C-D}). On the erection of trophies in bronze and stone he also states (n. 193) that «cette pratique [...] est sans doute liée à des croyances magiques, la dégradation du trophée s’accompagnant dans l’esprits d’une diminution de la puissance ennemie», but he provides no proof for this interpretation, which is arguably non-trivial.

²³² Transl. Clement in CLEMENT AND HOFFLEIT 1969 (with a slight adjustment). Cf. *Lun.* 13 927^B.

regions of Greece, rather than to point at their geo-mineralogical peculiarities²³³. It is true that in Plutarch's *corpus* the term *mármaros* is never used to refer to marble works²³⁴, rather always referred to by the generic word λίθος (including the Pentelic marble of the Parthenon, which I will also mention below), but in absence of specific textual qualifiers or of any archaeological or geological evidence it is always safer not to assume the composition of the mentioned λίθοι²³⁵. After all, the Greek οἰκοδόμος certainly did not choose only marble for his constructions, and a passage in *Profect.* remarks emblematically that «to those who build (οἰκοδομοῦσιν) some boundary wall (αἰμασία) and cornice (θριγκόν) it makes no difference whether they throw into the foundation a chance piece of timber or any ordinary stone (λίθος χυδαῖος) or set below it a slab (στήλη) that fell from a tomb» (17 85^F). This is certainly an example of a hasty kind of construction²³⁶, as opposed to a harmonic association of affine materials for a pleasant result (such as that in *QConv.* I 2.5), but it does attest that a variety of stones were used by *oikodómoi* for different ends, rather than only marble²³⁷.

The proper term for an artisan working on stone is λιθοζῶος, meaning “stonemason” or more literally “that who scrapes stones”. The literal sense is based on one of the stonemasons' primary activities and is probably still active in Plutarch's understanding of the word: in fact, in an artisanal analogy in *Adul.* he describes λιθοζῶοι in the act of «smoothing (ἐπιλεαίνοντες) the previously smitten and rough-hewn parts of the sculptures (ἀγάλματα) and making them bright (γανοῦντες)» (37 74^E), giving us a synthetic overview of the sculpting process of stones, which clearly included a scraping phase²³⁸.

²³³ ABRAMOWICZOWNA 1960, n. *ad loc.* Cf. FUHRMANN 1972, n. 1 *ad loc.*: «en Attique se trouvaient surtout les beaux marbres de l'Hymette et du Pentélique. Ceux de Laconie étaient généralement noirs; les plus renommés d'entre eux venaient des carrières du Ténare»; SCARCELLA 1998, n. 164.

²³⁴ Note that the meaning of the term μάρμαρος, originally, was not restricted to marble, but referred more generally to shiny stones (especially white): see e.g. BLÜMNER 1884, 26; CHANTRAINE, s.v. ‘μάρμαρος’. The Latin *marmor* is a calque from the Greek. On Plutarch's references to *mármaros* see below, sec. 7.1.

²³⁵ This also applies to the term λίθος opening the generic list of materials in *Per.* 12.6, used for the great constructions and works promoted by Pericles during his rule. Compare with the reference to λίθοι Θάσιοι («Thasian stones») in *CMi.* 11.3. Here, the toponymic may allow us to identify such stones as marble: as indicated in the IGME map uploaded on <https://www.orykta.gr/oryktes-protos-yles-tis-ellados/26-latomika-orykta/marmara> (last accessed May 15, 2022), in fact, the island hosts multiple quarries of white and greywhite marble, still exported in present days. For an ancient source on this stone see e.g. Pliny, *NH* XXXVI 5. See also *Publ.* 15.4 on columns made from Pentelic λίθος, i.e. from marble quarried at mount Pentelicus near Athens.

²³⁶ Philippon in KLAERR, PHILIPPON, AND SIRINELLI 1989, n. 4 *ad loc.* compares this passage with Thucydides, *Hist.* I 93.2, in which the Athenians are described to build in a hurry the foundations for their city boundaries, also employing «many slabs (στήλαι) from tombs». Cf. also *Nic.* 19.8, where the Syracusans, in war with the Athenians, are described to build a wall «with the stones and timber that they (*scil.* the Athenians) had brought to the place (προσεκόμιζον)».

²³⁷ On stone walls cf. *Laud.* 12 543^B, where Demosthenes is quoted, from *Cor.* 299: «not with stone (λίθοις) did I encircle Athens nor with brick; survey the wall I build and you will discover arms, cavalry, and allies» (transl. DE LACY AND EINARSON 1959). See also Teleclides's verses quoted in *Per.* 16.2 (= Fr. 42 Edmonds).

²³⁸ On scraping see below, sec. 8.2. In *CMi.* 11.3, commented on above, n. 235, a stone monument is explicitly presented as ξεστόν («smoothed»); in *TG et CG* 28.1, a road is described to be paved in «smoothed rock» (πέτρα ξεστή). In *Op.* 746, Hesiod uses the adjective ἀνεπίξεστος («unsmoothed») to refer metonymically to an «unfinished» house; Plutarch comments on this verse in Fr. 94

Stonemasons are also mentioned in their role as sculptors in *Superst.*, among other kinds of craftsmen who make anthropomorphic statues of gods, thereby inspiring a most superficial piety in the superstitious²³⁹. Passages in which they appear instead as housebuilders, however, are not lacking. In *Symp.*, when Aesop mocks Anacharsis due to his vagrancy and substitution of a stable home with a simple cart, he is rebuked by the latter for his superficial understanding of the concept of home: «but you go about,» Anacharsis tells Aesop, «inspecting the works of carpenters (τέκτονες) and stonemasons (λιθοζόοι), and regarding them as a home (οἶκον), and not the inward and personal (οἰκειᾶ) possessions of each man, his children, his partner in marriage», etc. (12 155^{B-C})²⁴⁰. On specific stonemasons' techniques, in addition to the practice of burying stones which I will discuss later²⁴¹, we can already learn from a proverb quoted in *Profect.* that they used to work with a plummet: «adjust the stone (πέτρος) to fit the line (στάθμη), and not the line to fit the stone» (2 75^F)²⁴², as Plutarch instructs his readers in metaphorical terms. The σταθμή was properly the plumb line, *i.e.* a red thread with a leaden weight that carpenters and builders used when they needed a vertical reference line for their works²⁴³.

In Plutarch's *corpus*, in addition to the ones I have already shown, there are a few other references to different kinds of stonework. In architecture, we also find that stone is used for pillars (but possibly hermae, κίονες)²⁴⁴, for bridges²⁴⁵, and for the construction of the «*hekatómpedon* temple» (also known as Parthenon)²⁴⁶. In sculpture, besides the other references to statues of gods (to which people frequently refer to, metonymically, by the sole names of the gods they represent)²⁴⁷, we also find stone used for votive or general

Sandbach. In *Publ.* 15.4, an unrequired recut and smoothing has negative consequences on the beauty on some already proportionate columns in Pentelic marble (see above, p. 61 n. 235), which Plutarch saw in person: «but when they were recut (πληγέντες) and smoothed again (ἀναξέσθηντες) at Rome, they did not gain as much in fineness (γλαφυρία) as they lost in symmetry and beauty, and they now look too slender and thin» (transl. PERRIN 1914, slightly modified).

²³⁹ On the polemic against plastic and general anthropomorphism see LOZZA 1980, n. *ad loc.* and LAURENTI AND SANTANIELLO 2007, n. 75, with abundancy of references to passages in and outside Plutarch's *corpus*.

²⁴⁰ Transl. BABBITT 1928. For a similar disambiguation of οἶκος/οἰκία see *Aud. poet.* 6 22^{D-E}.

²⁴¹ See below, sec. 4.

²⁴² Transl. BABBITT 1928. The proverb is in *Paroem. Gr.* II, [Arsenius], 14.88a, p. 625 Leutsch (= Epicharmus, *PCG* I 261 Kassel-Austin).

²⁴³ See VALGIGLIO 1982, n. 29 *ad loc.*

²⁴⁴ See *Sanit.* 20 133^D, in a quote from Aristo, either the one from Chios or that from Ceos: on his identity see Klaerr in DEFRAZAS, HANI, AND KLAERR 1985, n. 7 *ad loc.* and SENZASONO 1992, n. 45. The term κίων is indeed ambiguous and after Klaerr it is normally understood to refer to hermae.

²⁴⁵ See *Nu.* 9.6.

²⁴⁶ See *Sollert.* 13 970^A. The Parthenon's construction was commissioned by Pericles in 447 BCE and completed in 432 (MAGINI 2001, n. 146). The adjective *hekatómpedon*, as explained by BOUFFARTIGUE 2012, n. 165, means “long a hundred feet”, and Plutarch uses it to refer to the Parthenon also in *CMA.* 5.3 and *Glor. Ath.* 7 349^D. Cf. *Per.* 13.7.

²⁴⁷ See *Isid.* 71 379^C: «there are some among the Greeks who have not learned nor habituated themselves to speak of the bronze, the painted, and the stone (λίθινα) [effigies] as statues (ἀγάλματα) of the gods and dedications (τιμαί) in their honour, but they call them gods» etc. (transl. BABBITT 1936B, square brackets mine). See also *Isid.* 76 382^{B-C}: «wherefore the Divine is no worse represented in these animals than in works of bronze and stone (χαλκὰ καὶ λίθινα δημιουργήματα) which are alike subject to destruction and disfiguration, and by their nature are void of all perception and comprehension» (transl. Babbitt).

sculptures (ἀγαλματα not further specified, if not for their artistic quality)²⁴⁸, for colossi²⁴⁹, and for statues of men (ἀνδριάντες). A quite interesting event featuring a stone ἀνδριάς is reported by Philinus in *Pyth.* 8: it is surely amazing that «the stone statue of Lysander [...] put forth a growth of wild shrubs and grass in such abundance as to cover up the face» (397^F)²⁵⁰ just before the Spartans were defeated at Leuctra (371 BCE)²⁵¹, so much that it is very hard to think of the phenomenon as a coincidence; it is more reasonably explained by reference to the divine force to which even the apparently «empty» and «insensible» (ἀναίσθητα) bodies are again proven to be receptive (398^{A-C})²⁵². In sculpture, stone is also explicitly used for anthropomorphic figurines (ἀνδριαντίσκοι)²⁵³, small statues of animals²⁵⁴, statues' pedestals (lit. κίονες, “pillars”)²⁵⁵, inscribed hermae²⁵⁶, cinerary urns (σοροί)²⁵⁷, and seats (ἔδραι)²⁵⁸.

Finally, Plutarch's *corpus* also includes some evidence on the economy of stonemasonry. It is possible to find passing references to stone quarries (λατομῖαι, from λατόμος, literally meaning “stone cutter”) — specifically, to the Latomiae which in Syracuse were repurposed as a prison²⁵⁹— but the interesting information concerns stone transport. In *Sollert.*, Aristotimus speaks of stones brought «every day» to the *hekatómpedon*'s construction site by «many yokes of beasts» (πολλὰ ζεύγη) up from the Ceramicus, and focuses his attention on one of these «mules» (ὄρεῖς). Although exempted from the transportation due to its age, it nonetheless trotted along with the other beasts —which were evidently fatigued by their burdens— as if to encourage them (13 970^{A-B}). Another information is contained in a short glimpse at Plutarch's own biography passingly inserted by him in *Praec.* 15, where after writing that he may look ridiculous to foreign visitors when he is busy with a humble activity as part of a public service, he reports the defense he uses in such cases: «I [...] say to those who accuse me, if I attend to the measuring of a tile and the transport of

²⁴⁸ See *An. procr.* 33 1029^F, on which I commented above, p. 30 n. 101.

²⁴⁹ See *Ad princ. ind.* 2 779^F-780^A, already discussed above, p. 15-6 with n. 43.

²⁵⁰ Transl. Babbitt

²⁵¹ Philinus does not specify the moment in which the *mirabile* occurred, but it is easily inferred from the context, since it is mentioned just after two other omens: that of the disappearance of the stars dedicated by Lysander (at Delphi) in gratitude for his victory at Aegospotami in 405 BCE (something which happened before the battle of Leuctra, as Plutarch writes in *Lys.* 18.1), and that of the eyes falling from the statue of Hiero «before the death which came to him in Leuctra» (397^F). The link between the sprouting of the statue and the Spartans' defeat in Aegospotami is explicit in Cicero, *Div.* I 75. Lysander's «stone statue», which was part of the treasury of the Acanthians at Delphi, is described in *Lys.* 1.1. For another omen surrounding Lysander's enterprises cf. *Lys.* 12.1.

²⁵² Cf. *An. procr.* 33 1029^F for the stones' κωφότης (“numbness” or “insensibility”), as discussed above, p. 30 n. 101. For a similar portent see *Caes.* 47.1-2, in which a palm tree is described to shoot up through the stone paving below a statue. For akin miracles of sweating and talking statues see especially *Cor.* 37.3-38 and *Cam.* 6.4-6, on which see BRENK 1977, 28-48; MEEUSEN 2017b, 92-94. For stones involved in other supernatural occurrences, unrelated to stone masonry, see *Rom.* 28.7 and *TG et CG* 17.4-7.

²⁵³ See *Demosth.* 19.3.

²⁵⁴ See *Cic.* 26.11.

²⁵⁵ See *Aem.* 28.4 («from white stones», ἐκ λίθων λευκῶν).

²⁵⁶ See *Cim.* 7.4-5.

²⁵⁷ See *Nu.* 22.2.

²⁵⁸ See *Alex.* 7.4. Of course, also normal, unworked stones may be used as seats, as in *FM* 16.6.

²⁵⁹ See *Nic.* 28.2 and 29.1; *Di.* 35.5.

cements and stones, that it is not for myself that I am constructing these buildings (οικοδομῶν), but for my homeland (πατρις)» (811^C). It was clearly considered shameful and embarrassing for a distinguished man to take part in handicraft activities, but it was honourable to coordinate them, as Plutarch's reply shows²⁶⁰; we see here that housebuilding in stone (and in ceramic tiles) was among the public services that could attract a rich citizen's funding and supervising effort.

²⁶⁰ Plutarch shows here no “feinte modestie”, as is supposed by Carrière in CARRIÈRE AND CUVIGNY 1984, n. 3 *ad loc.*; on the nobility of public services see *ib.* (with an extensive list of references on the subject) and CAIAZZA 2001, n. 217: both scholars also point to *Praec.* 25 819^A, where Plutarch refers to a few instances of public commitments he disdains.

4. Warm burials for stubborn stones

We can take the cue from an appeal to the authority of stonemasonry made by Plutarch's character in *QConv.* VII 2.3 to concentrate again on stone 'thermodynamics'²⁶¹. Plutarch himself has already taught us not only that stones are effective in reflecting cold due to their density, but also that they are naturally cold—the denser, the colder, so much to be considered *págoi* of frozen earth—and may thus be able to refrigerate surrounding waters on their own²⁶²; we have also learned that the earth's petrification occurs when all the heat has been expelled and all the moist solidified, and that this happens at its highest degree in the depths of earth, where freezing cold is most intense²⁶³. Given these premises, it would not be unreasonable for us to be surprised at some of Plutarch's statements in this *quaestio*. Here he proposes, as a solution to the problem why the seed hitting the horns of cattle (the so-called *kerasbóla*, "horn-struck") allegedly become *aterámona* («unyielding» to coction), that this occurs because the seed are hardened by the cold instead of being kept softer by the soil²⁶⁴: since, after hitting the horns, they fall onto the soil at a bad angle rather than being properly sown, they remain unprotected from cold weather (αἰ ψυχρότητες), which subsequently either destroys them or makes them «hard to liquefy (δύστηκτα), tasteless (ἄχυμα) and woody (ξυλώδη)». Plutarch begins justifying this view through an analogy with the mineral world, which is in turn supported by a reference to a stonemasonry technique, apparently not attested elsewhere²⁶⁵ (701^{B-C}):

ὁρᾶς γὰρ ὅτι καὶ τῶν λίθων τὰ ἔργα καὶ ζώφυτα²⁶⁶ μέρη μαλακώτερα τῶν ἐπιπολῆς ἢ ἀλέα φυλάττει· διὸ καὶ κατορύττουσιν οἱ τεχνῖται τοὺς ἐργασίμους λίθους, ὥσπερ ἐκπεπαινομένους ὑπὸ τῆς θερμότητος· οἱ δ' ὑπαιθροὶ καὶ γυμνοὶ διὰ ψῦχος ἀντίτυποι καὶ δυσμετάβλητοι καὶ ἀτεράμονες ἀπαντῶσι τοῖς ἔργοις.

²⁶¹ There may be some doubt on which character actually proposed the explanation, since the indication of its speaker (ἔφην, 701^A) is part of a *locus vexatus*, as shown by TEODORSSON 1989c, n. *ad loc.* and Ingenkamp in INGENKAMP AND BERNARDAKIS 2011. Florus is mentioned at the beginning of the passage, and it cannot be excluded that the text became so corrupt as to deform the speaker's indication from a reference to Florus to the narrator (*i.e.* Plutarch himself). Sirinelli in FRAZIER AND SIRINELLI 1996, n. 47 seems to believe that Florus is here the speaking character («on peut apprécier la pensée de Florus [...]»), but this was probably just a slip of the pen, since he maintains the reading ἔφην in his printed beginning lines of the speech.

²⁶² *QConv.* VI 5, 691^B, discussed above, p. 37-40.

²⁶³ *Ib.*, and *Frig.* 19 953^{E-F}, discussed above, p. 40-2.

²⁶⁴ Cf. Fr. 104 Sandbach.

²⁶⁵ See TEODORSSON 1989c, n. to 701^C. He stresses that the information is not included in Theophrastus's *CP*, whose passage in IV 12.9-12 seems to be Plutarch's source of inspiration for the proposed solution (see *ib.*, p. 43, n. to 701^B and Sirinelli in FRAZIER AND SIRINELLI 1996, n. 42). Theophrastus's passage corresponds with one of his answers to the question «on seed, how are the *terámona* and *aterámona* generated?» (12.1). Shortly after proposing this solution, he also precedes Plutarch in mentioning the popular belief in *kerasbóla*, but only to dismiss it as «too simple-minded» (ἄγαν ἐηθεές) and refute it (12.13).

²⁶⁶ The variant reading ζώφυτα is the one transmitted in all manuscripts but one, and is preferred by Minar in MINAR, SANDBACH, AND HELMBOLD 1961, TEODORSSON 1989c, n. *ad loc.*, Sirinelli in FRAZIER AND SIRINELLI 1996, and Montalbano in LELLI, PISANI, ET AL. 2017 (clear from her translation, which does not correspond to the printed text). As reported by Ingenkamp in INGENKAMP AND BERNARDAKIS 2011, this is substituted in ms. g (Palat. (Vat.) *Gr.* 170, XV cent.) with ζωόφυτα, which is the one printed by

In fact, you see that also in stones the heating keeps the parts that are underground and ‘life-bearing’ (or ‘living plants’)²⁴⁵ softer than the superficial, which is also why the technicians bury the stones that are to be worked, as if they were ripened by the heat: those, instead, that lie naked under the sky, reveal themselves to be, because of cold, resistant, not easily transformed, and unyielding in stonework.

Although this passage raises a few issues, at least the connection between cold and hardness fits well with the one we are already acquainted with between stone’s density and its coldness. What might strike us as odd, however, is the fact that the cooling effect is not associated with earth’s underground, whose depths are regarded in *Frig.* 19 (953^{E-F}) to be extremely cold, but with the (airy) atmospheric conditions²⁶⁷: while in *Frig.* the coldness seems to increase proportionally with earth’s distance from aether (which is a source of heat), in this *quaestio*, almost paradoxically, what is most exposed to hardening cold is ὑπαιθρος, and the underground, in contrast, seems to actively provide ἀλέα to buried stones. If we look more closely, though, the contradictions prove to be only apparent. The reason is that in the underground the presence of the other elements gets progressively scarcer as the earth’s proximity to the center is increased, making earth in the far depths considerably purer than the one composing the soil, but this soil is precisely what technicians dig into in order to bury their stones: this means that the respective undergrounds of the two passages are non-comparable. In the very same *Frig.*, indeed, not long after the passage on πάγοι, Plutarch defends his ‘earthy’ position on what is primarily cold by retorting to «those who think that they (can) feel (αἰσθάνεσθαι) cold air and water, but not so much cold earth» that this way they are only considering «the earth that is closest (ἡ ἔγγιστα γῆ), which has become a kneaded mixture (σύμμιγμα καὶ συμφόρημα) full with airs, water, sun, and heat», rather than the earth in the depths, *i.e.* «what one would specially consider (to be) earth, all by itself (αὐτὴ καθ’αὐτῆς)

WYTTENBACH 1797C and normalized by BERNARDAKIS 1892 (ζώφνυτα). Wytttenbach explains it as a popular late form («vulgo») of ζώφνυτα, and in his index to the *Moralia* lists it as ζώφνυτος (WYTTENBACH [1830] 1962, *s.v.*). In fact, the variant in ζώφ- is coherent with the general oscillation that is found in the manuscript tradition —of also other texts— between alternative spellings of the botanical-zoological noun ζωόφνυτον, which according to FERRINI 2019, 415, n. 1 (I found the passage that she cites as proof in CHANTRAINE, *s.v.* ζώω to be actually not pertinent to her information) was also written as ζωο-, ζω-, or ζω-. This has a different meaning from the adjective ζώφνυτος, since it designates a taxonomical middle-ground between the biological categories of “animal” and “plant”, an “animal-plant” to which the modern and early-contemporary naturalists will still refer to as “zoophyte”. The story of the term and concept is reconstructed in detail by Ferrini. According to her exam of the sources, this technical use of the term would only spring in later Greek (ca. IV cent. CE), and probably in the context of the commentaries to (or philosophical reflection on) the Aristotelian *corpus*. This is strong evidence in favour of an original ζώφνυτα in the *quaestio*’s text, especially considering —as I will show below— that Plutarch himself uses the adjective, clearly with the meaning of “life-bearing”, in another passage. This meaning might have been forgotten by some of the later copyists, who, maybe, would more easily recognize a spelling variant of the almost-homonym biological *taxon*. Other editors have opted for conjectures in the place of ζώφνυτα: see below, p. 69 n. 276.

²⁶⁷ See, a few lines below in the same passage, πνεῦμα [...] διὰ τὸ ψύχος. The reference to wind and air is also present (and repeated more than once) in the probable Theophrastean source in *CP* IV 12.9-12 (see above, p. 65 n. 265). On air’s cooling effect cf. *e.g.* above, p. 27-8 (affecting water, *QConv.* VI 5 690^F-691^A).

and separated by the others (ἀποκεκριμένη τῶν ἄλλων)» (21 955^A). The dug soil protecting stones from cold, as we can see, is therefore not composed of only earth. Furthermore, going back to our *quaestio*, the farmable soil is also (and unsurprisingly) regarded by Plutarch's character to have a certain share of moisture, because he states, shortly before the mineral analogy, that seeds which are properly sown, penetrating deeply, «benefit more from the heat and moisture inside the earth» (*QConv.* VII 2.3 701^B). It is clear enough that the farmable soil of our *quaestio*, both on surface and on the inside, is quite different from the underground of *Frig.*, so it can indeed provide some heating to the seeds and stones it hosts, and it can as well be warmer than the air blowing above it (especially in case of the mentioned seed-destroying ψυχρότητες). The stonemasons' practice of burying stones is thus explained this way.

Other trouble, in this passage, might come from its use of the adjectives *zōphutos* and *aterámōn* as both referred to stones. The latter, which I have already mentioned above as meaning “unyielding” or “tough”, is part, together with *kerasbólos* (“hornstruck”), of the *quaestio*'s specific object of investigation, and is introduced in its very first lines (*QConv.* VII 2.1 700^C) as a quotation from Plato. The allusion is to *Leg.* IX 853^{C-D}, where *kerasbólos* is used analogically and *aterámōn* metaphorically to refer to a stubborn citizen who would not follow the laws. Plato himself clarifies his image by adding an explicit reference to seed cooking: the “hornstruck”-like individual he refers to «would be born as naturally *aterámōn* to such a point that he would not bend (lit. liquefy, τήκεσθαι); just as those seeds [become not liquefiable] by fire, so these people would be born not bendable (ἄτηκτοι) by laws, even if these were as strong [as fire]». It is evident that *aterámōn* is used in a sense that would not be captured by the alternative *σκληρός*, referring to a specific seeds' resistance to cooking²⁶⁸. This is the way Theophrastus normally uses the term in *CP* (i.e. the probable source of inspiration for Plutarch's solution to his *quaestio*)²⁶⁹ and *HP*, specifying in the latter that «the terms *terámōn* and *aterámōn* are only applied to legumes (ὄσπρια)», and that «something similar or identical might also happen to cereals (σιτῶδη)» (VIII 8.6)²⁷⁰. From this, we can infer that the seed Plato referred to were probably

²⁶⁸ Another possible interpretation is that Plato did not use the adjective *aterámōn* metaphorically, but only activated both its meanings at the same time (“stubborn” and “unyielding to coction” are both attested before Plato), building the analogy (be it ornamental or persuasive) on this semantic ambiguity. Cf. below, n. 270.

²⁶⁹ See above, p. 66 n. 265.

²⁷⁰ As reported by LSJ, s.v., Theophrastus actually used *τεράμων* for «a soil fit for such plants» too (as in *CP* IV 12.3). It seems that *τεράμων* also had a substantive homonym with the meaning of “reed” (it was paraphrased as *κάλαμον* in the IV-V cent. CE by Theodosius, *Can.* 21.13, with reference to Anacreon, = Fr. S314 Page and 505A Campbell, and Plato, *Soph.* 221^A, for which our manuscripts transmitted *καλάμοις* instead). Its antonym *ἀτεράμων* is a variant of *ἀτέραμνος*, whose earliest occurrences, as reported by LSJ, s.v., carry the possibly metaphorical (or, alternatively, original) sense of «stubborn, unfeeling, merciless» (e.g. in Homer, *Od.* XXIII 167), and mostly appearing later, as it seems, with the meaning of «unyielding to coction» (e.g. Hippocrates, *Aër.* IV.8, of constipated *κοιλία*; Aristotle, *GA* IV 2 767^A32-35, of water as a part of nourishment). Only Theocritus, in poetry, seems to have predated Plutarch in referring it to *πέτραι*, clearly in the sense of “steady” or “hard” (X 7; see below, p. 68 n. 272). It is interesting to note that in the I cent. CE Erotianus, s.v., defines *ἀτεράμωνι* (as a Hippocratic term) as *δυσμετάβλητοι*, “hard to transform” (i.e. “digest”;

pulses²⁷¹. All these things considered, we might be surprised to see Plutarch use such a specific, technical term in reference to stones, because there is no reason to suppose that these had to be cooked and liquefied while worked for their destined ἔργα: they are not to be intended, we can safely assume, as «uncookable to stonework». Plutarch, then, probably uses the term as a metaphorical substitute of σκληρός, based on the actual correlation he believes to exist between the seeds' resistance to fire and the hardness of their texture, which we have seen underlying the entire *quaestio*'s solution through its reference to heat and softness. He probably uses this agricultural and culinary metaphor to increase the level of perceived pertinence of the mineral analogy towards the botanical *explanandum*, while also implying that the stones' hardness should be regarded as an analogue of the seeds' "stubbornness"²⁷².

Our explanation, now, to why Plutarch uses for stones the term *ζόφυτος*, meaning "life-bearing" or (in the neuter plural, as in our passage) "living plant", can be very similar to the one we have just given for *ατεράμων*, since this word too is quite specific to 'biology' and agriculture. The term is very rarely attested in Greek literature, and its pre-Plutarchan attestations are only two: one in Aeschylus's *Suppl.* (855-7, of human blood that is made to «flourish», θάλλειν, by water)²⁷³ and one in a fragment of the lyrical poet Philicus (680.53 *SH*, of «the only *ζόφυτα* of the barren earth», *i.e.* sprung plants). We can also find three attestations of its cognate verb *ζόφυτεῖν* (LSJ: "put forth live shoots") as early as in the two centuries preceding Plutarch, as it appears, in the botanical sense, in both Apollodorus of Artemida (Fr. 7.9 Müller = Athenaeus, *Deipn.* XV.29 682^D, of germinating branches) and Philo of Alexandria (*Spec.* IV 217, of the *pneûma* in a thriving earth, and II 169,

but he also mentions the adjective in his definition of σφιγνός, "dense", as part of a quotation from Aristophanes, *Ach.* 180-1, where various metaphors for «tough» —the term is actually σπιπτοί— and «ruthless» veterans of Marathon follow one another in quick succession): notice the correspondence with the δυσμετάβλητοι of Plutarch's text. Both the words *τεράμων* and *ατέραμος* might be etymological relatives of the early adjective *τέρην* ("tender", "soft"), on which see CHANTRAINE, *s.v.* *τέρην*, *τεράμων*, *τέρυς*, but, even if this is the case, I would argue that centuries before Plutarch's time their original, 'mechanical' meaning was already no longer (immediately) perceived. This meaning might perhaps have never been there: see Beekes, *s.v.* *ατέραμος* («it seems more natural to connect **terh2-* 'to overcome', as found in Hitt. *tarra-tta(ni)* 'to be able', Skt. *tirāte* 'to overcome'»).

²⁷¹ See TEODORSSON 1989c, n. to 700^C: «*ατεράμων* is used above all of hard seeds of pulse that cannot be cooked [...]».

²⁷² Cf. Theocritus's use of the adjective in X 7 (see above, p. 67-8 n. 270). Plutarch might have taken inspiration from him (it is not impossible that Plutarch had read or listened to the tenth Theocritean idyll, since he seems to have quoted the first, 105-7, in *Aet. phys.* 36). A possible explanation for Theocritus' coupling of the adjective with *πέτραι* is that he still understood it, like the earlier poets, with the meaning of "stubborn", and that he implicitly personified the stones as something "not surrendering" to pressure or blows. This could hardly be said of Plutarch too, since he writes at the beginning of the *quaestio* that Plato, in referring the adjective to stubborn people, used it ἐκ μεταφορᾶς (*QConv.* VII 2.1 700C), signalling that he did not regard the 'behavioural' meaning of the term to be as immediate and intuitive as the 'biological'.

²⁷³ The term *ζόφυτος* is here commonly interpreted (as in LSJ) to mean "life-giving", possibly in the sense of its "fecundity", since blood was perhaps already believed by Aeschylus (as later by Diogenes of Apollonia and Aristotle) to be the humour from which semen originated (see SOMMERSTEIN [1956] 2009, n. *ad loc.*), but it is also possible that Aeschylus just meant to allude at the fact that blood keeps alive the humans in which it flows. In any case, there could be another layer of semantic complexity to this use of the adjective, since the botanical metaphor of θάλλω, although widely lexicalized in its reference to any growth or prosperity, may suggest that *ζόφυτος* was already also understood by Aeschylus in its passive sense (*i.e.* "something that is made to spring" from earth, said of plants).

of earth²⁷⁴). After these authors, Plutarch does use the adjective *zōphutos* in another passage, namely in *Rom.* 20, and there it is unambiguously referred to a fertile earth: «the head of the spear sank deep into the ground, and no one had strength to pull it up, though many tried, but the earth, which was fertile (ἡ γῆ ζώφυτος οὔσα), cherished the wooden shaft, and sent up shoots from it (βλαστούς ἀνήκε), and produced a cornel-trunk of good size» (6)²⁷⁵. The basic meaning of the word is clear enough. Now, going back to its puzzling appearance in the *quaestio*, its interpretation in the context has puzzled scholars so much that, although most editors remain faithful to the transmitted text, some have even proposed conjectures, although lacking in philological grounding and consisting in terms that would be otherwise unattested in Greek literature²⁷⁶. Translators show a certain variety in their interpretations, but generally opt for a literal understanding of the term²⁷⁷. Let us start with Teodorsson's: although he writes that «Plutarch uses the term metaphorically», we can actually consider him to be the proponent of the most literal interpretation of *zōphutos* (which he translates as “fertilizing”). In his opinion, in fact, stones are presented «as fostering fertility because they are moist and rather soft, so that insects and roots of plants thrive beneath them»²⁷⁸, and we can argue that providing an ideal place for insects and roots to thrive in can qualify as a central feature of a ‘fertile’ object²⁷⁹. The problem with Teodorsson's interpretation is that it remains unclear why this should be a specific feature of buried stones²⁸⁰, since we can easily experience in everyday life that also stones on surface do often host a multitude of plants and bugs beneath as well as above them. Maintaining a literal understanding of the word in the sense of “fertilizing”, we might instead advance as a hypothesis that Plutarch meant to refer to a kind of stones which were used in agriculture to increase the soils' fertility by being buried in them²⁸¹. In particularly dry soils, indeed, plants such as vines might not be able to grow without the application of a technique able to raise their moisture: an ancient form of such technique, called “lithic mulching” and spread in many areas including the Mediterranean Near East, consisted in covering the soil with an upper layer of stones, which «can increase soil moisture, reduce soil erosion, increase average soil temperature and moderate diurnal extremes», and therefore «increase

²⁷⁴ This latter passage is ambiguous: see below, p. 71-2 n. 293.

²⁷⁵ Transl. PERRIN 1914.

²⁷⁶ Reiske proposed ζοφόδντα (maybe as a variant of ζοφώδης, “obscure”), accepted by Ingenkamp in INGENKAMP AND BERNARDAKIS 2011; HUBERT [1938] 1971, doubtfully, proposed ζοφόφυτα (“growing in darkness”), rejected as «cacophonous» by GULICK 1939. TEODORSSON 1989c, n. *ad loc.* probably mistaking ζόφος for ψόφος, rejected both conjectures because «the notion of ‘noise’ of course has no relevance in this context».

²⁷⁷ An exception is the translation by XYLANDER 1599, which is loose and indefensible (τῶν λίθων τὰ ἔγγαια καὶ ζώφυτα μέρη: «lapidum [...] et lignorum partes»).

²⁷⁸ TEODORSSON 1989c, n. *ad loc.*

²⁷⁹ Cf. *Cor.* 21.7, where the fertility of a soil is linked to the presence in it of «fatness» (λιπαρότης) and «putrefaction» (σηπεδών).

²⁸⁰ This might have also been particularly counter-intuitive to Plutarch: cf. Philo's association of infertility precisely with the “stoniness” and “hardness” of soils in *Spec.* II 169 (on which I comment below, p. 71-2 n. 293).

²⁸¹ I owe the following considerations to Noemi Borrelli, whom I thank for her insightful suggestions and for the bibliographic references.

crop biomass and crop yield»²⁸²; although such stones, differently from the *zōphutoi*, would be laid on the soil's surface rather than underneath it, Virgil, in *Georg.*, attests to the existence of a variant procedure which prescribed to bury them: «or bury with them (*scil.* with the planted cuttings, *virgulta*) moisture-drinking (*bibulus*) stone or rough shells; for the water will glide between, the air's searching breath will steal in, and the plants sown will take heart» (II 346-50)²⁸³; these verses were also quoted as authoritative by Columella in *Rust.* (III 15.4). If this connection is correct —and it does seem to be safer than its alternatives—, the term *zōphutos* is used by Plutarch in a technical sense of which our *quaestio* is the only survived testimony.

A quite different interpretation, but almost literal, comes from Sirinelli, who translates the term as “alive” («vives») and easily infers from its use in this context that «le monde mineral n'est pas exclu de la vie, mais il y participe plus ou moins et une pierre extraite n'est pas aussi vivante qu'une pierre encore engagée dans le sol»²⁸⁴. This inference, inasmuch as it is based on only one specific sense of the word *zōphutos*²⁸⁵, which might as well be used metaphorically, and refers to an idea that is unparalleled in Plutarch's *corpus*, is arguably too rushed and in need of further proof. This ‘biological’ manner of speaking, after all, is well attested in ancient mineralogy in a way that shows a certain consistency of metaphorical matrix —with terms such as *γενῶν* (“beget”), *κύνειν* (“conceive”), and *φύειν* (“be born and grow”) often used for mineral formations—, possibly (but not necessarily) suggesting an original animism on the miners' part, whether this was shared or not by the ancient naturalists²⁸⁶. This is also what allows us to imagine two other possible, and unattested, literal meanings of *zōphutos*, which could have stemmed originally from a metaphorical extension, then remaining for a very short-lived technical use. We might reconstruct them by taking inspiration from the well-attested geographical and mineralogical meanings of the word *διαφύη* (“growth between”, hence “interstice” or

²⁸² LIGHTFOOT 1996, 206.

²⁸³ Transl. Rushton Fairclough in RUSHTON FAIRCLOUGH AND GOULD 1916, slightly modified.

²⁸⁴ In FRAZIER AND SIRINELLI 1996, n. 47. This is repeated by FERRINI 2019, 415 n. 2, who connects the idea with the ancient beliefs in the magnet as a «pietra ‘animata’ per eccellenza» (although clearly not for Plutarch, as I show below, sec. 8.1) and with the biology of corals.

²⁸⁵ More specifically, I suppose, on an implicitly reconstructed original sense (*e.g.* “being kept alive”, from *ζῶω* and *φύομαι*) out of which the common use for “living plants” might have evolved; Sirinelli does not justify his translation at all. This allegedly original sense, as far as I know, would be unattested elsewhere in Greek literature.

²⁸⁶ On the subject see HALLEUX 1970, although his supposition of animism on the sole basis of this systematicity in metaphors is arguably too rushed: the terminology of biological generation lends itself quite easily to uses for non-biological processes leading to the formation of new entities and was certainly not specific to mineralogy (see *e.g.* Heraclitus, DK 22 B76 and B77; Parmenides, DK 28 B8.21 and 27); the verb *γίνεσθαι* (“originate” or “become”) was already used in a generic sense well before the examples reported by Halleux (as is clear in the dictionaries); and a good metaphorology should also try to take into account the different authors' lines of influence, avoiding to flatten the relevant *loci* as all equally representative of their culture (*e.g.* Halleux quotes Plinius many times, without ever considering the hypothesis that he might be imitating the terminology of his Greek direct or indirect sources, rather than representing the traditional, Latin, worldview). However, he is commendable in his conclusion, when he writes: «Tous les auteurs que j'ai cités croyaient-ils à la sexualité des pierres, à la croissance du métal dans la mine, au renouvellement des mines après jachère? Non certes. La plupart rapportent, sans y croire, des superstitions de mineurs. Ils emploient, sans y prendre garde, des expressions consacrées du langage des lapidaires». Compare with Sirinelli's treatment of Plutarch's passage.

“joint”)²⁸⁷ or *αὐτοφυής* (“self-grown”, *i.e.* “native” or “not artificial”)²⁸⁸. The latter is consistently used by at least Theophrastus, in *Lap.*, to refer to stones that are spontaneously produced in earth rather than by artificial means (see *e.g.* 55: «just as there is a natural (*αὐτόματος*) and an artificial red ochre, so there is a native (*αὐτοφυής*) *kúanos* and a manufactured kind, such as the one in Egypt»²⁸⁹), and it is not absurd to suppose that the adjective might have also had a variant in *ζῶφυτος* (in its plural use for “plants”) due to its botanical connotations, *i.e.* as it was evocative of “wild” plants²⁹⁰: these “native” *i.e.* “self-growing” stones would be of course regarded as *ἔγγαιοι* rather than superficial, and Plutarch, in coupling the term with the stones’ *μέρη* rather than with the stones themselves, would be extending its sense only metonymically to refer to the underground setting of stone formation²⁹¹. More interesting may be the term *διαφυή*, which is used by both Diodorus Siculus and Theophrastus as a synonym of *φλέψ* (“vein”) to refer to “mineral veins”. A noteworthy occurrence of the word is in a passage where Diodorus mentions a riverbed from which the Britons used to extract tin, and he specifies on its earth that «this, being rocky (*πετρῶδης*), has earthy (*γεώδεις*) veins (*διαφυαί*)», which are the ones that are mined by the workers (V 22.1-2)²⁹². Considering the fact that the “rockiness” of a tract of (submerged) soil is here explicitly associated with the presence of *διαφυαί*—and implicitly contrasted with non-rocky “earths”, which would not be expected to contain mineral veins—, we might suppose that some rocks could be sometimes described directly as that which hosted the veins. If this is true, when they included *διαφυαί* they might have also been called *ζῶφυται*, being them interpreted (or metaphorized) as that which actively generated the veins or participated in their generation²⁹³. The ideal place for the veins’ growth,

²⁸⁷ From *διαφύω*: see LSJ, *s.v.* ‘*διαφύομαι*’, III («grow between»); CHANTRAINE, *s.v.* ‘*φύομαι*, *φύω*’, B; MONTANARI, *s.v.* *διαφύομαι*, a («*svilupparsi*, *crescere* (fra qcs., in un interstizio)»); BEEKES, *s.v.* *φύομαι*.

²⁸⁸ See *Cr.* 4.6, where the adjective is referred to *ῥωχμοί τῆς πέτρας* («clefts in the rock»).

²⁸⁹ Transl. RICHARDS AND CALEY 1956. The first «fused» (*χυτόν*) *kúanos*—Theophrastus continues— was produced «in imitating the native» (*μιμησάμενος τὸν αὐτοφυή*). According to EICHHOLZ 1965, *n. ad loc.* the «native» is massive azurite and the «fused» Egyptian frit; cf. RICHARDS AND CALEY 1956, *n. ad loc.*, who are of the same opinion and discuss the identification in detail. The use of *αὐτοφυής* in *Lap.* 55 was already pointed out (as a signal of the ancient biologization of the mineral world) by HALLEUX 1970, 19 (see above, p. 70 n. 286). See also *Lap.* 39 («native» *kúanos* contains *khrusókolla*, on which see RICHARDS AND CALEY 1956, *n. ad loc.*). The term also appears in 58 and 62.

²⁹⁰ For this meaning see *e.g.* Theophrastus, *CP* III 1.1.

²⁹¹ Notice that this fits the analogical interpretation of the term in MONTANARI, *s.v.* *ζῶφυτος*: «*di pianta viva*: [...] le parti delle pietre che si trovano nella terra e sono nate dalla terra come piante». Stone formation is regarded to happen underground, rather than on surface, since well before Plutarch’s presentation in terms of *πάγοι* in *Frig.* 19 953^{E-F}: this is explicit *e.g.* in Aristotle, *Meteor.* III 6 378^A12-26, IV 8 384^B30-40, and Theophrastus, *Lap.* 1.

²⁹² See also Diodorus Siculus III 12.1 (*διαφύας καὶ φλέβας* of white *μάρμαρος* or *μάρμαρον*, later referred to again as *μαρμαρίζουσα πέτρα*, 12.5, identified by OLDFATHER 1935 as «quartz-rock»); Theophrastus, *Lap.* 63 (*διαφυή* of «Melian earth», *i.e.*, according to RICHARDS AND CALEY 1956, *n. to Lap.* 62, who also discuss the previous identifications, a white or greyish silicious earth that «has appeared on the market under the trade name ‘Milowite’»; cf. EICHHOLZ 1965, *n. to Lap.* 62: «[...] ‘Milowite’, or kaolin, or a natural mixture of the two» — Eichholz also examines Theophrastus’s description of the *διαφυή* in great detail in his *n. to Lap.* 63).

²⁹³ It is interesting to note that Philo, in *Spec.* II 169 (already cited above), associates the verb *ζῶφυτεῖν* with rocks, hardness, and earthy *φλέβες*, confirming the possibility of a ‘mineralogical’ relevance of the term. This passage, however, is clearly about the literal

again, would be the underground rather than the earth on surface, and therefore it would be only under the soil that rocks (or parts of them) had a chance of conquering the adjective *zōphutos*. Now that we have considered the possible literal meanings of the term, which are the ones of specific interest in this section, we can leave the question open on its metaphorical interpretation. In any case, the ‘biological’ connotations of the word *zōphutos*, as is also true for *aterámōn*, help in tightening the thematic connection of the mineral analogy with the agricultural context that includes it, and the term was probably chosen by Plutarch for this reason.

fertility of soils: «the land which has fallen to their lot is not derelict nor indifferent soil, but good land, well fitted for breeding domestic animals and bearing fruits in vast abundance. For in it there is no poverty of soil and even such parts as seem to be stony (λιθώδη) or hard (ἀπόκροτα) are intersected (διέζωσται; cf. διαφυαί) by soft veins (φλέβες μαλακαί) of very great depth (σφόδρα βαθείαι), the richness (πιότης) of which adapts them for producing life (ζωοφυτεῖν)» (transl. COLSON 1939). It is ambiguous whether the mentioned φλέβες should be understood as strips of earth or as waterways (cf. the translation by DANIEL 1975: «sont parcourues en profondeur par des artères d’eau douce»), but the adjective μαλακός can be hardly imagined to refer to water (especially in the present syntactic opposition with «stony or hard» soil), and πιότης can be expected to be associated by Greek authors with soils that are “rich”, *i.e.* “nourishing” to plants: cf. Plutarch’s use of λιπαρότης in *Cor.* 21.7, mentioned above, p. 69 n. 279.

5. Burnt projectiles and the fanning framework

We have thus learned that cold weather, through the implied action of cold air, has a hardening effect on stones²⁹⁴. We can now go back to another passage informing us on the ‘thermodynamics’ of stones in relation to air, centred on heating rather than on cooling. I have already mentioned it when discussing the stones’ material constitution²⁹⁵: in *Lun.* 5, as part of Lamprias’s attack against the Stoic theory of the moon, we have read that «impetus (ῥύμη) combusts (συνεκκάει) both the air which is in stones and that which is in cold lead» (922^C); for this reason, it is unlikely for any moving celestial body to be made of air and survive as such for a long time, a problem which would not pertain to them if they were made of earth (I have already discussed at length Plutarch’s apparent preference for a ‘stony’ astrometeorology above)²⁹⁶. The example chosen by Lamprias in this passage, apart from being a proof that Plutarch did not consider the stones’ earthiness to be completely pure, includes in a succinct form an interesting etiology of combustion involving movement, air, and some mineral or leaden objects, which deserves some commentary. Mentions of the marvelous phenomenon of leaden projectiles catching fire or liquefying during their flight —despite this being physically impossible in the context of ancient ballistics²⁹⁷— were curiously well spread in the Latin world, appearing both in narrative poems and in philosophical texts, in these latter associated with minimal etiologies on which I will return below²⁹⁸. Its first occurrence, however, is Greek and Aristotelian. M. Adler rightly compared Lamprias’s information with those given by Aristotle in *Cael.* II 7 (289^A19-35), a chapter discussing the origin of the celestial bodies’ light and heat —where stones are mentioned as well—, suggesting as a mere hypothesis that Plutarch might have received them through the mediation of Theophrastus²⁹⁹. Although I would rather refer to an indeterminate Aristotelian tradition, which of course was also influenced by Theophrastus, Adler’s suggestion of a textual derivation does have some merits, since it may be corroborated by a terminological correspondence.

²⁹⁴ Compare with Chrysippus’s theory as discussed by Plutarch in *Stoic. rep.* 43 1053^F-1054^A, examined above, p. 30-1.

²⁹⁵ See above, p. 44.

²⁹⁶ See above, sec. 3.1.

²⁹⁷ A scientific take on this mental experiment can be found in FEDERSPIEL and GYSEMBERGH 2017, n. to 289^A25, who point out that the required temperature for a leaden body to melt is 327 °C, which a projectile can only reach by traveling at 1024 km/h. They argue in any case that a leaden bullet starting its trajectory with an initial temperature of 25 °C might be able to increase its temperature by 12-20°C while traveling at 200-250 km/h, an increase «suffisamment sensible au toucher» (which corroborates the earlier claim by ANDERSON 1972, 172 n. 9), and add that «comme la balle de plomb, si elle a frappé un corps dur, s’est déformée, on comprend que ce type de projectile ait pu être choisi comme exemple d’une expérience imaginaire». A different suggestion on the origin of this belief is offered by LEGGATT 1995, n. to 289A23-4: «Aristotle was perhaps influenced in this view by his experience of shooting-stars»; a suggestion, arguably, which is not able to account for the clear reference to lead as a constituent of sling-bullets.

²⁹⁸ Guthrie 1939, n. a to 289^A29 collects the following *loci*: Lucretius, *Rer. nat.* VI 178 (to which we should add 300-8), and Seneca, *Nat.* II 57.2, on both of which I comment below; Ovid, *Met.* II 727 (which I quote below, p. 82 n. 330) and XIV 825; Lucan, *Phars.* VII 513; Virgil, *Aen.* IX 588. VOTTERO 1989, n. 4 to II 57.2 adds Statius, *Theb.* X 533, and the Greek Onasander, *Strat.* 19.3, on which I return below. A necessary addition to the list is Theophrastus, *Metars.* 6.17-21 Daiber.

²⁹⁹ ADLER 1910, 141.

In fact, only three occurrences of the verb *συνεκκαίειν*, strikingly rare in the extant Greek literature, precede Plutarch's uses: the first two are in Theophrastus's *Ign.* (27, 37), suggesting a technical Aristotelian origin, and the third is in Polybius's *Hist.* (III 14.3), where it is used metaphorically. In both of Theophrastus's uses, the verb appears in connection with the action of fanning, which is done to kindle fires and augment their strength: in *Ign.* 27-8, while arguing that the agents of the fire's extinction are only effective «by excess» (ταῖς ὑπερβολαῖς), he presents the example of «wind» (πνεῦμα), which «by [its] motion (τῆ κινήσει) participates in kindling (συνεκκαίει) and invigorates the flames (καὶ ζωπυρεῖ) —hence lamps consume more oil in windy weather (ἐν τοῖς πνεύμασιν) and wood burns down (κατακαίεται) more quickly when the movement (κίνησις) has increased and has become more intense—, but in greater, disproportionate quantity extinguishes it (ἀπέσβεσε); and because of this, on one hand, the lamp is extinguished when fanned (φυσώμενος), and, on the other, wood and coal catch fire (ἐκκαίονται)». In chap. 37 he mentions this dynamic again to illustrate the occasional need of technicians to get stronger fires, which they also do by using «bellows» (φύσαι): «in fact, this way the heat [is] more intense and concentrated, as the wind participates in kindling (συνεκκαίοντος τοῦ πνεύματος)». In these passages, we see, the verb *ἐκκαίειν* appears both alone (in the “catching fire” of wood and coal) and combined with prefixes which modify its meaning: if the *κατα-* in *κατακαίειν* unambiguously suggests the prosecution of a burning and its downwards motion on a fuel until complete incineration (see «wood burns down more quickly» in chap. 27), the interpretation of the *συν-* (“together with”) in *συνεκκαίειν* can be open to debate, but the sense apparently most fit to the context is that of a “participation”³⁰⁰. Indeed, all the fires which the *πνεῦμα* is pushed against are clearly implied to have been started earlier on their fuel at least in part —e.g. as a result of transmission, or of a forceful “striking” (πληγή) or “rubbing” (τρίψις), as explained in chap. 1—, or simultaneously with the fanning; the *πνεῦμα* does not start the fires, but aids their kindling and causes them to intensify (see *συνεκκαίει καὶ ζωπυρεῖ* in chap. 27, and «more intense and concentrated» in chap. 37)³⁰¹. On why

³⁰⁰ Cf. COUTANT 1971 who incoherently translates «causes the fire to flare up» in chap. 27 (combining *συνεκκαίει καὶ ζωπυρεῖ*), and «helps the combustion» in chap. 37; and BATTEGAZZORE 2006, who equally incoherently translates «brucia insieme con il fuoco» in chap. 27, and «favorendo [...] la combustione» in chap. 37. The interpretation I defend is associated with these Theophrastean *loci* in both LSJ, s.v. ‘συνεκκαίω’, and MONTANARI, s.v. ‘συνεκκαίω’.

³⁰¹ It is true that in chap. 28 Theophrastus writes that «wood and coal catch fire (ἐκκαίονται)» when fanned, but this example is part of a discourse (as started in chap. 27) concerned with the causes of fire extinction —implying a reference to fires that have already been started or are being kindled—, illustrated by opposition with the causes of fire intensification; the agents are the same, and excess and proportionality are the only relevant factors. The *ἐκκαίονται* in chap. 28 may perhaps have an implicitly localized sense, alluding to the burning of those parts of wood and coal —in some places already burning— that had not yet caught fire, lighting up with the expansion of the fire (intensified by the *πνεῦμα*) on their neighbouring parts. Of course, it is also possible that the prefix *ἐκ-* does not participate to the meaning of this instance of *ἐκκαίειν*, which should then be taken as a synonym of *καίειν* (simply, “burn”). However, on one hand, blowing wind on a piece of wood is hardly enough to start a fire; on the other hand, we may assume that Theophrastus, in the context of *Ign.*, would be careful to differentiate between the two verbs: chap. 30 may contain a sign of such a care (containing the couple *ἐκκαίω καὶ αὐάνω*, i.e. «kindling and augmenting», in which two moments are distinguished). In chap. 39, *ἐκκάεσθαι* also

the πνεῦμα helps, Theophrastus is very succinct: it does it «by [its] motion». A century and a half later, air and movement will have no role in Polybius’s metaphor, but the sense of συνεκκαίειν, preceded by ἐρεθίζειν (“rouse to fight”), will still imply a “participation”; in fact, the historian will use it to describe how the fugitives from Hermandica contributed to excite the Carpetani and their neighbouring tribes to war, thus complementing the ἐρεθίζειν which was already being performed by the Olcades (*Hist.* III 14.3). This appears to be the original meaning of συνεκκαίειν, the συν- consistently suggesting a complementarity.

Now, considering Theophrastus’s focus on «movement» (κίνησις) in the passages of *Ign.*, it is not unreasonable to suppose his theories to have had an influence on Lamprias’s words, in which συνεκκαίειν occurs in association with «impetus» (ρόμη). There are, however, some important differences to consider. The first thing to note is that while Theophrastus —as it seems— always attributed a meaning to the prefix ἐκ- in ἐκκαίειν, specifically signifying a “kindling” and thus the initiation of a burning (as in “bringing out”, ἐκ, “the burning”, καίειν), whether or not with the bellows’ concurrent action³⁰², Plutarch’s texts bear some traces of a looser use of the form, although irregular: in three passages, in particular, the action of ἐκκαῦσαι (metaphorical) becomes quantifiable, associated in all three with the adverb μᾶλλον (*FM* 7.4; *TG et CG* 13.4; *Demetr.* 5.1)³⁰³. If sometimes Plutarch was indeed less ‘technical’ than Theophrastus in using the prefix ἐκ-, he might have also been less careful with the prefix συν-. In fact, if we try to apply what seems to be the original sense of συνεκκαίειν to Lamprias’s words in *Lun.* 5, we obtain a physical nonsense: «impetus participates in the kindling (συνεκκαίει) of both the air which is in stones and that which is in cold lead», which contradicts the fact that the only fire-starter, in this scenario, appears to be the «impetus» itself, there being no concurrent causes it can aid and complement. The meaning of the prefix, then, has either fallen out of relevance in Plutarch’s usage of the verb or changed, and I intend to show that there exists a possibility it has changed.

In *Alex.* 35, we find it used in association with the extremely volatile behaviour of naphtha, which Alexander found in Babylonia and decided to experiment with: in introducing this substance, Plutarch claims that «it resembles asphalt in all its other [aspects], but is so susceptible (εὐπαθής) to fire that before touching the flame,

occurs with the meaning of “burn away” (*i.e.* burn until complete departure of the fuel from its medium: οὐδὲν γὰρ μέλαν ἀνευ ὑγρότητος, ἀλλ’ ὅταν ἐκκαυθῆ, πάντα λευκά καὶ τεφρώδη καθάπερ καὶ τὰ ὄστᾶ).

³⁰² See preceding footnote.

³⁰³ Passages using the verb in its fuller sense, however, are not lacking. With the proper meaning of “kindling” it is metaphorically referred to πόλεμος (“war”) in *Ages.* 31.4, *Comp. Ages. Pomp.* 1.4 and *Herod.* 6 856^A. In *Adul.* 34 72^E, still metaphorical, it is absolute and coupled with ποιεῖ διαφορὰν («causes disagreement»). It appears with φιλονικία («due to contentiousness») in *Alex.* 31.3, with φιλοτιμία («due to ambition») in *Ag. et Cleom.* 2.8, and with ζήλοστυπία («due to rivalry») in *Laud.* 18 546c. In a physiological context —perhaps not metaphorically, yet surely metonymically— it is used by Plutarch’s character in *QConv.* III 8.2 656^E, claiming that «the [summer] season, beginning, stirs up (ἀνακινεῖ) and kindles (ἐκκαίει) the fevers». The meaning of “burn away” (and depart from the medium) is also attested: in *QConv.* VI 1 687^A it is used for «the moist» (τὸ νοτερόν) burning completely in wood and deserting «the earthy» (τὸ γεώδες), which remains as ashes; similarly in *Frig.* 21 954^{E-F}, for the same dynamic, with «the fatty» (τὸ νοτερόν) (presented as example of a νοτερόν).

through the beam (ἀλύγη) itself that is radiated (lit. being lit, ἐξαπτόμενος) around the light (φῶς) [of the flame], it often kindles with itself (συνεκκαίειν) the air that separates it from the flame (lit. the air in the middle, τὸν μεταξύ... ἀέρα)» (2)³⁰⁴; notice the relevance of air in the chemistry of this reaction, paralleling both the Theophrastean uses of the verb and Lamprias’s in *Lun.* 5. This use of *συνεκκαίειν* —expressing the participation of its subject in a kindling in the specific sense that it receives itself the kindling it causes, and that it causes it exactly as a result of its own kindling—, anticipates the meaning with which it will be employed by Galen, Aelian, and Gregory of Nyssa, who are the only authors, in the extant ancient literature, using it after Plutarch, apparently always referring to a ‘contagion’³⁰⁵. If we compare, then, Lamprias’s reference to the “combusting” bullets with the Aristotelian original, such a sense might seem to be appropriate to the scenario, perhaps attesting to a Theophrastean-like technicalization, in terminology, of a dynamic that was already expounded by Aristotle using different terms. I find it unlikely that the sense of a ‘contagious-simultaneous’ kindling can be directly attributed to Lamprias’s *συνεκκαίειν* in *Lun.* 5, but there are interesting enough correspondences to suggest the possibility that there may have been a time, in the Peripatetic tradition on the “combusting” bullets, in which the verb was indeed used with this meaning; a meaning which was then cut away —whether willingly or not— in Plutarch’s paraphrasis of the report. In examining this hypothesis, we should first look at Aristotle’s reference to the phenomenon in *Cael.* II 7 (289^A19-35):

Ἡ δὲ θερμότης ἀπ’αὐτῶν (*scil.* ἀπ’ἄστρων) καὶ τὸ φῶς γίνεται παρεκτριβομένου τοῦ ἀέρος ὑπὸ τῆς ἐκείνων φορᾶς. Πέφυκε γὰρ ἡ κίνησις ἐκπυροῦν καὶ ξύλα καὶ λίθους καὶ σίδηρον· εὐλογώτερον οὖν τὸ ἐγγύτερον τοῦ πυρός, ἐγγύτερον δὲ ὁ ἀήρ· οἷον καὶ ἐπὶ τῶν φερομένων βελῶν· ταῦτα γὰρ αὐτὰ ἐκπυροῦται οὕτως ὥστε τήκεσθαι τὰς μολυβδίδας, καὶ ἐπεὶ περ αὐτὰ ἐκπυροῦται, ἀνάγκη καὶ τὸν κύκλω αὐτῶν ἀέρα τὸ αὐτὸ τοῦτο πάσχειν. Ταῦτα μὲν οὖν αὐτὰ ἐκθερμαίνεται διὰ τὸ ἐν ἀέρι φέρεσθαι, ὅς διὰ τὴν πληγὴν τῇ κινήσει γίγνεται πῦρ. [...]

³⁰⁴ The interpretation of this passage is difficult and uncertain, but all the translators seem to be in agreement, me included: see PERRIN 1919; FLACELIÈRE AND CHAMBRY 1975; MAGNINO [2002] 2016. For minimal commentary on this chapter see DESIDERI 1992; the earlier treatment by SANSONE 1980 is notably unconvincing, although amusing (see *e.g.* p. 68-9: «how then does the excursus on naphtha illuminate Alexander’s nature? Both Alexander and naphtha are obviously of a fiery and volatile nature. [...] “If,” Athenophanes joked [in *Alex.* 35.5], “the naphtha can cause him [*scil.* the singer Stephanus] to light up, it would seem that it has irresistible and remarkable power (ἄμαχον καὶ δεινὴν αὐτοῦ τὴν δύναμιν εἶναι)”. [...] Most obviously, of course, Alexander is himself irresistible and remarkable»).

³⁰⁵ In Galen’s passages, it continues being referred to air: see *Meth. med.* IX 2, X p. 605 Kühn (with ἀναθυμίασις as its subject) and *Simpl. med. fac.* I 14, XI p. 406 Kühn (with ἀήρ as its subject and coupled with an explicit αὐτῷ, *i.e.* «with itself»). In Aelian, *VH XIII* 1.101-2, it refers to the act of burning trees by the use of torches. There might be some doubt about its sense in the metaphorical use by Gregory of Nyssa, *Eccl.* 2, V 313.13-5 Alexander (ἡ ἐπιθυμία τῆς τρυφῆς συνεκκαίεται, καὶ ἡ τρυφή τῆς ἐπιθυμίας συνεπιτείνεται), but it appears to still indicate a ‘contagious’ kindling, perhaps in a closer sense to its occurrence in Plutarch, *Alex.* 35.2. There are no further occurrences in these authors.

Heat and light originate from them (*scil.* from the stars) as the air is rubbed by their motion. In fact, movement naturally ignites pieces of wood, stones and iron—even more reasonably, then, that which is closest to fire, and air is closest—, as is also the case for moving projectiles: these themselves are ignited in such a way that leaden sling-bullets liquefy, and, if these are ignited, it is necessary that the same will also happen to the air surrounding them. Now, these things are heated due to their moving through air, which [in turn] becomes fire because of movement due to the impact [with these things]; [...]

The point of this passage, as is clear in its first sentence, is explaining the physical cause of astral heat and shining. In doing this, Aristotle projects onto his understanding of the interaction between the rotating heavens and the air flowing underneath them the common experience of fire-kindling by means of chafing. The first examples he refers to, despite him not being explicit in it about the rubbing, are clearly meant to be interpreted within this frame: indeed, one can produce sparks and start a flame both by chafing together two «pieces of woods» and by rubbing «iron», *i.e.* a fire striker, onto «stones», when these are flint³⁰⁶. Now, since Aristotle needs to establish that also air can be so ignited by being chafed (otherwise, the celestial bodies would not be able to kindle it), he mentions the phenomenon of liquefying sling-bullets: if even these, being leaden³⁰⁷, can liquefy by merely moving into air—notice how closely their exemplarity is paralleled in Lamprias’s reference—, the air itself that they traverse, «closest to fire» and more susceptible than them to ignition, will surely ignite on their impact. Although Aristotle, in referring to the kindling agents, mentions explicitly the chafing only in the first sentence (see *παρεκτριβομένου*), then switching to the simple «movement» (*κίνησις* and *φέρεσθαι*) and to the «impact» (*πληγή*) starting it, we can safely assume that his analogical frame of reference is always that of rubbing as a means of fire-starting; it might seem from his succinctness that it should be movement alone to cause the ignition, but this is disproved in the following lines, in which Aristotle claims that the upper celestial bodies do not ignite as they are carried in their spheres, in contrast to the air being heated underneath them (289^A28-33)³⁰⁸; the cause of the heating, we may conclude, is not movement, but its induction through continuous impact, which is chafing³⁰⁹. An explanation of a similar spirit can be found in

³⁰⁶ See FEDERSPIEL AND GYSEMBERGH 2017, n. to 289A22: «allusion à la manière dont les Grecs se procuraient du feu, en frappant des noyaux de silex ou en frottant du bois.

³⁰⁷ Aristotle’s mention of wood, stones and iron for their roles as fire starters must have been what induced Simplicius to absurdly paraphrase the example of projectiles as concerning «lead balls which contain iron inside wood» (*in Cael.* 439.9-10), transl. MUELLER 2004. As Mueller comments in n. 369: «I do not know what to make of this description».

³⁰⁸ GUTHRIE 1939, n. b *ad loc.* correctly points out that «the revolving element of which they (*scil.* the stars) and the spheres are made cannot be transmuted into any of the other elements, since it is not the contrary of any of them», but this does not seem to be Aristotle’s point in this example: the *ὥστε* in *τῶν δὲ ἄνω ἕκαστον ἐν τῇ σφαίρᾳ φέρεται, ὥστ’ αὐτὰ μὲν μὴ ἐκπυροῦσθαι, τοῦ δ’ ἀέρος [...]* presents the non-occurrence of the ignition as the consequence of a star’s “being carried” in the sphere.

³⁰⁹ This interpretation is in alignment with the one assumed by WILSON 2013, 48–49. A different interpretation was defended by THORP 1982, at the end of an illuminating examination and critique of the Aristotelian physics expounded in this passage. Despite the

Meteor. I 3, as part of Aristotle’s account for the presence of heat on earth (341^A15-36). Aristotle here never refers to chafing, presenting the air’s ignition to be rather caused by a “scattering” (διακρίνεσθαι)³¹⁰, but the parallels between this passage and that in *Cael.* II 7 are enough to suggest the probability of their coherence. He argues that, among those of all the stars, only the «motion» (φορά) of the sun is both fast enough to produce heating and close enough to earth for its effect to reach us, and to support this claim he remarks that «we see that movement (ἡ κίνησις) can scatter (διακρίνειν) air and ignite it, which is also why moving things (τὰ φερόμενα) often appear to liquefy (τηκόμενα)» (*Meteor.* I 3 341^A17-9); to reinforce his conclusion, he notes that it is especially reasonable for the sun to be the cause of such a heating: «in fact, even here [on earth] the air in the neighbourhood (πλεσιάζων) of the things that are being forcibly moved (τὰ βία φερόμενα) becomes hottest; and it is reasonable for this to happen: in fact, the movement (κίνησις) of what is solid scatters it most» (341^A24-8). This last example is evidently a generalization of the reference to leaden bullets in *Cael.* II 7, as is also, probably, the earlier mention of the liquefying φερόμενα. For what regards the chafing, it is surely implied that air is scattered due to impact with the projectiles and with the sun: if a proper ‘rubbing’ might not be thought to happen, the dynamic here described, at least, contains no elements which contradict it. Interestingly, the passage closes with a reference to the phenomenon of shooting stars (αἱ διαδρομαὶ τῶν ἀστέρων, *Meteor.* I 3 341^A31-5), which in fact precedes a very long section dedicated by Aristotle to the etiology of comets (4-7 341^B1-345^A10). I will argue below that comets might be also alluded to in Lamprias’s reference to the «stones».

Now, if we try to apply the verb *συνεκκαίειν* to the description of air’s behaviour in these passages, we can notice that it does not work if used in the Theophrastean sense: in fact, it can neither be said that the stars, the sun, or the moving bullets “participate in kindling” the air, nor that the air —corresponding to Theophrastus’s «wind»— “participates in kindling” the bullets, because the ignition of both air and bullets is presented to require a single cause, *i.e.* a chafing or impact, in a way which leaves no space for concomitant agents. The later use of *συνεκκαίειν* for a ‘contagious-simultaneous’ kindling, in contrast, would seem to be adequate, as Aristotle argues in both passages that the air surrounding the projectiles should catch fire in the same way as projectiles do; even keeping the chafing or impact as the first efficient cause of the ignition, then, it seems a reasonable hypothesis that, in the tradition of Peripatetic meteorology, the example of igniting bullets might have at some point incorporated the verb *συνεκκαίειν* to refer to the simultaneous, and subsequently intensifying, ignition of the air with that of the projectiles: both the air and the projectiles do catch fire because

quality of such critique, his interpretative proposal, basically aimed at saving Aristotle from his inconsistencies, is difficult to accept for simple linguistic reasons; see *e.g.* p. 119 for the way he suggests to read *παρεκτριβομένον*: we should find in it «not the notion of being rubbed, but rather that of suffering a series of impacts, being buffeted. The air is buffeted along by the quintessence [of the celestial spheres] and is thus made to diverge (*παρεκ-*) from its normal radial motion to a circular one».

³¹⁰ On the air’s “scattering” as a cause of its ignition, introduced by Aristotle in *Meteor.* I 3 340^B13, see WILSON 2013, 70–72.

of their respective friction, but their catching fire, in turn, intensifies the heat in both. The example, perhaps, came down to Plutarch in this form, and for this reason he might have felt the need to refer to the air's combustion using *συνεκκαίειν*. In Lamprias's words, though, the implication of a 'contagious-simultaneous' kindling is necessarily sacrificed, because, as we have seen, the subject of the verb is not air—which instead figures as its object—, but the «impetus» itself, surely not susceptible to ignition. The only possible sense remaining, therefore, is that of a 'complete' lighting up, the prefix *συν-* referring to the integrality of the air's ignition, to stress the intensity of the flaring: «impetus makes all the air that is in stones catch fire, as well as that which is in cold lead». It is interesting to note that both the Latin verbs *combūrere* and *conflagrāre*, *i.e.* the closest etymological equivalents one can find of *συνεκκαίειν*, were used precisely in this sense³¹¹, and a Latin influence on Plutarch's understanding of the verb, either direct or indirect, is indeed possible to suppose³¹². My translation of the *συνεκκαίει* in *Lun.* 5 as «combusts» (from Latin *combūrere*) is inspired by this etymological correspondence and is meant to convey the 'fullness' of the ignition as is denoted by all these verbs³¹³.

There might have been a reason why the «impetus», in Lamprias's words, remained as the only cause of the combustion (perhaps finding support in Aristotle's explanations, already oscillating between *κίνησις* and *πληγή* or *διάκρισις*, in indicating the agent of the ignition). In Plutarch's physics, in fact, there is at least one sign that motion might have been assumed to be a sufficient cause for heating, namely in *Aq.* 9: «marsh waters and such as are stagnant [...] are bad and end up putrefying for their having very little movement (*κίνησις*), which by fanning (*ῥιπιζουσα*) preserves (*τηρεῖ*) the heat in each» (957^D)³¹⁴. Even this passage, though, contains a reference to “fanning”, which raises the suspect that Plutarch may have still thought of «wind» as the actual

³¹¹ See TLL III, *s.v.* 'combūro', I («propre de vi ignis et flammaram: i. q. in cinerem, carbonem massamve resolvere», cf. above, p. 74-5 n. 301 and 303 for *ἐκκαίειν* in the sense of “burn away”); and IV *s.v.* 'cōnflagro'. The latter lemma is not explicit about the 'fullness' of the burning, but cf. CASTIGLIONI-MARIOTTI, *s.v.* 'conflāgro', 1 («ardere, bruciare del tutto»).

³¹² On Plutarch's Latin see ZIEGLER [1951] 1965, 345–47 and BRENK 1977, 32 n. 5.

³¹³ See the like-minded translation by LEHNUS [1991] 2013: «il movimento fa conflagrare»; cf. the translations by KEPLER 1634 («cursus impetus inflammare solet»), WYTENBACH 1797C («motus suo impetus [...] accendit», identical in DÜBNER 1877), Gent in GOODWIN [1874D] 1878 («the swiftness and violence of motion is wont to inflame»), Cherniss in CHERNISS AND HELMBOLD 1957 («velocity ignites»), DONINI 2011 («la violenza del movimento infiamma»), LERNOULD 2013 («la vitesse aide à [!] enflammer»), Castello in LELLI, PISANI, ET AL. 2017 («il movimento incendia»); GÁRRIGA 2021 («speed ignites»). The verb appears to be used with this meaning, *i.e.* of a complete combustion, also in *QConv.* III 8.2 656^F-657^A by Plutarch's character in the couple *συνεκκαίειν καὶ καταναλίσκειν* («combust [the fuel] and consume it wholly»); in this passage, the agent of the ignition is wine, and its object «the delirious [element] of the soul» (*τὸ μανιώδες τῆς ψυχῆς*). Plutarch happens to be the only Greek author to use *συνεκκαίειν* in this sense. An analogical contamination from the meaning of *συνεξάπτειν* does not appear to be a possible explanation, because in all the seven Plutarchan occurrences of this term in the extant *corpus* it is used in a different sense. The only pre-Plutarchan occurrence is in a fragment from Posidonius (Fr. 453.L Theiler), quoted by Marcus Aurelius (*Eis heautón*, IX 9.1), still with a different meaning. Cf. also *ἐξερρίπιζε καὶ συνεξεθέρμαινεν*, of *μαχιμον καὶ θαρραλέον ἤδη σβεννύμενον* (*Pomp.* 8.6)

³¹⁴ Cf. the different etiology in *QConv.* VIII 5.2 725^{C-D}, quoted below, p. 96. On the acquisition and permanence (*digerere nequeant*) of a bad quality «from either air or earth» by stagnant waters see also the third answer in *Aet. phys.* 33, with MEEUSEN 2017a, n. *ad loc.*

cause of heating: in *Aet. phys.* 8, after all, it is ἀνεμοί («winds») that are supposed to “fan out” (ἐκριπιζουσι) and “fuel” (τρέφουσι) the sea’s congenital (σύμφυτος) heat (914^B), and in *Aet. phys.* 22, in arguing that the bear’s paw is heated more than the other parts of its body (leading to an increase in sweetness), Plutarch proposes that «what transpires (τὸ διαπνέον) is concocted (πέττει) most, as it is most moved (κινούμενον), and with this trained most (συγγιμναζόμενον)» (917^D)³¹⁵. If Plutarch did think of blowing air as a generally required cause for heating, one may wonder why he might have felt the need to expel it from the etiology of combusting bullets — still assuming, of course, that it was him to do so.

We might be able to find an answer to this question by looking at Plutarch’s understanding of projectile motion, since a possible hypothesis is that he may have perceived the physics of the air and bullet’s ‘rubbing’ to be incompatible with his presuppositions³¹⁶. In the *Timaeus*, in fact, Plato had explicitly connected the behaviour «of the thrown [bodies] (τὰ ῥιπτούμενα), [both] those sent in mid-air (ἀφεθέντα μετέωρα) and those that are pushed on earth» with the explanatory mechanism of the air’s *periōtheîn* (80^A). Plutarch, who referred to it as *antiperístasis*³¹⁷, had even integrated Plato’s hasty reference to the dynamic with a full etiology in *QPlat.* 7.5: «and weights that are thrown (τὰ δὲ ῥιπτούμενα βάρη) cleave (σχίζει) the air and separate (δίιστησι) it because of the impact (μετὰ πλῆγῆς) with which they have fallen upon it (ἐμπεσόντα); and the air because of its nature always to seek out and fill up the vacated space flows around behind and follows along with the object discharged, helping to accelerate its motion (τὴν κίνησιν συνεπιταχύνων)» (1005^A)³¹⁸. If we think of the “fanning” of flowing waters referred to in *Aq.* 9, it will be especially interesting to note that also the motion of water streams was connected by Plato to the *periōtheîn* (*Tim.* 80^B), and explained in full by Plutarch in *QPlat.* 7.8 (1005^D-1006^A). We see, then, that both projectiles and moving waters are made to depend on a dynamic of “acceleration” (see *συνεπιταχύνων*) whose protagonist is a pushed-and-pushing air: this mechanism —if Plutarch also accepted it outside the frame of Platonic exegesis, which is probable³¹⁹— may have been felt by him to be incompatible with the ‘chafing’ of the air onto the objects piercing it, because, if we try to imagine it, this would require the air around these objects to exercise at least a minimal resistance to their pushing, allowing them to rub a little onto its texture before pushing it away; such a rubbing may become impossible if one assumes *antiperístasis*, as all the particles of air would be instantly displaced by the pressure

³¹⁵ For a discussion on this ambiguous passage see MEEUSEN 2017a, n. *ad loc.* See also Sanit. 2 123^A, in which Zeuxippus claims that in touching a body by one’s hands it is the hands’ motion (κίνησις) itself to «bring» (ἐπάγειν) and «concentrate» (συνέχειν) the body’s heat in the touched zones: this dynamic does not concern increases in heat, but its simple redistribution.

³¹⁶ Note that this would not be a reaction to the Aristotelian mechanics of projectile motion as expounded in *Phys.* IV 8 215^A14-17 and VIII 10 266^B28-267^A8, 267^B9-15, since the explanations in these passages do not imply any rubbing. On these passages see WAGNER [1967] 1995, n. to 101,13–24 (a 14–9); ROSS 1936, n. to IV. 8. 214b 15–17; to VIII. 10. 266a 27–267a 20.

³¹⁷ See below, p. 161-6.

³¹⁸ Transl. CHERNISS 1976a, slightly modified. He remarks in his n. *ad loc.* that «nothing is said in the *Timaeus* of the acceleration to which Plutarch refers».

³¹⁹ Cf. my comments on Plutarch’s general acceptance of *antiperístasis* for the phenomenon of magnetism below, p. 162 n. 656.

of the solid body, then circling back to the vacated space to exercise a stronger push on the body's surface. In Plutarch's physics, the air can be "clef" and "separated" by an "impact", then returning on its piercer with an even stronger impact, but apparently never 'rubbed'. While this may exclude the possibility of aerial combustions happening because of chafing, this is instead compatible with the conception of a 'fanning' constantly exercised by the air onto the bodies piercing it: their simple motion, in fact, always induces the air to circularly 'fan' onto their surfaces, and it may be for this reason that the air helps to "preserve" (see *τηρεῖ* in *Aq.* 9 957^D) the heat which they contain. We have seen that in *Aet. phys.* 8 (914^B) Plutarch suggests that winds may "fuel" (see *τρέφουσι*) the «congenital» heat of the sea; this verb might not be used gratuitously, because air itself might be regarded to contribute to the heat by its own ignition³²⁰: we read in fact in *Frig.* 21 that «air, by itself (*ἐξ ἑαυτοῦ*), often sends forth flames (*φλόγας ἀναδίδωσι*) and, igniting, flows and flashes (*ρεῖ καὶ διαστράπτει πυρούμενος*)» (954^E), a meteorological example Plutarch contrasts with the impossibility of the earthy substances to burn (*καίειν*) —or its very low susceptibility to burning—, before turning his focus to moisture and claiming that «heat [only] makes use of moist nourishment (or fuel, *τροφή*)»³²¹.

This is not the appropriate place to expand on Plutarch's etiological explanation of lightnings and on its relationship with the contemporary philosophical discussion, but it is important to note that Plutarch—who in *Frig.* 21 presents the air to be able to flare up «by itself»— explicitly assimilates lightning bolts with projectiles in *QPlat.* 7.5 («and the falls (*πτώσεις*) of lightnings too resemble throws (*ρίψεις*)», 1005^B—remember the couple *ρίψεις καὶ πτώσεις* referred to meteorites in *Lys.* 12.3 and 12.5)³²², and he does it just after explaining the aerial "acceleration" of thrown bodies, coherently with Plato's indication in *Tim.* (80^C)³²³. And while Plutarch, in connecting the lightnings' motion with *antiperístasis*, probably excluded that there could be any 'rubbing' between lightnings and air, virtually all of his (non-Platonist) close predecessors and contemporaries considered "chafing" to be a possible cause for the ignition of lightning bolts or for the associated thunders: this applies to Theophrastus (see *Ign.* 1 and especially *Metars.* 1.3-5, 1.21-3, 6.17-21 Daiber), to the Stoics (see *SVF* II 703, 704, and 705, consistently associating the "rubbing" with an *ἔξαψις*, which we have seen Plutarch denied for meteors)³²⁴, to Epicurus (see *Pyth.* 101 and, in analogy with meteors, 114-5), to Lucretius (see *Rer. nat.* VI 300-16, with explicit analogy with fire-starting by use of flint), to the

³²⁰ Cf. SENZASONO 2011, 29: «Plutarco non spiega adeguatamente perché il mare si riscalderebbe quando è agitato, né perché i venti, agitando il mare, dovrebbero suscitare o alimentare il calore»; MEEUSEN 2017a, n. *ad loc.*: «Plutarch does not explain why this movement exactly increases the heat of the seawater [...]. One may wonder if this is perhaps due to the friction of the earthy particles in it» (with reference to the *γεώδη* occurring in the following sentence).

³²¹ This is followed by the example of burning wood, whose ignition only concerns the moist part (while the earthy remains as ashes). The idea of moisture as a fuel is paralleled in *QConv.* VI 1 687^A (see above, p. 75 n. 303) and implied in III 2.2 649^B, and perhaps also in VI 2.2 688^C.

³²² See above, p. 48-53.

³²³ Lightning bolts are also discussed by Plutarch in *Aet. phys.* 4 912^F-913^A and *QConv.* IV 2.2 664^E.

³²⁴ See above, p. 49-52.

evolved Aristotelian meteorology as reflected in Aëtius's *Plac.* (III 3.13, similar to the theory of meteors presented in Pseudo-Aristotle's *De mundo*, 14 395^B5-8)³²⁵, and to Arrian (Fr. *phys.* 3 Roos-Wirth = Stobaeus, *Flor.* I 29.2)³²⁶; none of these philosophers, of course, made use of the Platonic mechanism of *periōtheîn* in their physics³²⁷. It seems to be suggested, then, that Plutarch might have wanted to react to such a systematic reliance on chafing in meteorological matters, which could also be related to his preference for a 'stony' conception of meteors, as defended in *Lys.* 12³²⁸. This, indeed, is mostly speculation, but it may not be a coincidence that all the extant etiologies of the combustion of flying bullets after Aristotle's consistently refer to chafing, and while in Onasander's *Strat.*, as one can expect from a treatise on military tactics, the phenomenon is only mentioned in relation to the danger of exposure to thrown weapons (19.3, with τριβόμενον τῷ ἀέρι... ἐκπυρωθέν), all the other philosophers refer to it as a *comparans* for the ignition of lightning bolts: so do Theophrastus in *Metars.* (see 6.17-21 Daiber, with «they become hot by rubbing against the air, catch fire and melt away»)³²⁹, Seneca in *NQ* II (57.1-2, with *liquescit... et attritu aeris velut igne destillat*), and Lucretius in *Rer. nat.* V (173-84, without rubbing, and 300-8, with *conradens aere portat parvula, quae faciunt ignem commixta volando*)³³⁰.

In such a context, it begins to appear more likely that it was Plutarch himself to restrict the reference to «impetus» in the example of igniting bullets, and perhaps even to modify the sense of *συνεκκαίειν*: he was the only one who did not mention “rubbing” and presented motion as the direct agent of the burning³³¹; furthermore, he was the only one referring to an ignition of the air contained “inside” the projectiles (τὸν ἐν

³²⁵ MANSFELD AND RUNIA 2020, 1135–37 stress the parallels between the meteorological part of Aëtius's work and the reconstructed edition of Theophrastus's *Metarsiologiká*; this work might be at the origin of the evolution in the non-Peripatetic perception of Aristotle's meteorology.

³²⁶ This Arrian is still identified as the historian born in 120 CE by Dognini in KEYSER AND IRBY-MASSIE 2008, *s.v.* 'L. Flavius Arrianus of Nikomēdeia', as by SENZASONO 2011, n. 36 (with older references); Senzasono insisted on chronology in response to Sandbach in PEARSON AND SANDBACH 1965, n. f to *Aet. phys.* 4 931A, who however simply cited Arrian's passage for comparison.

³²⁷ According to J. Bollack, Lucretius employs it in his explanation of magnetic attraction, but I argue against her interpretation below, p. 165 n. 665.

³²⁸ See above, sec. 3.1.

³²⁹ Transl. DAIBER 1992. In his translation, the subjects of the ignition are «bullets when they are thrown by a catapult»; he probably uses the term «catapult» with the meaning of “slingshot”, since in the Arabic text—in the Syriac the sentence is missing—we find the term *miqlā'* (“slingshot”, “catapult”) for the «catapult», and *raṣās* (“bullets” or “lead”) for the «bullets». The latter term, as shown in KĀS 2010, *s.v.*, is frequently used to translate the Greek *μόλυβδος*, and according to the online Glossarium Græco-Arabicum it was even used to translate Aristotle's *μόλυβδιδας* in *Cael.* II 7 289^A19-35. I thank Matteo Martelli for his advice on the Syriac and Arabic text.

³³⁰ Lucretius's Epicurean presentation of the burning, caused by the projectiles' acquisition, by rubbing, of igneous atoms from the air they pass through (coherent with Epicurus's etiology of lightning bolts in *Pyth.* 101) matches Ovid's description of the phenomenon in *Met.* II 726-9: [...] *et aethere pendens non secus exarsit, quam cum Balearica plumbum funda iacit: volta illud et incandescit eundo, et, quos non habuit, sub nubibus invenit ignes.*

³³¹ Consider, however, that there was already an oscillation in the previous sources: Lucretius in *Rer. nat.* VI, for instance, despite ending on the rubbing in 300-8 (which we have seen being followed by an analogy with flint and iron, 309-16), in 173-84 had said of wind that *mobilitate sua fervescit*, then adding *ut omnia motu percalefacta vides ardescere, plumbea vero glans etiam longo cursu volvenda liquescit*. This is the closest parallel one can find to Plutarch's presentation of the phenomenon, but movement is still not presented as a subject of the action of combusting.

λίθοις ἀέρα καὶ τὸν ἐν ψυχρῷ μολίβδῳ, notice the insistence on ἐν), rather than of that surrounding them. In fact, in Lamprias's words, the projectiles are excluded altogether from the ignition, coherently with the claim in *Frig.* 21 that only aerial or moist substances can burn (954^{E-F}). If the liquefaction of the leaden bullet is implied—consider that Lamprias does not make it explicit—it should be assumed to happen for the expulsion of the inner air as flames³³², rather than for direct heating of the metal. The problem remains, though, that Lamprias also refers to «stones», which would be absurd to imagine ending up being liquefied, just as it seems unlikely that stones thrown by catapults would be supposed to ignite during their flight: this scenario, certainly, does not appear in the other etiologies of the phenomenon. It is true that in the original description by Aristotle in *Cael.* II 7 stones are mentioned just two sentences before the bullets due to their implicit exemplarity as fire-starters, *i.e.* as flint, which is paralleled in Lucretius's reference to *lapis* and *ferrum* just after the example of the *plumbea glans* (*Rer. nat.* VI 300-16), but it seems unlikely that such identification could apply to Lamprias's stones: one confers no «impetus» to flint by striking it with iron. We may then take inspiration from an old suggestion by P. Raingeard and advance that the allusion is most probably to aeroliths³³³, or to any shooting star: we might have indeed found, in this small example in *Lun.* 5, the only surviving trace of Plutarch's explanation of the flaming trail of meteors, assumed to be flying rocks in the digression in *Lys* 12 (5)³³⁴.

The fact that the igniting bullets, in *Lun.* as in the previous and contemporary philosophical texts, are consistently used as an example, either argumentatively or didactically, for the explanation of important astrometeorological occurrences—ranging from astral brilliancy to the genesis of lightnings—is a sign that its minute etiology was of much higher stakes than might appear at a first glance³³⁵. To allow the air surrounding the projectiles to 'chafe' onto them and burst together with their liquefaction, in the context of the heated philosophical debates around the nature of celestial bodies and weather phenomena, would have serious systematic consequences on the explanation of a wide range of analogous events. Other traces of Plutarch's care in showing consistency with his own tenets and opposing the theories of his adversaries even when reporting on events of minimal importance—in the context of the air's behaviour in relation to moving bodies—may be also found in other places: in *Fl.* 10 (9-10) and *Pomp.* 25 (12-3), for instance, Plutarch makes sure that the puzzling phenomenon of ravens falling from the sky after too loud a shouting by a crowd does not remain accounted for through simple postulation of an aerial «rupture» (ῥήξις) opening a void, preferring

³³² Compare with Theophrastus's explanation of the melting of lead and tin in cold weather in *Ign.* 17, which I quote below, p. 192.

³³³ See RAINGEARD 1935, n. to 922 c: «plutôt qu'à des silex dont nous n'imaginons pas la manipulation nous pensons aux aérolithes: nous les voyons très bien sous la forme de pierres enflammées, nous voyons peut-être moins bien que de l'air y était renfermé qui a disparu par suite du combustion». Note that none of the other commentators except LERNOULD 2013, n. 47 («cf. les météorites») say anything about the «stones», nor notice their absence in the parallel reports on the phenomenon.

³³⁴ See above, p. 49-50.

³³⁵ Cf. ADLER 1910, 141, who remarks that Plutarch's *quaestiones* in *Aet. phys.* «haud dussimiles sunt huius quaestiunculae: "Qua causa aër in lapidibus inclusus incendatur"».

to assimilate the air-mediated «voice» (φωνή)³³⁶ with a «projectile» (βέλος in *Fl.* 10.9) that knocks down the birds «by impact» (see τυπτόμενα τῆ πλῆγῃ in *Pomp.* 25.13); in both *Pel.* 19 (5) and *Caes.* 44 (8) Plutarch starts with a scientific, concise reference to the increasing impetus of runners during their run —of chariot-pulling horses in the former (again with an open negation of the air’s ῥέγνυσθαι)³³⁷, and of a charging army in the latter (whose φορά increases the «violence» of the «impacts», πλῆγαι)— to develop it into a psychological remark on the runners’ combusting «animosity» (θυμός), that their situation, metaphorically, συνεκκαίει (“contributes to ignite”, since the θυμός is likely to be stirred by other factors too)³³⁸. These two passages contain the only Plutarchan occurrences of συνεκκαίει I have not already touched upon above, and in both there may be an allusion to the ignition of flying bullets, a concrete frame of reference whose relevance is reinforced, in *Caes.* 44, by the coupling of συνεκκαίει with ἀναρριπιζόμενον, i.e. «fanned up» (referred to τὸν θυμόν); if any unspoken physics can be extracted from these metaphors, it can only be a physics of “fanning” (not of chafing!) in its correlation with a body’s high-speed motion, which results in an increase in heat. As we have seen, this is probably coherent with *antiperistasis*, which in turn is incompatible with any «rupture» (ῥῆξις or ῥέγνυσθαι) affecting air — any of such fractures, it is clear, would be instantly filled-up with whirling motion, not allowing emptiness to exist.

It only remains to explain how Plutarch, in Lamprias’s reference to projectiles in *Lun.* 5, could conceive the impetus to be the cause of their internal air’s combustion. Taking inspiration from the “fanning” in *Caes.* 44, and remembering the τρέφουσι referred to winds in *Aet. phys.* 8, we may perhaps suppose that the projectiles, in piercing air, might be understood to consistently receive inside them masses of its particles, penetrating in their textures due to the strong push of *antiperistasis*³³⁹; these particles, increasing the availability of fuel for the heat already present in the projectiles, would aid its expansion to the point of it being strong enough to burst in flames (in this scenario, συνεκκαίει would have the meaning of “participating in kindling”). Considering, however, that Lamprias makes no reference to such a penetration; that the ‘static’ way he presents the internal air suggests that he conceives it to be inside the projectiles from the beginning of the throw up to the ignition (without implied variation of quantity); and that stone and lead, as paradigms of ‘cold’ substances³⁴⁰, can hardly be implied to contain heat (or enough for it to be kindled to fire by fanning), this

³³⁶ On air as the medium of sound see Plutarch’s remarks in *QConv.* VIII 3.2 3 721^{D-F} (discussed above, p. 28-30), which are associated, perhaps not coincidentally, with an open rejection of the Epicurean void.

³³⁷ Ghilli in PIERANGELO FABRINI, GHILLI, AND BOCCI 1998, n. 168 informs us that SORDI 1989, 125–26 —in Ghilli’s words— «ritiene che queste considerazioni non appartengano a Plutarco, ma alla sua fonte». I verified Sordi’s paper and could not find anything corresponding to Ghilli’s report.

³³⁸ At the chariot, it is the horses’ «competition» (ἄμιλλα) to stir the animosity, while in the army it is its nearing towards the enemies: notice the coherency of the metaphor with Plutarch’s metaphorical uses of ἐκκαίει in connection with ζήλοστυπία and φιλονικία (above, p. 75 n. 303).

³³⁹ On particles of air penetrating solid textures in the frame of its *antiperistasis* cf. below, p. 166-70.

³⁴⁰ See e.g. *QConv.* VI 5 691^B, in my quotations above, p. 38-40 and below, p. 171.

interpretation proves to be unlikely. Perhaps, then, it could be literally «impetus» to make the air combust, which might also be the implicit reason why the air of *Frig.* 21 can «by itself» flare up and manifest as flashes, coherently with the Aristotelian associations between κίνησις and heat (as in *Cael.* II 7) — if purified, of course, from its reliance on “rubbing” and on “impact”. Both the air inside flying stones, then, and that inside flying lead might «combust» for the extremely high speed it reaches, not being able to escape freely from the solid texture trapping it. Its turning into fire, both thinning its particles³⁴¹ and rarefying its mass³⁴², induces it to escape through the projectiles’ pores³⁴³. In so doing, it causes the lead’s liquefaction due to its heat, and provides to the falling aeroliths or meteors (if the stones are indeed to be identified as such) their flaming trails and incandescent look³⁴⁴. In this etiology, despite the heating of moving bodies being generally associated by Plutarch with fanning, the “fanning” of *antiperístasis* would have no relevance; a possible explanation for this apparent inconsistency in ‘thermodynamics’ might be the close connection, in the meteorological debate, of the example of igniting bullets with the etiology of lightning bolts, whose flaring, despite their assimilation with projectiles, was probably not explained by Plutarch by application of the ‘fanning’ framework, but by reference to the air’s self-ignition at high speeds.

³⁴¹ Cf. *Lun.* 5 922^B (discussed above, p. 52); note that this is just a few lines above the reference to combusting lead and stone.

³⁴² Cf. *Frig.* 14 951^A.

³⁴³ On the pores of stones and metals cf. above, p. 28-30 and below, p. 163-70.

³⁴⁴ Cf. above, p. 57-60.

6. ‘Steeling’ water with cold lead and pebbles

Frig. 21, in addition to connecting the origin of lightnings with the air’s self-ignition, is also the chapter containing the information on the difference between the earth on surface —a «kneaded mixture» with the other elements— and the unadulterated earth in the depths, which I have shortly reported above³⁴⁵; it expands on the theory of stone as an earthy *págos* introduced earlier in chapter 19 (953^{E-F}), which I have already commented on as well³⁴⁶. Now, considering its context and the parallels we have already noted between this and *QConv.* VI 5, i.e. the *quaestio* on the refrigerating *ákmones* and «pebbles»³⁴⁷, it might not be coincidental that also *Frig.* 21 includes a reference to the act of plunging *χάλικες* in water in order to cool it (955^B). Before quoting it, it is useful to go back to *QConv.* VI 5 and complete our account of the etiology it contains. Plutarch’s character, here, not only connects the refrigeration first with a mechanical reflection of cool air into the depths —due to the stone’s (or lead’s) high density—, and then to an active property of the density of stone —as rooted in a process of deep freezing—, but also mentions another dynamic, which would account for the refrigeration as a less direct effect of the immersion (691^{A-B}):

κατ’ἄλλον δὲ τρόπον εἰκός ἐστι τὰ λεπτότερα τῶν ὑδάτων περιψύχεσθαι μᾶλλον ὑπὸ τοῦ ψυχροῦ· κρατεῖται γὰρ δι’ἀσθένειαν. αἱ δ’ἀκόνοι καὶ οἱ χάλικες λεπτόνουσι τὸ ὕδωρ, ὃ τι θολερὸν καὶ γεῶδες ἀναμίχεται, τοῦτο συνάγοντες καὶ κατασπῶντες ἀπ’αὐτοῦ, ὥστε λεπτότερον καὶ ἀσθενέστερον τὸ ὕδωρ γεγόμενον μᾶλλον ὑπὸ περιψύξεως κρατεῖσθαι. καὶ μὴν ὃ τε μόλιβδος τῶν φύσει ψυχρῶν ἐστίν [...]· οἳ τε χάλικες πυκνότητι τὸ ψυχρὸν διὰ βᾶθους ποιοῦσιν [...]· ὥστ’ οὐκ ἄτοπον, εἰ τὴν ψυχρότητα τοῦ ὕδατος ἀντερείδων συνεπιτείνει καὶ ὁ λίθος καὶ ὁ μόλιβδος.

[explaining] in another way, it is also likely that the thinner waters are cooled more by the surrounding cold: in fact, they are overpowered due to [their] weakness. Now, both the [lead] ‘whetstones’ and the pebbles make the water thinner, gathering and drawing down from it the turbid and earthy parts that have become mixed [with it], so that the water, having become thinner and weaker, is more easily (or quickly, thoroughly, etc.) overpowered by the exterior cooling. And, indeed (or moreover), both lead is among the naturally cold [substances]» [...]; and the pebbles with [their] density produce the cold in the [water’s] depths [...]: it is thus not strange, if both the stone and the lead, exerting counter-pressure, contribute to intensify (lit. tighten) the water’s coldness.

³⁴⁵ See above, p. 66-7.

³⁴⁶ See above, p. 40-2.

³⁴⁷ See above, p. 27-8, 38-40.

In the first part of the quotation, the stones and leaden «whetstones» —notice the substitution with the term *akónai* of the earlier *ákmones* (“anvils”)— are credited with a sort of suction effect (see *κατασπώντες*) concerning the earthy particles specifically (the *θολερὸν καὶ γεῶδες*). One might feel inclined to explain this selectivity by supposing that earthy substances are regarded to have a sort of kinship with lead and stone, leading them to converge around them in a similar way to Lamprias’s stone presented in *Lun.* 8 (924^{D-E}), as something necessarily falling back to earth after being lifted from it (*i.e.* a *προσῆκων* returning *πρὸς οἰκεῖον*)³⁴⁸; this solution, however, is by no means obvious and cannot be supported by other passages: the large-scale cohesiveness of the earthy region is assumed by Lamprias in both *Lun.* and *Def. orac.* to be dependent on a cosmic rationale which does not necessarily also apply to ground-level phenomena³⁴⁹, and we will see that even in the etiology of magnetism Plutarch tends to reject the widespread theories based on *sumpátheia*³⁵⁰. The refrigerating “drawing down”, therefore, is likely to be dependent on a different principle, of which I will later propose my interpretation: this will be aided by the assumption that this answer in *QConv.* VI 5 is not to be understood as an alternative to the additional considerations following it (introduced by *καὶ μὴν*, either asseverative or introductive), and will be inspired by an analysis of the close parallelism between this etiology and the second answer in *Aet. phys.* 10 (914^{D-E})³⁵¹. For the moment, we can provisionally suppose that Plutarch, in referring to the “drawing down”, might have also (or exclusively) been inspired by empirical observation. If this is the case, it is possible that Plutarch observed that the submersed pebbles tend to become progressively coated in limescale, while the water’s heavy impurities precipitate on their surface³⁵²: this should also happen to the containers’ internal bottom, of course, but the pebbles could probably make it more noticeable, thanks to the possibility of closely examining their covering by taking them out of the water.

In whatever way Plutarch supposes this ‘suction’ to work, and whatever grounding it has, its effect is clearly presented as a redistribution of the water’s parts: while the earthy parts sink to the bottom, the purely watery parts, as a result, stay up above it³⁵³. Their mass becomes thus thinner (see *λεπτότερον*) as soon as it is freed from the thick impurities³⁵⁴, and the result of such a thinning is a decrease in their resistance towards changes in temperature (see *ἀσθενέστερον*), coherently with the Platonic ‘micro-chemistry’ expounded in *Tim.* (57^{A-B})³⁵⁵; it is noteworthy that the term of comparison for the water’s “weakness” is the external coldness (see

³⁴⁸ See above, p. 24-6.

³⁴⁹ See above, p. 18-22, 24-6.

³⁵⁰ See below, p. 160 with n. 643 and p. 162-3.

³⁵¹ See below, p. 138-40.

³⁵² Cf. Hoffleit in CLEMENT AND HOFFLEIT 1969, who translates the *συνάγοντες καὶ κατασπώντες* in *QConv.* VI 5 691^{A-B} as «they collect and precipitate».

³⁵³ *Contra* TEODORSSON 1989b, n. to 691 B: «the reasoning is confusing indeed. It is hard to conceive that Plut. actually means that pebbles or pigs of lead put into a water container purify the water. One would suppose that he (or his source) thought of the limpid waters flowing over stony river-beds and so concluded that the stones are the cause of the purity».

³⁵⁴ *Contra* VOLPE CACCIATORE 2007, 100: «i pezzi di piombo e i ciottoli, se gettati nell’acqua, la rendono pure più leggera [!]».

³⁵⁵ See above, p. 52 n. 196. This is also coherent with Peripatetic physics, of which I will provide an example below, p. 188-93.

περιψύχεσθαι and περίψυξις), and therefore, implicitly, the cool air: this is coherent with the first explanation proposed by Plutarch’s character in the *quaestio* (690^F-691^A), accounting for the cooling as a direct effect of air and an indirect effect of the pebbles’ density, which allows them to oppose the air and reflect it back into the fluid (remember *στέγοντες ἀνακλώσιν*); an idea which also appears to return in the participle *ἀντερείδων* («exert counter-pressure») in the final sentence of the etiology (quoted above), suggesting that none of the answers proposed by Plutarch to the *quaestio* are meant to exclude one another, but to be all possibly valid at the same time.

In any case, the answer centred on the “drawing down” is followed by Plutarch’s reference to a direct refrigeration (691^B), and this is the account we find in *Frig.* 21, where it is used as a further proof of the earth’s intrinsic coldness (955^B):

οἱ δὲ ψυχροτέρου ποτοῦ δεόμενοι χάλικας ἐμβάλλουσιν εἰς τὸ ὕδωρ· γίγνεται γὰρ οὐλότερον καὶ στομοῦται παρὰ τὴν ἀπὸ τῶν λίθων ψυχρότητα, πρόσφατον καὶ ἄκρατον ἀναφερομένην.

And those who need a cooler drink throw pebbles into the water: in fact, it becomes more compact and *stomoũtai* due to the coldness from the stones, which is brought up fresh and unmixed.

Coldness is clearly presented as a direct emission of the «pebbles» themselves. It is «fresh and unmixed» as it is not adulterated (yet) by the progressive “kneading” of the elements occurring on the surface of the earth: the adjective *ἄκρατον*, indeed, is the same Plutarch had used in chapter 19 for the extreme coldness of the underground, described to be «unmixed and unsoftened» due to its being «thrust away in the farthest place from aether» (953^{E-F}). Now, some interpretation issues may be raised by the expressions «more compact» (*οὐλότερον*) and *stomoũtai*, which are ambiguous and may not seem to be directly relevant to the phenomenon. The importance of the verb *stomoũsthai* is confirmed by the fact that it is also used at the beginning of *QConv.* VI 5, right when Plutarch’s character introduces the problem: «“but then, do you remember” —I said— “about the pebbles or the ‘anvils’ (*ákmones*), which when thrown into the water appear to cool and *stomoũn* it, as was told by Aristotle?” “he mentioned this phenomenon” —he (*scil.* the guest) said— “only among *problémata*, but let us get our hands onto the cause; it is indeed extremely hard to understand”» (690^F). In this introduction, Plutarch explicitly links his *quaestio* to an original Aristotelian report which did not contain a satisfying explanation³⁵⁶, and it is not unlikely that his seemingly gratuitous use of the verb *stomoũsthai* might be meant to quote the Aristotelian text *verbatim*, like the unusual —and soon discarded— term *ákmones*.

³⁵⁶ He does something similar in *QConv.* III 3, 650^A. SANDBACH 1982, 210–11 offers a list of Plutarch’s unspecific citations of Aristotle that may be interpreted to refer to *Problémata physiká*; on Plutarch’s relationship with the Aristotelian *problémata*-literature see above, p. 5 with n. 15.

The verb is not easy to translate, but like the «anvils» pertains to the semantic sphere of ironworking: *stomoŭsthai*, as a derivative of *stóma* (“mouth”, hence “point” or “edge” of a weapon or tool)³⁵⁷ may be literally translated as “provide an edge”, but the process it generally refers to is not that of a simple “sharpening” or “pointing” (as in *θήγειν* or *ἀκονᾶν*, *i.e.* “rub with an *akónē*”)³⁵⁸, but the preparation or production of a hardened edge or point³⁵⁹, and therefore either the “reinforcement” of a part of a piece of iron by heat treatment (*i.e.* quenching, tempering, or annealing)³⁶⁰, or the “steeling” of a piece of wrought or cast iron³⁶¹ to make it suitable for quenching (*i.e.* fast immersion of the incandescent iron in a liquid medium, which in appropriate conditions results in an increase in hardness)³⁶²; quenching is useful as a non-hardened edge, in addition to having an inferior cutting power, is of course more easily blunted³⁶³. The material product

³⁵⁷ See CHANTRAINE, *s.v.* ‘στόμα’: «“bouche, gueule, embouchure, entrée” d’où “ce qui est en avant (et qui mord ?), pointe” ou “tranchant” d’une arme, “front de bataille”, etc.»; BEEKES, *s.v.* ‘στόμα’: «mouth, muzzle, front, peak, edge».

³⁵⁸ On sharpening see below, sec. 8.2.

³⁵⁹ See BLÜMNER 1887, 342–46; CHANTRAINE, *s.v.* ‘στόμα’, *στόμωσις*: «action de tremper, durcir»; HALLEUX 1974, ann. 3 par. 14 (eBook version), or 2007, 1302–3 (the differences between this and his former treatment of the subject are minimal); BEEKES, *s.v.* ‘στόμα’, *στομώω*: «to stop the mouth, provide with an opening, edge, to harden»; *στόμωσις*: «‘hardening’ (S., Hell. And late)».

³⁶⁰ On these operations see especially CONGDON 1971; see also *e.g.* FORBES 1964D, 210–11; RAMIN 1977, 164; HEALY 1978, 233–34; CRADDOCK 1995, 237–38. On annealing see below, p. 118 with n. 488 and 490.

³⁶¹ Iron can be referred to as “wrought iron”, “steel” or “cast iron” on the basis of its carbon content in solid solution: “wrought iron” has up to 0.04% carbon (SIM 1998, 151); “cast iron” has 1.8–4.5% carbon (*ib.*, 149) and a much lower melting point to that of wrought iron (respectively, 1150–1200 °C and 1500 °C, CRADDOCK 2003, 232); “steel” is between these extremes (and of best quality with around 1.00% carbon, see following footnote). The common way, in antiquity, to smelt the iron from iron ores (most generally haematite and magnetite, see HEALY 1978, 39–41) was by reduction of their iron oxides with carbon in a furnace known as “bloomery”: from this process resulted a “slag”, containing a large part of the non-ferrous impurities (“gangue”) expelled in liquid form—and then solidified again—and a spongy mass of iron called the “bloom”, which after repeated hammering and re-heating (required to remove as much of the slag incursions as possible) eventually became wrought iron (see *e.g.* HEALY 1978, 182–89; CONOPHAGOS AND PAPADIMITRIOU 1986, 133–35; CRADDOCK 1995, 241–50; 2003, 232–34); wrought iron, therefore, had to be turned into steel by the artificial raising of its carbon content, *i.e.* by “carburization” (see below, p. 90 n. 366). There exists no evidence that cast iron was widely used in the Roman world, where it seems to have rather been regarded as an undesirable by-product; in fact, it was too brittle to endure hammering or shaping, and it seems that the technology of “fining”, *i.e.* conversion of cast iron into steel or wrought iron by controlled lowering of the carbon content (obtained by stirring it in molten form in an open vessel or hearth), was not in use in the ancient West (see CRADDOCK 2003). However, see below, p. 107.

³⁶² When the iron’s carbon content is too low (see previous note) the solid solution is indifferent to quenching, since the fixing in place (obtained through quenching) of the carbon’s particles into the phase called “martensite” (an arrangement which is obtained by heating the solution of iron and carbon above the eutectoid point, *i.e.* ca. 723 °C, and then cooling it as fast as possible after extraction from the hearth) is what determines the increase in hardness of the material, so that the obtainable hardness is directly proportional to the carbon’s quantity in the solution (see *e.g.* CONGDON 1971, 20, 22). Since the increase in hardness is directly proportional to an increase in brittleness, a prerequisite for a quench-hardened iron tool or weapon to be useful is for its carbon content not to be too high (otherwise, the object would fracture very easily): this would surely be the case with “cast iron” (on which see preceding footnote). JERNBERG 1918, 94 considers 0.90–1.20% to be the best range of carbon content for a successful quenching, and claims that the increase in brittleness only starts to occur above 0.90% (while that in hardness is also noticeable below this point); cf. OBERG AND JONES 1918, 111, who claim that steel «begins to show an appreciable hardening effect when cooled quickly» when its carbon content is above 0.20%, while the increase in brittleness starts to manifest above 0.70%.

³⁶³ Although a steel edge which has not received quench-hardening would have in any case superior hardness to a bronze edge (on copper and bronze weapons see below, p. 174–8), such superiority would be limited without the complement of quenching; see *e.g.* VERHOEVEN, PENDRAY, AND DAUKSCH 2016b, 2259: «the blacksmiths had to heat their blades to forge them. As shown in this work [*scil.* in this experimental replication], in the final stages of forging a blade they had heated it up to the temperature range of 1000–

of the *stómōsis* is referred to as *stómōma* (corresponding to Latin *acies*)³⁶⁴, which can be identified, depending on the context, as either the zone of a steel tool or weapon —normally its point or edge— that has been locally hardened in a distinct way from the rest (in the case of differential heat treatments such as tempering)³⁶⁵, or to a piece or leaf of iron that has been subject to steeling (generally by means of carburization)³⁶⁶, and is thus ready to either receive further working —which will be followed by heat treatment—, or be forge-welded to other non-steeled pieces of iron —even fully-made iron tools— to reinforce them with a harder part³⁶⁷; considering this latter procedure, it is not unreasonable to suppose that the verb *stomōũsthai* might have also

1150°C for 5 min, and then water-quenched it to cool it down faster, they would have produced a blade that was file hard on the edge, a hardness of 700–800 DPH, compared to their best bronze blades of hardnesses of only 270 DPH. In addition, if they had simply air-cooled a blade with a thin edge, they would have produced a blade with surface hardnesses of 360–370 DPH.

³⁶⁴ See CHANTRAINE, *s.v.* ‘στόμα’, στόμωμα: «“embouchure” [...] mais généralement “fer trempé”, etc., parfois au figuré [...]»; BEEKES, *s.v.* ‘στόμα’, στόμωμα «‘mouth’ (A.), ‘hardening, which is hardened, steel’ (Cratin., Arist., Hell. and late)». I do not agree with translating στόμωμα as “hardening” (*i.e.* the operation of), which is rather indicated by στόμωσις; nouns formed by the suffix -μα express principally the result of an action (see *e.g.* HEILMANN 1963, 135–36) rather than the action itself. BLÜMNER 1887, 343 with n. 6 wrote that στόμωμα was also used for «die Eigenschaft des Gestähltseins, die Verstählung», but in support of his claim he mainly cited Plutarchan *loci*, where the reference, according to my scrutiny, is rather always to a concrete steeled part of iron (*i.e.* never to an abstract property or to the hardening process). See also also BÜLOW-JACOBSEN 2016, who is the first to take into account the documentary evidence, attesting to the existence of a specific commerce of ready-made *stomōmata* to be welded into cutting tools (whose points or edges were exposed to degradation). Cf. the quite inaccurate LE COZE 2003, 16 («the word στομωμα (plur. στομωματα) means “cutting”»), somewhat improved in 2020, 44 («*Stomoma* [...] signifie *tranchant d’une lame*»).

³⁶⁵ On tempering see *e.g.* FORBES 1964D, 210 («tempering was a Roman achievement as it seems»); CONGDON 1971, 21; HEALY 1978 («the Romans undoubtedly practiced tempering. Plutarch refers [in *Adul.* 36 73^C] to a process which can be regarded as tempering»; actually, it is safer to interpret the process there described by Plutarch as quenching, perhaps at the end of a steeling procedure); CRADDOCK 1995, 237.

³⁶⁶ Carburization of wrought iron (on this kind of iron see above, p. 89 n. 361) could be obtained by heating the iron in a furnace environment with a high presence of carbon oxide, generated by the burning of coal: the carbon atoms would dissolve into the iron and increase the carbon content of the solid solution; on this process, known as “cementation”, see especially VERHOEVEN, PENDRAY, AND DAUKSCH 2016a; 2016b, who replicated it experimentally. In this procedure, the penetration of the carbon atoms would not be deep, and only a superficial stratum of the iron would result in steel (while the inner part would remain softer): this form of cementation is referred to as “case hardening”. To obtain a more thorough distribution of the carbon content, the blacksmiths could proceed to either bend and hammer the iron multiple times, or forge-weld multiple steeled strips in a pile, to be twisted and hammered repeatedly: see LIVADEVS 1956, 61–62, whose analyses show that this technique was indeed used for the steel dowels and clamps used to stabilize the Parthenon’s walls (similar analyses in CONOPHAGOS AND PAPADIMITRIOU 1981, who found the same internal stratification in dowels and clamps from the Erechtheion); see also the following footnote and below, p. 91 n. 369. In antiquity, of course, nothing was known about carbon atoms, and the procedure was surely understood in different terms (see below, p. 105-11). Wrought iron can be also carburized by means of fusion in a crucible, in association with either carburising materials or cast iron, but there exist no evidence that this technique was used in the Graeco-Roman world: see CRADDOCK 2003, 242–48. Another way of homogenizing the distribution of carbon atoms is to melt a carburized piece of steel in a crucible, but apparently the Romans also ignored (or disregarded) this technology (see *ib.*). At p. 243-4, Craddock drew attention to an alchemical text on «the tempering of Indian iron» (CAG II 347-8, transl. III 332) which he presented to be «the earliest unequivocal reference to crucible steel»; its supposed dating to the III cent. CE is based on Craddock’s identification of the author as Zosimus (already declared in 1995, 279), but the problem is that this text is nowhere associated with the name of Zosimus, despite Craddock, for undiscernible reasons, giving his authorship for granted. The recipe was recently edited in HALLEUX AND EL GAMMAL 2021, 57–73, who show that its dating is highly uncertain and may be even placed in the Byzantine period (see their n. 1 to the text with p. 41-2).

³⁶⁷ On the welding of *stomōmata* to iron tools see BÜLOW-JACOBSEN 2016. On the pattern welding of steel swords see below, p. 91 n. 369.

been used to refer to the “welding of a *stómōma*”³⁶⁸, and possibly even to the production of faggotted iron (a forge-welded pile of steeled leaves alternated with leaves of wrought iron)³⁶⁹. It is easy to see that this term is extremely ambiguous, and context is not always sufficient for disambiguation; in the case of Plutarch we can at least be sure that he tended to associate *stómōsis* with “quenching” (βαφή or βάπτεσθαι, lit. “immersion”)³⁷⁰. This might also apply to his understanding of the metaphorical *stomoũsthai* in *QConv.* VI 5 and *Frig.* 21, perhaps based on an analogy between the refrigerated water and the abruptly cooled-down incandescent steel; indeed, Plutarch had used precisely this analogy in *Frig.* 20, not many lines above our passage, to convey a similar message: «and then, again, in summer we desire the [water which is] earthborn and terrestrial due to the heat (καῦμα), not as it is itself cold, but as it shoots forth from that which is by nature and primarily cold, and dipped (βεβαμμένον) by the power (δύναμις) in the earth like iron by means of quenching (βαφή)» (954^C). Plutarch’s *stomoũsthai* certainly refers to a similar idea³⁷¹, but I am going to show that there might be more to it, possibly in a way that justifies its coupling with οὔλοτερον and the presence of some details in the etiology in *QConv.* VI 5.

For the moment, let us focus on the adjective οὔλος: this term—which in Plutarch’s *corpus* only appears two more times—originally designated in Greek a “frizziness” or “woolliness” specific to textiles, hairs, and plants with curving offshoots, which was later extended (at the latest in Theophrastus) to the “compactness” of wood fibres, then leading (at the latest in Callimachus) to its metaphorical use for “rapidity” or “concision”³⁷². It is unclear in what sense Plutarch used and understood the term: it does appear in its original sense in *Cim.* as referred to Cimon’s «frizzy and abundant hair» (5.3), but Plutarch frames this information as a testimony of Ion of Chios (= *FGrH* III 392 F 12; V cent. BCE), whom he might have partially quoted *verbatim*. In *Garr.*, instead, his use of the adjective is clearly metaphorical in its temporal sense, occurring as

³⁶⁸ To my knowledge, the first to propose this interpretation is BÜLOW-JACOBSEN 2016, based on documentary evidence (see above, p. 90 n. 367).

³⁶⁹ On this technique, called “pattern welding”, see e.g. FORBES 1964D, 272; TYLECOTE [1976] 1992, 66.

³⁷⁰ This was already pointed out, without specific commentary, by LEE 1952, 327–28 and by HALLEUX 1974, ann. 3 par. 15 with n. 38 (eBook version); this latter, among the «témoignages qui mettent en rapport trempe et στόμωσις» cited Plutarch, *Adul.* 36 73^C, *Def. orac.* 41 433^A, *QConv.* VIII 9.3 734^A, *Lun.* 28 943^P; and among the testimonies on «la trempe en général» *Alc.* 6, *Sanit.* 23 136^A, *Vit. pud.* 4 530^C, *Frig.* 13 950^C and 20 954^C (which I quote below); he repeated the list in HALLEUX 2007, 1304 n. 21 and in ID. AND EL GAMMAL 2021, 66 n. 22; I will comment on some of these passages and others below, p. 179-80 n. 724 and p. 182-86.

³⁷¹ Cf. the following translations of the verb *stomoũsthai*: in *Frig.* 21 955^B, with γίνεται... οὔλοτερον, Fetherston in GOODWIN [1874D] 1878 («it becomes denser and quicker to the taste», discussed below), Helmbold in CHERNISS AND HELMBOLD 1957 («which becomes thicker and denser»), VOLPE CACCIATORE 2007, 100 n. 13 («diviene più increspata e quasi [?] si addensa»), Nuzzo in D’IPPOLITO AND NUZZO 2012 («diviene più densa e aumenta la sua forza»); in *QConv.* V 5 690^F, with ψύχειν, Creech in GOODWIN [1874b] 1878 («they temper and cool it»), Hoffleit in CLEMENT AND HOFFLEIT 1969 («to cool and temper it»), FUHRMANN 1978 («la rafraîchir et la condenser»), VOLPE CACCIATORE 2007, 100 n. 12 («raffreddarla e indurirla»).

³⁷² See the lemma in CHANTRAINE, s.v. ‘2 οὔλος’, and BEEKES, s.v. ‘οὔλος 2’. Cf. LSJ, s.v. ‘οὔλος (B)’, who also report a very early use of the term as a metaphor for “quick succession”, namely in *Il.* XVII 756 and 759, as referred to cries: οὔλον κεκλήγοντες («uttering quick (frequent) cries»); however, they themselves invite to also consider for this case the homonym s.v. ‘οὔλος (C)’, which means «destructive, baneful, cruel»: in its definition, they interpret the same expression of *Il.* as referred to «the death-cry of birds flying from the hawk». On the different interpretations of these lines see EDWARDS 1991, 137, n. *ad loc.*

the adverbial οὔλα in reference to the quick-speaking of the wiser βραχυλόγοι (“short in speech”): these, Plutarch reminds, are precisely those who «Plato praises [...], saying that they resemble skillful javelin throwers, speaking οὔλα, densely (πυκνὰ) and συνεστραμμένα» (17 510^E — on this I will return below). In the passage of *Protagoras* here alluded to (342^E), which includes the analogy with javelin throwers, Plato does not use the adjectives οὔλος and πυκνός, but instead the pair βραχύ («short») and συνεστραμμένον, as referred to a «remark» (ῥῆμα). Now, the verb συστρέφεισθαι, which is thus the only word not introduced by Plutarch in his trio of qualifiers, refers literally to a “curling” or “twisting” of one thing onto itself or of multiple things into a compact whole, and is also well attested as a metaphor, or metonymy, for any kind of “gathering” (consider also its analytic meaning “turn towards a common point”); a semantic field which is compatible with both the “denseness” of πυκνὰ and the “woolliness” of οὔλα, and may be interpreted as a sort of unifying ground between these two related concepts. Considering the association between these terms in Plutarch’s passage, then, it is likely that he understood the three to be similar in meaning, so much that they could be used as almost-synonyms, cumulatively, in the same metaphor for temporal concision (in *Garr.* 17)³⁷³; the adjective οὔλος, we can conclude, is probably more about “compactness”, for Plutarch, than about a “frizziness” or “crispness”³⁷⁴. In this understanding, he might have been influenced by Theophrastus, who in *HP* not only uses the adjective many times, unambiguously, in the sense of “dense” —although always referring it to the texture of wood—, sometimes even coupled with πυκνός or explicitly opposed to μανός (“loose”)³⁷⁵, but is also the only author predating Plutarch in associating it with the verb συστρέφεισθαι: indeed, when describing the «male» variety of the maple tree, he writes that its ξύλα are οὔλότερα συνεστραμμένα (III 11.3), *i.e.* “of a more tightly intertwined texture” than the female’s³⁷⁶.

³⁷³ On this metaphor I will return below, p. 99-101.

³⁷⁴ I therefore agree with the translation by DEFRADES AND DUMORTIER 1975 («parce que leur langage est dru, solide et ramassé»); cf. HELMBOLD 1939 (“for what they say is crisp, solid, and compact”), with his n. c *ad loc.*: «that is, they speak, as the acontist throws, with the sure aim which puts the adversary to rout with a single cast». Cf. also Philips in GOODWIN [1874c] 1878, who does not interpret the temporal ‘compactness’ to refer to concision, but to high frequency («darting forth their sentences thick and close, as it were crisped and curled one within another»).

³⁷⁵ For the couple πυκνός καὶ οὔλος see *e.g.* *HP* III 2.3, IV 1.4, VII 4.6; for the opposition between μανός and οὔλος see III 11.4 and 11.2 (quoted in the following footnote).

³⁷⁶ Cf. the different translation by HORT 1916 («is of compacter texture and twisted»), which would only be defensible if Theophrastus had used a καὶ. It is also useful to read some of the lines preceding the quotation, to observe Theophrastus’s oscillating lexical choices in his repeated focus on the density and looseness of wood texture: «The difference between *zugía* and maple proper is that the latter has white wood of finer fibre (εὐνότερον), while that of *zugía* is yellow and of compact texture (οὔλον). [...] The bark too is somewhat rougher than that of the lime, of blackish colour thick closer (παχὺν καὶ πυκνότερον) than that of the Aleppo pine, and stiff (ἀκαμπῆ) [...]. But the people of Mount Olympus say that, while *zugía* is rather a mountain tree, the maple proper grows also in the plains; and that the form which grows in the mountains has yellow wood of a bright colour, which is of compact texture (οὔλη) and hard (στερεά), and is used even for expensive work, while that of the plains has white wood of looser make (μανοτέρα) and less compact texture (ῥῆτον οὔλη) [...]» (*HP* III 11.1-3, transl. HORT 1916).

All this evidence suggests that the ούλότερον in *Frig.* 21 (955^B) should be interpreted as pointing to an increase in the “compactness” of the water’s texture, following the action of the pebbles. This is not a trivial conclusion³⁷⁷, and brings new issues to the table. The first problem is that it is unclear how the information should be relevant to the context, because the plunging of the pebbles is not described to be instrumental in increasing the water’s denseness, but only as a means to refrigerate water for those who need it «colder»: it is true that cooling normally increases denseness³⁷⁸ and that water is expected to thicken when refrigerated, as it begins its transition into ice³⁷⁹, but it may seem somewhat gratuitous for Plutarch to specify it in this passage, since it is unclear how the information could contribute to the discourse. It is natural to interpret the epexegetic sentence it is included in (introduced by γάρ) as an immediate clarification of why people plunge the «pebbles» in water —and, implicitly, of why the phenomenon is relevant to proving the earth’s “primary” coldness—, but the mention of a “thickening” effect, even coupled with *stomoïsthai*, seems to overcomplicate the matter rather than making it more understandable. It would be strange if these effects were mentioned as intuitive, observable phenomena to illustrate that water does get colder, because they do not really seem observable: if, on one hand, the verb *stomoïsthai* might be used as a simple metaphor for cooling, on the other hand it is hard to imagine that Plutarch’s contemporaries could feel or see the water becoming «more compact» as a direct effect of the pebble’s plunging; if there was any condensation, it is likely that it was too slight to be even noticeable. Perhaps, as I have suggested for the introduction to *QConv.* V 5, the verb *stomoïsthai* might be also meant in *Frig.* 21 to quote the original text attributed to Aristotle, despite the philosopher not being here explicitly named; if this is true, this might also apply to the adjective ούλος —which we have seen being very rare in Plutarch’s *corpus* but quite frequent in Theophrastus’s—, and the epexegetic clause be simply functional to connect Plutarch’s reference to the refrigerating pebbles with the authoritative Aristotelian formulation. In addition to this intertextual allusion, Plutarch might have also wanted to refer to the relieving effect of a higher concentration of water on a very thirsty organism; in fact, we have seen that in *Frig.* 20 Plutarch uses the analogy of «quenching» (βαφή) in connection with our summer desire for cold drinks, and it might not be a coincidence that in *QConv.* II 2 —another *quaestio* based on an Aristotelian claim (635^B)— his character presents (635^{C-D}) the same seasonal increase in thirst to be associated with our higher need for «moisture» (τὸ ὑγρόν) due to the «heat» (καύμα), and that in VI 2.2 (687^D-688^A), in explaining the cause of thirst, he insists on the natural function of human appetites as means for filling the deficiencies in our «temperament» (κράσις): perhaps, he might have thought that a cooler sip of water fulfills our desire more as its ούλότερος texture allows more of its parts to enter our body at the same time, thus compensating more,

³⁷⁷ See the varying translations I have reported above, p. 92 n. 374.

³⁷⁸ See *e.g.* above, p. 38-41.

³⁷⁹ Cf. *e.g. Aet. phys.* 7 914^A.

simultaneously, for both the *κρασις*'s lack of coldness and its lack of moistness; a more “concentrated” water, when the thirst is scorching, might be more relieving than a looser³⁸⁰.

Plutarch's use of the adjective, however, might have even subtler implications. To see these, let us test it against the second explanation in *QConv.* VI 5 (691^{A-B}). The supposition that the water is made «thinner» (*λεπτότερον*) by the pebbles, thereby becoming «weaker» against the external cooling, might seem to be in contradiction with the idea of water getting «more compact» through their same action; in fact, it is intuitive that a higher concentration of matter, although possibly consistent with the “thinning”, should increase its resistance against opposing forces, rather than reducing it. This is not necessarily an issue, of course, as there is no need to assume that the second explanation of *QConv.* VI 5 was anything more than a disposable hypothesis: the *καὶ μὴν* which follows it may still be interpreted to introduce a new and non-cumulative answer—the one compatible with the remark in *Frig.* 21—, and Plutarch might have been more convinced by this than by the one preceding it. Nevertheless, a unified interpretation might be also possible. It is important to remember that the increase in the water's “thinness”, in *QConv.* VI 5, is supposed to be the result of a precipitation of its «turbid» parts: these, being «earthy» and coarser than the watery, contributed to the water's thickness and made it more resistant against the external cooling; as soon as they are carried down below, we can infer that the watery parts, no more interspersed by the impurities, can finally gather into a purer mass: in this sense, the watery texture would surely become *οὐλότερος*, as its parts would finally draw closer to one another, there not being earthy parts obstructing their reunion³⁸¹. In *Pyth.* 4, Plutarch considers the possibility that the attribution to a same substance (*i.e.* the air at Delphi) of both the characters of «thinness» (*λεπτότης*) and «denseness» (*πυκνότης*) might be perceived as paradoxical, and has Theon defend it as a totally legitimate attribution, drawing attention to the densely woven textures of thin silk and *bússos* (396^B). The use in *Frig.* 21—or in its Aristotelian source—of the ‘textile’ *οὐλότερος* might have thus been intended to refer to the water's ‘purified’ compactness while avoiding the ambiguity of the term *πυκνός*: like compacted wooden fibres, wool, or hair (remember the original meanings of the term), the watery texture may be implied to become «more compact» without its parts becoming thicker; these, in fact, may even become thinner, as the reason of their ‘felting’ might be an expulsion of the thick impurities.

This idea may even be related with the metaphorical *stomoũsthai* of the water. In fact, to interpret this verb as a mere allusion to the act of “quenching” an object into a cooling agent might prove to be reductive, as this

³⁸⁰ Note that in the same *QConv.* VI 2.2, in connection with the etiology of thirst, Plutarch's character also refers to a particular dynamic related to the concentration of moisture, mentioning in 688^{C-D} that fevers, gathering the fluids at the bottom of our bodies, determine an increase in thirst as a drive to compensate the resulting dryness of the other parts. To this dynamic he refers again in 3.2 689^{E-F}, in which food under digestion substitutes the fevers as the agent of the moisture's concentration. FUHRMANN 1978, n. 1 *ad loc.* reports this part of the text finds a close parallel in Pseudo-Alexander, *PrIned.* III 51 Bussemaker: notice the recurrence of the connections with Aristotle, on this topic.

³⁸¹ For a similar idea of interspersion among the water's parts see *Frig.* 13 950^B, quoted above, p. 32.

act should probably imply some material consequences and preconditions. The intended implication of giving a *stómōma* to water, for example, might be that the water, increasing its coldness, acquires an ‘edge’ or ‘point’ with a superior ‘cutting’ or ‘piercing’ power; a metaphor, in turn, which would call for an interpretation. This might be taken to allude, perhaps, to an increase in the water’s effectiveness on the senses —as in the English metaphor of “crispness”—, which was reflected in the translation by F. Fetherston: «for it becomes denser and quicker to the taste» (*Frig.* 21 955^B)³⁸². This interpretation, however, does not seem to be supported by parallel passages: on one hand, the usual Aristotelian and Plutarchan terms for the activation of the senses are related to the verb κινεῖν (“move”)³⁸³, which does not imply any ‘cut’ or ‘penetration’³⁸⁴, and on the other, when Plutarch does use metaphors of ‘piercingness’ and ‘steeling’ for the intensity of perception, he does not relate them to the perceived object, but to the perceptive faculty itself³⁸⁵. The allusion, then, might perhaps be to a refrigeration tending to the extreme of ‘piercing cold’; however, as much as this metaphor can sound intuitive to an English speaker, it does not seem to be paralleled in the Aristotelian or Plutarchan *corpus*: we might find a faint trace of this association in an analogy quoted from Theophrastus in *Frig.* 16, in which cold air is said to break full vessels «using the moisture like a nail» (τῷ ὑγρῷ καθάπερ ἤλω χρώμενον, 952^{A-B}), but this is arguably not a sufficient proof of a tendential metaphorization of coldness as a ‘piercing’ thing³⁸⁶.

To find the best interpretation, then, we may start to consider the implications of an act of *stomoũsthai* that may be related to the water’s increase in “compactness”. An object which has become οὐλύτερος, for instance, might be understood to also increase its solidity and hardness, and of «more solid» waters it is indeed possible

³⁸² In GOODWIN [1874D] 1878.

³⁸³ See e.g. Aristotle, *An.* II 7 419^A14-6; *GA* V 2 781^A31-3; *Pr.* III 18 873^B31-2; and Plutarch, always referring to taste: *QConv.* I 7 625^B; IV 4.3 668^F-669^A; *Suav.* 3 1087e.

³⁸⁴ It is to be noted, however, that in acoustics Aristotle presents the «acute» (ὄξύ, *i.e.* sharp) sound to be perceived in a different way than the «heavy» (βαρύ, *i.e.* low): «the acute moves (κινεῖ) the sensation a lot (ἐπι πολὺ) in a short time while the heavy a little (ἐπ’ὀλίγον) in a long time» (*An.* III 6 430^A30-1). Cf. Plato, *Tim.* 80^{A-B} and Plutarch’s exegesis in *QPlat.* 7.9 1006^{A-B}: «the fast [sound] becomes acute, and the slow heavy; hence, the acute moves (κινουσι) the sensation before [...]», and «sound, in fact, is the impact made by air through the ears upon the percipient, for the air, when struck by the agent that moved it, strikes acutely (ὄξέως) if that agent is vehement and more softly if it is dull (ἀμβλύ!)» (transl. CHERNISS 1976a, slightly modified). The metaphorical frame of reference of “acuteness” for the intensity of perception seems to only apply to acoustics. Naturally, the «acute» also exists as a taste, *i.e.* the sour, but water does not increase its sourness when it cools.

³⁸⁵ See *QConv.* I 7 625^{A-C}, in the context of wine-drinking: «for the same thing occurs in regard to the old men’s perception of other stimuli; in apprehending sensations they are hard to stir and rouse (δυσκίνητοι... εἰσι καὶ δυσμετάβλητοι), unless these strike them with excessive strength. The cause is the relaxation (ἀνεσις) of their constitution; loosened out (ἐκλυομένη) and ill-strung (ἀτονουσα), it likes being struck (πλήττεσθαι)» (transl. based on CLEMENT in CLEMENT AND HOFFLEIT 1969, modified); the *quaestio* ends with this analogy: «in fact, what the *stómōma* provides to iron in relation to [its] edge (ἀκμή), this is what breath (πνεῦμα) provides to a body in relation to [its] perception; and when this (*scil.* the breath or *stómōma*) has given in (ἐνδόντος) and has relaxed (χαλάσαντος), it leaves the sense-organ idle (ἀργός) and earthy (γεώδεις), and in need of a more violent pricker (νύττοντος), such as is the undiluted wine». On the association between ‘earthiness’ and a weakening of the *stómōma* I return below, as well as on the ‘steelmaking’ metaphors for wine. An analogy of condensing breath with quenched iron, resulting in a higher ‘tension’ (ἐντέλειεσθαι) and *stomoũsthai* of «the foreknowing part of the soul» can be read in *Def. orac.* 41 433^A. In the former passage, in which the ‘steeling’ has more to do with tensile strength than sharpness, I return below in this section.

³⁸⁶ I refer again to this passage below, p. 193.

to find mention in the Aristotelian literature: in a fragment from Theophrastus's *Perì hudátōn* («On waters») —which Plutarch might have even known³⁸⁷—, we read that «heavier, harder (σκληρότερα) and colder waters are inferior» inasmuch as they are difficult to digest³⁸⁸, that «the cold [waters are] hard (σκληρά), hence more earthy», and that «the [waters] in the mountains are more drinkable than the ones on plains, for they have mixed less with the earthy (τὸ γεώδες)» (Athenaeus, *Deipn.* II 16 42^{C-D}, in Fr. 159 Wimmer); and, in the Pseudo(?)-Aristotelian *De plantis*, that earthquakes can only originate «in places [that are] dense (πυκνοί) and hard (σκληροί)», hence in the mountains, «because water [is] solid (στερρός) and the stones [are] solid (στερροί)» (II 2 823^{A1-5})³⁸⁹. A similar theme can be also found in Plutarch's *corpus*: in *QConv.* VIII 5.2 (725^{D-E}), Plutarch reports the idea that «waters that flow through a mountainous and stony country are more solid (στερρότερα) than those of the marshes and plains, since they do not draw off (ἀποσπᾶ) much earth»³⁹⁰; a kind of waters which he contrasts with the turbid, whose mixed-in earth «alters and ruins maximally what is drinkable and proper», making them «prone to putrefaction» (εὔσηπτα) when there is no flowing motion to shake off the impurities³⁹¹; such turbidity is also noticeable in the Nile, especially when its water is agitated, «for movement mixes the earthy (τὸ γεώδες) with the liquid, but, when the river is at rest, it leaves, sinking down due to [its] weight (κάτω ῥέπον διὰ βάρους). This is why they draw water at night, but also anticipating the sun, by whose constant evaporation (αἰρόμενον) of the finest (λεπτότατον!) and lightest (κουφότατον) [part] of the liquids, [this] deteriorates»³⁹². We can see that Plutarch regards the absence or depositing of «earthy» impurities to be correlated both with a “more solid” character of the water (see στερρότερα) and with its superior “thinness” and “lightness” (see λεπτότατον and κουφότατον): this clearly matches his supposition in *QConv.* VI 5 (691^{A-B}) that water may be made «thinner» (λεπτότερον) and «weaker» (ἀσθενέστερον) by the pebbles, but —if we accept the extension of this explanation to the γίγνεται οὐλότερον καὶ στομοῦται of *Frig.* 21 (955^B)— it is also coherent with the water's becoming «more compact» as a result of the “drawing down”, since this may surely be described to be στερρότερον (once the solid parts have been deposited), just like the purer mountain streams³⁹³. This comparative adjective, surely, may be also applicable to a quenched piece of

³⁸⁷ See above, p. 51 n. 193.

³⁸⁸ On water's resistance to digestion see also above, p. 67 n. 270.

³⁸⁹ Note that in 823^{A26-7} the «solid and dense» is opposed to the «rarified» (ἀραιός).

³⁹⁰ Transl. Minar in MINAR, SANDBACH, AND HELMBOLD 1961.

³⁹¹ Cf. the different etiology in *Aq.* 9 957^D, quoted above, p. 79-80.

³⁹² Transl. based on Minar's in MINAR, SANDBACH, AND HELMBOLD 1961, modified. TEODORSSON 1989c, n. *ad loc.* rightly compares the ending sentence with Hippocrates, *Aer.* 8.

³⁹³ See also the third answer in *Aet. phys.* 39: «or is it more plausible that the water of rivers and sea is anything but pure and unadulterated, but being imbued with an earthy quality (seeing that it is perpetually assimilating something from the earth over which the river runs or the sea tosses), turns muddier and less transparent when it settles to the bottom?» (transl. Sandbach in PEARSON AND SANDBACH 1965); Fr. 81 Sandbach (scholium to Hesiod, *Op.* 591-6): «[...] yet in many places the water, though light, is bad, as

iron³⁹⁴, and thus to the result of a *stomoũsthai*; since this form of hardening pertains specially to points and edges, it is surely coherent with the water's acquired "thinness" too, because thick, blunt edges are not cutting. The metaphor of *stomoũsthai* now appears to have a rich and complex meaning, showing a remarkable coherency with a wide range of conceptions on the water's purity and turbidity. Now that we know about these correspondences, we may even advance the hypothesis that the term *ákmones* («anvils»), which in *QConv.* VI 5 Plutarch associates with the Aristotelian report on the refrigerating lead, might be itself a part of this system of metaphors: maybe, these particular leaden objects were assimilated to anvils because anvils are the place in which iron is purified from slag incursions by repeated hammering³⁹⁵ — or maybe it was only Plutarch to make this association, reasoning etymologically; perhaps, he deliberately substituted it with the preferred form *akónai* («whetstones») as this metaphor appeared to him more fitting to the water's "thinning". This is all speculative, indeed, but it seems unlikely that these terms, both related closely to *stomoũsthai*, were used as simple metaphors for leaden «lumps» or «pigs»³⁹⁶: not only would this sense be unparalleled for both the words, but it was also already possible to express it using *πλίθος* ("brick"), at the latest since Dioscorides³⁹⁷. The importance of the form *akónai* is confirmed by its repetition in two Plutarchan *loci* associating it with «lead» as well: *QConv.* VI 8.6 695^D (*ἀκόναι μολίβδου*) and *Frig.* 11 949^C (*τὰς ἀκόνας τοῦ μολίβδου*)³⁹⁸, albeit none referring to the lead's refrigerating action (I will examine these in detail later)³⁹⁹. From these repetitions, never integrated by explanations, we can infer that Plutarch expected his readers to understand the expression easily; this might either mean that he used the term *akónai* in its literal sense (which is very unlikely, yet possible)⁴⁰⁰, or that the objects he referred to were widely known with this name, and thus originally baptized with it in correlation with some metaphorical extension.

Plutarch records of the water of Arethusa in Chalcis. [...] Others again put water into an earthenware cup and let it stand overnight; then they look the next day to see whether any earthy blackish ring has formed inside the cup; they count this a sign of the water's inferiority. They too enjoin a test that is not easy to carry out. Hesiod's advice is simpler than all tests of this sort: he tells the farmer to mix with his wine water from a spring that flows freely away, so that its movement will make it light and unmuddied, without earthiness» (transl. SANDBACH 1969); *Lyc.* 9.7: «and the Laconian *kóthōn*, or drinking-cup, was in very high repute for usefulness among soldiers in active service, as Critias tells us. For its colour concealed the disagreeable appearance of the water which they were often compelled to drink, and its curving lips caught the turbid sediment and held it inside, so that only the purer part reached the mouth of the drinker» (transl. PERRIN 1914, slightly modified).

³⁹⁴ See Fr. 30 Sandbach (scholium to Hesiod, *Op.* 148-9): «and for this they made use of copper, like of iron for agriculture, making it more solid (*στερροποιούντες*) by some form of quenching (*βαφή*), being it naturally soft». On the archaic use of copper for weapons and on this passage see below, p. 174-79.

³⁹⁵ See above, p. 89 n. 361.

³⁹⁶ *Contra* FUHRMANN 1978 with his n. 3 to 690^F («lames», «lingots»); TEODORSSON 1989b, n. to 691 B («it obviously means 'pig of lead'»).

³⁹⁷ See *MM* V 88.1 (*μολυβδίνην πλίθον*). Cf. Theophrastus, *Lap.* 56 (*μόλυβδος [...] ἤλικον πλίθος*).

³⁹⁸ These passages were treated as interrelated by VOLPE CACCIATORE 2007, 100 («È la *quaestio* VI 5 che riprende in modo più discorsivo quanto enunciato nel *de primo frigido*»). Her connection was endorsed by Nuzzo in D'IPPOLITO AND NUZZO 2012, n. 46 to *Frig.*

³⁹⁹ See below, sec. 10.

⁴⁰⁰ I examine the possibility of a literal use below, p. 170-4.

The interesting correspondences do not end here. In *QConv.* VI 7, the character Niger⁴⁰¹, among the arguments he uses against the practice of straining wine, presents it as a «trick» to enable its advocates to drink more: «and they remove the weighty (τὸ ἐμβριθές) [part] of wine, leaving the smooth (τὸ λείον), just like those who give boiled-down water to the ill with an unchecked desire for cold-drinking: in fact, whatever *stómōma* and strength of wine there is, they remove it and set [it] apart in the straining» (1 692^D); to this provocation answers Aristion —whose arguments are clearly meant to leave in the reader a better impression—, with a speech including a correction of Niger’s captious analogy: «but if, thrusting out and dispelling what of the wine is agitating and troublesome, brightening (and cheering, φαιδρύνοντες) rather than embellishing it, not as though we cut away a *stómōma* and edge (ἀκμή) of iron, but rather as though we cleansed away [its] rust (ἰός) and filth (ρύπος), and then we drank it, what would we do wrong?» (2 693^A). On the boiling-down of water I will return below; now, we may note that an unfiltered wine, with a «weighty» element⁴⁰², is here regarded to have a «a *stómōma* and edge» determining its effectiveness: the allusion, most probably, is not to the intensity of its taste, but to its psycho-physiological effects, as is implied in Niger’s insinuations that removing it is what allows the greedy drinkers to have more⁴⁰³. Aristion rejects this interpretation: none of the wine’s strength is lost in the straining, but only its filthy and undesired components. In fact, if the metaphor of the *stomoũsthai* of water can be extended, a reduction of turbid impurities should be even directly correlated with the improvement of the *stómōma*. In *QConv.* I 7, in a comparable *quaestio* on old people’s preference for undiluted wine (the so-called *ákrātos*), it is indeed explained that their sense-organ, enlivened by a breath (πνεῦμα) whose younger ‘tension’ is now relaxed, has been left «idle (ἀργός) and earthy (γεώδεις)», and therefore needs more violent blows from the perceptible (625^C)⁴⁰⁴; to explain this, Plutarch likens the contribution of breath to sensation with the contribution of a *stómōma* to an iron’s edge: it might not be accidental, then, that a sense-organ which has been deserted by its *stómōma* is presented to

⁴⁰¹ On this sophist, whose «appearance» in the *quaestio* «is rather unpleasant and presuming», see TEODORSSON 1989b, n. to 692 B and PUECH 1992, 4863–64, according to whom he is «cruellement caricaturé par Plutarque».

⁴⁰² TEODORSSON 1989b, n. *ad loc.* remarks that Plutarch «uses ἐμβριθής and γεώδης together» in *Aet. phys.* 1 911^D and *Lun.* 14 927^{E-F}, 936^E.

⁴⁰³ This may also apply to a possibly similar metaphor used by Sulla in *QConv.* III 3 650^B, a *quaestio* on why women get drunk more easily and old men more difficultly: «and this [...] is what I firstly hold about women, that they have a moist temperament (κρᾶσις), which being also mixed into the tenderness of [their] flesh provides both the gleam (τὸ στιλβόν) on [the] smoothness (λειότης) [of their skin] and the menstruations: when, therefore, wine falls into much moistness, being dominated (κρατούμενος), it loses [its] hardening (or hue, βλάβη) and becomes altogether intangible (ἀναφής) and watery». Stephanus proposed to correct the adjective ἀναφής to ἀβαφής (either “unhardened” or “hueless”), followed by e.g. WYTTEBACH 1797A and BERNARDAKIS 1892, but the original reading has been maintained by HUBERT [1938] 1971, Clement in CLEMENT AND HOFFLEIT 1969, TEODORSSON 1989a, n. *ad loc.* (Teodorsson offers the best, albeit minimal, discussion of the earlier proposals, including the ἀδρανής in FUHRMANN 1972), and CHIRICO 2001. Considering the optical focus of the sentence preceding the metaphors for the wine’s dilution, there might not be any implicit analogy with iron quenching, but only a reference to the wine’s loss of colour, taken as a correlative of its loss of power. This ambiguity was pointed out by TEODORSSON 1989a, n. *ad loc.* See also below, p. 99 n. 405.

⁴⁰⁴ I have quoted this passage more fully above, p. 95 n. 385.

remain more «earthy»⁴⁰⁵. The production of *stomōmata*, indeed, is explicitly linked with an expulsion of earthy components in *Garr.* 17, in a rich analogy for the rhetorical education imparted by Lycurgus to the Spartan boys, following precisely the Platonic quotation on Laconian speech we have seen above in relation to its use of οὔλος (510^E-511^A):

καὶ γὰρ Πλάτων τοὺς τοιοῦτους ἐπαινεῖ, δεινοῖς ἀκοντισταῖς εἰκέναι λέγων, οὔλα καὶ πυκνὰ καὶ συνηστραμμένα φθειρομένους. καὶ ὁ Λυκοῦργος εἰς ταύτην τὴν δεινότητα τοὺς πολίτας εὐθύς ἐκ παίδων τῆ σιωπῆ πιέζων συνηγε καὶ κατεπύκνου. καθάπερ γὰρ οἱ Κελτίβηρες ἐκ τοῦ σιδήρου τὸ στόμωμα ποιοῦσιν, ὅταν κατορύξαντες εἰς τὴν γῆν τὸ πολὺ καὶ γεῶδες ἀποκαθάρωσιν, οὕτως ὁ Λακωνικὸς λόγος οὐκ ἔχει φλοῖον, ἀλλ'εἰς αὐτὸ τὸ δραστήριον ἀφαιρέσει τοῦ περιττοῦ διωκόμενος⁴⁰⁶ στομοῦται. τὸ γὰρ ἀποφθειγματικὸν αὐτοῖς τοῦτο καὶ τὸ μετ' εὐστροφίας ὄξυ πρὸς τὰς ἀπαντήσεις ἐκ τῆς πολλῆς περιγίγνεται σιωπῆς.

And in fact Plato praises suchlike people, saying that they resemble skillful javelin throwers, speaking compactly, densely and intertwiningly. And Lycurgus has gathered and condensed the citizens to this excellence by pressing them with silence ever since they were little. In fact, just as the Celtiberians make the *stómōma* from iron, when they cleanse away [its] excessive and earthy

⁴⁰⁵ But TEODORSSON 1989a, n. *ad loc.* remarks that Plutarch uses this adjective for old people also in *QConv.* III 3 650^C: here, in a much similar context of wine-drinking —already seen above, p. 98 n. 403 —, Sulla proposes an etymological play on γέρων ≈ γηρός, but without relation to any *stómōma*, albeit with reference to their δυσκαμπές... καὶ σκληρόν character (which may hint at the presence of another smithing metaphor). Notice that a few lines above he does use the metaphor of βαφή for the effectiveness of wine.

⁴⁰⁶ The manuscripts' reading διωκόμενος was maintained by DEFRAZAS AND DUMORTIER 1975 (who translated «acculé aux valeurs essentielles memes») and defended by PETTINE 1992 (n. 158: «nel senso di “costretto a seguire, indirizzato, rivolto a”»). Pohlenz in PATON, POHLENZ, AND SIEVEKING [1929] 2001 proposed the emendation διακονόμενος (from δι-ἀκονᾶν, “rub throughout with a whetstone”), accepted by MICHELETTI 2011 (who skipped the verb altogether in his liberal translation: «il parlare laconico, nella sua essenzialità, privato di ciò che è superfluo, ha la consistenza del ferro» [?]), and endorsed by Ingenkamp in INGENKAMP AND BERNARDAKIS 2010 (who also pointed out that the verb would be a *hapax*). The whetting metaphor would indeed be fitting to the context, especially considering Plutarch's likely wordplay on the following τὸ ὄξυ (both «rapidity» and «sharpness»): Laconic speech would be turned «into sharpness/rapidity itself» by reduction, *i.e.* by removal of its external bark through whetting (on Plutarch's references to whetting and sharpening see below, p. 172-4). It is not impossible that such operation could be referred to by the verb *stomoîn*, in this case indicating the cutting power of the obtained “(hardened) edge” rather than its acquired strength (although an unquenched and unsteeled edge would not be able to retain its sharpness for long — see above, p. 89-90 with n. 362 and 363). This interpretation, however, arguably banalizing, would be less coherent with the compression metaphors introduced in the preceding sentences and prompting the analogy with the Celtiberian technique of *stómōsis*. Regardless how Plutarch understood it, his source(s) on the technique were probably focused on iron reinforcement (*i.e.* steeling) rather than sharpening (see the parallel report in Diodorus Siculus, quoted below); this, in combination with Plutarch's other references to steeling and quench-hardening as a result of compression (following a dilation, see below), might explain why he introduced this technical analogy just after referring to Lycurgus' “pressing” and “condensing” action onto the Spartan citizens. Nevertheless, in using the verb *stomoûsthai* he might have also wanted to allude, cumulatively, to the expected sharp quality of a finalized steel weapon, and hence develop his initial analogy with compression-strengthening into a whetting metaphor, in the last sentence (see also my considerations above, p. 97, on Plutarch's choice of the term *akónai* for the refrigerating leaden objects). Even in this case, the emendation διακονόμενος appears to be unnecessary. HELMBOLD 1939, following E. Capps, prints διοικόμενος and translates «it is tempered to complete efficiency». He provides no parallel occurrences of such use of διοικεῖν (“administer”).

[part] by burying it in the earth, Laconic speech has no bark, but, forcibly driven⁴⁰⁶ into effectiveness itself by removal of the superfluous, *stomoūtai*; in fact, this sententiousness and versatile rapidity (or sharpness) of theirs towards replies is what is left over from [their] much silence.

The information on the Celtiberian technique of *stómōsis* is paralleled in the earlier report by Diodorus Siculus (*BH* V 33.4), who did not use the word *stómōma* (referring to the burying as a form of «preparation», *παρασκευή*, of weapons and armour) nor mentioned the “earthy” quality of the iron’s impurities, but made explicit that the iron is buried in the form of «strips» (*ἐλάσματα*) and that the improvement takes some time, during which the «weak» part of the iron (*τὸ ἀσθενές*) is “eaten around” (*περιφάφοντος*) by the «rust» (*ἰός*), a corrosion which does not affect the iron’s «firmest» part (*τὸ στερεώτερον*)⁴⁰⁷. In Plutarch’s passage, the *stomoūsthai* is understood to happen by removal of the «earthy» —as for the water in *QConv.* VI 5—, and it is strongly associated with an increase in compactness — as in *Frig.* 21. Indeed, the assimilation of Laconic speech with a *stómōma* can only be intelligible if both are equally supposed to be “compact” and “dense”, as the implicit metaphor of ‘sharpness’ (and ‘resistance’) for effectiveness (see *τὸ δραστήριον*) is only secondary, and the absence of external superfluity (see the *φλοιός*) is mainly used as a connector between *comparans* and *comparandum*; the point of the analogy is not to convey that neither Celtiberian *stómōma* nor Laconic speech are essential and ‘uncoated’, but that they both become as compact, ‘cutting’ and ‘strong’ as they are by subtraction rather than by addition⁴⁰⁸. The choice of the peculiar Celtiberian technique for steelmaking might have depended on the connotations of enclosure and suffocation coming with the image of the burying (compare with *πιέζων*); the image of a *stómōma*’s quench-hardening in water, indeed, might have seemed to be less fitting to the idea. Plutarch describes this rhetorical education also in *Lyc.* 19 (2), using a different image but still comparing the Laconic speech with iron, namely, with the iron money introduced by

⁴⁰⁷ OLDFATHER 1939, n. 1 *ad loc.* qualifies Diodorus’s claims as «a naïve explanation». He follows DAVIES 1935, 59 (in turn followed by HEALY 1978, 236), who proposed a very unconvincing explanation of the technique: «owing to the uncertainty of its quality, the Celtiberians buried their iron in the ground, because soft iron rusts more quickly than steel, and so by reforging a superior product can be obtained». Davies, in turn, depended on an explanation given by VOGEL 1904, 773 which was not immune to presentism: Vogel, first, compared Diodorus’s report with Japanese sword making as described in E. Swedenborg’s *De ferro*; then, he referred to the presence of steel tools scattered around in his times in the soil of the Rheinland and Pfalz; lastly, he informed on the steel’s inferior susceptibility to rusting without citing evidence, perhaps having in mind modern stainless steel (which is an alloy), probably the one which he could find in the two regions’ soil. I was not able to find chemical or metallurgical evidence on the varying resistances to rusting of wrought iron and steel. Diodorus’s explanation is highly compatible with Aristotle’s account of normal *stómōsis* (which we will see below).

⁴⁰⁸ This consideration is only valid if Pohlenz’s emendation *διακονώμενος* for *διωκόμενος* is not accepted (see above, p. 99 n. 406). If it were accepted, the focus of the analogy would be that a weapon whose external superfluities have been removed —either by Celtiberian burying or by whetting— becomes sharper (or faster, *ὄζυ*). This analogy would be unrelated with the compression metaphors which introduce Plutarch’s reference to Laconic speech.

Lycurgus's monetary reform⁴⁰⁹: in contrast with this kind of currency, in which a large «weight» (σταθμός) was associated with a small δύναμις («power», thus «value»), Lycurgus promoted a rhetoric which would allow an «affordable» (εὐτελής) and «small» (ολίγη) diction to convey «much and abundant (περιττή) thought (διάνοια)», a result which was obtained by the exercise of silence⁴¹⁰; despite the focus of this analogy being rather on the lightness and smallness of Laconian speech, it is clear that its effectiveness (*i.e.* intelligence) is implied to be closely related to its compactness. The association between the act of squeezing, resulting in more compact textures (see the πιέζων συνήγε και κατεπύκνου in *Garr.* 17), and the hardening of iron is confirmed by another 'ethical' analogy in *Alc.* 6 (5), used by Plutarch to describe the philosophical influence exerted by Socrates on Alcibiades during his youth⁴¹¹:

ὥσπερ οὖν ὁ σίδηρος ἐν τῷ πυρὶ μαλασσόμενος αὖθις ὑπὸ τοῦ ψυχροῦ πυκνοῦται καὶ σύνεισι τοῖς μορίοις εἰς αὐτόν, οὕτως ἐκεῖνον ὁ Σωκράτης θρύψεως διάπλεων καὶ χαννότητος ὁσάκις ἀναλάβοι⁴¹², πιέζων τῷ λόγῳ καὶ συστέλλων ταπεινὸν ἐποίει καὶ ἄτολμον, ἡλικίων ἐνδεής ἐστι καὶ ἀτελής πρὸς ἀρετὴν μανθάνοντα.

Hence, just as the iron which is softened in the fire is then condensed by cold and collects itself in its parts, so Socrates, whenever he took him in his hands⁴¹² full of delicacy (lit. softness by internal fragmentation) and vanity (lit. sponginess), pressing and putting [him] together by means of discourse made him humbled (lit. low) and cowardly, as he learned the extent of what he was missing and how unaccomplished he was towards virtue.

We find here again the participle πιέζων, which was already used in *Garr.* 17 to describe Lycurgus's action on the Spartan youth. Socrates's dialectical education is likened to the quenching of iron, as explicitly correlated with a compression of the iron's texture: the softening —and thus dilation— induced to the iron by the heating corresponds to Alcibiades's loosening up in vanity, and both are subject to the violent shrinking

⁴⁰⁹ On this reform cf. Xenophon, *Lac. resp.* 7.5-6, Polybius, *Hist.* VI 49.8, Pollux, *Onom.* VII 105, and see below, p. 183-6.

⁴¹⁰ This is the full passage (*Lyc.* 19.1-3): «the boys were also taught to use a discourse which had sharp viciousness (πικρία) mixed with grace (χάρις), and much observation [coming] from short speech. His iron money, indeed, Lycurgus made of large weight and small value (or power, δύναμις), as I have observed, but the current coin of discourse he adapted to the expression of much and abundant thought with affordable and small diction, by contriving (μηχανώμενος) that the general habit of silence should make the boys sententious and disciplined (πεπαιδευμένους) in their answers. For as the seed of the licentious (ἀκόλαστοι) in sexual intercourse is most often infertile and unfruitful, so intemperance (ἀκρασία) in talking makes discourse empty (κενὸν) and senseless (ἀνόητος)» (transl. based on PERRIN 1914, modified).

⁴¹¹ On this passage see also below, p. 185.

⁴¹² The variant ἀναλάβοι is transmitted in in the group of concordant ms. known as Y, *i.e.* ms. U (Vat. Gr. 138, first hand X/XI cent.), M (Marc. Gr. 385, XIV/XV cent.), and A (Par. Gr. 1671, 1296), and was favoured by LINDSKOG and ZIEGLER in LINDSKOG, ZIEGLER, AND GÄRTNER [1914] 1994 (followed by FLACELIÈRE AND CHAMBRY 1964 and Raffaelli in CESA, RAFFAELLI, AND PRANDI 1992) over the reading ἀνλάβοι in ms. N (Matrit. 4685 = N 55, XIII/XIV cent.; see Ziegler's 1959 preface in ZIEGLER AND GÄRTNER [1914] 2000, p. XII). The latter, chosen by PERRIN 1916 («whenever Socrates found him [...]»), is semantically appropriate but is harder to explain syntactically (due to the presence of ἄν).

caused by cold or by discursive reasoning. In this analogy, the implied hardening of iron is certainly not carried over to the *comparandum*, as Alcibiades’s “humbling” can hardly be assimilated to the improvement of an edge (despite it being a morally positive outcome); it can therefore be inferred that Plutarch’s conception of quenching was so closely linked to the idea of the iron’s shrinking that quenching, in his prose, could be used in analogies for abrupt condensations intervening on dilated textures without further connotations being thematized.

This association, naturally, must also pertain to the *stomoŷsthai*, as a piece of iron which has not been made into a *stómōma* (*i.e.* steel) is indifferent to the quenching, and hardening or toughening should always be the final step of a *stomoŷsthai* (which otherwise would not be very useful)⁴¹³. Indeed, all the relevant terms appear together in *Adul.* 36, where we read, again in an analogy, that «just as iron condenses (*πυκνοῦται*) with the exterior cooling (*περίψυξις*) and receives the *stómōsis* when it is has been first relaxed (*ἀνεθείς*) by heat and has become soft (*μαλακός*), so [one must] bring over the frankness to friends who are distended (*διακεχυμένοις*) and hot by the work of praises, firmly, like a quenching (*βαφή*)» (73^D)⁴¹⁴. It is worth noticing that *περίψυξις* is the same term used in *QConv.* VI 5 for the external agent of the water’s cooling, not effectively resisted by the liquid due to its “thinning”: its loss of earthy parts, which “weakens” it, may correspond to the iron’s “relaxation” (see *ἀνεθείς* and *διακεχυμένοις*) due to fire, and its becoming *οὐλότερος* in *Frig.* 21 to the resulting *stómōsis* caused by the cooling, *i.e.* the re-aggregation of its watery parts. For more compatible terminology we may refer to *Def. orac.* 47 (436^C): in this passage, the *stómōsis* of iron is described to start with a «softening», a “slackening”, and the induction to iron of «tenderness» and «looseness» (the terms are *μάλαξις*, *χαλαῶσαι*, *ἀπαλότης*, and *μανότης*), and to end with a “compression” and “condensation” (the verbs are *πλειῖσθαι* and *καταπυκνοῦσθαι*), resulting in the iron’s acquisition of «strength» and «solidity» (*εὐτονία*, lit. «the [state of] being well-strung», and *πῆξις*)⁴¹⁵. Now, focusing on the verb *πλειῖσθαι*, we may note that it was originally used to refer to the “felting” of wool (*i.e.* the making of wool into a *πίλος*, «felt»)⁴¹⁶, which implies its semantic closeness to the adjective *οὔλος* in *Frig.* 21. This connection is confirmed by the fact that Theophrastus employed *πλειῖσθαι* in *CP* to indicate the “contraction” of plant texture induced by cold wind⁴¹⁷, which proves that this verb is closely related to the idea of a tightening of fibres: in the frame of this Peripatetic terminology,

⁴¹³ See above, p. 89 n. 362 and 363, p. 90 n. 366.

⁴¹⁴ For similar descriptions cf. below, p. 182-3.

⁴¹⁵ Cf. *QConv.* VIII 3.2 721^A, in which Boethus—who uses Epicurean assumptions in acoustics (see above, p. 28-9)—, describes the effect of heating and cooling in this way: «for warmth slackens (*χαλαῶ*) and separates (*δύστησιν*) and dissolves (*λύει*) concentrations (*πυκνώσεις*), which is why bodies when boiling or softening (*μαλασσόμενα*) or melting take up more room, while on the other hand solidifying (*πηγνύμενα*) and cooling bodies draw close to one another and gather (*συγχωρεῖ πρὸς ἄλληλα καὶ συνάγεται*), and leave vacuums—spaces from which they have withdrawn—in the vessels which hold them» (transl. Minar in MINAR, SANDBACH, AND HELMBOLD 1961, modified).

⁴¹⁶ See CHANTRAINE, *s.v.* ‘πίλος’, and BEEKES, *s.v.* ‘πίλος’.

⁴¹⁷ See *CP* I 12.3, II 1.4, 3.1, III 23.3, IV 7.1, and, in the couple *πίλησις καὶ πύκνωσις*, V 8.3. Cf. above, p. 92 n. 375 and 376.

it might be not coincidental that in *QConv.* VI 5, just after the reference to the “carrying down” of the earthy impurities, we find the ‘geological’ remark, already examined earlier⁴¹⁸, that «every stone is a solid mass of earth which has been cooled down (κατεψυγμένης) and compressed (πεπιλημένης) by freezing cold» (691^B); in the whole of Plutarch’s extant *corpus*, indeed, it is impossible to find further occurrences of the verb *πιλείσθαι*⁴¹⁹. In this way, the adjective *οὔλος*, although absent from the text of *QConv.* VI 5, appears to be evoked somehow between its lines, in the shadow of the water’s described “thinning” (and implied *stómōsis*), and of the subterranean “felting” of stones. The physical frame of reference, again, is proven to include strong Aristotelian suggestions.

Finally, we may go back to Niger’s reference in *QConv.* VI 7 (1 692^D) to the «boiled-down water», namely, that offered by physicians to the ill patients not suppressing their desire for a cold drink (and who are implied to refuse the lukewarm)⁴²⁰; its physical explanation, in fact, may also be related on an analogical level with *stómōsis* and iron quenching. The medical practice of heating water was presented both in Pliny’s *NH* XXXI (40) and, much later, in Oribasius’s *Coll. med.* as an effective way to remove from the drink its bad and harmful properties⁴²¹, but this does not seem to be the rationale of the technique mentioned by Niger. We must consider that Pliny, in the same passage of *NH*, refers to a method of refrigerating water which he claims to have been invented by the emperor Nero: by boiling down water, pouring it in a glass, and then sinking this glass in snow, it was allegedly possible to obtain its fast and intense cooling «without the [harmful] defects of snow» (*sine vitiis nivis*), because heated water «is refrigerated more» (*item calefactam magis refrigerari*). The use of pouring snow in drinks, apparently common on «the tables of the very rich», has already been studied by R. J. Forbes, who also collected a number of passages in medical literature attesting to the widespread condemnation by ancient physicians of snow-water, believed to have deleterious effects on the organism⁴²². It is surely for this reason that the doctors referred to by Niger opted for the technique of boiling-down: namely, to avoid giving their patients a harmful snow-cooled drink, whose negative effects would be aggravated by their ill conditions; if the snow is left outside the drink and the drink pre-heated, which increases its receptiveness to cooling, then its quality is not worsened by the snow’s damaging qualities, and with this «trick» even ill patients can indulge in their cold-drinking — just like the insatiable wine-drinkers are enabled

⁴¹⁸ See above, p. 38-40.

⁴¹⁹ Exceptions are Fr. 14 Sandbach (scholium to Aratus, *Phaen.* 828), which might be paraphrased from the original, and the dubious Fr. 179.3* Sandbach. In both passages the verb is referred to air.

⁴²⁰ Cf. *Sanit.* 3 123^{B-D}, in which it is suggested that one should become accustomed to drinking warm water in summer, even when snow is available for its refrigeration, to avoid complaining about the impossibility of indulging in this pleasure during illnesses. The implication is that drinking cold water is detrimental to ill constitutions (see below). See also 11 128^B.

⁴²¹ See Oribasius, *Coll. med.* V 1.11, 3.36. Attention was drawn to these passages by TEODORSSON 1989b, n. to 690 C, who remarked that «this knowledge of the effect of heating strikingly anticipates the discoveries made by L. Pasteur in 1857». He also cites the parallel in Galen, *Hip. prog.* II 31, XVIII.2 p. 156-7 Kühn. In *Aet. phys.* 5 913^C, Plutarch mentions a different but similar practice, of boiling seawater to remove its «salty and biting» element; for parallels of this information, including Aristotle, *Meteor.* II 3 358^B16-8 (in the context of distillation, which I also mention below), see MEEUSEN 2015, n. to 913C.

⁴²² See FORBES 1964D, 113–16. On Plutarch’s views on this matter, see above, n. 420.

by the straining to have more of their loved beverage⁴²³. The alleged physical mechanism of pre-heated water cooling more intensely may have been inferred from the observation of the so-called Mpemba effect, *i.e.* the fact that liquids, in certain conditions, apparently freeze faster if they start from hotter temperatures: today, both the causes and the existence itself of this phenomenon are still being debated⁴²⁴; in antiquity, it was pointed out in writing, at the latest, by Aristotle in *Meteor.* I (13 348^B30-349^A11), who also reported of several practices based on its exploitation, proving that it had some cultural or technical significance (note that in the text he specifically refers to fishermen in Pontus). The Aristotelian interest for the phenomenon is confirmed by its inclusion as a *quaestio* in the collection of *Problemata* by Pseudo-Alexander of Aphrodisias (I 58), who offered an explanation of the alleged fact that warmed waters left suspended in a well become colder. This leads us back to Plutarch, because his *QConv.* VI 4, which precedes the *quaestio* on the refrigerating *ákmones* and pebbles without solution of continuity (introducing the conversation that the following *quaestio* ends), is specifically devoted to an almost-identical problem, of which the Peripatetically-cultured guest⁴²⁵ reports the solution he found in «Aristotle» (690^{C-D}); in this solution, not only do we find a reference to the technique of boiling water and surrounding it in snow, but we also read of an analogy with changes in temperature in the human body, presented in a way which is especially reminiscent of the descriptions of quenched iron: «our bodies too are cooled more by the surroundings (περιψύχεται) after a warm bath; in fact, the relaxation (ἀνεσις) caused by the heat, having made the body porous (πολύπορον) and loose (μανόν), accepts much of the external air and makes the alteration (μεταβολή) more violent». The human body, in the same scenario, will be also explicitly presented to receive «quenching (βαφή) and *stómōsis*» by Plutarch's character in *QConv.* VIII 9 (3 734^{A-B}). We may therefore note that what is presented to be the Aristotelian explanation of a dynamic of water refrigeration seems to rely on an analogy with iron quenching, or at least on a dynamic which in turn is understood in terms of iron quenching. It can already appear more coherent, then, that the description of the water cooled by *ákmones* and pebbles, just in the next *quaestio*, uses the term *stomoūtai* — but there is even more to it. In fact, Plutarch's character does not accept the Aristotelian explanation, as his *quaestio* did not refer to any pre-heating: he was simply wondering why the water kept suspended in a well for an entire night, when taken out, has a cooler temperature than the newly drawn. This is how he answers, applying the very same assumption we have seen him using in his second answer to *QConv.* VI 5: «rather, cold air itself cannot alter (μεταβάλλειν) the spring-water due to its amount (πλήθος), but if one lifted a small quantity of it, it would

⁴²³ Both the spoiled cold-drinkers and the greedy wine-drinkers are of course charged with negative moral connotations. On the former cf. above, p. 103 n. 420. It might be implied in Niger's words that the boiling-down of water, like the straining of wine, makes the water lose its *stómōma*, but this implication seems unlikely: if anything is lost by the water, it is either its harmful qualities (which would lend a hand to Aristion's correction of the analogy in 2 693^A, seen above) or its salinity (on which see above, p. 103 n. 421); neither of these epurations seem to be relevant to Niger's analogical argument, which seems rather to be only founded on the common shamefulness of the two «tricks» (both allowing people to indulge more in pleasure when they should stop).

⁴²⁴ See *e.g.* ZIMMERMAN 2022.

⁴²⁵ See above, p. 88.

cool it (περιψύξει) dominating it more» (4.2 690^E). The reduction of its mass —again compatibly with Plato’s *Tim.*— is what allows the water to be dominated by the cooling force.

To draw together the threads of this long discussion on the *stomoūsthai* of water, permeated with Peripatetic connections in almost every turn, we may finally examine Aristotle’s very own account of *stómōsis* in *Meteor.* IV 6, to verify whether it can be interpreted to be consistent with the themes we have touched upon (383^A29-^B5):

[...] ὅσα δὲ διὰ ψύξιν, καὶ τοῦ θερμοῦ συνεξατμίσαντος ἅπαντος, ταῦτα δὲ ἄλυστα μὴ ὑπερβαλλούση θερμότητι, ἀλλὰ μαλάττεται, οἷον σίδηρος καὶ κέρασ. τήκεται δὲ καὶ ὁ εἰργασμένος σίδηρος, ὥστε ὑγρὸς γίγνεσθαι καὶ πάλιν πήγνυσθαι. καὶ τὰ στομῶματα ποιοῦσιν οὕτως· ὑφίσταται γὰρ καὶ ἀποκαθαίρεται κάτω ἢ σκωρία· ὅταν δὲ πολλάκις πάθῃ καὶ καθαρὸς γένηται, τοῦτο στόμωμα γίγνεται. οὐ ποιοῦσι δὲ πολλάκις αὐτὸ διὰ τὸ ἀπουσίαν γίγνεσθαι πολλήν καὶ τὸν σταθμὸν ἐλάττω ἀποκαθαίρομένου. ἔστιν δ’ ἀμείνων σίδηρος ὁ ἐλάττω ἔχων ἀποκάθαρσιν.

[...] and the things which [solidify] by cooling, and out of which the heat has evaporated completely, these are unliquefiable if not with an overwhelming heat, but soften, like iron and horn. But the iron that has been worked liquefies too, to the point of becoming moist and then solidifying again. And this is how they make *stomōmata*: in fact, the dross sinks and is cleansed off below [the iron]; and after it has endured this repeated times and has become clean, this becomes a *stómōma*. But they do not do this many times due to the increasing waste and decreasing weight of what is cleansed off (*scil.* of the iron). And a better iron is that which has less cleansing off.

As in Plutarch’s references to *stómōsis* in *Garr.* 17 and in his extension of the model to the water’s cooling by “drawing down” in *QConv.* VI 5, we find here the production of a *stómōma* being presented as directly dependent on a cleansing off of impurities, which are even described to sink. The technical interpretation of this passage is not easy and has puzzled many scholars, and in fact multiple and incompatible proposals have been advanced in the last century. That offered by H. D. P. Lee in 1952, as an appendix to his edition of Aristotle’s *Meteor.*⁴²⁶, was influenced by the assumption, in the archaeometallurgical literature of his time, that ancient furnaces could not reach sufficient temperatures for the melting of wrought iron (1500 °C)⁴²⁷, and that therefore the reference to its liquefaction (see *τήκεται*) or moistening (see *ὑγρὸς*) had to be non-literal, describing rather an increase in softness and pliability. His assumption might square with Aristotle’s presentation of iron as an «unliquefiable» substance (albeit disregarding the reference to the special conditions

⁴²⁶ See LEE 1952, 324–29.

⁴²⁷ See above, p. 89 n. 361.

of «overwhelming heat» and the “pre-working”, in εἰργασμένος); however, it has now been long disproved that ancient furnaces could not attain to iron’s melting point, since shaft furnaces, already in use in the Greek and Roman world for the smelting of iron, could even reach temperatures of 1600 °C⁴²⁸. Not knowing this, Lee supposed that Aristotle’s description may have applied to the smelting of iron in the “bloomery” process and its subsequent hammering, which is indeed a cleansing procedure, aimed at separating the iron from its oxides and from other mineral impurities associated with it in the ore⁴²⁹. This interpretation has two main problems: first, the reference to the “sinking down” of the impurities is not compatible with the primitive model of bloomery furnace Lee has in mind, in which the ferrous “bloom” would be the one to be submerged by the upflowing and then solidifying “slag” (while the more advanced shaft furnaces may indeed be equipped with drains to allow the slag to flow out and re-solidify in pits)⁴³⁰; second, the product obtained at the end of the process would be the soft and pliable wrought iron, which can certainly not qualify as a *stómōma*⁴³¹.

A different proposal was offered by C. J. Livadevs in 1956, who supposed that Aristotle’s description may have applied to the fusion of multiple pieces of hammered and wrought iron in a pot⁴³²; since —he assumes— the ancient blacksmiths were not able to heat the pot enough to have its temperature reach the melting point of iron, a «non-flowing fusion» would be obtained, in which the heterogeneous mass of metal, behaving as a semi-fluid, would stratify in three layers due to its components’ varying resistances to melting: «carbon-free iron, which is more difficult to melt than carburized iron, was in a thick-flowing condition and sank to the bottom of the melting pot, thus constituting the lowest layer. Slag, being more fusible, remained in a fluid state and floated, thus constituting the uppermost layer. The middle layer consisted of steel, which is more eutectic than iron but more difficult to melt than slag»; in this way, the blacksmiths would be able to select the *stómōma* in the middle and proceed with further treatment of the iron sunk below it. The obvious problem with this interpretation, as in Lee’s, is that the «dross» flows into the upper layer, instead of sinking below the iron⁴³³. In 1974, Halleux proposed a novel interpretation which he claimed, inaccurately, to correspond to Livadev’s: «il s’agirait, selon lui, d’une production d’acier au creuset par carburation de morceaux de loupe

⁴²⁸ See TYLECOTE, AUSTIN, AND WRAIGHT 1971; SIM 1998, 7–8, 12–13.

⁴²⁹ See above, p. 89 n. 361.

⁴³⁰ Cf. DÜRING 1944, n. to 383a34: «κάτω is in some way or another wrong. Either Aristotle did believe that the dross sinks to the bottom, or our interpretation is wrong». On the primitive bloomery furnace see *e.g.* HEALY 1978, 184–85 (with the clearest illustration in literature).

⁴³¹ See above, p. 89 n. 362. Lee assumes that the wrought iron would naturally become carburized during the hammering phase (due to the frequent re-heating), but this is unlikely. In his conclusion, he supposes that Aristotle may have used *stómōma* «as a general term for iron, which becomes hard after quenching» (LEE 1952, 328). General iron, if smelted in the bloomery, does not become hard after quenching.

⁴³² See LIVADEVS 1956, 64. The reference to the pot is inspired by Theophrastus, [*De metallis*] Fr. 261 Rose = Pollux, *Onom.* VII 99 and X 149, who mentions a vessel called *períodos* used for the fusion of iron.

⁴³³ Note that Livadev’s understanding of the Greek text was very limited: «these considerations explain the last sentence of Aristotle’s text—“... the best iron is that which is less pure [*sic!*]”»

[*i.e.* bloom] dans des récipients en terre réfractaire»⁴³⁴. The technique he refers to is one of the possible ways of producing “crucible steel” by the melting of wrought iron in contact with agents of carburization, *i.e.*, either carburizing materials such as coal, or cast iron⁴³⁵: by stirring these together for a long time, one could obtain a very homogenous distribution of carbon inside the iron, and thus high-quality steel. This interpretation is obviously inadequate⁴³⁶, not only because there seems to exist no evidence that crucible steel was produced in the ancient West⁴³⁷, but also because this process would not imply any sinking of impurities: as it was a deliberate fusion of heterogenous materials, it could certainly not be interpreted as a purification⁴³⁸. In 1989, E. Photos referred instead to a process of “fining”⁴³⁹—which consists in the deliberate decarburization of cast iron by heating it for a long time in molten state, until its carbon content lowers to a desired range (either that of steel or that of wrought iron)—, and supposed that the re-solidification mentioned by Aristotle depended on the successful lowering of this carbon content, which resulted in the iron’s higher melting point⁴⁴⁰. Despite the absence of any archaeological evidence or concurrent literary testimonies on the ancient existence of the practice in the West, this interpretation may be accepted, because in fining, as Photos notes, «prolonged exposure to an oxidizing blast would result in oxidation of iron to scale and “in great wastage and loss of weight of iron that is purified”»; such iron oxides, as was noted by P. T. Craddock, may even produce a slag, thus surrounding the decarburized piece of iron in an impure coating: «[...] some of the iron oxides would have reacted with the silica in the clays of the crucible or hearth lining to produce a slag. In postmedieval Europe, it was common practice to encourage this by sprinkling clean sand onto the iron to remove the iron oxide scale as a liquid slag [...], some of which became incorporated in the pasty iron during the working»⁴⁴¹ (on such a sprinkled flux I will return in the next section); this slag, we can suppose, may have been interpreted to be the result of a depositing⁴⁴².

⁴³⁴ HALLEUX 1974, ann. 3 par. 18 (eBook version). He repeats his misrepresentation of Livadev’s proposal, without changes, in ID. 2007, 1305 with n. 38; ID. and EL GAMMAL 2021, 64 with n. 29. These two works contain no reference to the Aristotelian passage.

⁴³⁵ See CRADDOCK 2003, 242–48 and above, p. 90 n. 366.

⁴³⁶ It did not convince RAMIN 1977, 170–72, who went back to the interpretation of the process as a combination of bloomery smelting and hammering: «en définitive nous avons [...] émis l’hypothèse d’une confusion entre le fer et la scorie de la part d’Aristote. Pour ce qui est de la suite de ce passage, le renouvellement des opérations nous fait penser au travail de la loupe puis à la cémentation du fer. [...] Ce passage demeure très obscur».

⁴³⁷ See *ib.*

⁴³⁸ For the same reason, the proposal by SAUDER 2013, who observed that it is possible to obtain a partial melting of an iron rod plunged in the coal of a small furnace, and then find drips of carburized steel onto its bottom, cannot be accepted. In this procedure, furthermore, it is the *stómōma* to «sink».

⁴³⁹ See PHOTOS 1989, 293–94.

⁴⁴⁰ On the carbon content of wrought iron, steel, and cast iron and on their varying melting points see above, p. 89 n. 361.

⁴⁴¹ CRADDOCK 2003, 236. Note that his comments on the slag from fining are not related to the Aristotelian passage; at p. 249 he mentions Photos’s interpretation without explicit approval or disapproval; before this mention, he points out that in Aristotle’s text «the slag is removed from below the metal, which sounds like a solid-state operation» (his emphasis).

⁴⁴² Cf. PHOTOS 1989, 294: «in addition it is pointed out that slag sinks to the bottom, in which case the metal must have been kept apart, possibly held at the end of a rod». I find this explanation unintelligible.

Notwithstanding the validity of Photos's view, the Aristotelian passage may be also interpreted to describe a carburization procedure of wrought iron by means of "cementing": this consists in the careful high-temperature heating of the piece of iron in a furnace filled with coal, which in the appropriate conditions results in the dissolution of a quantity of carbon atoms (from the molecules of carbon oxide generated by the burning coal) into the iron's surface texture, determining its steeling ("case hardening")⁴⁴³. Multiple analysis published in the archaeometallurgical literature have shown that this technique is likely to have been of common use in the ancient West⁴⁴⁴, as opposed to the lack of evidence on the fining of cast iron. Naturally, in antiquity nothing was known about carbon oxide and the carbon content of steel, and the actual role of coal in the cementation could have never been guessed, since this was simply used as fuel; the only discernable actions of coal, indeed, would be those of burning and heating. In this framework, Aristotle may have provided an explanation of the procedure which, in trying to make sense of the limited details accessible by observation, combined direct experience with inference. This cementation procedure was replicated experimentally, compatibly with the technology and materials to which an ancient blacksmith would have access, by J. D. Verhoeven, A. H. Pendray and W. E. Dauksch in 2016⁴⁴⁵. In their experiment, they built a cylindrical furnace filled with charcoal, kept the temperature of its bottom area inside a range of 1050 °C to 950 °C, and inserted in the furnace two wrought iron plates in a vertical position. After a certain time, they removed the plates to immediately quench them in water: the first, roughly 30 minutes after its bottom area had exceeded a temperature of 900 °C, and the second 30 minutes after the removal of the first. They succeeded in significantly carburizing and hardening both (bringing them to around Rc = 55, which approaches the hardness of mild steel, around Rc = 65). In a follow-up experiment, they even demonstrated that «file-hard well-formed martensite⁴⁴⁶ cases can be formed at the tips of iron blades with only 5-min to 10-min immersion times in charcoal-fired furnaces»⁴⁴⁷, which corroborates that the procedure was accessible to ancient blacksmiths. By heating wrought iron plates in the appropriate conditions, then, the blacksmiths could certainly turn them into *stomómata*, and thus receptive to quench hardening.

Now, Aristotle claims that iron can liquefy only if heated at extremely high temperatures (see *ὑπερβαλλούση θερμότητι*), which he thus implies to be normally avoided; shaping, for instance, only exploits the iron's "softening" (see *μαλάττεται*). A piece of iron which has finished being worked (*ὁ εἰργασμένος σίδηρος*), however, might need a final treatment to turn into a *stómōma*, and in this specific case such extreme temperatures would be reached. What was accessible to the blacksmiths' knowledge is that certain kinds of

⁴⁴³ See above, p. 90 n. 366.

⁴⁴⁴ See *ib.* and VERHOEVEN, PENDRAY, AND DAUKSCH 2016b, 2259.

⁴⁴⁵ See VERHOEVEN, PENDRAY, AND DAUKSCH 2016a.

⁴⁴⁶ *I.e.* the hardest phase of steel, see above, p. 89 n. 362.

⁴⁴⁷ VERHOEVEN, PENDRAY, AND DAUKSCH 2016b, 2258.

iron, when abruptly quenched from a high degree of incandescence (at least red-yellow, *i.e.* above 760 °C)⁴⁴⁸ could increase their hardness dramatically: probably, this was the only way they knew of distinguishing wrought iron from a *stómōma*⁴⁴⁹; and it is likely that every time the blacksmiths produced a *stómōma* their aim was specifically to harden an initially soft piece of iron (which may explain why *stómōsis* and quenching are often closely associated in the sources, especially in Plutarch). In Aristotle’s passage there is no explicit reference to quenching, but this might be implied to be the cause of the iron’s re-solidification (see *πάλιν πήγνυσθαι*) at the end of the treatment. In any case, in his description he does not focus on the iron’s successful hardening at the end of the procedure (*i.e.* the quenching), but on the steps leading to this outcome, *i.e.*, possibly, on the process we call carburization. Instead of understanding that this occurred thanks to the penetration of carbon in the iron’s texture, he went in the opposite direction, and assumed that the iron became purified by the expulsion of some «dross». In fact, every time iron is brought to incandescence in oxidizing conditions —*i.e.* in contact with air— a thin layer of iron oxides forms on its surface (as already remarked by Photos)⁴⁵⁰. If we assume that the surface of the *εἰργασμένος σίδηρος*, when put into the furnace for its *stómōsis*, was always removed beforehand, we can suppose that there was no oxide film shedding off the iron during the heating itself; a new one, however, would certainly form during carburization (if the iron was not completely isolated from the oxygen), resulting in a thin oxide coating on top of the carburized layer. This oxide film, known to the blacksmiths to always form on the iron during every step of forging, could perhaps be interpreted to be an emersion of impurities (*σχωρία*) from the iron’s core, whose removal, of course, would lead to a decrease in the iron’s overall weight and size (see *ἀπουσίαν γίνεσθαι πολλήν καὶ τὸν σταθμὸν ἐλάττω*). If the iron was immediately quenched at the end of the carburization attempt and while still incandescent — which is likely—, such oxidized film, unnoticed on the glowing iron, would always flake off during the cold immersion⁴⁵¹, and lead to a conspicuous depositing of scales on the container’s bottom (see *ὑφίσταται καὶ ἀποκαθαίρεται κάτω*, on which I will return in a moment)⁴⁵². If the quenching was successful, which the blacksmith could verify by a hardness test, the carburization had effectively taken place and the *stómōma* would not endure further heat treatment; if the quenching was instead unsuccessful, the blacksmith would try

⁴⁴⁸ See CONGDON 1971, 22.

⁴⁴⁹ See OBERG AND JONES 1918, 88 for other techniques of distinguishing between various kinds of steel. Probably, only the analysis of a «fresh break» from a hammer blow on the anvil (varying in smoothness and in colour) would have also been accessible in antiquity, but the blacksmiths would probably want to avoid fracturing their *stómōma* at the end of its carburization and heat treatment.

⁴⁵⁰ See *e.g.* TYLECOTE 1962, 254–55.

⁴⁵¹ See *e.g.* CONGDON 1971, 23 with n. 39. I could personally observe this phenomenon by heating and quenching an iron bar repeatedly, with or without the application of a welding flux: part of the scale that detached from the iron is visible on the bottom of the bucket in Figures 3 and 4 below, p. 131-2.

⁴⁵² This material is known in archaeometallurgy as “hammerscale”, and because it is produced in every step of iron forging and working, always taking different shapes, and changing its composition based on its association with other substances, it can be analysed to reconstruct some of the operations which took place in the excavated smithies or apparatuses. See *e.g.* TYLECOTE 1962, 254–55; SIM 1998, 97–146; DUNGWORTH and WILKES 2007.

the carburization again, which would thus result in the formation of a new film, again detaching from the iron during its immersion. Since each new trial would end in the formation and detachment of new oxide scales, it could be intuitive to interpret each attempt at a successful carburization as a further ‘expurgation’ of the iron: when the iron, sufficiently carburized, would harden as expected, it would be presumed that the expulsion of its «dross» was finally complete. A piece of iron which, for whatever contingent reasons⁴⁵³, needed more carburization attempts before becoming receptive enough to the quench hardening, would coherently be assumed to contain more «dross», and therefore to be worse than a piece of iron undergoing less «expurgation» (see ὁ ἐλάττω ἔχων ἀποκάθαρσιν). The iron’s alleged “liquefaction” (see τήκεται), in this process, is thus not observed, but is supposed to happen in the furnace —as an intuitive development of the “softening”— at the extreme temperatures above red-yellow incandescence. Its role in the physical etiology of the phenomenon, probably, is to provide a cause to the rearranging of the «dross» from the iron’s inside onto its exterior surface, allowing it to «sink» during the immersion: in fact, if the iron remained solid, and none of its parts acted like a fluid, these solid impurities could never be expelled into the water; since, however, the iron «liquefies», and «to the point of becoming moist» (ὕγρὸς), the impurities can move freely, “sinking” outside due to their weight. In this process, then, the verb ὑφίσταται («sinks») may be perhaps referred to the rearrangement of the «dross» in the ‘moistened’ iron, and the expression ἀποκαθαίρεται κάτω («is cleansed off below») to its detachment and sinking in the quenching bath — or both expression to this latter event.

In these regards, it is important to make two terminological considerations. First, there may be a reason why Aristotle used the form τήκεται... ὥστε ὑγρὸς γίγνεσθαι («liquefies [...] to the point of becoming moist») instead of τήκειν... ὥστε στάζειν καὶ ῥεῖν («liquefy [...] to the point of dripping and flowing») or simply τήκονται ὥστε ῥεῖν, which he employed in the immediately following sentences for melting stones, of the *purímakhos* or *muliās* variety (*Meteor.* IV 4 383^B5-7)⁴⁵⁴; perhaps, he did not want to imply that the iron ‘relaxed’ so much that it became a flowing liquid, but simply that the incandescence made it begin to act internally as a fluid (due to its acquired moistness)⁴⁵⁵. Second, the verb ὑφίστασθαι, like its derivative ὑπόστασις (“the being below” or “sediment”) is only used in *Meteor.* in contexts of fluid mechanics, and almost always to refer to the

⁴⁵³ E.g. an insufficient CO/CO₂ ratio in the furnace environment due to an excessive presence of ashes near to its tuyeres; see VERHOEVEN, PENDRAY, AND DAUKSCH 2016a, 2253–55.

⁴⁵⁴ These stones also appear in a similar exposition in Theophrastus, *Lap.* 9 (who refers to their liquefaction with the expression τήκονται καὶ ῥέουσιν, «melt and flow», rather than τήκονται ὥστε ῥεῖν). Some scholars have assumed that their described liquefaction alludes to their use with iron as smelting fluxes (see RICHARDS AND CALEY 1956, n. to *Lap.* 9; HALLEUX 1974, chap. 4 par. 8 with n. 16, eBook version), but I stand with EICHHOLZ 1965, n. to *Lap.* 9, who points out that in Theophrastus’s text it is the stones to receive the flux, and not the reverse. Cf. also DÜRING 1944, n. to 383b5: «as to πυρίμαχος, the original sense of the word seems to be “refractory”, that is, a stone that does not yield to treatment with fire or at least has a strong resistance against fire; it could consequently be used as a hearth bottom in melting ores».

⁴⁵⁵ The syntagm τήκειν ὥστε ῥεῖν was already present in Hippocrates, *Vict.* II 54.28. In Theophrastus, this becomes τήκονται καὶ ῥέουσιν (see preceding footnote). In Plutarch, see *QConv.* III 2.2 649^C (snow ἀπορρεῖ καὶ περιτήκεται); 8.2 656^E (fire, when unmoderated, instead of «strengthening» and «fixing» the clay, συνέτηξε καὶ ῥεῖν ἐποίησεν). See also below, sec. 10.

spontaneous arrangement of heavier substances under the lighter (sometimes opposed to ἐπιπολάζειν, “to surface”)⁴⁵⁶; its only other occurrence in book IV is not many lines below, and in reference to the depositing of sediment in various liquids, certainly qualifying as dregs (5 382^B11-7); its most interesting use, though, is in II 3, where it refers to the supposed sinking of rainwater, due to its weight, below the upper level of the potable water in rivers (385^B24-25)⁴⁵⁷. It may now be totally unsurprising, perhaps, that an internal rearrangement of the water’s parts, resulting in a higher compactness, due to cold, of its upper level may come to be metaphorized as a *stomoũsthai*. If the obtained *stómōma* can be readily quench hardened —*i.e.* compacted by the cold— even after further heat treatment (*i.e.* tempering or annealing), it is because it has expelled a sufficient quantity of its «dross», making it well-receptive to the sudden cooling. This etiology, of course, cannot account for the further oxidation which would inevitably occur after re-heating (and can neither in Photos’s interpretation), but offers the perfect framework to understand Plutarch’s take on the *stomoũsthai* of water (and even the other references to *stómōsis* in his *corpus*). In his explanation, in fact, all the properties of a *stómōsis* seem to be mapped onto the refrigeration of the liquid, except for the necessity of a heating agent (explicitly denied in *QConv.* VI 4.2): not only —like quenched iron— does the water become cooler and more compact due to a περίψυξις, but the effect of this περίψυξις is also intensified by the depositing of the “turbidity” below a purified part, which can now become ούλότερος under the effect of cold. All the answers in *QConv.* VI 5 are thus cumulative if not complementary, and are compatible with the short reference in *Frig.* 21. When translating the verb *stomoũsthai* in these two passages, we can conclude, it is fairly safe to opt for “steeling”.

⁴⁵⁶ See *e.g.* I 2 39^A15-7 (of the four elements, the ἐπιπολάζον is fire and earth the ὑφιστάμενον); 4 341^B10-2 (the moister exhalation sinks below the hot, subject of ἐπιπολάζειν); II 8 368^B7-13 (a wind remains trapped under the sea, and its forced ὑπόστασις causes an earthquake).

⁴⁵⁷ On this passage, in which Aristotle also describes the distillation of seawater, see also above, p. 103 n. 421. See also II 2 357^B1-8 (ὑπόστασις in reference to a salty deposit in urine).

7. Gripping ‘marble’ and white dusts

7.1 Sprinkling iron with *latúpē* and *mármaros*

These are not the only places in which Plutarch mentions the refrigerating effect of stones. We may exploit the presence of a vague reference to *stómōsis* in *Symp.* 13 (156^B) to proceed to its analysis and to comment on the technical use of *latúpē* («stone chippings») which it reports: as we will see, this material, which was apparently used in iron smithery, was interpreted by Plutarch to operate as a cooling device. In this passage, the talking character is Mnesiphilus the Athenian⁴⁵⁸. He wants to explain Solon’s decision of not drinking wine during the present symposium—which seemed to contradict his earlier praise in passionate verse of the «works [...] of Dionysus»—, and defends the view that wine-drinking is only a means to an end: namely, a means to promote friendship among the guests by «softening» their characters, which obviously makes it superfluous when the party is already composed of friends. Introducing this view, he states in general terms that «the work (ἔργον) of every art (τέχνη) and ability (δύναμις), whether human or divine, is that which is originated more than that through which (δι’ οὗ) it is originated, and the end more than that which serves (τὰ πρὸς) the end». To illustrate the concept, he starts by mentioning the arts of the weaver and the blacksmith:

ὕφάντης τε γὰρ ἂν οἶμαι χλαμύδα ποιῆσαι μᾶλλον ἔργον αὐτοῦ καὶ ἱμάτιον ἢ κανόνων διάθεσιν καὶ ἀνέγερσιν ἀγνύθων, χαλκεύς τε κόλλησιν σιδήρου καὶ στόμωσιν πελέκεως μᾶλλον ἢ τι τῶν ἔνεκα τούτου γιγνομένων ἀναγκαίων, οἷον ἀνθράκων ἐκζωπύρησιν ἢ λατύπης παρασκευήν.

In fact, I think that both a weaver would consider (lit. make) a chlamys and piece of cloth to be a work, more than a disposition of rods or a raising of loom-weights, and a blacksmith an iron’s welding and reinforcement (or sharpening) of an axe, more than any of the things that are necessary for this end, such as the kindling of coals or the preparation of stone chippings.

The term *latúpē*, as defined in LSJ, refers to «the chips of stone in hewing» (from *λατύπος*, “stone-cutter” or “manson”, which comes from *λάσας*, “stone” and *τύπτειν*, “cut”)⁴⁵⁹. Depending on the chippings’ size the word may also be understood as referring to «stone-dust», as in Davies’s translation of our passage⁴⁶⁰. This does not raise any interpretative issue in itself, but in this extremely synthetic allusion to the technical procedure the *latúpē*’s role is left unclear. We can surely understand that blacksmiths used it to achieve the «welding»

⁴⁵⁸ On this character and on the chronological difficulties related to his presentation as a *hetairo*s of Solon see LO CASCIO 1997, 60–61.

⁴⁵⁹ See LSJ, s.v. ‘λατύπη’. BLÜMNER 1884, 93 presented it as the «ergebende Abgang, Splitter», of the action of ζέειν or λαιίνειν rocks (on which see above, p. 61). See also below, n. 117 n. 483.

⁴⁶⁰ In GOODWIN [1874A] 1878.

(κόλλησις)⁴⁶¹ of iron, its *stómōsis*, or both, but it is difficult to understand how the *latúpē* should be instrumental to these ends. By examining the passage closely, however, we may be able to extract a few more details from its syntactical structure. First, let us suppose that the references to coal kindling and stone-dust preparation are meant to be coupled, separately, one with κόλλησις and the other with στόμωσις. Since coal kindling would actually be useful to both ends, in interpreting the reference to *latúpē* we can only be guided by the syntax: if the two parts of the sentence were constructed as a parallelism, the ἄνθρακες would go with κόλλησις and the λατύπη with the στόμωσις; if they were constructed, instead, as a chiasm, the reverse would be true, and the stone chippings would be the ones required for welding. Both the hypotheses are acceptable, because, if we took στόμωσις to refer to the preparation of the axe's edge⁴⁶², they would both find corroboration in parallel passages, as I will show. To proceed, we shall try to verify the parallelistic or chiastic structure by also examining the first part of the period, on the art of weaving: considering the clear rhetorical parallelism between the first and the second sentence of the passage⁴⁶³, in fact, we may expect the former to be constructed in the same way as the latter, and the hypothetical parallelism or chiasm to appear in the former first. This expectation, however, is not met, because the disposition of the rods and raising of loom-weights seem to be equally required for the production of both a *khlámys* and a *himátion*. Now, it is indeed true that the parallelism between the first and the second sentence is not complete, since κανόνων διάθεςιν and ἀνέγερσιν ἀγνύθων are connected with a καί («and»), while ἀνθράκων ἐκζωπύρησιν and λατύπης παρασκευήν by an ἢ («or»), which may be a sign that the operations required for weaving are meant to be connected with the mentioned products collectively while those of the blacksmith individually. This consideration, however, leads to a dead end for the syntactic analysis, as we would no longer have any grounds to confirm or reject our parallelistic or chiastic interpretation of the sentence on smithery. Rather, drawing inspiration from the sentence on weaving, and from the fact that a *himátion* is not necessarily something distinct from the chlamys, but as «an outer garment, formed by an oblong piece of cloth worn above the *khitón*» (LSJ) it can also be interpreted as a simple generalization of the previous (more specific) *khlámys*, we may propose that κόλλησις and στόμωσις are not mentioned as completely unrelated activities, but as results of the same process, one of the two being more general than the other and including it (which might also be the reason why Plutarch used the singular τούτου to refer to the couple, rather than a plural). This would not only fit better with the mention of the kindling of coals, which is required for both results, but could also be explained without particular difficulty as an allusion to either the “piling” of “faggoted iron” as a means for *stómōsis* or to the welding of a *stómōma* inside the

⁴⁶¹ On this term I return below, p. 119 with n. 494.

⁴⁶² BLÜMNER 1879, 200 n. 2 suggests comparing Virgil's *subiguntque in cote secures* («and they sharpen the axe on the whetstone») with our passage in *Symp.* 13, despite presenting *stómōsis* as a verb that is only related to steeling (see above, p. 89 n. 359).

⁴⁶³ Notice their beginning in ὑφάντης τε and χαλκεύς τε; both mention two technical products, which are distinguished by two instrumental activities through the formula μάλλον ἢ.

axe's blade⁴⁶⁴. If this connection were correct, the «reinforcement of an axe» would just be a peculiar application of the technology of iron welding, and thus στόμωσις a specification of κόλλησις as ἱμάτιον was a generalization of χλάμυς (notice that in this case there would be a semantic chiasm): inasmuch as the *latúpē* would be instrumental to welding, it would also be instrumental to the blade's *stómōsis*, if achieved through welding. Nonetheless, the 'non-unifying' interpretation would remain equally possible, because *stómōsis* might also refer to the shaping and filing of the axe's edge, which may require its iron to be annealed, and the *latúpē*'s role, in this operation, might be that of an annealing medium (as I will show below). For the moment, we have no elements to understand exactly how Mnesiphilus regards the stone chippings to be employed.

The very few scholars commenting on this passage, as it seems, have different ideas. Babbitt, at the expense of literality, translates *λατύπη* as «flux» without justification⁴⁶⁵. We can infer that he understood the stone chippings to be of a material which, when added to a piece of iron undergoing intense heating, would yield one of the following results: in a bloomery furnace, it would combine with some of the non-ferrous impurities in the iron ore, lowering the melting point of this “gangue” and thus helping the purification of the iron remaining in the “bloom”⁴⁶⁶ (the material, in this case, could be lime, *i.e.* calcium oxide or hydroxide)⁴⁶⁷; or, in an open environment, it would be applied to a piece of iron to dissolve its surface oxide films while also isolating its surface from air (thus preventing further oxidation)⁴⁶⁸, to allow for an easier forge welding, in which no interpolated oxidized iron would obstruct the joint⁴⁶⁹ (in this case a possible flux would be pure quartz sand, *i.e.* silica or silicon dioxide, or today, more commonly, borax, *i.e.* disodium tetraborate)⁴⁷⁰. Recent archaeometallurgy tends to call into question that flux was actually used in ancient times during the smelting

⁴⁶⁴ See above, p. 90 n. 367 and p. 91 n. 369.

⁴⁶⁵ BABBITT 1928.

⁴⁶⁶ See above, p. 89 n. 361.

⁴⁶⁷ See the remarks by J. F. Richards and E. R. Caley on Theophrastus, *Lap.* 9 which I discuss above, p. 110 n. 454. For use as a smelting flux, RAMIN 1977, 124 also mentions silica (mostly used for welding, as I report below): «il fallait ajouter par exemple du carbonate de chaux ou du spath fluor si la gangue était siliceuse, ou de la silice si la gangue était calcaire ou argileuse». The common idea that lime was used as a smelting flux has been problematized by TYLECOTE 1962, 186–88; see below, p. 115 n. 471.

⁴⁶⁸ See above, p. 109 with n. 451 and 452.

⁴⁶⁹ See *e.g.* BUCHWALD 2005: «under the reducing conditions on the hearth, this [*scil.* the flux] will react with the thin oxide films on the surface of the objects and combine to form fayalite [...]. Above 1200°C fayalite is fluid and will be squeezed away under the hammer-strokes, leaving pure iron surfaces to be welded». Cf. SIM 1998, 12: «the blow causes the metal parts to weld together and become a solid mass. Every time a fire weld takes place, large amounts of metal are lost because of oxidation - often as much as 60%. To ensure enough metal remains, the welded parts are made larger than the finished size. The surfaces to be joined are often coated with a flux [...] to help dissolve the oxide film and prevent further oxide from forming».

⁴⁷⁰ On quartz sand see *e.g.* BUCHWALD 2005, 65: «quite often the blacksmith adds sand to facilitate the joining operation. The sand may be rather pure quartz sand, SiO₂, or crushed flint, or impure beachsand, but the active component is SiO₂» (note that quartz is the crystalline mineral of SiO₂, *i.e.* silica); SIM 1998: «a certain amount of hammer scale mixed with sand is used by blacksmiths as a flux when fire-welding» (on hammerscale see above, p. 109 n. 452). On borax see *e.g.* OBERG AND JONES 1918, 111, quoted below, p. 115 n. 476 and p. 118 n. 490, and JERNBERG 1918, 21–22. It is uncertain whether this mineral was already known and used in antiquity: see below, p. 135-6 n. 547.

phase⁴⁷¹, and it must be noted that the practice is never clearly mentioned in literary sources⁴⁷²; this is also true for the use of welding flux, and although this has sometimes been suggested as an explanation for the composition of a kind of hammerscale (a flaky by-product of the iron forging process) found in archaeological deposits⁴⁷³, these suggestions have not been corroborated by more recent investigations⁴⁷⁴. Both identifications, as we can see, should thus be taken with a grain of salt. In any case, in Babbitt's interpretation the use of *latúpe* would be better connected to iron welding than to *stómōsis* as a distinct and unrelated activity, because it does not seem that iron carburization —as a means for steeling— called for any addition of a fluxing agent⁴⁷⁵. Babbitt's interpretation, then, implicitly supports the hypothesis that *latúpe*'s role, according to this passage, was in iron welding, and that it would be relevant to *stómōsis* only in the case this were achieved through welding⁴⁷⁶. Defradas's and Hani's interpretation is apparently very different. In fact, they avoid Babbitt's (justifiable) presentism and provide a disambiguating translation of *λατύπη* as «sciure de marbre». Then, in a footnote, they comment that «l'expression a été généralement très mal comprise», since an explanation is provided by Plutarch himself in *Frig.* 19 (954^A, which they simply quote)⁴⁷⁷. It might perhaps be useful, then, to proceed to examining this passage. In the context of Plutarch's defence of the stance that the earth is the primarily cold element —we shall remember chapter 19 as that which also includes the *págos-*

⁴⁷¹ See especially TYLECOTE 1962, 186–88: «Up to about 12% of lime (CaO) will decrease the melting point by about 50° C but more than 15% begins to increase the melting point considerably [...]. But additional lime (usually limestone or chalk) cannot be absorbed in large pieces by fayalite slags at such a low temperature as 1200° C, and where such pieces are found on primitive smelting sites, they cannot have been used as fluxes as has been suggested by so many excavators. [...] if the limestone was ground into powder it could be absorbed in small quantities into primitive slags, but the result would only reduce the melting point by about 50° C which would not be of much benefit to the process. Large quantities would raise the melting point, clog the furnace and be detrimental». See also CRADDOCK 1995, 244: «Usually the ore was self-fluxing, that is there was sufficient silica etc in the ore to react with some of the iron minerals to make the liquid slag that was essential for the formation of the bloom. Exceptionally, if the ore was very pure it might prove necessary to add a little silica, and clay from the walls and tuyere could also act as slag formers»; ID. 2003, 233 and 235 (on the use of «limestone or aluminium-rich clays» as fluxes in blast furnaces introduced in Europe during the late Middle Ages).

⁴⁷² But see above, p. 110 with n. 454 on the ambiguous testimony of Aristotle and Theophrastus, and below, p. 133 n. 537.

⁴⁷³ On hammerscale see above, p. 109 n. 452. For hypothetical identifications of welding fluxes in hammerscale remains see e.g. TYLECOTE 1962, 254–55 («the silica in the fayalite cementing films in this material comes from the slag in the metal and possibly from sand used as flux in the smithing operation»); MCDONNELL 1986, 145–46 («the oxide scale formed due to oxidation of the metal surface, and the silicate scale was a thin slag layer formed by the sand flux»).

⁴⁷⁴ See especially DUNGWORTH AND WILKES 2007, 34: «the compositions of the archaeological samples provides no evidence for the use of a separate flux» (and p. 3–4 for a review of the earlier bibliography). Cf. SIM 1998, 12: «it has not been possible to prove the use of fluxing in ancient forge welding. A series of three experiments was carried out by the author to determine if forge welds carried out using different fluxes left any identifiable residues in the welds. Scanning Electron Microscope (SEM) analysis of all welds showed no traces of fluxes left in the welds».

⁴⁷⁵ On carburization see above, p. 90 n. 366.

⁴⁷⁶ According to OBERG AND JONES 1918, 111, while iron «which is very low in carbon can easily be welded», the welding becomes more difficult «when the carbon content is above 0.33 per cent» —i.e. in the range of a steeled *stómōma*— «and can only be done by the use of borax or some other flux [...]». If this is true, the use of *latúpe* would indeed be necessary for the welding of steeled leaves or edges into iron tools, blades, or piled structures.

⁴⁷⁷ In DEFRAZAS, HANI, AND KLAERR 1985, n. 2 *ad loc.*; note that they do not explain why and how the other interpretations should be wrong, and avoid to cite them explicitly. They translate *στόμωσιν πελέκεως* as «trempe d'une hache», without clarifying how «marbre» would be useful in the operation.

wordplay on petrification and the idea of an absolute coldness in the earth's extreme depths⁴⁷⁸—, we find yet another proof that earthy substances are naturally cold:

οἱ δὲ χαλκεῖς τῷ πυρουμένῳ καὶ ἀνατηκομένῳ σιδήρῳ μάρμαρον καὶ λατύπην παραπάσσουσι, τὴν πολλὴν ῥύσιν ἐφιστάντες καὶ καταψύχοντες· ψύχει δὲ καὶ τὰ τῶν ἀθλητῶν κόνις σώματα καὶ κατασβέννυσι τοὺς ἰδρώτας.

And blacksmiths sprinkle marble and stone chippings on (lit. along) the iron that is burning and melting up, arresting [its] great flow and cooling [it] down; and dust cools the bodies of the athletes too, and extinguishes [their] sweating.

The first relevant detail is that Plutarch presents the terms *λατύπη* and *μάρμαρος* in a pair: if this were to be interpreted as a hendiadys (like Defradas and Hani did in *Symp.* 13: «sciure de marmbre»)⁴⁷⁹ or as a semi-synonymous pair⁴⁸⁰, he would be informing us on the material out of which the stone chippings were made. In this case, Babbitt's interpretation of *latúpē* as a fluxing agent could find support in the frame of the bloom purification process: marble, in fact, being very often a limestone —*i.e.* a rock largely composed of calcite (a mineral of calcium carbonate)—, can be able, when high temperatures are reached, to provide the quicklime (calcium oxide) acting on the impure iron as a flux⁴⁸¹. The production of quicklime from marble is indeed reported by Theophrastus in *Lap.* 69, when he writes that marble is the preferred stone in Phoenicia and Syria for producing *gúpsos* through calcination: this is a hint that quicklime was probably among the substances encompassed by the Greek term *γύψος*, together with slaked lime (calcium hydroxide) and gypsum proper (the mineral of calcium sulfate dehydrate)⁴⁸². This would mean that the difference between gypsum and lime was

⁴⁷⁸ See above, p. 40-1.

⁴⁷⁹ The pair in *Frig.* 19 was already translated as «the dust of marble» by Fetherston in GOODWIN [1874D] 1878.

⁴⁸⁰ On this feature of Plutarch's style see TEODORSSON 2000, spec. p. 513: «even such pairs as *πολύφίλος καὶ πολυτίμητος* (497 C) and *ἄφίλος καὶ ἀδύνατος* (497 C) also seem to be acceptable as partly synonymous, seeing that the meaning of the second word of each pair is implied by the first. It specified and clarifies that word. In some cases the pair can be interpreted as *hendiadyoin*, but this is a less common type».

⁴⁸¹ See above, p. 114 n. 467. The identification of marble as a source of lime is proposed by CHERNISS 1976a, n. f to *QPlat.* 10.4 1011^B, as I will show below.

⁴⁸² See RICHARDS AND CALEY 1956, n. *ad loc.*, together with *Lap.* 9 and their respective n. *ad loc.* (partly discussed above, p. 110 n. 454). EICHHOLZ 1965 does not agree with the identification of *gúpsos* as quicklime, remarking in his n. to *Lap.* 69 that «plaster of Paris [*i.e.* *gúpsos*] is not made from limestone or marble. Theophrastus probably mistook the character of Phoenician and Syrian gypsum pebbles and exaggerated their hardness»; see also his n. to *Lap.* 9: «*μάρμαρος* [...] here means 'limestone' in general, including probably crystalline limestone (marble). The word is not used specifically of marble until a later date» (a claim he does not support with evidence). In *Lap.* 9, Theophrastus reports that calcinated *mármaros* provides *konía* («dust»), and he also uses this term in relation to *gúpsos* (as provided by *mármaros*) in chap. 69, but as part of an analogy: «after baking it, they cut it like the *konía*». Eichholz argues in his n. to *Lap.* 9 that the term *konía* «is used in two senses in the course of this work. Here and in §§ 68 and 69 it means 'quicklime', but in § 40 a fine powder» (followed by AMIGUES 2018: see her translation «chaux» and her n. 6 to *Lap.* 2); I will return

not always recognized in ancient Greece, and could justify, once the identification of the “stone chippings” with *mármaros* is accepted, a fuzzy interpretation of *latúpē* as made of either gypsum or lime, as in the second definition of the term in LSJ⁴⁸³. However, if the pair *μάρμαρον καὶ λατύπη* is interpreted as neither hendiadic nor synonymous, there would still seem to be no reason to translate it, like Helmbold, as «marble chips and gypsum»⁴⁸⁴, and introduce a clear-cut chemical distinction that does not seem to be supported by the technical context of the passage: without an explicit mention of gypsum, it seems entirely gratuitous to suppose that this had any role in the procedure.

In any case, to interpret our passage as referred to the *latúpē*'s fluxing action is not really straight-forward, since the effect Plutarch reports seems to be unrelated with it. In fact, he makes no mention of either purification, *stómōsis*, or *kóllēsis*, but he clearly credits the minerals with a cooling action, which he regards to be helpful against the excessive laxness of the heated iron. Now, the present form of the participles *πυρούμενος* and *ἀνατηκόμενος* probably indicates that the chippings were sprinkled on the iron while it was still being burned (and possibly still on the fire)⁴⁸⁵ and on the verge of liquefaction; because the melting point of iron could only be reached in a high temperature shaft furnace⁴⁸⁶—and surely not in the open air—it is likely that its «great flow» was either overstated or inferred, but probably not observed (in a similar way as in

on this below, in this note. Eichholz maintains a coherent interpretation of *gúpsos* as «plaster of Paris» since its appearance in *Lap.* 65, regardless of the thermic details to which Richards and Caley decide to give more relevance: on the passage in *Lap.* 66 «the workmen [...] pour water over it and stir it with sticks, for they cannot do so by hand owing to the heat», Eichholz comments (n. to 68) that «the thermal reaction is exaggerated», while Richards and Caley argue (n. to 66) that «though both quicklime and dehydrated gypsum generate heat when mixed with water, quicklime generates far more heat. Since Theophrastus makes a point of mentioning the heat, it is likely that he is referring to mortar made from quicklime and not to gypsum mortar». For another point in favour of the identification of *gúpsos* as a lime mortar see their n. to 65, in which Theophrastus claims that «it is used on buildings and is poured around the stone or anything else of this kind that one wishes to fasten»: they comment that «unless this statement applies to a very dry country like Egypt, the material must be lime mortar and not gypsum mortar, since the latter soon disintegrates in wet weather. Though only a few chemical analyses have been made of ancient Greek mortars, they indicate that lime mortar was the only kind used in Greece at the time of Theophrastus» (with reference to FOSTER 1934). Note that Eichholz does not provide any counter-argument: in his n. to 65 he simply states that «the reference is to *grouting* with a plaster of Paris slurry, not to *bonding* with a lime mortar» (my emphasis); he is followed by Amigues (see her n. 14 to chap. 9), who does not join the debate. A point in favour of Eichholz's interpretation may be the analogical reference to *konía* in *Lap.* 69: although translating *konía* as «quicklime», in general, might seem to be too interpretative and specific (arguably, it is always reasonable to refer to quicklime, analytically, as a «fine powder»), the presence of the article in the passage («the *konía*») —potentially a corruption of the text, considering the surrounding textual problems— goes against the generic interpretation of *konía* as (any) «powder»; Richards and Caley themselves acknowledge that if the term had to be translated as «lime [...] that would imply that Theophrastus regarded this kind of *gúpsos* as different from lime» (n. to 69). The term *konía*, however, does not necessarily have the same meaning as in its earlier occurrence in *Lap.* 9, and may be interpreted here to refer to «lye», *i.e.* to any powdery alkaline detergent, which is a well-attested meaning (see LSG, *s.v.* «*κονία*», II). On the confusion between gypsum and lime cf. also CULTRARO 2018, 127–28, who refers to a “persistent confusion”, in archaeology, «tra i tre minerali chiamati in causa, gesso, calcite ed alabastro».

⁴⁸³ LSJ, *s.v.* «*λατύπη*», II (note that the first of the cited *loci* for this meaning is our *Frig.*, 19 954^A; this is the only reported *locus* in MONTANARI, *s.v.* «*λατύπη*», for the meaning «gesso, calce»). BLÜMNER 1879, p. 140 only mentions *latúpē* as a synonym of *gúpsos*, without considering the Plutarchan occurrences (but he does present it in more general terms in 1884; see above, p. 112 n. 459).

⁴⁸⁴ In CHERNISS AND HELMBOLD 1957. He is followed by Nuzzo in D'IPPOLITO AND NUZZO 2012.

⁴⁸⁵ The static designator for an incandescent metal is the adjective *διάπυρος*; notice its use in the parallel passage in *QConv.* IV 660^{B-C}, quoted below.

⁴⁸⁶ See above, p. 106.

Aristotle's etiology of *stómōsis*⁴⁸⁷. Considering these premises, I argue that the described scenario can be interpreted in at least two ways: either the 'refrigerating' dust was used as an annealing medium, and thus in the process of malleableizing the iron piece for the shaping and filing of its edge (in this sense the iron would be prepared for *stómōsis*)⁴⁸⁸; or it was used, again, as a welding flux, and thus for *kóllēsis*⁴⁸⁹. In the first case, lime (*i.e. mármaros*) would be an adequate substance for the job, as it is still used for the same purpose in present-day blacksmithing, being it effective in insulating the slow cooling piece of iron from the surrounding air⁴⁹⁰. However, the fact that it is explicitly regarded to "arrest" the iron's «flow» (ῥύσις) is difficult to place in the picture, along with the small detail that the iron should be still «burning and melting up» at the time of the sprinkling, rather than put to rest after a moderate reheating, which is what the annealing procedure consists in⁴⁹¹; its alleged 'cooling' action, moreover, might seem to be contradicted by the actual effect of a longer conservation of the iron's heat, and the act of "sprinkling" (see παραπάσσοσι) is arguably ill-suited to the aim of an extensive, and insulating, covering of the iron (which would be quickly obtained by plunging the iron in a container already filled with sand, or by pouring the sand on top of it)⁴⁹². The interpretation in terms of *kóllēsis*, therefore, seems to be more likely. In fact, not only would it be understandable that the flux

⁴⁸⁷ See above, p. 106-7, where I also refer to Photos's and Craddock's remarks on the production of steel by means of fining. The liquefaction of cast iron, admittedly, would have been observable directly, but the sprinkling of sand onto the liquid iron during the fining process, so common in postmedieval Europe to remove its surface oxides, is not applicable to Plutarch's description: in fact, it seems to be impossible to infer from this kind of fluxing that any «flow» was being "arrested". I obviously do not agree with the interpretation of the passage in *Frig.* 11 proposed by PHOTOS 1989, 294: «[...] Plutarch gives a unique insight into an intermediate step known to be an integral part of blast furnace iron making. Addition of lime (base) would remove silica (acid) and other impurities from the iron, while simultaneously keeping most of the iron in the metal rather than the slag. Thus, it is highly likely that Plutarch's text refers to cast iron melting [...]».

⁴⁸⁸ Annealing is required when a piece of steel has been made too hard and brittle by the act of quenching (see above, p. 89 n. 362), for instance in the case it needs further mechanical treatment. On this practice see *e.g.* CONGDON 1971, 20–21: «martensite [*i.e.* the hardest phase of steel] is a material with a high potential: it is strong, hard, and brittle, while the carbon scattered throughout the "solution" retards slips and cracks. In order for it to be useful for most tools and implements, the brittleness must be lessened if the entire object is of martensite; however if the martensite is only a coating on the iron (in other words, a *case-hardened iron*), it is retained without modification since it will hold an excellent edge. To make martensite less brittle, the iron must be *annealed* or carefully reheated to about 550° F [*i.e.* 288 °C] and held there for a while (about an hour or two), permitting the strained atomic structure to relax somewhat [...]» (her emphasis). The annealed iron must then be permitted to cool slowly and homogeneously, and for this end it can be covered throughout, after the heating, in an "annealing medium" (see below, n. 490).

⁴⁸⁹ FUHRMANN 1964 interpreted the technique to be instrumental to both ends: «curieuse est la technique du refroidissement par le marbre, pour la façon et la soudure du fer (*Quaest. conv.* 660c, *Plat. quaest.* 1011b)», citing *Frig.* 19 954^B in a footnote (p. 50 with n. 2); I comment on both the other passages in what follows. I also quote Fuhrmann below, p. 126 n. 521 and p. 132 n. 534.

⁴⁹⁰ See RICHARDSON [1889] 1978, 47: «the best mode of annealing heavy blocks of crucible cast-steel is to heat the block to a uniform red heat, and as soon as you have obtained this heat place the steel in a cast-iron or sheet-iron box [...]. This box is filled with common lime and wood ashes, equal parts of each. [...] The only secrets in annealing steel, that I know of, are to exclude air from the steel as much as possible, while it is annealing, and to avoid overheating». Cf. OBERG AND JONES 1918, 292–93: «[...] use an iron box or pipe of sufficient size to allow at least one-half inch of packing between the pieces of steel to be annealed and the sides of the box or pipe. [...] This pipe is packed carefully with powdered charcoal, fine dry lime, or mica, and is covered with a cap, which should be air-tight; [...]. It is then cooled as slowly as possible, care being taken not to expose it to the air until cold; a good way is to allow the box or pipe to remain in the furnace until cold»; JERNBERG 1918, 99.

⁴⁹¹ See above, n. 488.

⁴⁹² On the "sprinkling" see also above, n. 487.

is described to be added during the course of the welding procedure (*i.e.* while the iron is *πυρούμενος*), but the reference to “melting” would be also easily explainable, namely as a (wrong) interpretation of the process leading to the union of the iron pieces that were to be welded: their successful jointing —which today we know does not require any liquefaction and only happens through mechanical interlocking⁴⁹³— was perhaps regarded to be an effect of the two surfaces’ partial melting and combined resolidification, which could be clearly observed for other metals in their alloying or soldering procedures; after all, it was the term *κόλλησις*, literally meaning “gluing”, to be used for iron welding⁴⁹⁴. If this is correct, the added flux, rather than a means to prevent impurities from obstructing the joint, might have been interpreted as the agent which solidified (*i.e.* cooled) the joint itself: when it was not added, in fact, the weld would be more difficult, and this difficulty might have been interpreted as a consequence of the iron remaining too loose in texture (because too hot)⁴⁹⁵. This interpretation of the passage appears to have only one serious problem, that is, the fact that lime and marble do not seem to have ever been used as welding fluxes. The isolated mention of *latúpē* could initially allow us to identify it with any possible kind of stone dust, but now, if we want to retain this interpretation, we cannot avoid translating *μάρμαρος* in a non-standard way⁴⁹⁶. It is certainly easy to associate with any white ground dust — especially if one considers the etymological meaning of the term, *i.e.* “glittering [stone]” (from *μαρμαίρειν*)⁴⁹⁷. For instance, we might think of the dust of milky quartz (the white form of mineral silicon dioxide, *i.e.* silica) or white sandstone (rock mostly composed of quartz), whether naturally occurring as sand or artificially powdered⁴⁹⁸: these minerals, which are remarkably similar to white marble, would be in fact appropriate for fluxing⁴⁹⁹, but this identification would still be arbitrary to a certain degree. We might perhaps find some support for it in the fact that Plutarch, in our passage, mentions the athletic use of «dust» (*kónis*) immediately after referring to *mármaros* and *latúpē*, implicitly associating its “extinguishing” effect on sweating with that of the “arresting” power of stone dust. This coupling of illustrations may be a sign that Plutarch thought of this *mármaros* as a substance similar (if not identical) with the athletes’ «dust», of

⁴⁹³ See *e.g.* SIM 1998, 12.

⁴⁹⁴ See the use of *κόλλησις σιδήρου* in *Symp.* 13 156^B, extensively discussed above. For other parallels see BLÜMNER 1887, 293-4 with n. 3, who also considers the possibility that the expression may have been used to refer to an actual soldering of iron (note that neither FORBES 1964D nor CRADDOCK 1995 refer to any technique of iron soldering). The technique of *κόλλησις σιδήρου* was regarded to be an invention of the archaic sculptor Glaucus of Chios.

⁴⁹⁵ But cf. the different etiology of copper soldering through tin embedded in *Frat.* 20 491^A; on the metaphorical welding of the lovers’ souls see *Amat.* 21 767^E (this requires a liquefaction, see *συνάγουσι συνάπτουσι... και συντήκουσι*).

⁴⁹⁶ However, as we have seen, Plutarch in his *corpus* never refers to marble, in the context of art or in architecture, using the word *μάρμαρος*, preferring to refer to it with *λίθος* (see above, p. 61).

⁴⁹⁷ Cf. the almost-contemporary Pseudo-Democritus, *PM* 8, where the instruction *ποίη μάρμαρον* («make it glittering») is used in relation with an ingredient named *klaudianón*: on the uncertain identification of this material, more likely to be a mineral than a metal, see MARTELLI 2011, n. 51.

⁴⁹⁸ Cf. Oldfather’s interpretation of the *mármaros* in Diodorus Siculus, *BH* III 12.1, quoted above, p. 71 n. 292.

⁴⁹⁹ See above, p. 114 n. 469.

whatever composition it was: if this were true, *mármaros*'s identification with silica sand (*i.e.* the most common kind of sand) might prove to have a firmer basis⁵⁰⁰.

The importance of the term *μάρμαρος*, in any case, is confirmed by its appearance in two other Plutarchan parallel passages. We should begin with the prooemium to *QConv.* IV—in which the speaking voice is that of the author himself—, because it interestingly mentions the athletes' dust. The context is almost identical to that which we have seen in *Symp.* 13: Plutarch explains to his addressee Sosius Senecio that symposia should be specifically instrumental to acquiring new friends—*i.e.* people well-disposed towards us—, since this is very easy to obtain when people have a pleasant conversation under the effect of wine (consistently with the earlier declarations in *QConv.* I 4.3 621^C, spoken by Theon)⁵⁰¹. In this passage, however, the analogy with smithery occurs with a different function—*i.e.* not to illustrate the wine's status as an instrument—, as if Plutarch wanted to employ the almost-same welding imagery in the two *loci* while also diversifying its focus and extension. Just before mentioning the *mármaros*, he develops an analogy with the use of *κονιορτός* (“dust-cloud”, so “dust”) by wrestlers: although this parallels the reference to *kónis* in *Frig.* 19, and could therefore reinforce the interpretation of *latúpē* as a welding flux, here the theme of iron welding is not explicitly touched upon (*QConv.* IV 660^{B-C})⁵⁰²:

ὁ γὰρ σύνδειπνος οὐκ ὄψου καὶ οἴνου καὶ τραγημάτων μόνον, ἀλλὰ καὶ λόγων κοινωνὸς ἦκει καὶ παιδιᾶς καὶ φιλοφροσύνης εἰς εὐνοίαν τελευτώσης. αἱ μὲν γὰρ παλαιόντων ἐπιβολαὶ καὶ ἔλξεις κονιορτοῦ δέονται, ταῖς δὲ φιλικαῖς λαβαῖς ὁ οἶνος ἀφήν ἐνδίδωσι μιγνύμενος λόγῳ· λόγος γὰρ αὐτῷ τὸ φιλάνθρωπον καὶ ἦθοποιὸν ἐπὶ τὴν ψυχὴν ἐκ τοῦ σώματος ἐποχετεύει καὶ συνδίδωσιν· εἰ δὲ μή, πλανώμενος ἐν τῷ σώματι πλησμονῆς οὐδὲν σπουδαιότερον παρέσχεν.

⁵⁰⁰ On the athletes' «dust» see below, sec. 7.3. Its identification with common sand is helped by the passage in Lucian, *Anach.* 2, where to refer to it he uses both the terms *κόνις* and *ψάμμος* («sand») interchangeably. In this passage, he pictures young men in the court of a gymnasium taking sand from the ground and throwing it one another; they also apply the dust to their own bodies «in order that it may be harder to break away in the clinches, I suppose, because the sand takes off the slipperiness (ὁ ὀλισθος) and affords a firmer grip (ἀντλήψις) on a dry surface (ἐν ξηρῷ)» (transl. HENDERSON 1925). Cf. MILLER [1979] 2004, «Index and Glossary», 222, who defines *κόνις* as «dust or, sometimes, a powder, like talc, used after bathing» and adds that «the word *kanis* is frequently mistranslated as sand». Cf. also Plutarch, *Cr.* 25.5 for the use of the expression *ἄμμου κονιορτόν* («dust-cloud of sand»), here referred to dust lifting on a battlefield.

⁵⁰¹ «None of this, I think, must our leader allow; rather he will only give a place to that talk, that spectacle, that amusement which accomplishes a party's aim, and this aim is through pleasure (δι' ἡδονῆς) to produce among those who are present the tightening (ἐπιτασις) of friendship or to bring it into existence; for the drinking-party is a passing of time over wine which, guided by gracious behaviour (ὑπὸ χάριτος), ends in friendship» (transl. Clement in CLEMENT AND HOFFLEIT 1969, slightly modified). This end was anticipated by Lamprias in I 2.6 618^{D-E}: «such a company I wish to make our dinner-party, not seating rich men with rich man, nor young man with young man, nor official with official and friend with friend, for this arrangement is static and inefficient in the promotion (ἐπίδοσις) and creation of good-fellowship» (transl. Clement); not many lines below, in 619^A, he had also used an image of iron welding, which I quote below, p. 127 n. 524.

⁵⁰² Paraphrasing mine. The translation draws *passim* from Hoffleit in CLEMENT AND HOFFLEIT 1969.

ὄθεν ὥσπερ ὁ μάρμαρος, τοῦ διαπύρου σιδήρου τῷ καταψύχειν τὴν ἄγαν ὑγρότητα καὶ ῥύσιν ἀφαιρῶν, εὐτονον ποιεῖ τὸ μαλασσόμενον αὐτοῦ καὶ τυπούμενον⁵⁰³, οὕτως ὁ συμποτικός λόγος οὐκ ἔξ̄ διαφορεῖσθαι παντάπασιν ὑπὸ τοῦ οἴνου τοὺς πίνοντας, ἀλλ' ἐφίστησι καὶ ποιεῖ τῇ ἀνέσει τὸ ἰλαρὸν καὶ φιλόνηθρον ἐγκέραστον⁵⁰⁴ καὶ κεχαρισμένον⁵⁰⁵, ἃν τις ἐμμελῶς ἄπτηται, καθάπερ σφραγίδι φιλίας εὐτυπῶτων καὶ ἀπαλῶν διὰ τὸν οἶνον ὄντων.

A dining companion does not come as a partaker of only meals, wine, and delicacies, but also of discourse, of jest, and of the kindness that ends up becoming goodwill. For the assaults and tugs of those who wrestle require dust, whereas to friendly holds it is the wine which gives the grip, mixed with discourse. In fact, discourse is that which channels and communicates by means of it (*scil.* the wine) the character-forming benevolence from the body to the soul; otherwise, wandering astray in the body, [wine] provides nothing more worthy than repletion.

Hence, just as marble, by removing the excessive moistness and flow of the incandescent iron through cooling, strengthens (lit. makes well-strung) the part of it that is softening and being shaped (or impressed)⁴⁷⁰, so table-talk does not allow the drinkers to be completely dispersed by wine, but arrests, and by the relaxation [of the wine's effect] makes [their] gaiety and benevolence blended in⁵⁰⁴ and pleasing⁵⁰⁵, if one engages with it [*scil.* the table-talk] harmoniously, while [the drinkers] are, as it were, pliable (*i.e.* easily shaped or impressed) and tender, due to wine, with respects to the seal of friendship.

⁵⁰³ Cf. *QConv.* III 10.3 658^D (glass receives μάλαξις καὶ τύπωσις), but see below, p. 126-7 n. 522.

⁵⁰⁴ The interpretation of the *hapax* ἐγκέραστον is not straight-forward (see below). BERNARDAKIS 1892 proposed to emend it into ἐπέραστον («lovable»), and later (see INGENKAMP AND BERNARDAKIS 2011) into εὐκέραστον («well-tempered», as in *Lun.* 5 922^{D-E}). TEODORSSON 1989b, n. *ad loc.* —according to whom «the periphrastic expression ποιεῖ ἐγκέραστον = ἐγκεράννησι is awkward» (arguably a non-trivial reformulation)— accepted the latter conjecture; all the recent editors, however, maintained ἐγκέραστον (Ingenkamp included). Cf. the semi-parallel passage in *QConv.* I 1.3 613^{D-E} quoted below, p. 125 n. 518.

⁵⁰⁵ HUBERT [1938] 1971 proposed the emendation καὶ <τὸ> κεχαρισμένον, accepted by Hoffleit in CLEMENT AND HOFFLEIT 1969, FUHRMANN 1978, SCARCELLA 2001, and Ingenkamp in INGENKAMP AND BERNARDAKIS 2011 (my translation would change in this way: «and by the relaxation [of the wine's effect] makes [their] gaiety and benevolence and their agreeableness blended in»). Such intervention seems unnecessary, and TEODORSSON 1989b, n. *ad loc.* —who rejected it— correctly pointed out that «the clause as a whole corresponds exactly to the preceding εὐτονον ποιεῖ τὸ μαλασσόμενον αὐτοῦ καὶ τυπούμενον». However, since he accepted Bernardakis's εὐκέραστον in the place of ἐγκέραστον (see the preceding footnote), he viewed the pair εὐκέραστον καὶ κεχαρισμένον as yet a further illustration of Plutarch's «predilection for pairs of roughly synonymous words» (see ID. 2000, spec. p. 513). My interpretation is different: if ἐγκέραστον is maintained, the participle κεχαρισμένον might have been attached to it for a hendiadic effect, as in «pleasingly blended in».

The interpretation of the sentences following the analogy with ironworking is very difficult, and their existing translations are quite diverse⁵⁰⁶. In the one that I provide, I have decided to maintain the ambiguity of ἐφίστησι («arrest»)⁵⁰⁷, which could be either referred (through an implicit demonstrative such as αὐτούς) to the forementioned πίνοντας («drinkers»)⁵⁰⁸, or to the following object τὸ ἱλαρὸν καὶ φιλόνηθρον («the gaiety and benevolence»), as a member of the functional couple ἐφίστησι καὶ ποιεῖ («arrests and makes»); it could as well be without an object («arrests» in an absolute sense). I have also interpreted τῇ ἀνέσει («by the relaxation») as an instrumental dative specifying the verb ποιεῖ («makes»), with its indirect object left implicit⁵⁰⁹; as a

⁵⁰⁶ See WYTTEBACH 1797A (identical in DÜBNER 1877): «ita quemadmodum marmor igne candentis ferri nimiam molliem et fluxum refrigerando sistens, validum et formabile reddit: sic convivalis sermo non diffuere omnino patitur vino bibentes, sed inhibet eos, ac dissolutioni humanitatem venustatemque admiscet; si quis bibentes tempestive oratione attingat, [...]» (notice that he skips κεχαρισμένον); Creech in GOODWIN [1874b] 1878: «thus as a marble, by cooling red-hot iron, takes away its softness and makes it hard, fit to be wrought and receive impression; thus discourse at an entertainment doth not permit the men that are engaged to become altogether liquid by the wine, but confines and makes their jocund and obliging tempers very fit to receive an impression [...]» (notice that he skips τῇ ἀνέσει, φιλόνηθρον and ἐγκέραστος); Hoffleit in CLEMENT AND HOFFLEIT 1969: «in consequence, just as marble eliminates excessive melting and fluidity in red-hot iron by cooling it down, and thus gives the right tensile strength to the metal during the softening and shaping process, so table-talk prevents the complete dissipation of the drinkers' minds under the influence of the wine. Conversation steadies those who drink, adding through relaxation an element of gaiety and —yes— of kindly sociability, if people go about it in the right way, [...]»; FUHRMANN 1978: «et, de même que le marbre rend, par refroidissement, le fer incandescent moins fluide et moins coulant, et lui donne la résistance voulue quand on le modèle et le façonne, de même la conversation, à table, empêche que les buveurs ne tombent, sous l'effet du vin, dans un relâchement complet; elle les contient, et, si l'on y prend part harmonieusement, fait qu'au laisser-aller se mêlent la gaîté, la prévenance et l'amabilité, [...]»; SCARCELLA 2001: «e alla stessa maniera del marmo che sopprime del ferro incandescente l'eccessiva mollezza e fluidità, rende resistente ciò che [sic!] lo modella e lo scolpisce, così la conversazione conviviale non permette che i simposiasti siano completamente annichiliti dal vino, anzi li frena e rende —con la distensione— la vivacità e la bonomia, limpida e amorevole, se uno vi si abbandona intensamente [sic!] [...]»; Citelli in LELLI, PISANI, ET AL. 2017: «perciò, come il marmo, raffreddando il ferro incandescente, gli toglie l'eccesso di flessibilità e di fluidità e lo rende resistente quando viene forgiato e modellato, così nel simposio la conversazione impedisce che i bevitori escano completamente di senno per effetto del vino, e anzi li trattiene in sé e fa sì che all'effetto disinibitorio si uniscano l'allegria, la cordialità e la piacevolezza, se ci si accosta al bere in modo armonioso [...]».

⁵⁰⁷ As in Creech in GOODWIN [1874b] 1878.

⁵⁰⁸ As in WYTTEBACH 1797A, FUHRMANN 1978, SCARCELLA 2001, Citelli in LELLI, PISANI, ET AL. 2017.

⁵⁰⁹ So did Hoffleit in CLEMENT AND HOFFLEIT 1969. The syntagm τῇ ἀνέσει could be also read as a causal dative to be connected to τὸ ἱλαρὸν καὶ φιλόνηθρον, which is indeed a result of the wine's influence on the mood («the gaiety and benevolence due to the relaxation»), as shown in the following passage reported by FUHRMANN 1978, n. 4 *ad loc.*: *QConv.* I 4.2 620^D, 4.3 621^C, VII 8.3 712^B, and, with the image of softening iron, *Symp.* 13 156^{C-D}, which I quote below. This interpretation, however, is highly unlikely (if not impossible) on a syntactic level, due to the placing of τῇ ἀνέσει outside of the syntagm τὸ ἱλαρὸν καὶ φιλόνηθρον: if this were the best interpretation, it would be helped by a philological intervention on the text, supposing an original reading τὸ τῇ ἀνέσει [impl. γεγόμενον] ἱλαρὸν καὶ φιλόνηθρον and a simple displacement of τὸ in the manuscript tradition. I could find no parallels of such 'embedding' of the causal dative (or of the construction with implicit verb) in Plutarch's corpus, but cf. e.g. Simplicius, in *Cat.* VIII 386.28 Kalbfleisch (καὶ δῆλον ὅτι τὰ μὲν τῇ συνηθείᾳ γεγόμενα γνώριμα, ταῦτα καὶ ὀνόματος ἔτυχεν συνηθούς, with causal dative); Athanasius, *Ar.* II 11.4 (τὸ τῇ πρώτῃ ἡμέρᾳ γεγόμενον φῶς, with temporal locative dative); Pausanias, *Graec. descr.* IV 24 (τὸ μὲν τῷ Ἀριστομένει γεγόμενον μάντευμα, with dative of benefit). If we decided to accept the philological intervention or ignore the syntactic difficulty, and interpret the «gaiety and benevolence» as the intended subject of the “dilution”, a further problem would come about, because there seems to be no reason to put a limit to ἱλαρότης and φιλονηθρία: even if their excess were proven to lead to διαφορεῖσθαι, this would still be beside the point of the passage, which is to argue that a well-conducted symposium should lead precisely to φιλία and φιλονηθρία — not to promote the practice of moderate wine-drinking. Cf. however *QConv.* I 4.3 621^{C-D}, where Theon, just after declaring that the end of the symposium is the creation of new bonds of friendship (see the quotation above, p. 120 n. 501), uses an analogy with the

consequence, the adjective ἐγκέραστος too —a *hapax* in Greek literature— is left without an indirect object⁵¹⁰, and must therefore either be interpreted in an absolute sense («internally blended», *i.e.* «diluted», considering the theme of wine-drinking)⁵¹¹ or referred to a possible implicit object, *e.g.* the ἦθος, considering the φιλόανθρωπον καὶ ἡθοποιὸν in the preceding period (as in «blended [with the character]»)⁵¹². This version might appear to be unlikely, if one wonders why and how should the «table-talk» itself, which is first credited with an “arresting” effect and unambiguously compared with the “cooling” μάρμαρος, also operate on the drinkers through «relaxation», which is rather brought about by the wine (as evident in the final sentence). This problem, however, can be solved by positing a different indirect object for τῆ ἀνέσει: in my interpretation, in fact, this is not referred to the drinkers or to their implicit ‘textures’ —undergoing the effect of wine like the iron pieces are “being softened” by the implicit fire (on which I will return in a moment)—, but to the intensity of the ‘softening’ effect of wine itself. It is impossible to reflect adequately in the translation the complexity of what seems to be Plutarch’s intended meaning: it is the drinkers’ wine-induced ‘softening’ and ‘relaxation’ (ἀνεσις, *i.e.* διάχυσις, διάλυσις or ἀραιώσις)⁵¹³ to be ‘arrested’ by the ‘letting go’ or ‘relaxation’ (ἀνεσις, *i.e.* ἔνδοσις) of the ‘intensity’ of the agent’s action, as this action is implicitly metaphorized as a ‘pulling’ whose effect is coherently weakened by a ‘slackening’ of τόνος (on the metaphorical frame of “tension” and ἔνδοσις I have already commented above, due to its association with motion in *Lys.* 12.5)⁵¹⁴. If we assume that in the analogical scenario of iron working it is heat to “soften” the iron (see the contrasting καταψύχειν), and that this heat continues lingering, implicitly and metaphorically, in the analogy’s completion and *comparandum* —*i.e.* in the depiction of drinkers on the verge of διαφορεῖσθαι—, we find that there is indeed a terminological parallel in Plutarch’s *corpus* to support our interpretation, presenting falls in temperature as “relaxations”. This is in *Frig.*, and presents the metaphorical frame of “tension”, as applied to the quantitative description of heat, in its systematic fullness: «but in cold things there is much ‘more’ (τὸ μᾶλλον) and [much] ‘less’ (τὸ ἥττον), and [much] ‘overly’ (λίαν) and ‘not overly’, and in general increases (lit. tightenings, ἐπιτάσεις) and relaxations (ἀνέσεις), just as in hot things, because matter, being affected sometimes strongly (σφόδρα) and other times

need of removing what is πλήσιμον and βλαβερόν of the *ákratos* wine by mixing it to argue for the necessity of the symposium’s entertainment to be variegated; cf. also below, p. 177-8.

⁵¹⁰ Although with some forcing in the syntax, the prefix ἐν- in ἐγκέραστος might also be referred to τῆ ἀνέσει: «blended with the relaxation»; this is the choice of WYTTEBACH 1797A, FUHRMANN 1978, and Citelli in LELLI, PISANI, ET AL. 2017. In this case, the abstract «relaxation» (ἀνεσις) would be strangely presented as the concrete substance receiving the blended ingredients; compare with the quenching imagery in *QConv.* VI 4 690^{C-D} (quoted above, p. 104), where the ἀνεσις of a texture is itself the subject which «accepts much of the external air» — a simple metonymy.

⁵¹¹ Cf. SCARCELLA 2001: «limpida». See also below, p. 177-8 for a similar image used in *Br.* 1.2-3.

⁵¹² Cf. Hoffleit in CLEMENT AND HOFFLEIT 1969, who translates ποιεῖ ἐγκέραστος as «adding» without further specifications.

⁵¹³ For ἀνέσεις of textures induced by heat cf. *e.g.* *QConv.* VI 4.1 690^{C-D} (discussed above, p. 104) and *Adul.* 36 73^D (in an analogy with iron quenching); see also the terms listed below, p. 182. Cf. also *QConv.* VI 8.6 695^C for a thermic-mechanical distension of human flesh described as an ἀραιώσις («rarefaction»).

⁵¹⁴ See above, p. 52-3.

gently (ἡρέμα) by the opposite forces (δυνάμεις), in the former more (μᾶλλον) than in the latter, presents itself both hotter and colder» (3 946^D)⁵¹⁵. The polar opposites of hot and cold are graduated by a spectrum of ἐπιτάσεις and ἀνέσεις, and it is thus possible to say, when the intensity of a heating has decreased, that this has been ‘relaxed’. The ‘relaxing’ effect of heat on iron, then, is coherently ‘arrested’ by the ‘relaxation’ of the heat, and as a consequence of such ‘relaxation’, without paradox, the iron —from ‘relaxed’— becomes ‘well-strung’ (εὔτονος). This also applies to the wine-drinkers. In my translation, I have inserted in square brackets what I regard to be the likely indirect object of τῆ ἀνέσει, *i.e.* «the wine’s effect»: in the context of Plutarch’s analogy, this is both implicit and assimilated to the iron’s heating (equally implicit), and the “arresting” action of the table-talk, therefore, consists precisely in the ἀνεσις of such effect.

Now, the parallelism with the analogy in *Frig.* 19 is evident: although the «blacksmiths» are not mentioned here, they are alluded to implicitly as the agents of the iron’s “shaping” or “impressing” (see τυπούμενον). Iron shaping or stamping seems to be the analogy’s theme (see also the last sentence, with the σφραγίς and the adjective εὐτύπωτος), rather than iron welding, but this shift of focus does not make the two images incompatible, since welding two pieces of iron does require the “shaping” action of a hitting hammer: if the verb τυποῦν, notwithstanding the final sentence, is indeed first used in the sense of “shaping” and not consistently with the meaning of “impressing”, welding can be still supposed to have an implicit role in the picture⁵¹⁶. Iron is the recipient of the effect of *mármaros* (this time, without the mention of *latípē*), and the effect is again a removal of the «excessive moistness and flow» (compare the τὴν πολλὴν ῥύσιν of *Frig.* with the present τὴν ἄγαν ὑγρότητα καὶ ῥύσιν), which happens through “cooling” (the verb is καταψύχειν in both *loci*). The piece of iron is «incandescent» (διάπυρος) rather than «burning» (see πυρουμένω in *Frig.*), but we can infer that a part of it is still and again put on the fire during the procedure (if not kept there continuously) from the detail that it is «softening» (μαλασσόμενον), just as the iron of *Frig.* was «melting up» (see ἀνατηχομένω). This part, under the action of *mármaros*, acquires “strength” (see εὔτονον, lit. “well-strung”, which is the opposite of “loose”), and so, most probably, hardness and denseness⁵¹⁷. The analogy continues in the following sentence through Plutarch’s use of a few ambiguously metaphorical terms. Table-talk prevents the guests from διαφορεῖσθαι («being dispersed») altogether by the wine: thus, it saves them from being either messily “disunited” as a social group or “excessively relaxed”, “breaking loose”, or “damaged” mentally and physically, precisely as a piece of iron would be “broken up” by excessive relaxation (I will come back to this

⁵¹⁵ Cf. *QConv.* VI 2.2 688^D, in which ἀνεσις is referred to either «fevers» (πυρετοί) or to the feverish body, as is the verbal form ἀνίεσθαι (“become relaxed”) a few lines below (688^E, referred to πυρέτων). See also *QConv.* VI 5 691^B (quoted above, p. 86), in which συνεπιτείνειν refers to the concurrent intensification of the water’s coldness exercised by stone or lead.

⁵¹⁶ On τυπούμενον see also below, p. 126 n. 522.

⁵¹⁷ Cf. Hoffleit’s acceptable presentism in CLEMENT AND HOFFLEIT 1969: «tensile strength». Such condition of superior ‘tightening’ is associated with the effect of quenching on steel: see *Def. orac.* 47 436^C (quoted above, p. 102-3) and, with τόνος, *Lun.* 28 943^{D-E}.

detail shortly). In fact, table-talk ἐπίστησι («arrests», *i.e.* “fixes in place” or “solidifies”) either the guests themselves or their free-flowing friendliness, in the same way as the blacksmiths in *Frig.* “arrest” (notice the correspondence with ἐφιστάντες) the «great flow» of burning iron. In consequence, the drinkers’ «gaiety and benevolence» becomes «blended in» (ἐγκέραστον), which is of course a pleasing result (κεχαρισμένον)⁵¹⁸, but the sense of this “blending” is far from being clear. Indeed, at least two interpretations are possible: either the blacksmithing analogy is here still going on (as the following sentence on ‘stamping’ would make us believe), and the “blend” is to be understood as that of two welded pieces of iron; or Plutarch, drawing inspiration from the theme of balanced wine-drinking, switches here to a metaphor drawn from the use of diluting wine — in this case, the excessive «relaxation» would be agreeably «diluted»⁵¹⁹. This latter interpretation seems to be less likely than the former, both for reasons of thematic coherence (in the analogical chain) and for reasons of meaning: in fact, although there may be some doubt about the «benevolence» (φιλόανθρωπον), the «gaiety» (ἰλαρόν) is unambiguously described by Plutarch, elsewhere, as a product of wine-drinking, which makes its presentation as a «diluent» of a wine-induced «relaxation» contradictory⁵²⁰; moreover, as stated just a few lines above, «discourse» itself is that which communicates, through wine, the φιλόανθρωπία and τὸ ἥθοποιόν («character-forming») from the body to the soul: it would be absurd to specify in the following period, which

⁵¹⁸ Cf. *QConv.* I 1.3, in which Plutarch’s character, invited to talk by his very addressee Sosius Senecio on the topic of philosophical conversations during symposia, argues that they should be introduced when fit to the characters of the guests: «for if the majority of the guests at a party are learned men (φιλόλογοι) [...] we shall let them talk philosophy (φιλοσοφεῖν), blending (κεραυνόντας) Dionysus not less with the Muses than with the Nymphs; for, while it is the Nymphs who introduce him as a kind (ἴλαος) and gentle (πρᾶος) god to our bodies (τοῖς σώμασι), it is the Muses who present him as one really gracious (μελίχιος) and a giver of joy (χαριδότης) to our souls (ταῖς ψυχαῖς)» (613^{D-E}, transl. Clement in CLEMENT AND HOFFLEIT 1969). As in our passage in *QConv.* IV, the combination of wine with (philosophical) discourse is presented to engender χάρις (“delight”, “goodwill” or “gratitude”, compare its derivatives κεχαρισμένον and χαριδότης), as part of an opposition between the limited effects of ‘unphilosophical’ drinking on the body and those of the ‘intellectual’ on the soul. In this allegorical presentation, the Nymphs represent the diluting water (cf. *Symp.* 2 147^F), while the Muses the learned conversation: while water tempers the undesired consequences of wine-drinking on the body, discourse complements the action of wine by cheering the soul; this may be used as evidence against the interpretation of ἐγκέραστον in *QConv.* IV as referred to a supposed ‘dilution’ of the guests’ winy ἀνεσις through λόγος, since discourse should be supposed to add to the effect of wine with a supplementing action (presented as a final “arrestation”), rather than moderating it as water does. Cf. also the prooemium to *QConv.* VIII, in which unlearned and erratic conversations are presented to end in «most ungraceful» drunkenness when they are combined with wine drinking (ὑβρις καὶ παροιμία τέλος ἀμουσάτατον καὶ ἀχαριστότατον, 716^F); it is as a result of a careful introduction of the Muses in the dinner’s λόγος, as a complement to the guests’ «drunkenness» (μέθη), that the wine’s «wild and manic component hides, benevolently restrained by the Muses» (ἀποκρύπτεται τὸ ἄγριον καὶ μανικόν, ὑπὸ τῶν Μουσῶν εὐμενῶς κατεχόμενον, 717^A). TEODORSSON 1989a, n. to 613 D misrepresents this passage as one in which «Plut. recommends λόγος as a means to check the manic effect of wine»; rather, λόγος is here presupposed to flow as drunken «blabbering» (ληρεῖν), and the Muses intervene by regulating it.

⁵¹⁹ Cf. *Br.* 1.2-3, discussed below, p. 177-8, which contains a very similar blending of a ‘hardening’ and ‘softening’ metaphor taken from metallurgy with the imagery of wine dilution, referred to ἥθος and φύσις.

⁵²⁰ See above, p. 122 n. 509 for the passages collected by FUHRMANN 1978, n. 4 *ad loc.*; assuming this interpretation, he remarked that «Plutarque aurait dû se rendre compte de la contradiction». See also TEODORSSON 1989b, n. *ad loc.*, who used this apparent contradiction as an argument against the manuscripts’ reading ἐγκέραστον (see above, p. 121 n. 505): «the role of conversation is only to temper this [*scil.* τὸ ἰλαρόν καὶ φιλόανθρωπον], not to add it [*i.e.* ἐγκεραυνῶναι]».

is also introduced with the consecutive ὅθεν, that discourse is actually what limits it. Therefore, the interpretation in terms of blacksmithing seems to be the best for the context.

If all this is correct, the adjective ἐγκέραστος reveals to be the only term in the entire passage explicitly referring to welding. Even in this case, Plutarch might have used it metaphorically: considering the repeated focus on “shaping” or “imprinting”, it could be the ‘stamp’ as given by the «seal of friendship» (σφραγίδι φιλίας) itself to be prompted by wine-drinking and then “fixed” by the table-talk; that is, if conversation intervenes when the ἰλαρὸν καὶ φιλόνηθρον is ‘stamped’ onto the drinking-party, this party, rather than “falling apart” (διαφορεῖσθαι) and becoming more disunited, does receive and keep the ‘stamp’ as something «blended within» (ἐγκέραστον) itself, thus tightening the bonds of friendship. This interpretation has the advantage of thematic coherence, but the disadvantage, arguably, of an excessively stratified metaphoricity, as it is not so trivial to associate a ‘blending’ with the permanence of a stamp. On a technical point of view, it would support the identification of *mármaros* as an annealing medium, which I have already proposed for *Frig.* 19: in fact, annealing a piece of iron is instrumental in lowering its excessive brittleness; this brittleness might have been understood to depend on the iron’s excessive looseness (as provided by the heating), and its removal, therefore, to be caused by a cooling-induced condensation⁵²¹. Although this may make technical sense (if we ignore that the iron’s brittleness is actually raised by quench hardening, and not by heating), it would still be hard to understand why the ‘stamping’ of «gaiety and benevolence», if tried on ‘unannealed’ drinkers, should be the one responsible for their “falling apart”, just as would happen on a brittle piece of iron: it seems that the message, rather, should be that the ‘stamp’ itself, on an excessively relaxed texture, would not be able to hold, and that it would, therefore, dissolve. This meaning, unfortunately, would be unsupported by both syntax and the actual function of annealing.

If the period were instead referred to welding, and the ἐγκέραστος to an actual “fusion” of the «gaiety and benevolence» —metaphorized as iron—, into the drinking party, all these problems would disappear. To be sure, the *kóllēsis* of two iron pieces, which is done by “shaping” them together (see *τυπούμενον*)⁵²², would have

⁵²¹ On the annealing of iron see above, p. 118 n. 488. This interpretation matches the translations by WYTTENBACH 1797A (apparently) and Creech in GOODWIN [1874b] 1878, and the paraphrasis in FUHRMANN 1964, 86–87 n. 1: «l’action refrigerante du marbre s’oppose à la fusion trop grande du fer chaud et donne à celui-ci la tension convenable pour qu’on puisse le façonner; ainsi la conversation à table empêche les buveurs d’être totalement brisés par l’ivresse»; cf. ID. 1978, n. 4 to 660^C: «cette technique, dont je n’ai trouvé nulle mention dans les ouvrages modernes spécialisés, est surprenante; on peut dire que le carbonate de calcium subit au contact du fer incandescent une réaction endothermique, qu’il capte par conséquent de la chaleur de ce fer, provoquant ainsi le raffermissement de la masse». On his interpretation see above, p. 118 n. 489 and below, p. 132 n. 534.

⁵²² It may be suggested to correct the transmitted *τυπούμενον* with a possibly original *τυπτόμενον* (“being smitten”), which might help the present interpretation as iron welding is obtained by hammering rather than shaping (although shaping is in any case a direct effect of hammering, and Plutarch does use the verb *συνελαύνειν* in *Vind.* 32 567^E for a form of welding, namely, for the «forging together» of «wholes» in their own «members»). The original copyist(s) might have decided to emend the *τυπούμενον* (or simply misread it) under the influence of the *εὐτυπώτω* in the last sentence (a derivative of *τυπώω*), going for a unified interpretation of the

to be secured by a “fixing” (see ἐπίστυσι) that follows the “softening” of their metallic surfaces (see μαλασσόμενον and ἀπαλῶν... ὄντων), and this would be provided—in Plutarch’s understanding—by the welding flux itself (the *mármaros*); if this were not applied (as I have already discussed for *Frig.* 19), the joint would be unstable, and it would thus risk “falling apart” (διαφορεῖσθαι)⁵²³. When διαφορεῖσθαι first appears, the breaking pieces are the drinkers themselves, not fully “welded” between them through the bonds of friendship and thus ultimately drifting astray in pointless tipsiness: this, which starts by helping sociability, ends in nothing when not complemented by the table-talk. It is noteworthy that the metaphor of the friends’ “fusion” is paralleled in other passages, including one in *Symp.* 13, which occurs, as part of its *explanandum*, just a few lines below the analogy with *kóllēsis* and *stómōsis* with which we have begun this long discussion: «[...] in the case of the majority of people, who are not altogether intimate or too well known to one another, Dionysus, softening (μαλάσσων!) and moistening (ἀνυγραίνων), as in a fire, their characters with wine, provides some beginning for a blending (σύγκρασις!) and friendship with one another» (156^{C-D})⁵²⁴. The parallelism with our passage is so striking that it might be a sign of a common metaphorical matrix, and thus corroborate the unified interpretation in the frame of welding. In the next sentence of our passage in *QConv.* IV, lastly, the metaphorical function of διαφορεῖσθαι changes while the message remains the same, and the (possibly) breaking pieces become the ἰλαρὸν καὶ φιλόνηρον and the softened textures of the drinkers’ souls: the social sentiment does find a way into the soul when this is made “tender” by wine-drinking, but it ultimately gets detached if table-talk is not applied, and new bonds of friendship, as a result, end up not being established, and the party keeping disunited.

To confirm this interpretation, we should also examine carefully the first part of the passage, which is built, as we have already seen, on the analogy with the athletic use of sand (κοινορτός), which I will further discuss

period as containing a coherent “stamping” analogy. The participle τυπτόμενον appears in other Plutarchan *loci*, and most notably in *Am. prol.* 2 (494^B), in the description of the halcyon’s nest that I have already commented on above (p. 34): the halcyon, «after having carefully packed the fish bones together with harmony and thickness, exposes [the nest] to the waves, in order for its compactness of surface to become water-tight as smitten (τυπτόμενον) and fixed (πηγνύμενον) [by the waves]: and it becomes difficult to divide (δυσδιαίρετον) with iron or stone». The action of τύπτειν is here responsible of a texture’s πηγνύναι (cf. ἐπίστυσι): this leads to such a tightly packed surface that it happens to be δυσδιαίρετος even to iron (cf. διαφορεῖσθαι). In our passage in *QConv.* IV, of course, the “shaping” or “smiting” is not presented as the agent of the iron’s “fixing”, but it might indeed be implied as such, in need of the complementing action of *mármaros* for its welding effect to be secured.

⁵²³ Cf. Hoffleit in CLEMENT AND HOFFLEIT 1969, n. c *ad loc.*, who comments that «lime is still used as a flux in metallurgy». His identification of the *mármaros* as a (smelting) flux makes no technical sense in this context, as the role of lime in the bloomery process—as I have explained above—would be to aid the expulsion of non-ferrous impurities in a liquid state at lower temperatures, and surely not to eliminate «excessive melting and fluidity in red-hot iron by cooling it down». It is also incoherent that smelted iron should acquire a higher «tensile strength» at the end of the operation (cf. above, p. 106).

⁵²⁴ Transl. BABBITT 1928, heavily adjusted. Cf. *QConv.* I 2.6 619^A (following the remark I have quoted above, p. 120 n. 501): «and I shall put together men who like to drink,—and lovers too [...]. For they will cleave to each other all the more (μᾶλλον ἀλλήλων ἀντιλήψονται) for being heated (θαλπόμενοι) by the same fire, like welded iron (καθάπερ ὁ κολλώμενος σίδηρος)» (transl. Clement in CLEMENT AND HOFFLEIT 1969).

below⁵²⁵. For the moment, it is sufficient to note that it is presented as a substance which allows (see *δέονται*) the wrestlers' moves to be effective. The sense of this facilitation is made clear by the analogy's *explanandum*, where the imagery continues in the theme of two metaphorical terms: «to friendly holds (*λαβαί*) it is the wine which gives the grip (*ἄφῆ*), mixed with discourse». The dust, as we can see, is clearly useful to the wrestlers inasmuch as it allows them to “hold” and “grip” each other's limbs, *i.e.* by increasing the friction of their skin, which otherwise would be too slippery (compare with the “arresting” effect on sweating as is presented in *Frig.* 19)⁵²⁶. Analogously, in a symposium, friendship requires the ‘friction’ of the drinkers to be increased, since otherwise they would escape its “hold” and ‘slip away’: in this operation it is helped by wine and by «discourse» (*λόγος*), insofar as they act together in a mix. Plutarch, elaborating further, adds an analogy from liquid channeling: if *λόγος* (*i.e.* «table-talk») is required in the mix it is because wine, without proper (implicit) ‘embankments’, would diffuse pointlessly (see *πλανώμενος*) in the body and leave onto the guests no worthy, and lasting, effect; it is *λόγος* which provides these ‘banks’, with which it «channels» (*ἐποχετεύει*) and «communicates» through the wine (*ἀύτῳ... συνδίδωσιν*) the «benevolence» (*φιλόανθρωπον*) —which started in the body (*ἐκ τοῦ σώματος*) as an effect of drinking— to the drinkers' souls (*ἐπὶ τὴν ψυχὴν*): by doing so, it orients τὸ φιλόανθρωπον's «character-forming» trait (*ἡθοποιόν*) towards its destination, and as a result it ‘fixates’ the sentiment onto the drinkers' ἦθη. Exactly as in the following period, in both these analogies the benevolent friendship, to be able to ‘hold’, requires the reduction of an excessive ‘fluidity’, which is contrasted by the table-talk, and the channeling analogy also makes it explicit that the fluidity is to be associated with free-flowing wine. In the following welding analogy, the fluidity is further associated with a ‘softening’, and the contrasting effect, in consequence, with a ‘fixation’. If the passage is fully coherent, it is clear that the result of such fixation is a lasting hold of τὸ φιλόανθρωπον onto the soul: first, the *φιλία* is described to secure its «grips» and «holds»; then, its benevolence is said to become effectively «character-forming»; and lastly it is described to become pleasingly «blended in» with respects to the drinkers, *i.e.* steadily welded to their ‘softened’ souls or characters. All these sentences communicate the exact same message with different, and increasingly complex, images, but these images, in the end, are all compatible and cumulative: the artisanal imagery, in fact, is already evoked by the suffix *-ποιόν* («-making») of the adjective *ἡθοποιόν*, which might have perhaps prompted the addition of the smithing analogy, and a successful blending, arguably, does require a tight *ἄφῆ* to “hold” the jointed pieces. The coherence in the imagery is so remarkable that it might be a further sign of a close connection, in Plutarch's understanding, between the wrestlers' *κόνις* and the *μάρμαρος*. There might even be a textual relationship between this passage and the ending lines of *Frig.* 19,

⁵²⁵ See below, sec. 7.3.

⁵²⁶ See above, p. 120 n. 500.

which would corroborate that the “arresting” effect of the *latúpē* onto the iron should be understood there too to be a part of a welding procedure.

The connection between welding and ἀφή is not without basis⁵²⁷. In fact, it is lexically explicit in the last parallel passage on the use of *mármaros* with iron: namely, in *QPlat.* 10. In this ‘grammatical’ *quaestio*, Plutarch offers a few possible explanations for Plato’s presentation of λόγος as a thing «blended from nouns and verbs» (ἐξ ὀνομάτων καὶ ῥημάτων κεράννυσθαι)⁵²⁸, a definition which leaves the other parts of speech, such as the pronoun (ἀντωνυμία) or the conjunction (σύνδεσμος), strangely outside of the picture. Conjunctions and prepositions (προθέσεις) are of particular interest here. Advancing an argument that resembles the distinction between instruments and products in *Symp.* 13 —with its mention of *latúpē* and coals—, Plutarch, in *QPlat.* 10.2, stresses that what Plato said is that «speech is a blend of (ἐκ) these [*scil.* nouns and verbs], not that it is blended by means of (διὰ) them, and lest then like one who, when the medicine is said to be a mixture of wax and galbanum, carps at the omission of the fire and the receptacle, without which it could not have been mixed, we too similarly object that Plato disregarded conjunctions and prepositions and the like, for it is not of (ἐκ) these that speech is naturally blended but, if at all, by means of (διὰ) them and not without (οὐκ ἄνευ) them» (1009^F)⁵²⁹. In fact, Plutarch continues, conjunctions and prepositions have no meaning in themselves, and only serve the purpose of connecting nouns and verbs (which instead are individually meaningful) between them (1010^A). Elaborating on this distinction, Plutarch uses more analogies to show that it is not unreasonable to consider these particles, although they do contribute to speech, to be not a part (μέρος) of it: salt, for instance, contributes to a meal (ᾠψον) without being regarded as one of its parts (*QPlat.* 10.3 1010^F). After other considerations, and immediately following a significant *lacuna* in the transmitted text, we see Plutarch focusing again on the instrumentality of the conjunction, and here is where the analogy with ironworking finally appears (*QPlat.* 10.4 1011^B)⁵³⁰:

<...> οὐ μέρος λόγου τὸν σύνδεσμον ἀλλ’ ὄργανόν τι συνδετικὸν ἀποφαίνει, καθάπερ ὠνόμασται, καὶ συνεκτικὸν οὐ πάντων ἀλλὰ τῶν οὐχ ἀπλῶς λεγομένων· εἰ μὴ καὶ τοῦ φορτίου τὸν ἱμάντα καὶ τοῦ βιβλίου τὴν κόλλαν ἀξιοῦσι μέρος εἶναι, καὶ νῆ Δία τὰς διανομὰς τοῦ πολιτεύματος, ὡς ἔλεγε Δημάδης, κόλλαν ὀνομάζων τὰ θεωρικὰ τῆς δημοκρατίας. ποῖος δὲ σύνδεσμος οὕτως ἐν ἐκ πολλῶν ἀξίωμα ποιεῖ συμπλέκων καὶ συνάπτων, ὡς ἡ μάρμαρος τὸν συλλιπαινόμενον διὰ τοῦ πυρὸς σίδηρον; ἀλλ’ οὐκ ἔστιν οὐδὲ λέγεται τοῦ

⁵²⁷ See also above, p. 119 n. 495.

⁵²⁸ 10.1 1009^B. The allusion, as noted by CHERNISS 1976a, n. b *ad loc.*, is to Plato, *Soph.* 262^C (cf. also *Crat.* 425^A, 431^C; *Theaet.* 206^D; *epist.* VII 342^B, 343^B).

⁵²⁹ Transl. CHERNISS 1976a.

⁵³⁰ Text from INGENKAMP AND BERNARDAKIS 2017. Transl. CHERNISS 1976a, heavily adjusted, especially in the sentences on iron and *mármaros*.

σιδήρου μέρος· καίτοι ταῦτά γε τοῖς κεραυνυμένοις ἐνδύόμενα καὶ συντηκόμενα ποιεῖ τι καὶ πάσχει κοινὸν ἐκ πλειόνων.

<...> shows not that the conjunction [is] a part of speech, but an instrument for conjoining, just as its name indicates, and for holding together not all statements but those that are non-simple; unless one also maintains that the strap is part of the load and the glue part of the book, and, by Zeus, the dole part of the government, as Demades said, when he called the festival-grants the glue of the democracy. And what kind of conjunction, by twining and connecting them together, makes from many things a proposition so united (lit. one) as marble does with the iron that is being dampened together through fire? But it (*scil.* the marble) is not and neither is said to be part of the iron; and yet, these things, penetrating the objects that are being blended and melting with them, surely make, and are affected by, something [that is] common from multiple things.

In order to argue that an «instrument for conjoining» (ὄργανον συνδευκόν), such as the conjunction, is not to be regarded *ipso facto* as a part of the whole that it connects, Plutarch offers three illustrations which he presents as intuitive; the last of these is also humorous. Just as a strap is clearly not part of a cargo —although it provides to it the possibility of existing as a whole—, and glue —which is necessary in book binding— is not itself part of the book, and public distributions —metaphorized by Demades as the «glue of the democracy»— are certainly not part of the institutions, so the conjunction, safely, can be not considered a part of speech. Not satisfied with these three instances, and possibly influenced by a mental association between κόλλα («glue») and κόλλēsis, Plutarch decides to add a further illustration, which he presents as the most extreme: how could we imagine something that would be more binding and uniting than the *mármaros* when it joins iron, under the dampening (see συλλιπαινόμενον) effect of fire? In fact, the connected iron becomes so thoroughly a whole, and the marble so one with it, that we cannot really be surprised when the conjunction is not presented as a «part» of speech, since marble itself, even in this feat of extreme unification, is still not said, by people, to be a «part» of the resulting whole. The parallel passages we have discussed above have prepared us to recognize the mentioned «marble» as a welding flux, but the context here is also less ambiguous, focused as it is on the themes of jointing and gluing. Here, details are missing on the way the *mármaros* secures the weld, *i.e.* by “arresting” the iron’s excessive “flow” through “cooling”, but its agency in the process is clear: like the conjunction, it makes something that is «one» (ἓν) out of distinct pieces by «twining together» (συμπλέκων) and «connecting» (συνάπτων) them; it is in the verb συνάπτειν that appears the lexical connection with the “hold” of friendship (ἀφή, from the verb ἄπτειν, “fasten”) of *QConv.* IV. Furthermore, if we assume that ταῦτα in the last sentence refers at least, and especially, to the forementioned μάρμαρος, which is likely, we can learn something more on marble’s own behaviour in the process: regardless how the iron pieces that are being blended (see κεραυνυμένοις) end up becoming fixed together and united, the

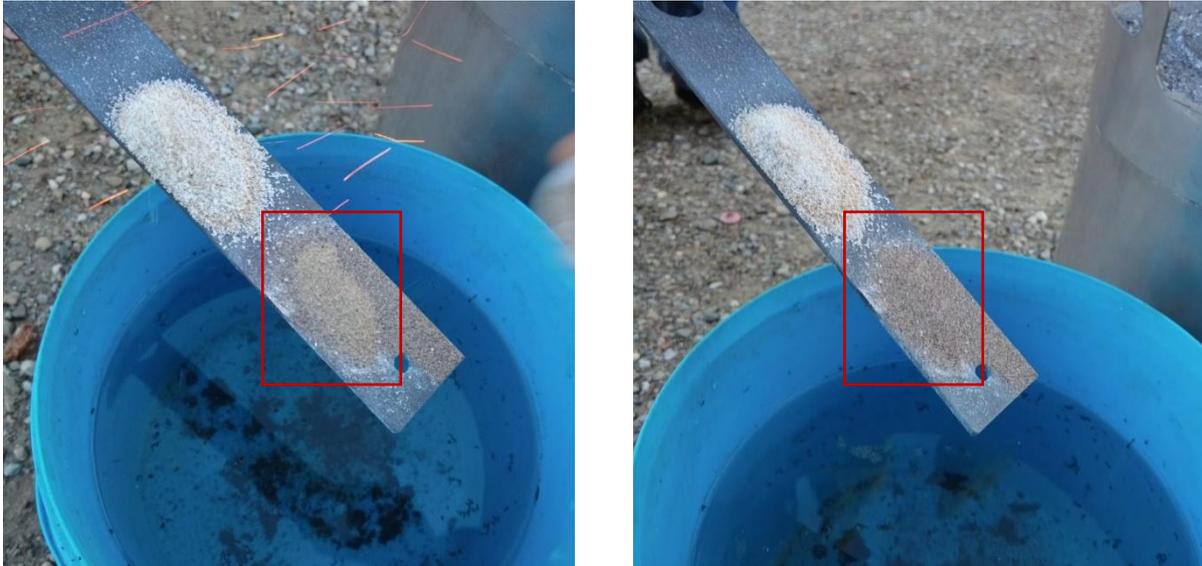


Figure 3. Application of impure silica sand (from the beach of Marina di Ravenna) on an iron bar brought to red heat (note that the incandescent part is wholly covered by the sand). These two frames have been extracted from the same videoclip, the second following the first by approximately seven seconds. The pile of accumulated sand clearly observable in the first frame has completely flattened in the second, as though it had been absorbed and somewhat moistened by the iron. Credits: experiment conducted by me, Marianna Marchini, Lucia Maini, and Matteo Martelli; furnace built by Ivan Aliprandi; video recorded by Lucia Raggetti.

mármaros acts onto them by «penetrating» (see ἐνδύμενα) into their surfaces (which have probably been softened, as in *QConv.* IV)⁵³¹ and also, quite interestingly, by «melting with them» (see συντηκόμενα). This last detail, which is confirmed by the following specification καὶ πάσχει («are affected»), implies that marble, when applied to (burning) iron during the operation, liquefies in contact with the metal. This is not necessarily incompatible with the cold character of *mármaros*, as described in both *Frig.* 19 and *QConv.* IV: after all, even ice would melt and run as water when subjected to extreme heat, without its cooling and “arresting” action being undermined; the same should probably apply to *mármaros* too. The question is whether this liquefaction was simply inferred, *e.g.* in order to explain how *mármaros* could “penetrate” the joint and fix even its less exposed parts, or also observed. Now, assuming that *mármaros* was indeed used as a welding flux, it is noteworthy that it would be actually possible to see it disappear progressively on application as a result of its decomposition with the iron’s surface oxides: I could personally observe this reaction (see Figure 3) after pouring a siliceous sand on a steel bar brought to red heat, where the sand on contact with its surface kept fading out, possibly giving the impression of being absorbed into the iron (cf. ἐνδύμενα); I also observed the behaviour of borax (see Figure 4), which disappeared while fizzling conspicuously and making the

⁵³¹ Cf. *QConv.* VII 8.3 712^B, on the moral effect of Menander’s plays on the drinkers in a symposium: «useful and simple maxims, flowing under (or penetrating, ὑπορρέουσai) [them], soften with the wine even the hardest characters, and bend them (κάμπτουςι) towards what is more convenient».



Figure 4. Application of borax on an iron bar brought to red heat. These two frames have been extracted from the same videoclip, the second following the first by approximately twenty-four seconds. The applied borax visibly melts on contact with the incandescent iron, fizzling and boiling around the edges of the pile while conferring to the underlying surface a moist look. Credits: see Figure 3.

underlying iron surface acquire a lucid moist look (note that the melting point of borax is 878 °C, which is reached at bright red incandescence)⁵³². Given this liquefaction, either real or inferred, it would have been not unreasonable for an ancient to interpret fluxing in terms of a *συντήκεσθαι*⁵³³.

We are thus offered, apparently, with a fully coherent and understandable picture of *mármaros* as a welding flux⁵³⁴. However, H. Cherniss's interpretation of the passage is altogether different⁵³⁵. By identifying the mentioned substance with (our) marble, he comments that in reality this «is not fused with the iron [...], but supplies the limestone which unites with the non-ferrous minerals of the ore (the “gangue”) and with the ash of the fuel to form the “cinder” or “slag”»; hence, the technical scenario Plutarch alludes to should be the application of a flux (of limestone origin) in the frame of iron smelting or bloom purification, which I have introduced above⁵³⁶. This interpretation relies on a couple of Peripatetic passages where such a flux, according to some scholars, might be ambiguously referred to it in connection with the smelting process, although not

⁵³² On the melting point of borax see <https://www.mindat.org/min-722.html>: (last accessed May 15, 2022) «the melt dissolves numerous metal oxides».

⁵³³ Chemically, the flux does become liquid after combining with the surface oxide and forming fayalite, but only if temperatures above 1200 °C are reached: see above, p. 114 n. 469.

⁵³⁴ Cf. FUHRMANN 1964, 203: «les conjonctions [...] provoquent parfois une véritable soudure, comme celle qu'opère le marbre sur le fer fondu». On his interpretation see also above, p. 118 n. 489 and p. 126 n. 521.

⁵³⁵ See CHERNISS 1976a, n. f *ad loc.*

⁵³⁶ On this process see above, p. 89 n. 361.

with the term *mármaros*⁵³⁷. Although Cherniss admits that «in no ancient text, so far as I know, is an explanation of the process offered», which would make of the present passage, as interpreted by him, a testimony not less precious —if not unique— than it would be if the allusion were instead to a welding flux⁵³⁸, he does manage to cite two *loci* from Agatharchides and Pliny where «the purpose of the flux used in refining gold is mentioned», specifically in the context of gold cupellation⁵³⁹. From a textual point of view, Cherniss’s interpretation is supported by a different understanding of the participle συλλιπαινόμενον: in my translation, I render the presence of the prefix συν- (“with”) with the absolute form «dampened together», implying that it refers to a simultaneous, and convergent, superficial “dampening” (with a tint of “anointment”) of contiguous pieces of iron, named collectively by Plutarch with the singular ὁ σίδηρος («the iron»)⁵⁴⁰, or of separated surfaces of the same mass (e.g. around a hole or fold)⁵⁴¹. In contrast, Cherniss clearly connects the συν- with μάρμαρος, going for the liberal translation «as the marble makes the iron that is smelted with it in the fire». To make this translation more literal, we could try and substitute the word «smelted» —which is ambiguous, and may refer to the liquefaction of either the iron ore or of its ferrous content— with our “dampened”; by so doing, we should better understand the details of the process Cherniss alludes to: «as the marble makes the iron that is <dampened> with it in the fire». Now, it is known that in this kind of smelting it would not be the iron itself to melt during the heating, but only its non-ferrous impurities: these, liquefying in the furnace and progressively submerging the solid particles of iron which are collecting in the bloom, at the end of the process

⁵³⁷ One of these is Theophrastus, *Lap.* 9, on which see above, p. 110 n. 454. The other is Pseudo-Aristotle, *Mir. ausc.* 48 833^B24-28. Better correspondences may be found in Hippocrates, *Morb.* IV 55.24-38, where the depositing of iron during the smelting process is presented as a “gluing” (κόλλησις, κολλᾶσθαι) exercised by «dross» (σκιωρία) on «stones» and «earth» when these are burned together: at the third repeated burning, the «dross» is expelled in liquid form (ἔξω ἔρχεται τηκομένη) and the newly-formed «iron» (i.e. the bloom) becomes observable. This process is presented in an analogy to explain how solid stones form in the bladder from the gathering of the «deposit» (ὑποστάθμη) mixed with phlegma. CRAIK 2014, 190 points out that there are some similarities between this Hippocratic treatise and the Aristotelian biological works and *Problémata*. On some of Aristotle’s references to dross and sediments see above, p. 110-1 with n. 457. In the described process, of course, the agent of the “gluing” is the «dross» of the iron ore, which cannot be identified with *mármaros*, and no mention is made of any flux. *Contra* HALLEUX 2007, ann. 3 par. 4 (eBook version): «dans la seconde opération, [scil. the second heating] la scorie se liquéfie, éventuellement avec l’aide de fondants».

⁵³⁸ The process of iron smelting was illustrated without mention of any flux by Diodorus Siculus, *BH* V 13.1: «for the island possesses a great amount of iron-rock (πέτρα... σιδηρίτις), which they quarry for its melting and preparation (ἐπὶ τὴν χωνεῖαν καὶ κατασκευὴν) of the iron, and they possess a great abundance of this ore (μετάλλων). For those who are engaged in the working of this ore crush the rock and burn the lumps which have thus been broken in certain ingenious furnaces; and in these they smelt the lumps by means of a great fire and form them into pieces of moderate size which are in their appearance like large sponges» (transl. OLDFATHER 1939, slightly modified).

⁵³⁹ On cupellation see e.g. HEALY 1978, 125–26: «cupellation is probably the oldest and most efficient method of separating precious metals from base. The gold is alloyed with lead in a special pot, or crucible, known as a *cupel*, and the product oxidized by a strong current of air blown into the surface of the molten metal. The base metals are consumed, or drossed, the oxides so formed being absorbed by the wall of the porous cupel while the gold and silver remain intact» (his emphasis).

⁵⁴⁰ For other instances in Plutarch’s *corpus* of liquefactions mentioned in relation to iron —but not directly involving it— see below, p. 182, in the context of quench hardening.

⁵⁴¹ On iron “folds” see below, p. 182.

would solidify again on top of them as “slag”⁵⁴². Since the addition of a flux lowers the melting point of these impurities, it would not be absurd to present marble as something with which the impure iron, at lower temperatures, is “dampened”⁵⁴³: its application, in fact, would make the iron, so to speak, ‘exude’ its gangue. The limestone, then, disappearing in the gangue, would flow together with it and be thought to remain inside the upper layer of solidified impurities: so, considering that it might indeed look like it were the flux itself to ‘collect’ all the gangue into a separate whole, it might be this, the later-solidified slag, to be the «one» (ἓν) alluded to by Plutarch. Although this interpretation has its merits and coherence, one can argue that in this process marble does not really act as a conjunction: although *mármaros* does become one with the slag, it does not seem to be required for the gangue to become a solid ‘whole’ — which only happens, as Plutarch himself would probably recognize, due to a lowering of temperature; the flux is only needed for the gangue to separate from the iron as a liquid. Nonetheless, Cherniss’s view, despite some archaeometallurgical caveats of unlikelihood⁵⁴⁴, remains defensible, especially if not tested on the parallel passages in *Symp.* 13, *Frig.* 19 and *QConv.* IV. On these *loci* (except *Symp.* 13, which he does not mention), he states in fact that Plutarch must have referred «to a different stage in the working of the iron», so renouncing to a unified interpretation of these reports on the use of *mármaros* by blacksmiths. Teodorsson, on the other hand, does not renounce to it, and in his note to the passage in *QConv.* IV quotes both *Frig.* 19 and *QPlat.* 10.4 to state that «these passages show that Plut. probably believed that the marble was fused with the iron»⁵⁴⁵. He then provides an explanation centred on the use of limestone as a «fluss» (*sic!*) which is quite reminiscent of Cherniss’s note, with only a few additional details: without crediting Cherniss for the information he reports, he does not make any attempt to justify how the passage in *QConv.* IV (as well as that in *Frig.* 19) should be understood to refer to iron smelting too. Since he offers no arguments for his interpretation, I will not linger further on this point⁵⁴⁶.

At the end of this long discussion, it is now clear that *mármaros*’s and *latúpē*’s role in these four passages, although in each case underdetermined, could be better explained with reference to the use of flux during the process of iron welding. The main problem with this interpretation, as I have already pointed out, is that it would require a non-standard identification of *mármaros*; that is, with a substance different from “marble”. Although today borax would be the obvious choice as a welding flux, and its identification would fit well with its alleged “melting” of *QPlat.* 10.4 due to its low melting point, its knowledge and use in the ancient world

⁵⁴² Note that this description can only apply to the more primitive model of bloomery furnace, not provided with drains to let the gangue flow out; see above, p. 106 n. 430. The more advanced model, apparently common in the Roman world, would perhaps not fit Cherniss’s interpretation, but consider the Hippocratic description of smelting I comment on above, p. 133 n. 537.

⁵⁴³ Cf. Pollux, *Onom.* VII, 107, where the iron’s *ὑγραίνειν* is presented as the first stage of iron working.

⁵⁴⁴ See above, p. 115 n. 471.

⁵⁴⁵ TEODORSSON 1989a, n. to 660 C.

⁵⁴⁶ ROMANO 1965, 130 eludes the problem: «resta infine la *Quaestio* X^a [...]. Crediamo inutile e ozioso esporre gli argomenti di Plutarco in difesa di Platone, giacchè essi rivestono un esclusivo carattere grammaticale, affatto assente nella mente di Platone quand’egli scriveva il passo in esame». Cf. below, p. 170 n. 680 for the way he eludes commenting on *QPlat.* 7.

is highly dubious⁵⁴⁷, which encourages a safer identification of *mármaros* with silica, either in the form of white sand or of artificially powdered milky quartz. This identification is also corroborated by Plutarch's repeated association of the flux with the athletes' *kónis*, as though they were part of a common, original, analogical textual block. This interpretation appears to be the most likely: in fact, it is more coherent with the theme of 'joining' and 'blending' that is clearly at the centre of three of the four Plutarchan passages, and in the only one where the theme is absent the use of *παραπάσσειν* ("sprinkle on", lit. "along") seems to fit better with the application of a welding flux. Both annealing and welding could be instrumental in reaching the iron's *stómōsis*: in the case of annealing, the iron's brittleness would be reduced, making it less likely to fracture during cold filing or hammering; and in the case of welding the iron would be reinforced by the insertion of steeled leaves. The interpretation in terms of annealing, lastly, does not seem to be applicable to

⁵⁴⁷ See TRAVIS AND COCKS 1984, 3–5: «according to legend, the Babylonians brought borax from the Far East more than four thousand years ago to be used by the goldsmiths, and works of reference have frequently cited the ancient Egyptians as users of borax in metallurgy, medicine and mummification, but none of this can be substantiated». They argue with good reasons that the Hebrew word *borith* (as used in *Jeremiah* 2.22, in association with *nether*, cf. Greek *nítron*) probably referred to a lye of vegetable origin rather than borax. They also draw attention to the fact that in medieval Arabic works the substance *bauraq* was taxonomically associated with *natron*, and its presentations do not allow for unambiguous identifications of the material as borax. For an important example see the list of six kind of «boraces» in al-Rāzī's *Instructive introduction*, as translated by STAPLETON, AZOO, AND HIDĀYAT ḤUSAIN 1927, 347–48: among the others, the list includes «Goldsmiths' Borax», which is «white and resembles the efflorescence which appears at the bottom of walls» (the translators, n. 2 *ad loc.*, identify this as either «the final product in drying 'Natron', or ordinary Niter»), and *Tinkār* (cf. English "tincal", a mineral of native borax), «which is artificial» (the translators, n. 6 *ad loc.*, claim that this is «almost certainly the χρυσόκολλα (Gold solder) of the Greeks», on which see below in this footnote). I thank Lucia Raggetti for drawing my attention to a different presentation of *bauraq* contained in the Pseudo-Aristotelian *Book of stones* (IX–X century). Here, the material (46) is listed in the category of minerals in the form of powders, after salt (44) and before *natron* (47), and is clearly associated with a dissolving or fluxing action: according to the text preserved in ms. Paris. 2772, «seine Eigentümlichkeit ist das Schmelzen der Körper aller Art; er beschleunigt ihr Flüssigwerden und macht sie weich zum Schmelzen» (transl. RUSKA 1912); in ms. Istanbul Aya Sofya 3610 (*i.e.* «the most inclusive version» of the Pseudo-Aristotelian work, according to RAGGETTI 2019), the description of *bauraq*'s behaviour, albeit more detailed, does not refer in any way to metals or metalworking. The Arabic word *bauraq*, curiously, shares a common trait with the Greek *mármaros*, as the etymology of both is linked with a "glittering" or "brilliance" (in Arabic, this is the meaning of the root *b-r-q*; on *mármaros* see above, p. 61 n. 234 and p. 71 n. 292); it seems however that in Arabic translations of Greek works *bauraq* was never used in correspondence with *mármaros*, but only for *nítron* and *líttron* (see KĀS 2010, *s.v.* 'bauraq'), while *mármaros* was translated as either *marmar* or *ruhām* (see *ib.*, *s.v.*). In any case, it is not unreasonable to suppose that borax, gypsum, and marble might have been confused in antiquity, if one considers the XIX century story of the French discovery of pandermite ores (from which borax can be extracted) in Turkish gypsum quarries, as reported by TRAVIS AND COCKS 1984, 28: «Henri Groppler, a Polish refugee, was carrying on a failing marble business at Bebek on this coast, and during a visit to Paris to try to drum up financial support he called on Desmazes, a French engineer with whom he had once been associated in constructing lighthouses on the Marmara coast. He gave him as a souvenir some small rough statuettes which had been carved by his workmen from certain unknown material which from time to time was picked out of the gypsum [!] that was used for polishing the marble. The unknown substance somewhat resembled lumps of hard chalk [!]. The statuettes stood on Desmazes's desk for a long time, but since, like Groppler, he was a dabbler in chemistry, the day came when he wondered about the composition of the unknown substance. An analysis showed that it contained a high percentage of borax»; see also *ib.*, p. 27: «outcroppings of pandermite occurred at the surface; it is a beautiful white stone more pure in colour than marble [!], but not so close in grain or so susceptible to high polish». Note, however, that Travis and Cocks consider unlikely that the Romans «mined pandermite and developed a process for its conversion to borax». We may perhaps suppose that its production began in the early Imperial Age, and that Plutarch's passages are the first survived testimonies on the use of borax as a welding flux. Borax was once supposed to be the substance referred to by the Greek term *khrosókolla* (literally, "gold glue", probably a green copper carbonate used for soldering gold), but this identification has long been rejected with good reasons, *e.g.* by RICHARDS AND CALEY 1956, n. to *Lap.* 26. Cf. MONTANARI, *s.v.* 'χρυσόκολλα', a, defined as «borace, carbonato basico di rame»: this is a blatant mistake, as sodium tetraborate (borax) has nothing to do with copper, unlike *e.g.* malachite.

the description in *QPlat.* 10.4, and therefore, if it were preferred for the passages in *Symp.* 13, *QConv.* 4 and *Frig.* 19, it would support Cherniss's supposition that they do not refer to the same process as the first. Incidentally, the use of *stómōsis* might also apply to the purification of the iron's bloom, not only because Plutarch, as I have already mentioned⁵⁴⁸, associates like Aristotle the iron's "steeling" with a form of cleansing, but also because the removal of non-ferrous impurities does concretely improve the quality of the iron. The problems of each interpretation remain in any case, but it seems most likely that all four passages refer to iron welding. If this is true, it is possible to extract from them a very interesting etiology of the phenomenon. The process begins when the adjacent pieces of iron, softened and dilated by the fire, allegedly start to liquefy over the hearth, and it ends, we can infer, when the iron's fused joint solidifies again. The weld, however, may be unstable, and the jointed pieces may easily break apart. This is due, allegedly, to the iron's excessive softness and "flow". To arrest the looseness from reaching this excess, one may sprinkle some *latúpē* or *mármaros* on the iron, as they can harden and solidify (again) the incandescent parts of the metal, by penetrating in their texture and exercising a cooling action; in so doing, they melt. As a result of this 'fixing', the weld is fully secured, and the two pieces of iron are made one and inseparable.

7.2 Winemaking with *gúpsos* or salt

Earlier, while commenting on the mention of *latúpē* and *mármaros* in *Frig.* 19 954^A, I have introduced *gúpsos* as a term which was probably used in ancient Greece to refer to more than one substance, as suggested by its use by Theophrastus in *Lap.* 69: apparently, it could refer both to gypsum and lime (either as quicklime or slaked lime), which are both employed in the form of gray or white powders⁵⁴⁹. I did then exclude that *latúpē* should be identified with gypsum in Plutarch's passages, and, as for *mármaros*, I have indeed removed calcite from the picture by opting for a unified interpretation of the scenario in terms of iron welding and welding flux. Nevertheless, Cherniss's identification of the 'marble' in *QPlat.* 10.4 (1011^B) with a smelting flux is still possible, and therefore quicklime (calcium oxide) might still be the substance that is credited by Plutarch with the penetrating, unifying action on the (slag of the) iron. Therefore, it would now be interesting to see how quicklime is described to behave in other passages. Unfortunately, the only two uses, in Plutarch's *corpus*, we can find of the noun ἄσβεστος ("quicklime") are not very interesting: these are in *Sert.* and *Eum.* (a unitary couple of parallel lives), and in both part of an analogy to describe the dust lifting on a battlefield, probably only to suggest its fineness in texture and its whitish colour⁵⁵⁰. However, we also find a single

⁵⁴⁸ See above, p. 98-111.

⁵⁴⁹ See above, p. 116-7 n. 482.

⁵⁵⁰ *Sert.* 17.2: «scattering like quicklime or dust» (ὥσπερ ἄσβεστον ἢ τέφραν... διαχεομένην). The description of the battle in *Eum.* 16.10 (see «burst out dust like quicklime, whitening the air and obscuring the sights», ἐξήνθει κόνιν ὥσπερ ἄσβεστον, ἀπολευκαίνουσαν τὸν ἀέρα καὶ τὰς ὄψεις διαθλοῦσαν) is very similar to those in Diodorus Siculus, *BH* XIX 42 and Polyaeus, *Strat.* IV 6.13, but Plutarch

Plutarchan passage mentioning *gúpsos*, in the etiological context of *Aet. phys.* 10. I have already mentioned this text earlier, in connection with the “drawing” which the refrigerating pebbles and *akónai* allegedly exercise on the impurities of the water they are plunged in, as is described in *QConv.* VI 5 (691^{A-B})⁵⁵¹; now, by examining it in detail, we might be able to disambiguate *gúpsos* as a term for either gypsum or lime, and we will also see that it is credited, just like *latúpē* and *mármaros* —as well as pebbles— with an “arresting” action too (*Aet. phys.* 10 914^{D-E})⁵⁵²:

διὰ τί τῷ οἴνῳ θάλασσαν παραχέουσι καὶ χρησμόν τινα λέγουσιν ἀλιεῖς κομισθῆναι προστάττοντα βαπτίζειν τὸν Διόνυσον πρὸς τὴν θάλατταν, οἱ δὲ πόρρω θαλάττης ἐμβάλλουσι γύψον Ζακυνθίαν ὀπτήσαντες; πότερον ἢ θερμότης βοηθεῖ πρὸς τὴν περίψυξιν, ἢ αὐτὴ ἐξίστησι μάλιστα τὸν οἶνον ἀποσβεννύουσα καὶ φθείρουσα τὴν δύναμιν.

ἢ τὸ ὑδατώδες καὶ πνευματώδες τοῦ οἴνου πρὸς μεταβολὴν ἐπισφαλέστατ' ἔχον ἴσθησι τὰ γεώδη πεφυκότα στύφειν καὶ κατισχναίνειν, οἱ δ' ἄλλες μετὰ τῆς θαλάττης λεπτύνοντες καὶ ἀποτήκοντες τάλλοτριον καὶ περιττὸν οὐκ ἔωσι δυσωδίαν οὐδὲ σῆψιν ἐγγίγνεσθαι. πρὸς δὲ τούτοις, ὅσον ἐστὶ παχὺ καὶ γεώδες, ἐμπλεκόμενον τοῖς βαρύτεροις καὶ συγκατασπώμενον ὑποστάθμην ποιεῖ καὶ τρύγα τὸν δ' οἶνον ἀπολείπει καθαρόν;

Why do people pour seawater onto wine —and they say that [certain] fishermen had an oracle instructing them to plunge Dionysus in the sea⁵⁵³—, while those [who are] far from the sea throw Zakynthian *gúpsos* (*scil.* in the wine), after baking [it]?

Is it that the heat helps against the cooling [exercised by the environment], which of itself alters the wine maximally by extinguishing and destroying its power?

Or do the earthy [substances], which by nature condense and make thinner, arrest the watery and windy part of the wine, which is most prone to slip into alteration, and the salt [which goes] with the seawater, thinning and dissolving what is foreign and superfluous, does not allow bad smell or putrefaction to develop? In addition to this, all that is thick and earthy [in the wine],

uses slightly different images and is the only one mentioning quicklime. Like Diodorus, Plutarch also mentions that the soil is rich in salt (a ἀλμυρὶς which Plutarch qualifies as «arid», ἀρχμηρά). This detail suggests that the analogy with quicklime might also allude at the dust's “causticity” (*drimútēs*) for those who inhaled it, because quicklime is a strong base (see below, p. 144 n. 574) like salt is a “piquant” solvent (see below, p. 143 n. 571). This association might be corroborated by the coupling of quicklime with «ash» in the analogy in *Sert.* 17, but here the soil, along with the quality of its dust, is not salty and is attributed qualities, in turn, which are not paralleled in *Eum.* 16.

⁵⁵¹ See above, p. 87.

⁵⁵² Transl. based on Sandbach in PEARSON AND SANDBACH 1965, heavily modified. His paragraphing.

⁵⁵³ Cf. Athenaeus, *Deipn.* I 26^B, who reports of people who interpreted Dionysus's flight into the sea in Homer, *Il.* VI 135-6 to refer to the addition of seawater to wine. See also Palladius, *Op. agr.* XI 14.13, with the mention of a Delphic oracle but not of Dionysus, before a recipe for treating wine with *gypsum*. On this oracle see PARKE AND WORMELL 1974, although they seemingly ignored Plutarch's almost-parallel testimony.

becoming entangled with the heavier [bodies] and being drawn down with them, produces sediment and dregs, and leaves the wine clean.

We can see that the parallels with *QConv.* VI 5 and *Frig.* 19 are also terminological. The first correspondence is the mention of a *περίψυξις*, i.e. a «cooling» exercised on the liquid by its surroundings (*περι-*), which parallels the opening of the first answer in *QConv.* VI 5, with its *περιψύχεσθαι*: «first, does it not seem to you that water is cooled by the air falling upon it from the external surroundings [...]»?; the effect is also recalled with the term *περίψυξις* in the following period, and the succession *περιψύχεσθαι-περίψυξις* is then repeated in the second answer of the same *quaestio*, where the “drawing” action of the pebbles and *akónai* is considered, resulting in a thinning of the purified (upper) water. The third answer (which, as I have discussed, may be integral to the second)⁵⁵⁴ is also vaguely paralleled here in *Aet. phys.*, namely, in the explanation’s focus on density: in *QConv.* VI 5, this property is presented as the cause itself of the pebbles’ cooling action —«and the pebbles with [their] density (*τῆ πυκνότητι*) produce the cold in the [water’s] depths»—, while here, in contrast, it appears as something that is naturally procured, to other objects, by what is «earthy» (the verbs used are *στούφειν* and *κατισχγαίνειν*)⁵⁵⁵. This (implicitly) universal statement on a natural property, moreover, finds a formal parallel in what immediately follows the sentence on the pebbles’ density-induced cooling, which is a universal statement on the properties of stone (*QConv.* VI 5): «for every stone is a solid mass of earth which has been cooled and condensed (*πεπλημένη*) by freezing cold». The most striking parallelism, however, is that between the verb *συγκατασπώμενον* (“being drawn down with them”) in our passage and the *κατασπώντες* («drawing down») in the second explanation of *QConv.* VI 5, there coupled with *συνάγοντες* (“gathering”): in *QConv.* VI 5, what is «turbid» (*θολερόν*) and «earthy» (*γεώδες*), mixed in the water but extraneous to it, is attracted by the pebbles and sinks down with them, while here what is «thick» (*παχύ*) and «earthy» (*γεώδες*) —and foreign to the wine, as it leaves it «clean» (*καθαρός*) after precipitating in the dregs— becomes entangled with the added *gúpsos* (and perhaps with salt); this additive, because it is «heavier» (see *τοῖς βαρυτέροις*) than the earthy impurities, can effectively displace them and drags them down to the container’s bottom. That the turbid part of the water in *QConv.* VI 5 is also made of thicker particles, as I have already argued⁵⁵⁶, is shown by the fact that its removal leaves the water «thinner» (*λεπτότερον*). The parallelism between the two *quaestiones* is so rich that one can reasonably suppose they are related, and although a textual relationship of

⁵⁵⁴ See above, sec. 6.

⁵⁵⁵ Cf. *Frig.* 21 954^D (already mentioned above, p. 4).

⁵⁵⁶ See above, p. 87-8.

dependency would be difficult—if not impossible—to prove⁵⁵⁷, it does not seem unsafe to argue that Plutarch may have thought of the refrigerating pebbles and wine-improving *gúpsos* as analogous objects, and thus tried to apply the same explanation to the behaviour of both: after all, they are both «earthy» substances plunged into a liquid, and what applies to the smaller, *i.e.* the fine-grained *gúpsos*, should plausibly also apply to the bigger, *i.e.* the mass of pebbles. If the connection is correct, and the mechanics behind the two phenomena are indeed the same, the verb *κατασπᾶν* in *QConv.* VI 5 might now be better understood: in fact, it would be clear that it does not refer to a “suction” exercised by the pebbles while they lay still on the bottom, but to a physical “traction” of the particles getting caught in the pebbles’ surfaces during their sinking. This “entanglement” could be the mere result of physical contact between the «heavier» earthy substances and the liquid’s impurities (the pebbles, while sinking, would certainly collide with many, both below and around them), but it could be also promoted by the former’s action of *συνάγειν* by ways of *στέφειν*. In fact, it is reasonable to assume that condensation should be stronger on the fluid that is closer to the condensing substance, *i.e.* the sinking pebble or grain of *gúpsos*: this would logically lead to a higher concentration of liquid around its surface, and therefore, plausibly, also increase the number of impure particles colliding with it. If the «thick» particles are the only ones getting stuck as a result, while the watery, or purely ‘winy’, end up not being displaced, it might be because the crags in the sinking bodies’ surfaces are imagined to be wide enough for the thinner particles to slip away from them, but narrow enough to keep the thicker particles fixed into them⁵⁵⁸; these details of the reconstruction, however, are purely speculative, and for the moment they should be only taken as such. In any case, if Plutarch tried to explain one of the two phenomena by analogy with the other—rather than applying to both an already-available explanation coming from elsewhere—, it is likely that the etiology for *gúpsos* came first, because its addition to wine, as I will show below, can indeed produce a larger sediment of lees on the bottom of its container, which is arguably a more noticeable and important effect—due to its careful consideration in the winemaking process—than would be a gradual formation of limescale on the surfaces of submerged pebbles⁵⁵⁹.

On the correspondences with *latúpe*’s use on iron, we can start by noticing that the “condensing” action, here attributed to all earthy substances, may be also implied for the *mármaros* in the prooemium to *QConv.* IV (660^C): here, the *mármaros* makes the softening iron «strong» (lit. well-strung, *εὖτονος*) by intervening «through cooling» on its «excessive moistness and flow». The iron’s acquired “strength”, in fact, as it is induced by cooling and opposed to a “liquid” looseness, is likely to be associated with a higher density (and

⁵⁵⁷ See the analysis by MEEUSEN 2016, 150–77, who convincingly argues, against the earlier assumptions that «the research conducted in *Quaestiones naturales* is actually done ‘for’ *Quaestiones convivales*», that «it is at least equally plausible that Plutarch relies on, incorporates and elaborates the same or similar hypomnematic material into the problematic framework of *Quaestiones naturales* as well as into the more dramatised and literary context of *Quaestiones convivales*» (p. 175).

⁵⁵⁸ Cf. the dynamic described in *QPlat.* 7 1005^{C-D}, which I discuss below, p. 166-70.

⁵⁵⁹ See above, p. 87.

thus solidity) of the metal⁵⁶⁰; furthermore, in the analogy, the “strengthening” effect of *mármaros* corresponds to the table-talk’s “arresting” action on the loosened drinkers, expressed by the verb ἐφίστησι. This term is paralleled in the verb ἰστάναι (“to arrest”) in our passage, which is closely associated with the earthy substances’ “condensing” action: the *gúpsos* can “arrest” the unstable watery and windy (*i.e.* airy) parts of the wine precisely because it is an earthy substance that naturally “condenses”. The parallelism with the succession in *QConv.* IV is thus clear, but the verb ἐφίστάν, as we already know, is also used in *Frig.* 19 (954^A), where Plutarch describes the blacksmiths’ practice of sprinkling *mármaros* and *latúpē* on the iron «that is melting up» (ἀνατηκόμενος), thereby «arresting (ἐφίστάντες) [its] great flow and cooling [it] down». This “arresting” effect, which also here in *Frig.* is only implicitly associated with a condensation⁵⁶¹, is not only again coupled with a “cooling”, but also partly assimilated to the action of athletic *kónis* on human skin (as it is perhaps in *QConv.* IV)⁵⁶². This net of correspondences may be a sign that all these explanations sprang from a common matrix of inspiration (whether textual or only cognitive), and it would not be difficult to understand why these scenarios might have seemed analogous to Plutarch: in fact, not only are the *gúpsos*, *mármaros*, and *kónis* —whose actions all apparently counter a looseness and fluidity— intuitively “earthy” substances (*i.e.* minerals), but they are also, and most evidently, white or grayish dusts. If an etiology applies to one’s behaviour, then, it may seem reasonable to try and project it onto the others’. If all this is correct, the ancient semantic overlap within *mármaros* and *gúpsos*, along with the possible inclusion of quicklime or slaked lime in the second’s meaning, could find a further corroboration⁵⁶³: not only, in fact, would lime and gypsum be perceived as similar due to their external appearance and partial functional equivalence —since they could both be used as plasters⁵⁶⁴—, but they would also be interpreted to act upon other substances in the same way, due to their common ‘chemical’ properties. It is important to remember, however, that this ‘chemical’ association might well be only Plutarchan and hypothetical, considering the merely tentative and creative character of his *quaestiones*.

Now, going back to *gúpsos* as an additive of wine, the text of *Aet. phys.* specifies that it is Zakythian and baked before use. The latter detail alone cannot aid us in its identification, since both gypsum and lime, outside the domain of winemaking, can be baked with desirable results. In the case of the former, the starting material is gypsum in its naturally occurring form, as mineral of calcium sulphate dehydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$): this, when heated, loses a part of water and turns into calcium sulphate hemihydrate ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$), which is today also

⁵⁶⁰ On εὐτόνια see above, p. 102-3. and below, p. 180.

⁵⁶¹ It is not explicit in the text, but its role can be inferred from the fact that it is the opposite of a melting.

⁵⁶² See above, p. 120-1 and p. 127-9.

⁵⁶³ This, assuming that *mármaros* is here to be identified as “marble” rather than silica or borax (see above, p. 119 and 134-5), but note that Cherniss’s identification of the substance as a source of lime is in another passage (*QPlat.* 10.4 1011^B, on which see above, p. 129-34).

⁵⁶⁴ See above p. 116-7 n. 482 and here, below.

known as “plaster of Paris”, and in combination with water can be used, as its current name suggests, as a mortar (although one, apparently, prone to quickly disintegrate in wet weather)⁵⁶⁵. Lime plasters exist too, and they are made starting from limestone (the mineral of calcium carbonate, CaCO₃), which is heated to produce quicklime (calcium oxide, CaO): by adding water to this latter, slaked lime (calcium hydroxide, Ca(OH)₂) can be obtained, and this, in combination with further water, forms a paste that can be used as mortar. When mixed with water (and so with wine too), both partly dehydrated gypsum and quicklime generate heat, although the latter in much greater quantity than the former; for this reason, they would both fit well with the first answer to our *quaestio*, i.e. the supposition «that the heat helps against the cooling». On the other hand, the second explanation, even though it does not mention cooling (but only the condensation that normally comes with it), could turn out to be remarkably counter-intuitive for quicklime; indeed, when quicklime reacts with water, it heats the water so intensely to make it almost instantly fizzle and boil, while the heat produced by the gypsum’s reaction, in contrast, can easily go unnoticed. This counter-intuitiveness is not decisive for the identification of *gúpsos*, for it might have been the exact reason why Plutarch avoided to mention the alleged cold quality of earthy substances in this *quaestio*, perhaps deciding, quite sneakily, to detach their supposed astringent effect from coldness, and refer to such astringency in this etiology just because *gúpsos*, although possibly heating in some circumstances, is at any rate an earthy dust⁵⁶⁶.

As for the toponym Ζακύνθια, Sandbach cursorily notes that «Zacynthus (Zante) is still the principal source of gypsum in Greece»⁵⁶⁷. This may have also been true in Plutarch’s times (or in the few centuries preceding them), as the island is indeed rich in gypsum deposits, and especially the ones «occurring south of the town of Zakynthos» are reported to «have been extensively quarried»⁵⁶⁸. On the other hand, Plutarch’s topographical specification —which for *gúpsos* does not occur anywhere else in ancient Greek and Latin literature— would still seem somewhat gratuitous, both considering that the island’s soil was surely not the

⁵⁶⁵ See LUGLI 2018, 22–23 and above p. 116–7 n. 482, also for the following chemical information.

⁵⁶⁶ On the cooling and astringent effect of earthy substances see above, p. 4. Cf. Galen, *Simpl. med. fac.* IX 3.6, XII p. 213 Kühn, where *gúpsos* is explicitly regarded to have the same δύναμις as all earthy and stony substances, i.e. “drying” (see ξηραίνειν) as well as «cementing» (έμπλαστική). See also 3.7, XII p. 214 Kühn on «burned *gúpsos*» (γύψος κεκαυμένη), supposedly «finer-grained» (λεπτομερεστέρα), «more drying» (ξηραντικωτέρα), and «repulsive (άποκρουστική), especially when it is has been drenched in *oxúkrāton* (i.e. a sour mix of water and wine».

⁵⁶⁷ In PEARSON AND SANDBACH 1965, n. a to 914^B.

⁵⁶⁸ HIGGINS AND HIGGINS 1996, 104, who cites UNDERHILL 1988 (in which see esp. the geological map at p. 273). Gypsum, indeed, is in present days still mined in Zakynthos (apparently, in that specific area), but also in the Western Greece region (close to Aitoliko) and in Crete, according to the map “Non-Energy Mineral Commodities & Operating Mines in Greece” in PAPAVALILEIOU AND ARVANITIDIS 2010. Analyses of Mycenaean gypsum artifacts reveal that Crete, with its more than one-hundred gypsum deposits, was one of the main exporters of the material for the Central Aegean, but the composition of some other artifacts can be traced back to the deposits in Cephalonia or Zakynthos and in Southern Laconia: see CULTRARO 2018, 136–37. There are also four deposits of gypsum (in the form of selenite, or *lapis specularis*) in the Italian peninsula, all of which seem to have been actively quarried in the Roman period: see GUARNIERI 2018. The other important deposits of selenite where in the Hispanic, Cypriot and Turkish regions: see LUGLI 2018, 18, 22. See also the following footnote.

only source of the mineral⁵⁶⁹, and knowing that the geographical origin of the powder, from a chemical point of view, should not make any difference in relation to its effect (since the active part in the desired reaction, which I will illustrate below, would in any case be the pure component of either gypsum or lime). Athenaeus mentions the *Zakúnthios*, together with the *Leukádios*, as a variety of wine which was prepared with *gúpsos* (*Deipn.* I 33^B), which may be a hint that the toponym, rather than pointing at the geographical origin of the powder, was used to refer to the Zakythian local wine and its traditional production techniques. If this is true—but one must keep in mind that Athenaeus, who wrote a century after Plutarch, might have been the one who distorted the original information—, Plutarch (or his source) was evidently mistaken in specifying that *gúpsos* is for those who live «far from the sea», and might have taken this detail from an originally distinct report: in fact, as I am going to show, this specification also appears in other sources, where it is not associated with *gúpsos*, but with an artificially prepared brine, which can indeed be more intuitively understood as an alternative for seawater, when the latter is too far away. Then, if the toponym did only refer to a local way of making wine with *gúpsos*, we lose yet another means to disambiguate the term, since Zakynthos’s soil is not only rich in gypsum, but in limestone too, and this is still quarried today either in the form of marlaceous limestone or for the production of aggregate minerals⁵⁷⁰.

Now, by examining the way Plutarch presents the utility of *gúpsos* in winemaking, and by comparing it to the other ancient reports on the practice, we might be able to find decisive clues for its identification. A relevant detail, whether to be associated with the vintners’ distance from the sea or not, is that *gúpsos* is regarded to be an effective substitute for seawater (or for the salt which comes with it), which means that by using any of these two substances one could allegedly obtain identical or similar results. The desired outcomes, insofar as Plutarch’s text conveys, seem to be mainly related to preservation: in the first answer, in fact, the wine’s proper «power» is supposed to be defended from the outside «cooling» by the innate heat of the

⁵⁶⁹ SENZASONO 2011, n. 67 draws attention to Theophrastus, *Lap.* 64, which attests at the existence of gypsum deposits in Cyprus, Phoenicia, Syria, Thuri, Tymphaea, and Perrhaebia, without mention of Zakynthos. See also the preceding footnote.

⁵⁷⁰ On the distribution of limestones in the bedrock of Zakynthos see HIGGINS AND HIGGINS 1996, 104. The position of the deposit of marlaceous limestones is indicated in the IGME map uploaded on <https://www.orykta.gr/oryktes-protos-ytes-tis-ellados/26-latomika-orykta/marmara> (last accessed May 15, 2022). SALVATOR 1904, 585-6 (last accessed May 15, 2022), wrote of the limestone marls as “the most important quarries” in the island: he reported of the ones located in Gerakas, Ag. Sostis (current Cameo Island), of the “many” limestone quarries around Keri, of the “snow-white” limestone slate quarried at Langadakia, Lithakia, and Vougiato, and of the “alabaster-like marble” in the places he called «Andilalos Aspra Paniá» and «Vrachos tu Zellaiti». I thank Christian Gilli of *Flora Ionica* (see FLORA IONICA WORKING GROUP 2016) for this bibliographic reference. For the locations of the production sites of aggregate minerals see the map “Λατομεία Αδρανών Υλικών Ελλάδας” in PAPAVALSILEIOU AND ARVANITIDIS 2010. Since limestone—differently from gypsum (see above, p. 141 n. 568)—is widely available in the Greek soil, one must also note that it would make little sense to export it from Zakynthos to the mainland: another possibility, therefore, is that the toponym *Zakynthos* may have been used to disambiguate between the two minerals, since between lime and gypsum only the latter would be known in Greece as an exported commodity.

additive⁵⁷¹, and in the second an unspecified but ruinous «alteration»⁵⁷², as well as «bad smell» and «putrefaction», to be prevented from occurring — the former by means of condensation, and the latter by means of dissolution, or precipitation, of the «foreign and superfluous» parts of wine. The result of adding *gúpsos* or seawater, then, is regarded to be primarily an increase in the wine’s stability and a longer conservation of its qualities, and secondarily, as a hypothesis, a general purification that can be either correlated with an increase in dregs or not. The idea of a longer preservation is indeed paralleled in other sources, but, if we examine them, the picture may prove to be more complex than expected⁵⁷³.

This is not the case, at least, for what appears to be the first survived Greek reference to the practice. In *Lap.* 67, Theophrastus reports very succinctly, of *gúpsos*, that «in Italy it is also [used] in wine». J. F. Richards and E. R. Caley, commenting on this passage, consider both lime and gypsum for the identification of the additive, and write, before presenting a number of other Greek and Latin sources, that «the first, either in the form of quicklime or slaked lime, served to neutralize the excess of acid in wine that had soured or was naturally

⁵⁷¹ I will show that there might be some uncertainty on the identification of this supposed δύναις, as the first answer to the *quaestio* shares some similarities with Plutarch’s report, in *QConv.* V 3.1 676^B, of Theophrastus’s idea that clay (ἀργίλος), being hot, helps in the fermentation of wine (συνεκπέττειν is unambiguous, *contra* TEODORSSON 1989b, n. *ad loc.*, who claims without arguments that «the process of maturing in the jar is meant»); as I will say, there might be some connection with Pliny’s report in *NH* XIV 121 that clay, like *marmor*, salt (!), and seawater «rouses» the *lenitas* of wine, an effect which might be paraphrased as an increase in δύναις in the sense of must fermentability; I will propose a possible explanation for these parallels based on the correspondences between Plutarch’s etiology and the recipes in *Geop.* VII 12. Notwithstanding the Theophrastean reference to fermentation, it is more likely that Plutarch, in *Aet. phys.* 10, refers to the risk of acetification: Sandbach, in PEARSON AND SANDBACH 1965, n. *c ad loc.*, correctly refers to the Aristotelian and Theophrastean idea reported by Galen (*Simpl. med. fac.* IV 3, XI 629 Kühn, in Fr. 222 Rose) that the «winy» parts of wine, having a «congenital (σύμφυτος) heat», «cool out (ἀποψύχεται) during the transformation into vinegar», passing their warmth into the «putrefying (σηπόμενον) watery residue (ὕδατόδης περιττώμα)». On the supposed coldness of vinegar cf. below, p. 185-6. On the «congenital» heat of seawater see *Aet. phys.* 8 914^B (quoted above, p. 80); on that of salt see *QConv.* V 10.2 685^A (note that salt is said to contrast putrefaction in 10.3 685^{B-C}, making cadavers ἀσηπτα καὶ μόνιμα πολὺν χρόνον) and VI 10 697^{A-B}, in which it helps the curdling of milk, compensating the coldness of «unfermentable» (ἀπεπτος!) serum (ὀρός) — compare with Galen’s reference to the «watery residue» of wine. The reference to heat appears to be less adequate for *gúpsos*, but this mineral does heat water when it is mixed to it (as I have mentioned above), albeit not as much as quicklime; perhaps, Plutarch’s explanation, relying on the cultural confusion between quicklime and gypsum, attributed to the second an obvious property of the first: I will argue for a different explanation, but the assimilation between these two dusts might be supported by the attribution to gypsum, in the oral or written tradition (as in *Geop.* VII 12.5, which I will quote below), of the property of *drimútēs* (“piquancy”, or objective “solventy” or “causticity” in *e.g.* *QConv.* VI 2.1 687^D and below, p. 148 n. 592), because this would make it an obvious ‘chemical’ analogue of both quicklime (*i.e.* calcium oxide, which is a strong base, see below, p. 144 n. 574) and salt (presented as *drimús e.g.* in *Aet. phys.* 3 912^D, and *QConv.* IV 4.3 669^A). Plutarch associates *drimútēs* with heat in *QConv.* VI 10 696^F-697^A, Fr. 113 Sandbach, and perhaps in *Cupid.* 3 524^C. SENZASONO 2011, n. 69 offers useful parallels for the verb ἐξιστάναι (“alter [ruinously]”) in the text of our *quaestio*, but his considerations on the term δύναις, which he connects with the Aristotelian ὕλη and “material cause”, are completely out of scope (see *e.g.*: «nel vino è insita la potenza [δύναις] del calore, che è in generale la condizione perché diventi ancora più caldo, mediante un processo di ulteriore fermentazione che attua questa potenza come qui, oppure più freddo [...]»); on the δύναις of wine I return below. Cf. also *QConv.* VIII 5.2 725^D, quoted above, p. 96.

⁵⁷² *Contra* Sandbach In PEARSON AND SANDBACH 1965, n. d to 914^D, who interpreted the «alteration» of the airy parts to correspond to their evaporation (followed by MEEUSEN 2017a, n. *ad loc.*). If the alteration of the watery corresponds to their putrefaction (as they both recognize), the alteration of the airy should not correspond to their dissipation in the environment, but to a degradation of the wine’s bouquet and acquisition of bad smell, probably in the direction of acetification. See also below, p. 148 n. 576.

⁵⁷³ References to most of the following passages, except those in Dioscorides, were already collected by SENZASONO 2011, n. 67.

sour⁵⁷⁴; and the second, normally added before fermentation, served to clarify and improve the wine», thus implying that the moment of addition, together with its goal, could be decisive for the material's identification. After their overview, they ultimately opt for gypsum⁵⁷⁵, stating that in the parallel accounts «*gypsos* always seems to mean partly dehydrated gypsum», and then explain that «the treatment of unfermented wine or must with partly dehydrated gypsum is a practice now commonly called “plastering”». They also provide an explanation of the chemical reaction occurring between the added calcium sulfate and the potassium bitartrate already present in the wine, which mainly consists in the formation of calcium tartrate, soluble tartaric acid, and potassium sulfate⁵⁷⁶. What is interesting here is that the first of these, *i.e.* calcium tartrate, precipitates immediately after being formed, and in so doing it «carries down various suspended impurities, thus greatly clarifying the must»: this could explain Plutarch's reference to an increase in dregs and to the “drawing” action exercised by *gúpsos*. In addition, «the removal of the potassium bitartrate also makes coloring matter more soluble, so that the color of the wine is improved», which lends itself to an easy interpretation in terms of cleansing. «Moreover», they finally add, «the fermentation is rendered more rapid and complete, and the wine is said to keep better», so that a longer preservation, which is central in Plutarch's report, seems to be also obtained. If Richards and Caley are correct, Plutarch's *gúpsos* should be clearly identified with gypsum⁵⁷⁷, but its association with seawater, which they understandably —following Theophrastus— do not even mention, is a detail that here we cannot ignore. Therefore, we should also consider the other sources on the practice, and see whether our tentative interpretation of Plutarch's baked *gúpsos* as partly dehydrated gypsum will be confirmed when tested against these text.

⁵⁷⁴ Cf. BILLIARD 1913, 502–3, who presents the addition of lime as a way to correct wines that are too “soft” and deacidify them: according to him, the reaction produces soluble «malate et tartrate de potasse» and insoluble «tartrate de chaux», which deposits on the bottom. Cf. also THURMOND 2017, 186. JACKISCH 1985, 107 describes the addition of calcium carbonate (CaCO₃, normally found as limestone) to wine, in present days, as a way to reduce its acidity. He does not endorse the addition of strong bases to wine (note that calcium oxide is one of these, with pH 12.5), but is open to the use of some weak bases: «although neutralizing by adding a strong base is less satisfactory than removing acid, certain weak bases perform a different function. They reduce acidity not by converting hydrogen ions into water but by precipitating acid anions and leaving a much weaker acid». The addition of gypsum has the opposite effect, increasing the wine's acidity by the formation of tartaric acid: see below, n. 576.

⁵⁷⁵ This is also the interpretation of EICHHOLZ 1965 and AMIGUES 2018, but note that they never consider the possibility of identifying *gúpsos* with lime (see above, p. 116–7 n. 482).

⁵⁷⁶ Cf. THURMOND 2017, 185, who depends on JACKISCH 1985, 104: «“Plastering” is a process once widely used in the sherry district of Spain. Calcium sulfate (plaster of Paris) is added to the must, calcium tartrate precipitates, and sulfuric acid replaces tartaric acid. Plastering increases acidity and imparts a slight bitterness characteristic of Spanish sherries. Its disadvantages are that acidity and pH changes are not exact (calcium sulfate has low solubility and may not completely react), and too much bitterness may result». Note that in this account the desired effect is an increase in the wine's acidity (opposite to the deacidification one can obtain by adding lime, on which see above, n. 574); this was also tested and confirmed experimentally by BENITEZ, DELGADO, AND MARTIN 1993, and is today officially recognized as one of the reasons justifying the use gypsum as an additive in wine (see ORGANIZZAZIONE INTERNAZIONALE DELLA VIGNA E DEL VINO 2017). An account of the chemical process was already provided by Sandbach in PEARSON AND SANDBACH 1965, n. a to 914^A.

⁵⁷⁷ Coherently with Sandbach in PEARSON AND SANDBACH 1965, n. a to 914^A: «Plutarch therefore correctly states the effects of adding sea-water and gypsum in wine-making, although he had no means of knowing how they are produced». On the effects of seawater see below, p. 153.

The earliest preserved references to the addition of salt or seawater to wine come from Latin authors, but in explicit association with Greek culture. This is already evident in the reference in Plautus's *Rud.*, where the character Charmides, on the shore, lamenting the wet state of his clothes in connection with his undesired hangover, states that «Neptune poured seawater (*mare*) underneath us as if we were Greek wines / and in this way he hoped that our constipation would be relieved with the briny goblets (*salsa pocula*)» (588-9)⁵⁷⁸. The unambiguous mention of Greek wines is evidence that the practice of intermixing them with seawater was regarded by the Romans to be specifically Greek; however, while the presence of Neptune's name in this analogical context curiously parallels, in part, Plutarch's metaphorical reference to Dionysus in *Aet. phys.* 10 as a substitute for “wine”⁵⁷⁹, the preservative function of the salty additive is here not considered, replaced by the ‘physiological’ focus on brine as a laxative. We will see shortly that other authors, in fact, explicitly regarded brined wine to have peculiar effects on the digestive tract. This may still be coherent, in any case, with Plutarch's attribution to the seawater's salt of a “thinning” and “dissolving” action on the «foreign and superfluous» part, because the idea that salt aids digestion by means of a dissolution does appear elsewhere in Plutarch's *corpus*⁵⁸⁰.

After Plautus, it is Cato to report in *Agr.* on the technique of adding «old seawater» (*aqua marina vetera*) or «pure salt» (*sal purus*) to must for the making of «Greek wine» (24), but without providing details on their specific effect, which is only clear to occur, or start, before the fermentation process begins: this also applies to his recipe for Coan wine (112), prescribing the use of a purposefully-aged seawater —selected and prepared according to a specific method (also mentioned in 106)⁵⁸¹— with grapes. According to Cato, seawater may be also added to wine as a last ingredient —after its first fermentation has occurred and ten days before cellaring— to make a rather low-quality wine destined to servants (*familia*) and lasting only until *solstitium*, after which it turns into a strong vinegar (104): in this procedure, the first important ingredient, to be mixed with must before its fermentation, is *sapa*, *i.e.* «boiled must», which the other authors too consistently mention, sometimes with the term *defrutum*, in the context of the wine's *conditura* (“preparation for conservation”, literally “seasoning”); this ingredient, although indirectly, would indeed promote a longer preservation of the wine, because increasing the sugar content in the pre-fermented must (a process now called “enrichment”) can result in a more thorough fermentation of the juice, and thus lead to a worse environment for acetic acid

⁵⁷⁸ Transl. DE MELO 2012, slightly modified.

⁵⁷⁹ See also above, p. 137 n. 553.

⁵⁸⁰ See especially *Aet. phys.* 3 912^{D-E} with the commentary by MEEUSEN 2016, n. *ad loc.* Cf. Pyth. 4 396^A, where Theon presents the beneficial effect of the Delphic air on «digestions» (πέψεις) as evidence of its “thinness” (see λεπτόν) and “mordancy” (see δηκτικόν). The connection with these properties parallels the first etiology in *Aet. phys.* 3, and is likely to be behind Plutarch's reference to saltwater's action of λεπτόνειν in *Aet. phys.* 10: salt, like the air at Delphi, is regarded to “thin” coarse bodies by piercing and cutting their masses, which is something it can do because of its own “thinness”.

⁵⁸¹ According to BILLIARD 1913, 502, seawater had to be aged for purification purposes and for the removal of its sharpness, «sans doute par la précipitation des diverses sulfates qu'elle contient». See also THURMOND 2017, 184.

bacteria to flourish in, effectively stopping the wine's acetification⁵⁸². As we can see, all these additives are meant to be used, even when this is not specified, before cellaring; we may compare this with the use of quicklime —as mentioned by Caley and Richard— to lower the excessive sourness of wine, which is an action that might be rather required, sometimes, after the wine has already aged. It is particularly interesting that Cato also provides a recipe for «Greek wine» suited to vintners operating «far from the sea», and who are thus unable to acquire seawater easily (105): the alternative ingredient, unlike Plutarch's *gúpsos* for the πόρρω θαλάττης people in *Aet. phys.* 10, is here an artificially-made brine (*muria*), and Cato, after shortly illustrating its preparation from freshwater and salt, guarantees that the resulting wine will not be inferior to the «Coan» (the Greek wine he gives the recipe for in 112). Given this evidence, one cannot exclude that Plutarch (or his source) wrongly conflated a report on *gúpsos* —as either a general alternative to seawater for the making of «Greek wine» or a core ingredient for the *conditura* of Zakynthian wine— with a report on artificial brine as a substitute for seawater that was convenient to people living far from the sea. That *gúpsos* and seawater (or salt) were in any case regarded to be comparable ingredients in a number of winemaking techniques does in fact emerge from the Latin sources. Cato himself, just before introducing the first recipe for «Greek wine», mentioned boiled-down *defrutum*, salt, 'marble' (*marmor*), and resin (*resina*)⁵⁸³ as seemingly alternative additives for the first phase of the treatment of must (23). Bearing in mind the association of *marmor* with these other ingredients, it is perhaps unlikely that Cato was referring here to limestone as a corrector of sourness: if the lexical ambiguity of the Greek *mármaros* is true⁵⁸⁴, this may also apply to the first occurrences of Latin *marmor* (which originated from the Greek term)⁵⁸⁵, and the substance actually referred to by Cato —whether he knew it or not— might have been gypsum, for its preservative effect⁵⁸⁶. Because of the text's paucity of detail, we have no way to confirm this hypothesis.

In the later sources, though, it is possible to notice, in the context of winemaking procedures, a certain oscillation (or association) between *marmor* and *gypsum*. In *Rust.* XII, firstly, Columella refers to *unciae singulae marmoris vel gypsi, quod flos appellatur* to be added to each amphora of must, in combination with a quantity of *defrutum*, in order to secure that the wine's flavour (*sapor*) will be preserved until the next vintage (20). The disjunction between 'marble' and 'gypsum' is evident (see *vel*), but it is uncertain whether the specification «which they call 'flower'» should be referred to both substances or only to the latter⁵⁸⁷. It is also

⁵⁸² See THURMOND 2017, 178–81, 183.

⁵⁸³ On the use of resins and pitch see THURMOND 2017, 186–87: «it must be emphasized that these were often used as preservatives, not to modify flavor, since our authors are at pains to recommend concentrations beneath the taste threshold. Aromatics do, in fact, have a marked antiseptic power».

⁵⁸⁴ See above, p. 61 n. 234 and p. 71 n. 292.

⁵⁸⁵ See TLL, s.v. 'marmor'; CASTIGLIONI-MARIOTTI, s.v. 'marmor'.

⁵⁸⁶ In his work he only uses the word *gypsum* once, in the context of a recipe for a plaster (39). Note that like *marmor* is a derivative of the Greek μάρμαρος, *gypsum* is a calque of the Greek γύψος: see TLL, s.v. 'gypsum'; CASTIGLIONI-MARIOTTI, s.v. 'gypsum'.

⁵⁸⁷ Cf. the translation by HEFFNER 1955: «of what is called the "flower" of marble or plaster».

unclear whether the characterization of *gypsum* or *marmor* as ‘flower’ is meant to indicate a special variety of the powder or not. The disambiguation is not helped by the fact that this expression, apparently, occurs in none of the other extant Latin works; it is indeed possible to find much later occurrences of the couple *flos calcis* («flower of lime»)⁵⁸⁸ in Latin literature, and a single use of γύψου ἄνθος («flower of gypsum») in Hippolytus’s *Haer.* (IV 34.2), but these can do little more than just corroborate the lexical overlap between the two substances⁵⁸⁹. In any case, it is unlikely that Columella wanted here to refer to actual marble as a source of lime, since it is quite clear that the point of the procedure is not to correct the level of sourness in must, but to make the *sapor* of wine last longer. After giving these instructions, in fact, Columella proceeds to illustrate a method of preparing wine with *defrutum* for a better preservation (21): it is particularly interesting that here, in the context of the same procedure, he not only instructs on the addition of «cooked and pounded salt» (*sal coctus et tritus*, of which he explains the careful preparation) after the must has fermented for two days thanks to the firstly added *defrutum*, but he also prescribes, as the last step after the completed fermentation, to mix in the *gypsi flos* («flower of gypsum» — this time without mention of *marmor*) and cellar the prepared wine just after one day. Columella presents this process as a *conditura* which he learned from his uncle, appropriate for vintners whose vineyards are on marshy grounds (*palustres vineae*); when his uncle worked with vineyards on the hills (*collina vina*), Columella explains, he preferred to rather use boiled-down salt water (*aqua salsa decocta*), prepared from carefully selected offshore seawater. After this method, he also provides a recipe for treating must with liquid pitch (*picus liquida*) —somewhat paralleling Cato’s reference to *resina*—, presenting it as a *medicamen* (“agent”, literally “remedy”, just as the Greek word φάρμακον)⁵⁹⁰ *quo mustum condias* (22): the mention of resin as a preservative, rather than an aromatic, is here unambiguous. In this same recipe, Columella also attributes an important role to «lye ash» (*cinis lixiviae*), to

⁵⁸⁸ In TLL, s.v. ‘flōs’, II.A.1 are collected Palladius, *Op. agr.* I 40.2 and 3, Vegetius, *Mulom.* II 62.1 (*calcis vivae*), Chiron, *Mulom.* 613 and 614, and Theodorus Priscianus, *Eup. Faen.* 28. In the Latin *glossae* to Greek terms collected by HERAEUS 1903, «calcis flos» occurs as a translation of both ἄσβεστος (“quicklime”) and *τιτάν(ο)ν (“lime”). Cf. the old Italian-English dictionary in BARETTI [1771] 1795, where the word «grassello», referring to a kind of plaster, is defined s.v. as «(fior di calcina) the flower of lime». The TLL interprets the occurrences of the term *flos* listed in II.A.1 to signify, perhaps reductively, a «pars quaedam alicuius rei, quae ab ipsa re segregatur, diverso plerumque ab ea aspectu», which «segregatur propter subtilitatem aut perfectionem». In this sense, it is reported to also be associated with ‘salis’, ‘nitri cocti’, ‘Assii lapidis’, different names for flour, ‘resinae’, the first juice extracted from olives, ‘lapis spumae candidae [...] alabastrum’, ‘spumae’, ‘gari’, ‘mirrae’, ‘lomentum’, ‘roris marini’, ‘cineris’, and ‘plumbi’.

⁵⁸⁹ Hippolytus uses the expression γύψου ἄνθος to refer to a plaster used for sealing letters: «they then use this as a seal. They also say that wax with pine resin has a similar effect, as well as a solution of two parts mastic, one part dry bitumen (ξηρὰ ἄσφάλτος). But sulfur alone is reasonably effective, as well as gypsum powder (γύψου ἄνθος) soaked with water and resin. This especially works wonderfully for sealing molten lead» (transl. LITWA 2016). Cf. the old German-English dictionary in BERTHOLD 1830, where the compound «Gyps-mehl» (lit. “flour of gypsum”) is translated s.v. as «flower of gypsum, powdered gypsum». Today, the expression “gypsum flower” is used to refer to one of the more common varieties of gypsum in crystalline form (on which see ROPP 2012, 153), described in THRUSH 1968, s.v. ‘gypsum flower’ as «curved; twisted crystal growths of gypsum resembling flowers». In Greek, the term ἄνθος, as reported in LSJ, s.v., I.2, may metaphorically refer to «anything thrown out upon the surface, eruption», either on solids, as e.g. verdigris on bronze (cf. Plutarch’s use of ἐξάνθειν, lit. «burst into flower», for the appearance of verdigris in *Pyth.* 4 396^A), or on liquids, in the form of scums and froths (e.g. on wine, as in Galen, *Simpl. med. fac.* IV 3, XI p. 628 Kühn).

⁵⁹⁰ On the meanings of the word φάρμακον in Plutarch’s works cf. AGUILAR 2008.

be repeatedly mixed in to the pitch and strained off in order to remove the smell of the latter and “wash the dirt away” (*eluit spurcitiam*)⁵⁹¹: this ingredient, to be identified as an alkaline detergent of vegetal origin, is obviously regarded as a cleansing agent by Plutarch too (who was perfectly aware of its use in laundering)⁵⁹², and its role as a remover of *spurcitia*, in the etiology of *Aet. phys.* 10, is interestingly passed on to salt, presented as a solvent of what is ἀλλότριον καὶ περιττὸν in the wine.

More information on the use of pitch with wine is provided by Pliny in *NH* XIV, where, although presenting it as an ingredient for *condiendi* to be applied during the first fermentation of must, in the exposition of its utility —differently than the preceding authors— he focuses exclusively on its effects on taste and bouquet, and on the “fierceness” (*feritas*, also referred to by the adjective *pugnax*) or “gentleness” (*lenitas*) of must (124-5). After this, he interestingly reports that «in some regions» wine is treated with *cinis* (here, not explicitly a detergent) and «elsewhere» with *gypsum*, a practice that he presents as an analogous example of «attention to the *medicamen* of wine», followed by a mention of *marina aqua* and the method of its aging (126). Pliny had already mentioned *gypsum* not many lines above, just after introducing the section on the wine’s *apparatus* («preparation») and crediting the Greeks who «made [it into] an art» (120): it is here that we find, as a first example, a report of the use of *gypsum* in Africa to «mellow» the excessive «harshness» (*asperitas*) of wine, and of the alternative use of «lime» (*calx*) in some of its regions. Immediately after this, Pliny refers to the seemingly opposite use, in Greece, of “rousing” the wine’s *lenitas* with «clay» (*argilla*), *marmor*, salt, or seawater; a result, he writes, which is also obtained in Italy by adding pitch (*pix* or *resina*). He then mentions the use of *sapa* as a way to “crush” the wine’s «fierceness» (*ferocia*), this time without geographical attribution (121). All the ingredients mentioned in this cluster, except clay⁵⁹³, have already appeared in the earlier sources we have examined, but never as explicitly linked to the wine’s *asperitas* or *ferocia* — whether these terms should be understood as metaphors for sourness, discernable alcohol intensity, or must fermentability. The fact that Plutarch, in *QConv.* V 3.1, reports Theophrastus’ statement that «clay (ἄργιλος) is hot, which is why it also helps in the fermentation (συνεκπέττειν) of wine» (676^B)⁵⁹⁴ may be taken as a sign that Pliny (or his source) might have used the metaphor of *lenitas* to refer to a low presence, in the

⁵⁹¹ The last ingredient in Columella’s recipe is once again seawater, either *vetustissima* («very old») or *decocta*. On ash cf. the much later Palladius XI 14.9, who mentions this substance, along with gypsum, among the alternative ingredients to make a wine *ex molli forte* (cf. Pliny’s reports, discussed below), and 14.16, in which he prescribes to seal the *dolium* for the cellaring of wine treated with gypsum with a mud made not from gypsum, but from *cinis sarmentorum* (cf. Plutarch, *Sollert.* 10 966^{D-E}, which I quote below, p. 158-9).

⁵⁹² See e.g. *QConv.* VI 9 684^B (the *konía* made from the ashes of the fig tree is ῥηπιικωτάτη, i.e. «most detergent», due to its *drimūtēs*), with TEODORSSON 1989b, n. *ad loc.*

⁵⁹³ Columella does give a role to clay in the preparation of the *sal coctus et tritus* he describes in *Rust.* XII 21.2: according to his recipe, salt of the whitest kind (*candidissimus*) must be thrown into an earthenware ewer (*in urceo fictile*) and smeared all over with a mud mixed with chaff (*luto paleato*), and then cooked on a fire until it stops crackling. This use of clay is clearly different from the one Pliny alludes to.

⁵⁹⁴ HUBERT [1938] 1971, n. *ad loc.* remarks that this information «non inveni in Theophr. libris».

wine, of the hot δύναμις causing its fermentation (and therefore to a low degree of must fermentability); this inference is possible for Pliny and for the tradition he depends on, but it can hardly be extended to Plutarch's understanding of the "heating" additives as expressed in *Aet. phys.* 10, since whenever he refers, in *QConv.* III 5, to the δύναμις of wine, he always uses the term to designate a hot or cold property of the drink which manifests in its effects on other objects (rather than on the wine itself), and primarily on the human body⁵⁹⁵; it seems therefore that Plutarch's δύναμις should rather be referred to the wine's alcohol content and proper taste and smell, probably opposed to that of weak and vinegary wines, which are thus assumed in *Aet. phys.* 10 (in the first answer) to have been degraded by an external «cooling»⁵⁹⁶. Still, the fact that Pliny associated closely the function of *argilla* with that of *marmor*, salt, and seawater, combined with the consideration that Plutarch knew —at least from Theophrastus— that clay was used in winemaking may offer us some insight into the genesis of the first answer to our *quaestio*, which does not concern clay, but perhaps two substances that are considered as functional analogues, and whose behaviour might have thus been explained by Plutarch by taking their argillaceous 'neighbour' as a model; as I will show, clay might also have inspired his second answer. For the moment, we can remark that Pliny (or his source), who does not even mention the preservative effect of the listed additives, appears to have had a very limited understanding of their use in winemaking. He may have projected, perhaps, an actually correct interpretation of the use of *calx* (*i.e.* calcium carbonate) as a regulator of sourness onto the other ingredients (both directly and by inversion): if this is true, his association of the substance with *gypsum*, whose addition has actually the opposite effect of increasing the wine's acidity⁵⁹⁷, may have depended on an ambiguity in his sources rather than on the existence of two alternative procedures in Africa (and this would again corroborate that the term *gypsum* or γύψος was also used for lime). In any case, Pliny's implicit opposition between the effect of *calx* and that of *marmor* as used in Greece is a clear sign that his ideas on these additives were quite confused: marble, in fact, which in this context would be nothing more than a source of lime, like *calx* would have the sole effect of lowering the wine's sourness, which seems to be different from an alleged "excitation" of its *lenitas* (the problem, indeed, might have been already present in an original Greek source, in which the term μάρμαρος was perhaps referred to gypsum). Furthermore, it is unclear why adding *sapa* to must should be instrumental to lowering its *ferocia*, considering that it was actually used to help its alcoholic fermentation (like Theophrastus's clay!), through an increase in sugar⁵⁹⁸: we may here suppose that this effective sweetening might have been understood by Pliny to be a

⁵⁹⁵ See *QConv.* III 5.2 652^C, 652^F, 653^B, always in the couple φύσις καὶ δύναμις. In this *quaestio*, Plutarch's character «argues *ex tempore* that the δύναμις of wine is cold» (MEEUSEN 2017a, n. to *Aet. phys.* 10 914D).

⁵⁹⁶ See also above, p. 143 n. 571.

⁵⁹⁷ See above, p. 144 n. 576.

⁵⁹⁸ See above, p. 145-6 with n. 582.

mere counterbalance to an unpleasant “fierce” taste⁵⁹⁹. This hypothesis, in addition, might explain Pliny’s presentation of resinous additives as simple correctors of flavour and “fierceness”, since it was probably much more intuitive to think of them as aromatics than as preservatives, thus having an obvious effect on taste and mouthfeel⁶⁰⁰. Analogously, he might have conceived salt and seawater to rouse the *lenitas* of wine simply because they would add to its taste a salty note, thus making it less flat and more piquant⁶⁰¹, while in his source the reference might have rather been to must fermentability. That Pliny was not much familiar with these procedures, after all, may be hinted by the fact that he was scared of them: as he expressly writes in *NH* XXIII, in a section dedicated to the effect of different kinds of wine on health, «of those treated (*condita*) with *marmor*, *gypsum*, or *calx*, in fact, who ever, even if robust, will not be afraid?» (45-46). After this, he lists the effects of different *conditurae* on the organism: while resinous wines can be beneficial towards cold stomachs, for example, wines mixed with seawater are altogether bad for it — a negative effect of *thalassites* (“sea wines”, a loanword from Greek) he had already mentioned twice in *NH* XIV⁶⁰², which we may compare with attribution of a laxative effect to saltwater, which we have already seen in Plautus’s *Rud*.

A specific treatment of the effects of all these wines on health, having not few points in common with Pliny’s exposition, can be found in Dioscorides’s *MM* V (especially 6). Here, we can read a description for wine treated with *gúpsos*, which according to the author «is bad for the nervous system, causes headaches, inflames, and is unsuitable for the bladder, but it is more suitable for deadly poisons than the rest» (6.5)⁶⁰³, and is unsurprisingly used in a recipe (72.3) to make the *helleboritēs* («hellebore-flavoured wine»), *i.e.* a helpful potion that «purges from childbirth and miscarriages», «destroys embryos», and «is good for uterine suffocation»⁶⁰⁴. Resinous wines, as in Pliny’s text, are instead regarded, among their other virtues, to be «heating and digestive» (θερμαντικοί καὶ πεπτικοί, 6.5), and, in illustrating their preparation, Dioscorides mentions an initial step in which the pitch is washed «with either seawater or brine (θαλάσση ἢ ἄλμη, 38.1)⁶⁰⁵,

⁵⁹⁹ Pliny explains that must is boiled down, in the production of *sapa*, in order for it «to sweeten proportionally to its strength» (*ut dulcescat portione virium*; 121), showing that in his understanding “strength” and “sweetness” are somehow connected, and possibly opposed.

⁶⁰⁰ What THURMOND 2017, 186–87 claims with respects to the use of pitch and resins (quoted above, p. 146 n. 583) may therefore also apply to these other ingredients.

⁶⁰¹ On the *drimūtēs* (“piquancy”) attributed by Plutarch to salt and to other substances see above, p. 143 n. 571.

⁶⁰² In 73, he reports on the practice of adding seawater to the Clazomenian wine, now most appreciated as they *parcius condiunt*; in 75 he claims that the Ephesian wine is made unhealthy by its preparation with seawater and *defrutum*; in 78 he assimilates the Coan white wine (*Leucocoum*) with the *Tethalassomenos* or *Thalassites* made elsewhere, as they are both made *vetustae praecox* by the addition of seawater into their must (this function is assigned to gypsum in Palladius, *Op. agr.* XI 14.3, which I quote below), obtained by immersing their containers in the sea (*vasis deiectis in mare*, cf. Plutarch’s reference to the “plunging” of Dionysus in the sea). The Coan and Clazomenean wines are only assigned unhealthy properties by Dioscorides: see below, p. 151 n. 606.

⁶⁰³ Transl. BECK 2005. Cf. Athenaeus, *Deipn.* I 33^B, where the *Zakínthios* and *Leukádios* wines are presented to cause headaches because of their treatment with gypsum.

⁶⁰⁴ Transl. BECK 2005.

⁶⁰⁵ Cf. the recipes for musts treated with waters of different kinds (*i.e.* freshwater, seawater, rainwater) in 6.16-7; see also the following footnote.

just like in Columella's recipe it had to be first cleansed with lye (compare again with the dissolving effect attributed to salt in *Aet. phys.* 10). Dioscorides also provides a short description of how wines mixed with seawater are prepared (19), there also claiming, among the other things, that they are good «for purging the bowel» and «for the constipated», although «bad for the stomach» (κακοστόμαχοι) —just as for Pliny— and «causing flatulence» (πνευμάτων γεννητικοί)⁶⁰⁶; like gypsum, seawater too can be used as an ingredient in the making of the *helleboritēs* (72.1-2). It is quite interesting to note that seawater, which according to *Aet. phys.* 10, as we have seen, should act on the wine in a similar way to a preservative, is regarded by Dioscorides to make the Coan and Clazomenean wines actually «prone to degradation» (εὐφθαρτοι), apparently due to its excessive quantity (6.9). He also mentions salt, as an ingredient to be mixed in last before the cellaring, in the recipe for the watered-down wine known as *deuterías* or *pótimos*, appropriate for ill and convalescent patients (6.15-16). Salt, he writes, is also used to prepare the *melititēs* («honeyed wine»), another mellow drink whose effects —all beneficial— include the cleansing of the stomach (7.1-2). Considering these positive connotations, it is unlikely that Dioscorides, in using the ambiguous expression *halòs ánthos* (“flower of salt”, or poetically “flower of sea”), an ingredient for a harmful wine «which is more purgative than that made from sea water» but «useful neither for health nor in sickness» (66)⁶⁰⁷, means to refer to salt — possibly gathered in the form of *fleur de sel*⁶⁰⁸. It is more likely that he refers to a form of the already-condemned seawater, possibly using “flower” as a metaphor (perhaps already lexicalized) for its froth⁶⁰⁹. Indeed, in the section dedicated to *halòs ánthos* in itself, *i.e.* outside the context of winemaking (112), Dioscorides clarifies that it «flows down the river Nile and settles on top of certain marshes»⁶¹⁰, showing that he understood it as a kind of scum, then also mentioning a number of organoleptic features that appear to be incompatible with *fleur de sel* (as its «saffron-like» colour and its bad smell); the repetition, in this section, of the deleterious effects of *halòs ánthos* on the bowel and on the stomach when mixed with wine is a clear proof that this substance is

⁶⁰⁶ Cf. Athenaeus, *Deipn.* I 32^{D-E}: «wines that have been aggressively treated with sea-water (ἐπιμελέστερον τεθαλαττωμένοι) do not cause hangovers; loosen the bowels; irritate the stomach; produce gas; and aid in the digestion of food» (transl. OLSON 2006, slightly modified). See also Dioscorides, *MM* V 6.3 (a τεθαλασσωμένος wine procures headaches but is also εὐκόλιος, *i.e.* loosens the bowels); 6.9 (the Coan and Clazomenean wines have been treated with too much seawater and have only unhealthy properties, including the agitation of bowels); cf. 11 (white and ἀύστηροι Italian, Chian, Lesbian and Ephesian wines, which are ἀθάλασσοι, *i.e.* untreated with seawater, are πρὸς τὴν ἐν ὑγιείᾳ χρῆσιν εὐθετοί, *i.e.* most suited to use in medicine).

⁶⁰⁷ Transl. BECK 2005.

⁶⁰⁸ On this substance see *e.g.* SAINZ-LÓPEZ, BOSKI, AND SAMPATH 2019, 1200: «*fleur de sel* or *flor de sal* (FS; meaning flower of salt, French and Portuguese terms, respectively) is an edible variety of table salt that forms at the surface of supersaturated brines under specific atmospheric conditions [...]. It has also been described as floating crystal rafts [...] or as a thin salt crust at the brine surface [...]. Recently, FS won the reputation of a gourmet product»; and p. 1201: «Light, brittle FS crystals form at the surface of evaporating brine, from which they are manually skimmed during harvesting. [...] When the surface is disturbed, the crystals sink, so FS salt must be collected daily before crystals drown in brine».

⁶⁰⁹ BECK 2005 appropriately translates the expression *halòs ánthos* as «salt-water froth». On this metaphorical use of ἄνθος see above, p. 147 n. 589.

⁶¹⁰ Transl. BECK 2005.

the same as the one mentioned earlier with the same name⁶¹¹. In Dioscorides's exposition, we can also find some information on decocted must (ἔψευμα), just after the illustration of the wines treated with gypsum and of those treated with pitch (6.5), where he claims that the additive is used to prepare the so-called *aparákhutoi* («unmixed») wines. Their alleged effects, we may notice, are quite similar to the negative ones attributed to both gypsum-treated wines and the ones mixed with seawater: in fact, the *aparákhutoi* are «striking (πληκτικοί) and burning (πυρωτικοί) towards the head, causing drunkenness, causing flatulence (φυσώδεις), slow to evaporate, and bad for the stomach (κακοστόμαχοι)». The ways in which the *conditurae* with seawater and those with gypsum harm the organism are somehow combined in the harmfulness of the *aparákhutoi*, perhaps hinting at a close cultural association between the latter and the former two. However, insofar as emerges from Dioscorides's text, it is not possible to prove a medical association between gypsum- and seawater-treated wines, as they have in common none of their described effects. Lastly, Dioscorides, in the context of winemaking, never mentions either *mármaros* or lime, and in the section dedicated to the latter, in the form of ἄσβεστος, *i.e.* «quicklime» (115)⁶¹², he does not consider its effects on wine⁶¹³. A possible hypothesis is that he did not know that *marmor* was also used for a specific *conditura* (although this was attributed quite confidently by Pliny to the Greeks), since otherwise, most probably, he would have mentioned it. Alternatively, we may suppose that Dioscorides, as a Greek author tapping into a better tradition of Greek sources on winemaking, did not confuse *gúpsos* with *mármaros* or *ásbestos*, substances which perhaps were never (or very rarely) used before the cellaring of wine, and were only misidentified by Latin authors when they learned about «Greek wines» (possibly, again, due to the ambiguity of the Greek terms).

Whether the latter hypothesis is true or not, it is in any case not necessary, when we find mention of *marmor* or *calx* in Latin texts, to automatically assume that these terms referred to actual marble or lime. After all, up to the I century CE, the only authors—in the extant literature—who distinguished between ‘marble’ and gypsum in the context of winemaking (*i.e.* mentioning both substances with different terms) were Columella

⁶¹¹ Cf. the parallel exposition in Pliny XXXI 90-2, where the substance is referred to as «a sort of salt ash» (*quadam favilla salis*) and as «flower of salt» (*flos salis*), different from both «salt» (*sal*) and «froth» (*spuma*). *Contra* Garofalo in CAPITANI AND GAROFALO 1986, n. 1 to 92, who, after quoting the passage in Dioscorides, *MM* V 112.2, comments without arguments that «pare certo che il fior di sale sia il carbonato di sodio», *i.e.* sodium carbonate or washing soda. This substance should rather be identified with ἀφρόντρον or ἄφρος νίτρον («foam of niter»), described by Dioscorides a few lines below in 113 (according to GOLTZ 1972, 166, the unclear description of this substance may fit the crystalline salts forming on the shores of soda lakes; see also Pliny, *NH* XXXI 112-3 and Galen, *Simpl. med. fac.* IX 3.5, XI p. 212 Kühn). Sea foam is not produced by salt, but by a variety of organic compounds; see *e.g.* SCHILLING AND ZESSNER 2011, 4356–57: «foam is a dispersion of a gas in a liquid or solid separated by thin liquid films or lamellae [...]. [...] Natural foams are usually linked to humic and fulvic acid substances [...], fine colloidal particles [...], lipids and proteins originating from aquatic or terrestrial plants leaching from soil by precipitations events [...], saponins representing a family of plant glycosides [...], the exudation or decomposition products of phytoplankton containing carbohydrates and proteins [...] and the natural reservoir of organic matter occurring in sediments [...]».

⁶¹² On the occurrences of ἄσβεστος in Plutarch's *corpus* see above, p. 136 with n. 550.

⁶¹³ But cf. 115.3: «when combined with certain other ingredients, such as suet or olive oil, they can further maturation (γίνεται πεπτικῆ!), soften, disperse, and cicatrize. That which is fresh and not wet must be considered the most effective» (transl. BECK 2005).

and Pliny. For what regards Columella, it is possible he did not choose the disjunctive *marmor vel gypsi* to refer to two alternative ingredients (which he would wrongly present to have the same preservative function), but that he did so either for reasons of lexical equivalence —as in “that substance we call *marmor* or *gypsum*”— or to reflect an ambiguity in his source; in fact, when not many lines below he repeats his reference to gypsum (again, as a clear preservative) he only uses the expression *gypsi flos*, excluding *marmor* — possibly showing a preference for the former term. For what regards Pliny, I have argued that his understanding of the process was probably very limited: in this frame, it is unsurprising to see *calx*, *gypsum*, and *marmor* being systematically confused, especially considering that he may have relied on already-ambiguous sources. Outside of Pliny’s text, we can conclude, it is always likely that the substance actually referred to is gypsum, and that this was primarily used, as the recipes show, as an aid to the preservation of must and wine.

All the other mentioned ingredients, as we have seen, were probably used for the same end: this also applies to seawater and salt. In fact, D. L. Thurmond, in presenting the Greek and Latin sources, claims that «the ancients recognized that salts promoted biological stability, suppleness, and clarity»⁶¹⁴, and O. Longo, providing some minimal detail on the involved chemical cause, explains that sodium and chlorine ions (Na+, Cl-) inhibit the oxidation processes induced by acetic acid bacteria⁶¹⁵, thus making it more difficult for wine to turn into vinegar. This stabilizing action is clearly suited to a preservative, and matches very well Plutarch’s explanation that the parts of wine «most prone to slip into alteration» are “arrested” and «bad smell or putrefaction» prevented: in other words, we may say, acetification is slowed down or stopped to a halt by the additive⁶¹⁶. Furthermore, if it is true that salt has the additional effect of clarifying the wine, Plutarch’s proposal that the drink may be “cleansed” by the added ingredient (as more impurities are allegedly dragged onto the bottom) is easily explained for seawater too, since it would be possible to actually observe the treated wine become more transparent, at the end of the process, than an untreated wine produced from the same must⁶¹⁷. A comparable effect, as we have seen above, can also be obtained by using gypsum. It is interesting to note that in a later source on the procedure, namely Palladius’s *Op. agr.* XI, reports a recipe attributed to

⁶¹⁴ THURMOND 2017, 183. See also BILLIARD 1913, 501: «c’était un préservatif précieux dans le cas de vendange lavée par la pluie», with reference to *Geoponica*, [Democritus], VII 4 (cf. Palladius, *Op. agr.* XI 14.4).

⁶¹⁵ LONGO 2003, 207. Cf. Sandbach in PEARSON AND SANDBACH 1965, n. a to 914^A: «[seawater] would slightly increase acidity, since chlorine ions, produced by hydrolysis of sodium chloride, decrease the pH value. This increased acidity might improve the wine by inhibiting the growth of micro-organisms that cause cloudiness and instability». Note that neither Longo nor Sandbach support their claims with chemical evidence.

⁶¹⁶ SENZASONO 2011, n. 71 correctly remarks that the understanding of salt as a preservative against «corruzione» (rather, putrefaction) must have been very ancient, due to its use in foodstuffs (already attested in Homer, *Il.* IX 214). On acetification, cf. above, p. 143 n. 572 for my criticism of Sandbach’s and Meeusen’s reference to evaporation, and n. 532 for the Aristotelian and Theophrastean opinion reported in Galen, *Simpl. med. fac.* IV 3, XI 629 Kühn (in Fr. 222 Rose). We find a focus on bouquet also in Athenaeus, *Deipn.* I 31^F-32^A, where the recipe by Phaenias of Eresus for the *anthosmía* wine (lit. “flower-fragrant”) is reported, requiring the addition of seawater to the must.

⁶¹⁷ Again, see Sandbach’s positive evaluation of Plutarch’s etiology quoted above, p. 144 n. 577.

«some Greeks» which requires both seawater (again selected and aged) and *gypsum* to be mixed one after the other to the must in order to obtain, explicitly, an improved and clarified wine: «after the third day, they stir it vigorously, and promise that this not only provides age (*aetas*) to the wine⁶¹⁸, but splendour and colour too» (14.3). A vigorous stirring, which is repeated at the ninth or eleventh day, has an obvious effect on the additive’s distribution in the fluid and on the rate of solution formation, but may have also been prescribed as a way to make the gypsum rise to surface before letting it sink again to the container’s bottom — possibly, in order to have it ‘drag down’ a greater part of the remained impurities. This dynamic, which would be coherent with Plutarch’s explanation of the “cleansing”, is somewhat suggested in a recipe for «plastering» (γύψωσις) collected in the *Geoponica* and attributed to a certain Didymos (VI 18), who appears to have lived about three centuries after Plutarch’s time⁶¹⁹. The text reads: «the *gúpsos* must be thrown in a wide vessel, and then also must poured on top of it, in such a way that this submerges the *gúpsos*, and it must be stirred rapidly and repeatedly (πυκνῶς)⁶²⁰, and thus be allowed to return still, in order for the thicker parts (παχύτερα) of *gúpsos* to deposit on the bottom. The upper parts must instead be removed from the must, [and the process must be repeated] until no more part of *gúpsos* sinks when the movement is interrupted». Although the stirring, here, seems to be only instrumental to a quicker solution of the gypsum and to a thorough erosion of its larger lumps —in order to ensure that as much *gúpsos* as possible reacts with the must and the unreacted powder is instead removed from it—, the mentioned sinking of the «thicker parts» may offer a nice parallel to Plutarch’s depositing of «the heavier», to which he describes all of the wine’s «thick (παχύ) and earthy» impurities to become entangled.

However, the best correspondence one can find in the *Geoponica* with Plutarch’s treatment is in a recipe attributed to an author who might have even lived in the same years as Plutarch: a certain Fronto (100–450 CE)⁶²¹. Indeed, this author is associated with a cluster of twenty-nine recipes titled «how it is possible to act in advance, and do not allow the wines to alter (τρέπεσθαι), but [make sure] that they are stable (μόνιμοι)» (VII 12), opening with «roasted salts» (1) and also including *gúpsos* (5), and never mentioning *mármaros*⁶²².

⁶¹⁸ On the ancient techniques for artificial aging see THURMOND 2017, 194–95.

⁶¹⁹ Ca. 350 – 450 CE, according to Rodgers in KEYSER AND IRBY-MASSIE 2008, s.v. ‘Didumos of Alexandria (II: Agric.)’.

⁶²⁰ Cf. the metaphorical use of οἶλος discussed above, p. 91-2.

⁶²¹ See Keyser in KEYSER AND IRBY-MASSIE 2008, s.v. ‘Fronto (Agric.)’: «the Latin name Fronto, known from the Augustan era [...], is concentrated in the 2nd c. CE.».

⁶²² In the recipe on *gúpsos* we read that «*gúpsos*, after being thrown in, initially makes the wine more piquant (or caustic, δριμύτερον), but with time the piquancy (or causticity, τὸ δριμύ) exhales, while the useful [that comes] from *gúpsos* remains in great quantity» (*Geop.* VII 12.5). RICHARDS AND CALEY 1956, n. to Theophrastus, *Lap.* 67 quote this passage without disambiguating on the identification of *gúpsos*. Although the implied preservative effect suggests that the substance should indeed be gypsum, the “piquancy” or “causticity” ascribed to it might also apply to quicklime (at least in Plutarch’s vocabulary, see above, p. 143 n. 571). THURMOND 2017, 185 reasonably takes the adjective δριμύς to refer to an increased «acidity» —in Greek literature the adjective is in fact very often coupled with «vinegar» (ὄξος)— but it may also refer to its opposite, i.e. alkalinity. This seems to be the only passage in Greek literature associating *gúpsos* with *drimútēs*,

Among these recipes, he offers a description of the effect of clay (ἄργιλλος) when added to the wine, which is extremely similar to Plutarch’s etiology for salt and gypsum: «and potter’s clay that is thrown into the wines after [their] fermentation cleanses (καθαίρει) them, bringing down (καταφέρουσα) with itself the turbid (τὸ θολερὸν) into the dregs (εἰς τὴν τρύγα), and more if it had been roasted (εἰ φρυγείη), and makes the wine fragrant (εὐώδη), for it is sweet [...]. Hence, potter’s clay sweetens the must (τὸ γλεῦκος), and makes it stable (μόνιμον)» (19). Excluding the reference to “sweetness” —perhaps in contradiction with Pliny’s mention of *argilla* as “rouser” of *lenitas*— there are evident close parallels between this recipe and Plutarch’s description: here we find again the additive’s role as a preservative, its action against bad smell, its roasting, its cleansing effect, and, most importantly, the explanation of this effect as a carrying down of impurities (compare *καταφέρουσα* with *συγκατασπώμενον*). All these correspondences strongly suggest that Plutarch, for the etiology of the action of gypsum in *Aet. phys.* 10, probably found inspiration in the use of clay in winemaking: we have earlier found some clues that this may apply to the first answer, possibly based on the Theophrastean report on the clay’s “heating” effect on wine (*QConv.* V 3.1 676^B), and aided by the functional clustering, in the tradition, of salt and *marmor* with *argilla* (Pliny, *NH* XIV 120); now we see that this may also apply to the conclusion of the second answer, in which *gypsos* acts precisely in the same way as Fronto’s clay. If Plutarch, in this context, felt that his analogical projection was legitimate it is because clay, in addition to being roasted like gypsum, would surely be added to the wine after being ground into a powder, which would evidently qualify it as an earthy dust. If we consider that D. L. Thurmond identifies this ancient clay with either bentonite or kaolin⁶²³ —which are both clay minerals—, we can even note that kaolin is white in colour, just like gypsum, making it the perfect choice for the etiology as a dusty analogue of gypsum.

Both clay and gypsum, after all, do promote the wine’s clarification: in the case of clay, it is directly one of its components (*e.g.* montmorillonite in bentonite) to precipitate by electrostatic attraction the gross particles that it encounters⁶²⁴, while in the case of gypsum the clarification is produced by the precipitation of the newly formed calcium tartrate (from tartaric acid and calcium sulphate)⁶²⁵. This latter effect, arguably, is more intuitively understood by an ancient as an action of “dragging-down” exercised by the gypsum itself. In 1913, R. Billiard presented the action of clarifying agents in the process today known as “fining”, in English, and as *collage* (“gluing”), in French, as «un procédé de clarification du vin, à la fois mécanique et chimique», in which various agents such as egg whites, blood, and milk are added to the wine to let them act «à la façon d’un voile ou d’un filet qui envelopperait dans ses plis toutes les souillures flottant dans la masse du liquide»⁶²⁶. It is easy to notice a resemblance between this analogical presentation of finings and Plutarch’s

⁶²³ See THURMOND 2017, 193.

⁶²⁴ See *ib.*

⁶²⁵ See above, p. 144.

⁶²⁶ BILLIARD 1913, 508–9. The connection between wine plastering and *collage*, along with the citation of Billiard, was first suggested by AMIGUES 2018, n. to *Lap.* 67.

words on the action of gypsum, and it is not unlikely that he himself may have had in mind, when writing his answer to the *quaestio*, the well-known “gluing” effect of gypsum when combined with water, *i.e.* when made into a plaster; after all, we have already seen that Plutarch writes somewhat coherently of *latúpē* and *mármaros* as both related to a κόλλησις (“gluing”) —although of iron—, and this term may have been easily associated with *gúpsos* too.

7.3 Athletic and cementing *kónis*

With this conclusion, we have fully circled back to the idea of white “earthy” powders acting as cooling and condensing —and thus ‘drawing’ and ‘gluing’— agents, which might have also inspired (as I have mentioned) Plutarch’s treatment of refrigerating pebbles and *akónai*. Another of such substances, and the last for us to examine, is the relatively unspecified *kónis*, or “dust”, which has already appeared above in both *Frig.* 19 (954^A) and *QConv.* 4 (660^{B-C}) in functional association with *latúpē* and *mármaros*. The former of these passages, as we have seen, is that in which its “extinguishing” effect is implied to be dependent on the natural cold quality of “earthy” substances, which shows that Plutarch included *kónis* in the same ‘chemical’ category as that of the other cooling dusts. Considering its alleged coldness, then, we may be surprised to see that in one of the answers to *Aet. phys* 16 (915^{E-F}), if we take the text literally, Plutarch seems to rely on an intuitive attribution of a certain heat to *kónis*, as opposed to the coldness of mud, but the difficulty is only apparent. This *quaestio*, which concerns two traditional agricultural practices and includes what seems to be a verbatim quotation —in trochaic tetrameter— of a popular saying, is formulated in this way: «why do they say “plant wheat in mud, but barley in dust”?»⁶²⁷. In the third answer, Plutarch suggests concisely that the κρᾶσις of the muddy soil may be commensurate and harmless to wheat due to the latter’s heat (διὰ θερμότητα), while barley is something colder (ψυχρότερον), thus implying that it can only grow in a hotter soil, which is the dusty⁶²⁸. Apart from the fact that dust, although in itself a possible astringent, is obviously hotter than a muddy soil, being this «more likely to be cold as it is drained with cool water»⁶²⁹, it is also true that *kónis* is specifically named, in the whole *quaestio*, only in the quoted saying, and that this, being a proverb, may merely use the

⁶²⁷ This verse was included in Diehl’s *Anthologia lyrica Graeca* among the *carmina popularia*, more specifically among the γρίφοι (“riddles”, II 6.16, p. 197). Sandbach in PEARSON AND SANDBACH 1965, n. c *ad loc.* points for comparison to Cato, *Agr.* 34-5.

⁶²⁸ Note that much in this passage is left implicit: it reads ἢ διὰ θερμότητα σύμμετρος καὶ ἀβλαβῆς ἢ κρᾶσις ψυχρότερον δ’ ἢ κριθή. The θερμότης, syntactically, might also refer to the muddy soil, but it seems more appropriate to refer it to the wheat. For a discussion of this interpretation, see especially MEEUSEN 2017a, n. to 915^E: «Plutarch implies that a hot plant (c.q. wheat) requires a cold soil (c.q. mud) and a cold plant (c.q. barley) a hot one (c.q. dust)».

⁶²⁹ MEEUSEN 2017a, n. to 915^E, who points to *Aet. phys.* 14, 915^D («unless the earth has been soaked so that there is lasting moisture to keep the ears [of wheat and barley] cool and damp», transl. Sandbach in PEARSON AND SANDBACH 1965).

word as a metonymy for a dry soil⁶³⁰. In fact, in none of the answers Plutarch mentions properties that are specific to *kónis* as a peculiar mineral powder, and in the fourth answer, when referring to the farmers' fear that ants may ruin a wheat crop if the soil is inappropriate, he simply writes of wheat that has been planted «in the dry» (ἐν ξηρῷ), showing that the only thing that counted was the absence of moisture from the soil. The mentioned *kónis*, then, is not a substance that should be added to the soil in preparation for a barley crop, but only a metonymic token for generic dry earth.

If *kónis* can be used as such, it is obviously because it is closely associated with the property of dryness, which is also evident in Plutarch's repeated attribution of a drying effect to it. We have already witnessed, in *Frig.* 19 (954^A), how effectively *kónis* «extinguishes» the athletes' sweating. Its action is the same as that of its cosmetic variant used by women, the *diapásmata* («dusting powders», literally «things that are sprinkled over») that Plutarch's character describes in *QConv.* I 6 to “snatch up” (ἀναρπάξουσι) their sweating: as the nature of these powders is «sharp» (πικρά) and «astringent» (στυπτικά), they are most fit to illustrate the “drying” property (ξηραντικόν) of the sharp taste-juice (4 624^E). We have also learned from *QConv.* 4 (660^{B-C}) that «the assaults and tugs of those who wrestle require dust» (or rather «dust-cloud», *koniortós*)⁶³¹, to counteract the excessive slipperiness of their skins⁶³². This was likely needed due to the athletes' traditional rubbing in oil in preparation for their activities: as we read in a comic fragment quoted by Plutarch in *Pomp.* 53, «each [wrestler] against the other / anoints himself and smears his hands with dust (ὕποκονιέται)» (9)⁶³³. According to E. N. Gardiner, *kónis* was not only used by athletes to help this oil dry up, but also because it «closed the pores of the skin, checked excessive perspiration, and kept the body cool, thus protecting it from chills and rendering it less susceptible to fatigue»⁶³⁴ — all compatible effects with those that we have come to expect from earthy substances. For these functions, Gardiner relies on the testimony in Lucian's *Anach.* (2 and 29), in which we can curiously find the same syntagm ἐν ξηρῷ by which we have seen Plutarch rephrasing the proverbial planting «in dust» of *Aet. phys* 16: Lucian writes, indeed, that «the sand (ἡ ψάμμος) takes off the slipperiness and affords a firmer grip on a dry surface (ἐν ξηρῷ)» (*Anach.* 2)⁶³⁵. The mineral composition of the athletic dust, which in the passage just quoted is simply identified with «sand»⁶³⁶, is left unspecified by

⁶³⁰ SENZASONO 2011, n. 86 debates Diehl's inclusion of the quoted verse among the popular γρίφοι (see above, p. 156 n. 627), claiming that it is instead «un precetto agricolo abbastanza chiaro di tono proverbiale». Cf. MEEUSEN 2017a, n. to 915E, with whom I agree: «it is perhaps a bit strange, however, to literally plant barley, or anything else, in dust or ashes (κόνις). The same is true for planting wheat in the mud».

⁶³¹ The term is used in this literal sense in *Di.* 13.4; 46.4; *Sert.* 17.5 (on which see above, p. 136-7 n. 550); *Pomp.* 72.1; *Sul.* 19.3; *Cor.* 26.4-10.

⁶³² The athletes' use of dust is also used as an analogy with the plovers' covering in mud (πηλούμενον... ὥσπερ ἀθλητὴν κονιόμενον) before attacking the ichneumons as presented by Phaedimus in *Sollert.* 10 980^E.

⁶³³ Transl. PERRIN 1917, slightly modified. The fragment is the anonymous CAF 401, III p. 484 Kock.

⁶³⁴ GARDINER 1910, 492, also cited by TEODORSSON 1989a, n. 660 B.

⁶³⁵ Transl. HENDERSON 1925. I have already commented on this passage above, p. 120 n. 500.

⁶³⁶ Cf. MILLER [1979] 2004, «Index and Glossary», p. 222, quoted above, p. 120 n. 500.

Plutarch, but Philostratus will later report in *Gymn.* (56) on some of its varieties—all credited with special virtues—, such as the *pēlōdēs* («muddy»), the *ostrakōdēs* («shelly» or «bricky»), and the *asphaltōdēs* («asphalt»)⁶³⁷; in *Alex.* 40, interestingly, Plutarch mentions Leonnatus’s decision to have *kónis* be imported from Egypt «on many camels» as evidence of the sumptuous living of Alexander’s favourites (1).

Whichever its composition, Plutarch makes Diadoumenos present the *koniortós* as a substance, just like mud, that can “irritate” the body as part of an analogy in *Comm. not.*, in which the Stoics, for their reactions to Academic criticism of their doctrines, are likened to «those who have mud or dust on [their] bodies and to which it seems that the person touching them and being in contact with them does not remove (κινεῖν) what is irritating [them] (τὸ τραχῦνον), but procures [it]» (2 1059^F)⁶³⁸. A similar analogy, more concretely grounded in the practices of «those who wrestle», appears in *Util.* to describe the usual tit for tat of average people spitefully reacting to a reproach: «just as those who wrestle (οἱ παλαιότες) do not wipe the dust (κόνις) from off their own bodies, so these persons do not wipe off the revilings from themselves, but they besmear one another (συμπάττουσιν), and in consequence get besmirched (φύρονται) and begrimed (ἀναχρώννυται) by each other as they fight» (6 89^D)⁶³⁹. Lastly, a reference made by Plutarch’s character in *QConv.* VI 3 to the drying power of dust might perhaps implicitly allude to its athletic or cosmetic use. As part of his answer to the physiological *quaestio* why eating increases thirst, he proposes that solid, dry food may increment the body’s overall dryness by attracting to itself the moisture that is scattered throughout it⁶⁴⁰, and defends this hypothesis by means of an analogy: the food absorbs the moisture «just like, outside [the body], we see earth, dust (κόνις), and sand (ψάμμος) take up the liquids that are mixed [with them] (τὰ μινύμενα τῶν ὑγρῶν) and make [them] disappear» (2 689^{E-F}). This everyday observation, although very general, might well also be related to the experience of *kónis* as an “extinguisher” of sweating, since it is quite certain that the more dust we apply to our body, the more our sweat is made invisible and our skin dry. However, the syntactic structure of the sentence may seem to allude to a different phenomenon, because according to its phrasing it is not the dust or sand to be «mixed» with the liquids, but the liquids to get mixed to the dust. It is also possible, then, that the idea is more akin to the one described by Aristotimus in *Sollert.* 10 (966^{D-E}), in which he praises swallows for their use of fixing nests through a «glutinous mud» (πηλός ἐχέκολλος) they make from water and *koniortós*: to

⁶³⁷ On this passage see GARDINER 1910, 492–93.

⁶³⁸ My interpretation of the passage is coherent with FUHRMANN 1964, 160 n. 2 and with Babut in CASEVITZ AND BABUT 2002 (where κινεῖν is translated as «enlever»); cf. CHERNISS 1976b: the people being touched by someone «think that he has struck them with the thing that irritates them and not that he has just disturbed it (κινεῖν)».

⁶³⁹ Transl. BABBITT 1928, slightly modified. It is Babut in CASEVITZ AND BABUT 2002, n. 47 to point to this parallel passage, together with *Col.* 1110^{D-E} (which only concerns slime). They also refer to FUHRMANN 1964, 160 n. 2, who connected these images before them.

⁶⁴⁰ I have already commented on this passage above, p. 94 n. 380. TEODORSSON 1989b, n. to 689 E points for comparison to the “drawing” action of *akónai* illustrated in *QConv.* VI 5 691^{A-B} (on which see above, p. 86-7). This comparison is not etiologically cogent, but Teodorsson does simply point out that the two passages have «a similar construction».

prepare and use this mortar the swallows «skim over a lake or a sea, touching the water with only the tips of their feathers to make them moist, yet not heavy with dampness; then they scoop up dust and so smear over (ἐξλείφουσι) and bind together (συνδέουσι) the parts [of the nest] that begin to sag or loosen»⁶⁴¹. In the resulting plaster—which is arguably a further sign of Plutarch’s implicit association between *kónis* and the ‘gluing’ *mármaros* and *gúpsos*—the mixed-in moisture would certainly “disappear”, though not completely, and its fluidity decrease as if the water were “taken up” by the dust’s grains.

⁶⁴¹ Transl. Helmbold in CHERNISS AND HELMBOLD 1957, slightly modified.. BOUFFARTIGUE 2012, n. 125 collects the parallel *loci* in Philo, *Alex.* 22, and Aristotle, *HA IX*, 7, 612^B23, source of Aelian, *NA III*, 24, and remarks that «les deux auteurs disent seulement qu'elle [*scil.* the swallow] “se mouille”, Plutarque y ajoute le détail —facilement observable— du vol effleurant la surface de l’eau».

8. Pushing onto metals

8.1 Lodestones and amber

A quite peculiar drawing action, not shared with any other earthy substance, was attributed by the ancients to one specific mineral: the lodestone, whose magnetism used to puzzle natural philosophers in the same way as the electrostatic properties of amber. It is not a coincidence that among the incredible, strange-but-true phenomena mentioned by the crowd «blabbering about antipathies» in *QConv.* II 7.1 we read in succession that «amber moves and draws to itself every light thing except those that are dampened in basil and oil»⁶⁴² and that «the *sidērītis* stone (lit. iron-related stone) does not draw iron, if it has been anointed in garlic» (641^C). In this passage, the etiological difficulty only concerns two specific behaviours of amber and magnets, which some of Plutarch's contemporaries would hastily explain by referring to the unsatisfactory model of natural «antipathies»⁶⁴³: for them, there would obviously exist an antipathy between amber and basil mixed in oil⁶⁴⁴, and another between lodestones and garlic⁶⁴⁵, determining the strange suspension of the attractive properties⁶⁴⁶. In addition to these particular phenomena, magnetic and electrostatic attraction already posed a problem in itself. In J. Opsomer's overview of the ancient debate on the issue —which he presents to better frame Plutarch's own take—⁶⁴⁷ we find Cicero writing on magnetism as a phenomenon «unintelligible to the

⁶⁴² *Contra* TEODORSSON 1989a, n. 641 C, whose interpretation shows that he referred the plural βρεχομένων («that are dampened» to amber: «when the amber is magnetized through rubbing it must of course be dry». If this were the correct explanation, the specific mention of basil and oil would also be unjustified.

⁶⁴³ On the theory of sympathies and antipathies, Clement in CLEMENT AND HOFFLEIT 1969, n. c *ad loc.* mentions the treatise *Peri sumpatheiōn kai antipatheīōn* written by the Hellenistic author Bolus of Mendes, who used to pass for Democritus (see HALLEUX 1974, chap. 4 par. 4–5, eBook version; GAILLARD-SEUX 2010). These concepts were originally associated with the Stoic doctrine (cf. above, p. 21 n. 61): in the words of OPSOMER 1999, 423–24, «the notion of cosmic sympathy is of course linked to the Stoics, and especially to Posidonius (see his n. 33 for references), which might be among the reasons why Plutarch rejected it as an explanation (in addition to the fact that it might have sounded to him like a «non-explanation» or elusion of the matter, see MEEUSEN 2014, 314 n. 13, p. 316; 2017, 256–57). FUHRMANN 1972, n. 10 *ad loc.* collects other examples in Plutarch's *corpus* of natural phenomena explained by reference to sympathy or antipathy; a fuller list is in CAIAZZA 2001, n. 249. Cf. the preposterous positivist claims in TEODORSSON 1999, 667–68: «the process of blurring the borderline between scientific facts and fancy in the study of nature was probably initiated by the obscure Bolus of Mendes [...]. His basic theory was the idea that there exist forces of sympathy and antipathy inherent in various things in nature [...]. His works have not survived but the material can be found in large quantity in writers from Hellenistic till Medieval times. This fact reveals the decline of critical thinking that developed in writers on natural history during the Hellenistic period. The strength of this trend is seen in the fact that not even the Peripatetic school was always able to keep off these imaginary beliefs».

⁶⁴⁴ TEODORSSON 1989a, n. to 641 C points to the parallel *loci* in *Geop.* XV 1.29 (without mention of olive oil) and XI 28 (were basil is «credited with antipathetic or miraculous faculties»).

⁶⁴⁵ TEODORSSON 1989a, n. to 641 C points for comparison to *Geop.* XV 1.28, in which it is the stone to lose its attractive property (ἐκπνεῖν) if rubbed with garlic; this is ambiguous in Plutarch's text. Cf. Pliny, *NH* XXXVI 61, in which diamond *dissidet cum magnete* so much that the latter suspends its attractive properties when the former is placed in its neighbourhood; on the terminology of *discordia* and *concordia* (reflecting the Greek *antipathia* and *sympathia*) see 59, mentioned below.

⁶⁴⁶ See FUHRMANN 1972, n. 10 *ad loc.*: «ne s'agit-il pas [...] du phénomène magnétique, [...] mais bien d'étonnantes exceptions à cette loi de l'attraction». *Contra* OPSOMER 1999, 422, who comments on this passage that «a brief allusion is made to the action of amber and lodestone — readily observed, but difficult if not impossible to explain».

⁶⁴⁷ OPSOMER 1999.

human mind» (p. 421, with reference to *Div. I* 86); a similar idea is also embedded in Pliny’s paradoxical description of the *magnes* in *NH* XXXVI, beginning with these words: «what is, in fact, more marvelous (*mirabilis*) [than this]? Or in what part of nature is there more impudence (*inprobitas*)?» (126).

The explanation of magnetism —normally equated with electrostatic attraction— was in fact a traditional problem⁶⁴⁸. Plato, in the *Timaeus* (79^E-80^C), denied the existence of any literal «attraction» (ὀλκή) and grouped the «marvels (θαυμαζόμενα) concerning the drawing (ἔλξις) of amber and of Heracleian stones⁶⁴⁹» with all the other «magic tricks» (τεθαυματουργημένα) that can be accounted for in the same way as respiration, by referring to the mechanical model of reciprocal «circular pushing» (*periōtheîn*), later better known as *antiperistasis*⁶⁵⁰. Just like the etiology of respiration, this was not the only solution on the market, and various were discussed by the author of the *Quaestiones* (*Aporiai kai lúseis*) attributed to Alexander (pp. 72-74 Bruns), including the ancient theories of Empedocles and Democritus, both centred on «effluvia» (ἀπόρροια)⁶⁵¹, and that of Diogenes of Apollonia, which attributed to lodestone a «drawing» action (ἔλκειν) on the moisture permeating its «cognate» (συγγενές) iron⁶⁵². Of some sort of structural familiarity or agreement between iron and the lodestone we find mention in *NH* XXXIV too, when Pliny attributes to the *magnes* a particular *concordia* with iron, determining the selective transferral of magnetic attraction to only this specific metal (147); since, in XXXVII (59), he explains that *discordia* and *concordia* correspond to the Greek words *antipathia* and *sympathia*, he is likely to be a testimony of an alternative strand of physical explanations, which partially relied on “sympathy” to account for magnetism⁶⁵³. At the beginning of XX, in fact, after guaranteeing the reader that the treated subject will not match the technical terms’ manifest *vilitas*, he mentions examples of natural dynamics of «peace» and «war», «hates» and «friendships», and Greek «sympathy» and «antipathy», among which «a magnetic [stone] drawing iron to itself and another, reversely, driving it away from itself» (1). The phenomenon of magnetic repulsion does not seem to have been considered by Plato, but Plutarch, although never explaining it, mentioned it once in *Isid.* while illustrating the cosmological dynamics hinted in the Egyptian myths: citing Manetho, he reports that the Egyptians call the *sidērītis* stone «bone of Horus» and iron «[bone] of Typhon», and explains, probably going well beyond Manetho’s information, that this is so because, «as the iron oftentimes acts as if it were (ὁμοίός ἐστι + dative) being attracted (ἐλκομένῳ) and drawn (ἐπομένῳ) toward the stone, and oftentimes is rejected and repelled in the opposite direction», in the same way the rational movement of the world sometimes “persuades” the irrational, Typhonian movement to turn

⁶⁴⁸ For an overview of the ancient theories of magnetism see YAMAMOTO 2018, 3–107.

⁶⁴⁹ This was a usual expression to refer to lodestones; it is also used by Plato in *Ion* 553^D.

⁶⁵⁰ As I have anticipated with some commentary above, p. 80, these τεθαυματουργημένα also included the mechanics of thrown bodies, the fall of lightning bolts, and the motion of water streams (etiologies which were also tackled by Plutarch in *QPlat.* 7).

⁶⁵¹ On Empedocles’s theory see below, p. 169 n. 678. Democritus’s theory was commented on briefly by HALLEUX 1974, chap. 1 par. 27 (eBook version); see also YAMAMOTO 2018, 10–12.

⁶⁵² On the theory of Diogenes of Apollonia see OPSOMER 1999, 422–23; YAMAMOTO 2018, 9–10.

⁶⁵³ Cf. OPSOMER 1999, 423–24.

towards it, and other times «again, after gathering itself together (ἀνασχεθεῖσα), has reversed it (ἀνέστρεψε) and plunged it into difficulties (ἀπορία)» (62 376^{B-C})⁶⁵⁴. It is especially interesting to note that Plutarch, here, makes sure that the verbs ἔλκεσθαι and ἔπεσθαι are wholly framed in a simile, rather than being referred to iron directly; in using this terminology in a merely figurative way, he can allude to the alternative, naïve ways of accounting for the phenomenon while also remaining coherent with Plato’s mechanistic model and denial of literal «attraction» (note that ὀλκή is a derivative of ἔλκειν). His choice of the verb ἔπεσθαι, perhaps, may have been influenced by the existing “animistic” descriptions of the behaviour of iron when attracted by the lodestone: Pliny, for instance, in the same paradoxical passage of *NH* XXXVI quoted above (126-7), had already presented the magnet as having been given by nature «senses and hands» and the iron «feet» and «habits» (*mores*), and this latter, when attracted by the lodestone, to “run” (*currit*) towards it, “leap upon” (*adsilit*) it, and cling to it «in an embrace» (*amplexu*); likewise, in the prooemium to his *Problemata*, Pseudo-Alexander of Aphrodisias wrote in later times that «the [magnetic] stone is enlivened (ζωοποιεῖται) by iron’s shards» (8)⁶⁵⁵. In such a historical context, Plutarch’s use of the analogical ὁμοίως ἐστὶ seems to have been especially considerate.

In fact, as shown by Opsomer in his article, Plutarch, in choosing to retain his allegiance to Plato’s mechanistic theory⁶⁵⁶, was probably reacting to philosophers who «surreptitiously introduced some kind of animism into the physical domain» and to proposers of «mysterious forces» such as unexplained “sympathies” and “attractions” when accounting for the *mirabilia* of amber and the lodestone: according to Plutarch, Opsomer argues, «one should not shroud them in mystery, but try to solve them» (with reference to *QConv.*

⁶⁵⁴ Transl. BABBITT 1936B, slightly modified. Plutarch’s report has been used for Manetho, Fr. 77 Müller. GÖRGEMANN [2003] 2009, n. 2 *ad loc.* comments that these Egyptian names for magnet and iron are not attested elsewhere. Cf. GRIFFITHS 1970, n. *ad loc.*, who, with reference to the current Egyptological debate, discusses the possible identification with Plutarch’s «iron» of the Egyptian *bḥ*, as referred to a metal adze «which came forth from Seth» (*Pyr.* 14a), *i.e.* from Typhon; he notes that the expression *bḥ m pt* (“iron from heaven”) referred to meteoric iron, with which Seth might have been associated from early times. For the identification of the «bone of Seth» he also considers the dark, iron-like mineralized bones of hippopotamus (an animal linked with Seth) which were found at Antaeopolis (current Qau el-Kebir, Egypt), but these were also associated with bones from other animals. He also notes that chthonic character of Seth may fit his link with iron. As he admits, however, none of these explanations can justify the complementary «bone of Horus» in Plutarch’s text. On the “persuasion” of the irrational tendency of the world cf. Plato, *Tim.* 48^A. FROIDEFOND 1988, n. 1 *ad loc.* reads in this passage an «atténuation de dualisme» on Plutarch’s part, since «le mal n’est que l’inertie par rapport à laquelle se définit tout mouvement», and praises his analogy with magnetism: «l’image de l’aimant qui tantôt attire tantôt repousse le fer est habile et rend exactement compte du “dualisme” de Plutarque»; he connects this form of dualism to the cyclical doctrine expounded in Plato, *Pol.* 273^D and to the Stoic cosmology, also pointing to Plutarch, *An. procr.* 28 1026^F. On Plutarch’s cosmological dualism, more recently, see Ferrari in DE SIMONE 2016, “Introduzione. Il *De Iside et Osiride* di Plutarco e l’interpretazione del *Timeo*”, 40-3.

⁶⁵⁵ Transl. SILVANO, OIKONOMOPOULOU, AND MEEUSEN 2021; see p. 131-4 on the likely post-Galenic date of the work. OPSOMER 1999 already mentioned these passages at p. 422-23, but he did not refer to *Isid.* 62 367^{B-C}.

⁶⁵⁶ It is not completely certain that Plutarch would propose Plato’s explanation outside the context of Platonic exegesis (*i.e.* that of *QPlat.* 7, which I examine below), but the passage in *Isid.* 62 367^{B-C} just examined appears to attest, at least, to a rejection of the alternative animistic accounts. Plutarch seems to never contradict the Platonic principle of *antiperistasis* throughout his works: cf. above, p. 80-5.

II 7.1 641^C, quoted above)⁶⁵⁷. This approach is especially evident in the complete etiology of magnetism given by Plutarch in *QPlat.* 7, a *quaestio* in which he tries to account for Plato's reference to *antiperístasis* in the *Timaeus* as the cause of not only respiration —on whose mechanism he had provided sufficient details— but also, more hastily, of other puzzling phenomena, among which «the apparent (φαινομένη) attraction (ὀλκή) towards amber and the Heracleian stone»⁶⁵⁸. Plutarch's exegesis of Plato's theory, which may well be considered faithful (although integrative)⁶⁵⁹, deserves to be read in full (7 1005^{B-C})⁶⁶⁰:

τὸ δ'ἤλεκτρον οὐδὲν ἔλκει τῶν παρακειμένων ὥσπερ οὐδ' ἡ σιδηρῖτις λίθος, οὐδὲ προσπηδᾷ τι τούτοις ἀφ' αὐτοῦ τῶν πλησίον· ἀλλ' ἡ μὲν λίθος τινὰς ἀπορροὰς ἐξίησιν ἐμβριθεῖς καὶ πνευματώδεις, αἷς ὁ συνεχῆς ἀναστελλόμενος ἀήρ ὠθεῖ τὸν πρὸ αὐτοῦ· κάκεινος ἐν κύκλῳ περιῶν καὶ ὑπονοστών αὐθις ἐπὶ τὴν κενουμένην χώραν ἀποβιάζεται καὶ συνεφέλκεται τὸν σίδηρον. τὸ δ'ἤλεκτρον ἔχει μὲν τι φλογοειδὲς ἢ πνευματικόν, ἐκβάλλει δὲ τοῦτο τῇ τρίψει τῆς ἐπιφανείας, τῶν πόρων ἀναστομωθέντων· τὸ δὲ ταῦτό μὲν ἐκπεσὸν ποιεῖ τῷ τῆς σιδηρίτιδος, ἐφέλκεται δὲ τῶν πλησίον τὰ κουφότατα καὶ ξηρότατα διὰ λεπτότητα καὶ ἀσθένειαν· οὐ γὰρ ἐστὶν ἰσχυρὸν οὐδ' ἔχει βάρους οὐδὲ ῥύμην πλῆθος ἀέρος ἐξῶσαι δυναμένην, ὥ τῶν μειζόνων, ὥσπερ ἡ σιδηρῖτις, ἐπικρατήσῃ.

Amber does not attract any of the objects placed near it as the lodestone does not either, nor does any of the things in their neighbourhood leap towards them of itself; but the (load)stone emits certain effluvia which are weighty and wind-like, and the contiguous air that is forced back by these [effluvia] pushes [the air] that [is] before itself; and that air, moving around in a circle and returning down to the vacated space, forces the iron away [from its position] and drags it along with itself. And amber contains something flame-like or windy, and ejects this through the

⁶⁵⁷ OPSOMER 2015, 424, 422. Actually, it is the theory of ὀλκή («attraction») he accuses of «animism», being allegedly «unable to offer a physical-mechanical explanation» to magnetism. I do not agree: the ὀλκή is arguably also a mechanistic concept, which is either used as a metaphor —and is thus exposed to the accusation of being insufficiently literalized, *i.e.* of remaining «mysterious»— or in literal terms — and is thus exposed to the accusation of being insufficiently clarified, as literal “drawings” happen through continuous contact, communicated by *e.g.* ropes (but cf. the Epicurean explanation in Fr. 293 Usener I mention below). This is the problem of Diogenes's theory according to Pseudo-Alexander (*Quaest.*, 74.4-5), as Opsomer himself acknowledges (p. 422). The ὀλκή can be judged as ‘animistic’ only if it implies a conscious decision to “draw” on the lodestone's part, but this does not seem the case for these theories, in which the “drawing” is posited as a natural, continuous property of the stone. Another animistic kind of “attraction” would be one directed towards an object of “fascination”, but such force would be rather expressed by terms like ἔυγξ or γοητεία.

⁶⁵⁸ See also above, p. 80-5 for Plutarch's accounts of *antiperístasis* in the phenomena of moving projectiles, flowing waters, and lightning bolts.

⁶⁵⁹ See OPSOMER 1999, 418. Note that CORNFORD 1937, 327, to comment on Plato's theory, refers to Plutarch's exegesis. Cf. ROMANO 1965, 127: «osserviamo soltanto che non si può, come fa Plutarco, dire che Platone avrebbe omesso di spiegare ampiamente gli altri fenomeni naturali, oltre alla respirazione, perché li considerava *misteriosi* [?]" (his emphasis). Plutarch simply writes that Plato, who «demonstrated sufficiently» (ικανῶς ἀποδέδειξε) the mechanism of respiration, on the other phenomena «left it to us to account for the particulars» (τὴν καθ' ἕκαστον ἐξεργασίαν ἡμῖν ἀφήκε).

⁶⁶⁰ Transl. based on CHERNISS 1976a, modified.

friction of its surface, as its pores become opened; and this [substance], escaped, does the same thing as that of the lodestone, but drags along the lightest and driest of the things in the neighbourhood due to its thinness and weakness; it is in fact not strong nor has a weight or impetus capable of expelling an amount of air with which to win over the larger objects as the lodestone does.

Plutarch's exegesis begins with a repetition of Plato's denial that any real "attraction" is exercised by amber or by the lodestone (see οὐδὲν ἔλκει), which he follows with a rejection of the 'reverse' idea that the attracted bodies "leap towards them" by themselves (see προσπηδᾶ); with this addition, Plutarch might have wanted to take a jibe, again, at the more recent 'animistic' descriptions of magnetism such as those attested in Pliny's *NH*, in which the behaviour of iron —as we have seen— is even referred to with the Latin equivalent of the verb προσπηδᾶν, *i.e. adsilire*. Removed these explanations from the picture, Plutarch proceeds to elaborate on how *antiperistasis* takes place between the attractor and the attracted; in so doing, he decides to combine Plato's indeterminate explanation with the theory of «effluvia» (ἀπορροαί), which he probably regarded as Empedoclean⁶⁶¹. In this way, he manages to integrate the explanation with the «missing piece» of a substance that is discharged by the attractors, able to function «as a counterpart to the "breath" that was discharged from living bodies» in Plato's earlier explanation of the *periōtheîn* as the mechanism of respiration⁶⁶². The aerial effluvia emanating from the lodestone are described by Plutarch to be heavy enough to dislocate the air they come against and trigger in the fluid the chain reaction of *antiperistasis*, reaching up to the surroundings of the piece of iron. Here, the mass of displaced particles of air, in circling back to their vacated spaces to prevent emptiness from existing, move with such an impetus that when they are intercepted by the iron's surface, pushing it, succeed in moving it towards the stone. The explanation for the attractive properties of amber is basically the same, but includes two *ad hoc* additional details needed by Plutarch to account for two empirical observations, namely: (1) the fact that its attraction —unlike magnetism— only occurs after amber has been rubbed, which he explains by supposing that a mechanical opening of its «pores» allows the earlier-blocked effluvia to come out⁶⁶³; (2) the noticeable weakness of amber's attraction, which he connects with the great thinness and lightness of the effluvia, thus supposed to be more fiery than the lodestone's (see φλογουειδές — a particularly intuitive constitution, if we think of amber's color and translucency)⁶⁶⁴.

⁶⁶¹ See *Aet. phys.* 19 916^D, discussed above, p. 43-4. We have seen that both Empedocles's and Democritus's theories of magnetism were centred on ἀπορροαί (Alexander, *Quaest.*, p. 72-74 Bruns, quoted above). OPSOMER 1999, 417 notes that the Platonic *periōsis* itself may be older and possibly already held by Anaxagoras and Empedocles.

⁶⁶² The quotations are from YAMAMOTO 2018, 23–24.

⁶⁶³ Cf. Theophrastus, *Ign.* 28 and 42 for a similar dynamic: blowing air opens the pores of charcoal when these are too tight, and let the fire or heat come in.

⁶⁶⁴ See YAMAMOTO 2018, 24: «for the first time in history we see the power of magnets and the power of amber recognized as two separate phenomena requiring separate explanations». On the thinness of fire (superior to air's) cf. *QConv.* IV 2.4 665^E-666^A and above, p. 51-2 with n. 185.

Plutarch's explanation of magnetism, for the central role he assigns to the effluvia and to the forceful "pushing" exercised by air, bears some striking resemblance with Lucretius's flowery account of magnetic attraction in *Rer. nat.* VI (906-1064), with the difference that the atomistic physics of this latter allow it to depend substantially on the existence of void, which Plutarch, following Plato, naturally rejects⁶⁶⁵. In Lucretius's account, *antiperistasis* has no place as it would be superfluous: the mass of «seeds» (*semina*), «or stream» (*sive aestum*) flowing from the lodestone, like in Plato, does push away «with blows» (*plagis*) all corpuscles in the trajectory towards the piece of iron, but the mere opening of this empty space is a sufficient reason for the «elements» (*primordia*) of iron to aspire to "falling" into the void, thus "slipping forward" (*prolapsa cadunt*) towards the stone (1002-7). However, their motion requires an ancillary cause, because the corpuscles of iron, when the lodestone is placed above them, would intuitively not be able to «rise into the air by their own will» (1017-41)⁶⁶⁶; this cause is provided by «air» (*aer*), since the pressure exercised by all its corpuscles around the piece of iron—which strike it constantly as they always do with any surface (*semper enim circumpositus res verberat aer*)—, can finally succeed in displacing it into the empty space, as soon as this is freed from the neutralizing counter-pressures of the particles of air now swept away: as a result, the air that strikes the iron from behind, «as it were, draws it and pushes it forward» (*quasi provehat atque propellat*) towards the stone. The impressive correspondences between this theory and Plutarch's have led R. A. Fritzsche to suppose that the two philosophers might have depended on a common tradition⁶⁶⁷: while Plutarch—whose originality is not even mentioned as a possibility— probably found his explanation in some Academic source, Lucretius might have been influenced, in combining the Empedoclean-Democritean theory with the mechanism of «Luftdruck», by a *milieu* of medical teaching in which Asclepiades of Bithynia's mechanistic views on respiration (indirectly inspired by the *Timaeus*) had become well known and frequently discussed⁶⁶⁸; this atomist physician, in fact, although never associated in the extant sources with an explanation

⁶⁶⁵ On Lucretius's explanation see BOLLACK 1963. I do not fully agree with her interpretation, which at times complements Lucretius's exposition with details present only in other theories of magnetism. For instance, she attributes to Lucretius's displaced particles of air a circular motion similar to Plato's περιωθειν (p. 172-3)—nowhere alluded to in Lucretius's text—, and interprets what is clearly presented as a liberation of the space between the lodestone and the piece of iron (*NH* VI 1004-5) as an opening up of the iron's pores allowing its effluences to come out (p. 169), as in Empedocles's theory (on which see below, p. 169 n. 678); consider that in Lucretius's explanation no effluence is ever attributed to iron, whose elements (as I show below) are simply said to "fall" into the void—helped by the surrounding air—with the whole mass attached to them, which is not left behind when they «arise together from the iron» (1013: *e ferro... coorta*). These integrations make Lucretius's explanation look more similar to its predecessors than it actually is, and support Bollack's conclusion that Lucretius built his theory by taking inspiration from all of them, especially from Plato's (see below, n. 668).

⁶⁶⁶ See BOLLACK 1963, 171: «les effluves ne se distinguent en rien des corps, si ce n'est par l'étendue: ils ne peuvent, non plus que les corps, s'élever spontanément dans les airs», with reference to II 184-206; cf. Lamprias's derision of the Epicureans' 'absolute' conception of the downwards motion in *Def. orac.* 28 425^{C-E}, discussed above, p. 18-22.

⁶⁶⁷ FRITZSCHE 1902, 369–87.

⁶⁶⁸ Asclepiades, partly reflecting Plato (see *Tim.* 79^E-80^A), also compared the process of respiration with the action of cupping-instruments (Aëtius, *Plac.* IV 22.2). FRITZSCHE 1902, 384 names Heraclides Ponticus as the possible intermediary between Plato's theory and Asclepiades's elaboration. Similarly to ABRAMOWICZÓWNA 1960, n. to 641 C, CHERNISS 1976a, n. d to 1005^C erroneously

of magnetism, was likely to be like Plutarch and Lucretius an opponent of the theories based on «attraction» (ὄλκῆ), which he excluded from his account of respiration (see Aëtius, *Plac.* IV 22.1-2). Now, it is true that Plutarch, in our passage, does also use some ἔλκειν-compounds to refer to the phenomenon of magnetism — first, *συνεφέλκεται* in relation to the air’s circular pushing, and then *ἐφέλκεται* as directly referred to amber — but these «unfortunate expressions at least»⁶⁶⁹ are easily explained as catachreses attesting to an ongoing lexicalization of the metaphorical use of the verb: after all, we do still speak today of magnetic “attractions” (*i.e.* “tractions towards”) happening in magnetic fields, without implying in any way that they are caused by concrete objects (*e.g.* Epicurus’s intertwined streams of atoms in Fr. 293 Usener = Galen, *Nat. fac.* I 14, II p. 45 Kühn) pulling the attracted bodies towards their attractors. In Plutarch’s case, naturally, the verb “to push” (ὠθεῖν) would be better suited to describe the action exercised by air on the piece of iron, and he does in fact use it in the following lines, in which he completes his explanation with a possible solution to a crucial problem (not using anymore any of the ἔλκειν-compounds). The problem is related to the fact that, at the moment, the only parameter he has given to account for a successful ‘drawing’ action is the air’s ability —given by its weight and strength— to “win over” (ἐπικρατεῖν) the resistance of the bodies. If this were the only parameter, nothing would prevent the lodestone’s effluvia to displace any of the substances of lesser weight than iron, while it is an empirical fact that its attraction only works on this specific metal. Plutarch, keeping the discussion in the frame of exegesis, tries to imagine a solution as could be proposed by Plato (*QPlat.* 7 1005^{C-D}):

πῶς οὖν οὔτε λίθον οὔτε ζύλον ὁ ἀήρ ἀλλὰ μόνον τὸν σίδηρον ὠθεῖ καὶ προστέλλει⁶⁷⁰ πρὸς τὴν λίθον; αὕτη δ’ ἐστὶ μὲν ἀπορία κοινὴ πρὸς τε τοὺς ὄλκῆ τῆς λίθου καὶ τοὺς φορᾶ τοῦ σιδήρου τὴν σύμπηξιν οἰομένους

reports that Fritzsche identified Asclepiades as the common source of Lucretius and Plutarch: for Plutarch, as I wrote, he rather proposed to see a source in the Academic literature (FRITZSCHE 1902, 387), and for Lucretius —explicitly denying a direct derivation from Asclepiades (*ib.*)— he advanced the hypothesis that the poet was influenced by the contemporary medical debate, in turn influenced by the spread of Asclepiades’s views, in turn influenced by the tradition on the Platonic theory. Fritzsche’s proposal is equally misrepresented by HALLEUX 1974, 131 n. 14 and by BOULOGNE 2003, 80. These two scholars cite BOLLACK 1963, 184 as the proponent of a Platonic origin of Lucretius’s theory, but she —in addition to having been anticipated in her suggestion by Fritzsche (whom she only rebuked for his superfluous proposal of a «source secondaire») —, is actually more nuanced on this point: she does conclude that «c’est au texte de Platon et à son eségèse qu’on doit faire remonter l’argument de l’air chez Lucrèce» (my emphasis), but she also stresses, in a remarkable manifestation of survivorship bias, that Lucretius must have had «une connaissance intime des plus grands textes, d’Empédocle, d’Anaxagore, de Thucydide, de Platon» —*i.e.* of all the texts on magnetism that have come down to us—, which is allegedly proved by the many similarities between his theory and the ones presented in these texts (cf. above, p. 165 n. 665).

⁶⁶⁹ CHERNISS 1976a, n. d to 1005^C. Cf. OPSOMER 1999, 424: «although Plutarch expressly rejects any explanation based on attraction and tries to avoid the term ὄλκῆ, he does make a few slips of the pen».

⁶⁷⁰ The emendation *προστέλλει* proposed by CHERNISS 1976a (in his translation, «presses against») is unnecessary, and the prefix *προς-* redundant, in combination with the immediately following *πρός*. Indeed, as proven by the *προωθεῖν* («pushes forward») at the end of the period, Plutarch clearly conceptualizes magnetic attraction as a forward motion (*προ-*), a directionality also noticeable in Lucretius’s verses on the matter: see *Rer. nat.* VI 1007 (*prolapsa cadunt*, quoted above) and 1026 (air *quasi provehat atque propellat* the iron ring towards the magnet). The reading *προστέλλει* is maintained in INGENKAMP AND BERNARDAKIS 2017.

γίγνεσθαι τῶν σωμάτων, ἐλύετ' ἂν δ' οὕτως ὑπὸ τοῦ Πλάτωνος⁶⁷¹. ὁ σίδηρος οὐτ' ἄγαν ἀραιὸς ἐστὶν ὡς ξύλον οὐτ' ἄγαν πυκνὸς ὡς χρυσὸς ἢ λίθος, ἀλλ' ἔχει πόρους καὶ οἴμους καὶ τραχύτητας διὰ τὰς ἀνωμαλίας τῶ ἀέρι συμμέτρους, ὥστε μὴ ἀπολισθάνειν ἀλλ' ἔδραις τισὶν ἐνισχόμενον καὶ ἀντερείσει περιπλοκὴν σύμμετρον ἐχούσας, ὡς ἂν ἐμπέσῃ πρὸς τὴν λίθον φερόμενος, ἀποβιάζεσθαι καὶ προωθεῖν τὸν σίδηρον. τούτων μὲν οὖν τοιοῦτός τις ἂν εἶη λόγος.

How is it then that the air pushes and sends forward⁶⁷⁰ to the lodestone neither stone nor wood but only iron? And this is a common difficulty to both those who think that the putting together [of iron and the lodestone] comes about by the lodestone's attraction and those [who think it comes about] by carrying (or motion) of the iron, but it might be solved by Plato in this way⁶⁷¹: iron is neither too loose like wood nor too dense like gold or stone, but has passages, paths, and asperities [which] through their irregularities [are] commensurate to the air; so that [the air] does not slip away, but holding onto certain seats and obstacles (lit. counter-pressures) which have a surrounding entanglement commensurate [to it], when falling onto the stone it is brought towards, it forces the iron away [from its position] and pushes it forward. So, of these [phenomena] there might be such an explanation.

As Plutarch makes clear in the last sentence, he simply presents this account as a possible formulation of the solution Plato would offer: he may be wrong about some details, but he is confident enough about its core. When he introduces the *aporía*, he presents it as something common both to the proponents of a *ὀλκή* exercised by the lodestone and to those of an iron's *φορά*: with this opposition, he is probably repeating, with some *variatio*, his earlier mention of the *ἔλκειν* and *προσπεδᾶν* at the beginning of the discussion (1005^B), to refer again to the whole spectrum of the theories he reacts to⁶⁷². These, we may note, would surely include the first half of Lucretius's explanation, which can be faithfully described as a theory of the iron's *φορά* towards the void, but Lucretius did also offer a solution to the *aporía*, in a somewhat similar way to Plutarch's (*Rer. nat.*

⁶⁷¹ For this corrupted *locus* I accept the excellent emendation tentatively proposed by BERNARDAKIS 1895 (who also mentions as an alternative *ἐλύετο δ' ἂν*) and endorsed by Inenkamp in INGENKAMP AND BERNARDAKIS 2017 (who however prints *ἐλύετο δ' ἂν*). Bernardakis's conjecture is modelled on the nonsensical *εἰλυσπᾶν* («to slither») transmitted in ms. X (Marc. Gr. 250, XI/XIV cent.), ε (Matrit. 4690, XIV cent.), and n (Neapol. Gr. 350 III E 28 + Vat. Gr. 1676, XV cent.), written as *ἔλυσπᾶν* in other testimonies (see the apparatus in CHERNISS 1976a, n. 10 *ad loc.* and in INGENKAMP AND BERNARDAKIS 2017); other manuscripts leave a gap of varying lengths between *σωμάτων* and *ὁ σίδηρος* or simply omit the phrase). The corruption of *ἐλύετ' ἂν* into *εἰλυσπᾶν* is paleographically not unlikely: the original copyist might have misread the second ε (in combination with τ) for a σ, and the τ for a π. Cf. the unconvincing proposals by Hubert in HUBERT AND DREXLER [1954] 1958 (*εὐλυτος δ' ἂν... ὑπὸ τοῦ Πλάτωνος*, «it is easy to solve [...] by Plato» — Hubert himself recognized that «magis placeret μετὰ 'adiuvante Platone'») and by CHERNISS 1976a (*εἶη λύσις δ' ἂν οὕτως ὑπὸ τοῦ Πλάτωνος*, in his translation «but Plato might provide a solution in the following way», but literally «there might be a solution in this way, by Plato»; this is semantically equivalent to Bernardakis's conjecture, but syntactically much unlikely).

⁶⁷² *Contra* CHERNISS 1976a, n. a *ad loc.*, who refers the *φορά* to the behaviour of iron in Plutarch's own explanation.

VI 1056-64): it is not marvelous (see *mirare mitte*), he claimed, if only iron moves towards the lodestone, because its natural composition (*natura*), in the middle between the “heaviness” of substances such as gold and the “looseness” of bodies such as wood, not only allows some corpuscles of air (*aeris... corpuscula*)⁶⁷³ to penetrate its mass, but also makes it yield to the air’s pressure — perhaps, as it is light enough to be successfully displaced by all the internal vectors coming with the penetrated particles (which add up to the propulsion already exercised by the surrounding air)⁶⁷⁴.

Going back to Plutarch, one can easily note that the substances he mentions to describe the intermediary ‘looseness’ of iron, like in Lucretius, are wood and gold, with the redundant addition of stone. Although his solution is more cohesive than Lucretius’, centring on varying degrees of density without including the parameter of weight, the choice of examples may be a further sign that the two authors depended on the same tradition. This could either mean that the *aporía* itself, in its known formulation, already used the examples of wood and gold as substances that are indifferent to the lodestone —which is unlikely, as any non-ferrous substance could be mentioned in their place—, or that a solution to the *aporía*, referring to the intuitive porosity of wood as well as to the composition of gold, had already spread in natural-philosophical debates, and then evolved into the explanations offered by Lucretius and by Plutarch. If such explanation existed — probably already based on the «Luftdruck»-mechanism (without which the iron’s density would not have any relevance)—, it was probably advocated for by atomists or by Epicureans, if not necessarily by Asclepiades of Bithynia; otherwise, it would have hardly found its place in Lucretius’s exposition. Plutarch, then, might prove to have integrated the Platonic etiology with a suggestion that some of his readers may have recognized to be Epicurean in character⁶⁷⁵. Of this ‘contamination’, which is not unlikely, Plutarch might have well been conscious: it is probably not a coincidence that in the only other passage, in the extant *corpus*, in which he

⁶⁷³ *Contra* SMITH 1924, who translates «when it receives certain minute bodies of bronze». Here, of course, *aeris* is not the genitive of *aes*, but of *aer*: if iron received particles of bronze inside it, in Lucretius’s understanding, it would be rather repelled from the lodestone (see below, p. 170 n. 680). FRITZSCHE 1902, 368 interpreted this verse correctly, but specified that the corpuscles belong to the (lodestone’s) “effluence”; the meaning is probably more general: the iron does receive some of the effluence inside it, but also some of the surrounding air converging towards the empty space.

⁶⁷⁴ *Contra* YAMAMOTO 2018, 53: «Lucretius leaves unsolved the question of why other metals of nearly the same specific weight as iron are not affected by magnets». Cf. BOLLACK 1963, 172: «ce processus [...] met en relation l’air extérieur et l’air intérieur et fait provenir le mouvement de leur interaction»; for the particles of air she posits a circular motion, which I deny: see above, p. 170 n. 680.

⁶⁷⁵ Cf. CHERNISS 1976a, n. d to 1005^C, who comments that the «unfortunate» uses of ἔλκειν-compounds «might be thought [...] to represent a contamination with the Epicurean notions expressed by *ducitur ex elementis* [...] and by *συνεπισπᾶσθαι τὸν σίδηρον* [...]». *Contra* BOULOGNE 2003, 78–80, who claims with confidence that Plutarch «y procède en s’inspirant de l’épicurisme», and more specifically imitating Lucretius, because «l’idée épicurienne d’évacuation [...] semble appartenir en propre à Lucrèce qui, en introduisant avec le mouvement de l’air une cause nouvelle pour l’épicurisme, enrichit la théorie atomiste d’un argument supplémentaire, dont l’origine remonte à Platon»; and «est bien épicurienne [...] la thèse que, si le fer est seul à réagir au courant magnétique, c’est en raison de sa nature intermédiaire entre celle de l’or, dont la texture est trop serrée [*sic!*], et celle du bois, dont le tissu est trop lâche» (cf. BOLLACK 1963, whom he claims to follow: «les effluves [...] ne peuvent rien contre la *pesante* immobilité de l’or», p. 177, my emphasis). Boulogne concludes that Plutarch, «bien qu’il ne nomme jamais dans les écrits qui nous sont parvenus de lui ce poète romain, plusieurs indices que nous aurons l’occasion de signaler ultérieurement donnent à penser qu’il n’en connaissait pas moins pour autant le *De rerum natura* et la similitude des raisonnements décrits ci-dessus suffit à le suggérer fortement».

focuses on the natural density of iron, whose structure is presented as «having something defective (*σαθρόν*), full of cavities (*πολύκενον*) and honeycomb-like (*τενθρηνώδεις*)» —making iron «the most noiseless (*κωφότατος*) of the *metalliká*»⁶⁷⁶—, he is elaborating his in-character reply to the explanations offered by Boethus on sound propagation (in *QConv.* VIII 3 2-3 721^{E-F}) which we have earlier seen being introduced by Epicurean assumptions⁶⁷⁷. Just like there Plutarch accepted Boethus’s assumption that copper has a lesser «bulk» (*ὄγκος*) and «fullness» (*πλερότης*) than gold and stone —notice the choice of examples—, but denied that void existed in its cavities and filled them up with a «smooth» *pneûma*, here he ‘Platonized’ the handy Epicurean solution to the *aporía* of magnetism by removing all its references to void and making it solely dependent on the movement of air. It is curious how after integrating this solution into his physics, in its corrected form, he shamelessly presented it as a theory that Plato himself would offer: if there was indeed an original explanation inspiring Plutarch’s, and this explanation was used by Epicurean philosophers, we would be witnessing here a notably bold act of Platonist appropriation.

According to Plutarch, then, it is Platonic enough to propose that the displaced masses of air, made to whirl back to their positions by the sweeping «heavy and wind-like» effluences of the lodestone, are only «commensurate» (see *συμμέτρους*) to the iron’s cavities⁶⁷⁸, from which they are thus held in an unescapable «surrounding entanglement» (*πέριπλοκή*), which is something that would not happen in different pores⁶⁷⁹. We may here note that a requirement for the dynamic described by Plutarch to work effectively, resulting in the iron’s push towards the lodestone rather than away from it, is for the iron’s cavities to be somewhat jar-shaped or hook-shaped, *i.e.* with such entrances and insides to allow the circling air to both come in and continue its motion towards its previous place, without being interrupted, until it has covered at least half of its circular vector. In fact, the *antiperístasis* of the air pushed forward by the lodestones’ effluences can only be imagined to be centrifugal with respects to the effluences’ vectors: $\odot \uparrow \odot$. This implies that if the whirling particles of air collided with the walls of the iron’s cavities during their frontwards motion they would push the iron forward and away from the stone, rather than backwards and towards it. Plutarch does not get into these details,

⁶⁷⁶ On the *metalliká* see above, p. 3-4.

⁶⁷⁷ See above, p. 28-9.

⁶⁷⁸ This explanation, like the theory of «effluences», might be of Empedoclean inspiration. Empedocles, as reported by Alexander (*Quaest.* II 23 p. 79 Bruns = DK 31 A89), claims that the effluences of iron are «commensurate» (*σύμμετροι*) to the lodestone’s «pores», and that the effluences of the lodestone, coming onto the iron’s pores, sweep away the air obstructing them, allowing the iron’s effluences to come out (compare with Plutarch’s explanation of the attraction of amber): these effluences can reach and penetrate the lodestone’s pores precisely in reason of their *συμμετρία*, and as they fit inside these they drag along with them the piece of iron. Cf. BOULOGNE 2003, 79 with n. 22.

⁶⁷⁹ This is not the only etiology in which Plutarch associates Empedoclean «effluences» with surfaces that either hold them tight or allow them to «slip away» (*ἀπολισθαίνειν*): in *Aet. phys.* 19 916^{D-E} (on which see above, p. 43-4) he supposes that the octopus, having a «wasp-nest-like» skin (*ἀνθρηνώδης*) with appropriate pores, can receive and retain the effluences coming from sea-rock and thus change colour. Compare the adjective *ἀνθρηνώδης* with the *τενθρηνώδεις* («honeycomb-like») assigned to the iron’s surface in *QConv.* VIII 3.3, quoted above.

and we have no element to assume that he even thought of this implication, but the term *περιπλοκή* might perhaps allude to a visualized ‘convolute’ shape of the iron’s cavities. If *antiperistasis* is accepted as an existing mechanism, Plutarch’s concise explanation does seem to have some merits, but it appears to be unable, still, to account for magnetic repulsion, like all of its contemporary theories of akin mechanistic character⁶⁸⁰.

8.2 Metaphorical, concrete, and absent whetstones (or scrapers)

In concluding this section, it is appropriate to consider another form of interaction between stones and metals, less troublesome and much more commonly experienced—in Plutarch’s time— than magnetic attraction: namely, the metals’ sharpening, smoothening, and thinning exercised by whetstones, which surely implies—although Plutarch never states it—that some stones are harder and more resistant than the metals they can whet⁶⁸¹. A very specific kind of *akónē* (“whetstone”) has already appeared multiple times as a refrigerator and ‘reinforcer’ of drinks in my discussions of *QConv.* VI 5 (690^F-691^C), where I have advanced as a hypothesis that in the *quaestio* (as well as in the parallels in *QConv.* VI 8.6 695^D and *Frig.* 11 949^C), both this term and its variant *ákmon* (“anvil”) are used metaphorically, to designate a kind of leaden objects devoid of factual whetting properties, since leaden whetstones do not seem to have ever existed⁶⁸²; I will later comment in detail on their alleged leaden constitution⁶⁸³. Here, it may be useful to suspend this hypothesis and evaluate whether a literal interpretation of such lead-related *akónai* is possible or not, if we understand differently the way they are presented in *Frig.* 11 (949^C). In this passage, in fact, they are not referred to by the same formula used by Plutarch in *QConv.* VI 5, *i.e.* *ἀκόνας μολίβδου*, but with the puzzling addition of an article: *τὰς ἀκόνας τοῦ μολίβδου*. The syntagm *τοῦ μολίβδου*, in this form, is less intuitively understood as a genitive of material—especially considering that the lead is neither associated with a qualifier nor has it been mentioned earlier in the same passage—, which might be taken to suggest the need of a different

⁶⁸⁰ Lucretius does explain magnetic repulsion as a result of the lodestone’s effluences being forestalled in their swiping action by particles of copper (1042-64, on which see BOLLACK 1963, 173–75), but this is an *ad hoc* explanation for the sole scenario in which a piece of copper is interposed between a lodestone’s attractive pole and the piece of iron. Cf. YAMAMOTO 2018, 52: «it appears likely that Lucretius just happened to use a bronze bowl in making his observation and then generalized about the principle involved on the basis of what he saw in that particular instance». According to this scholar (p. 226-32), magnetic repulsion will be properly accounted for (with reference to polarity) for the first time by Peregrinus, in his 1269 *Letter concerning the Magnet*: «by that time Albert the Great, Bartholomew, and Roger Bacon appear to have been aware that magnets sometimes attracted and sometimes repelled one another, but no one until Peregrinus had integrated this understanding into a general principle». On Plutarch’s *quaestio*, cf. ROMANO 1965, 127, who skips its analysis altogether just like he does with the tenth (on grammatical conjunction, see above, p. 134 n. 546), claiming that «non è il caso di esporre le singole interpretazioni scientifiche (per noi moderni pseudo-scientifiche) dei fenomeni dell’*antiperistasis* contenute in questa lunga questione plutarchea»; he does however rebuke Plutarch for an alleged fundamental exegetic error (on which see above, p. 163 n. 659).

⁶⁸¹ On stone’s paradigmatic hardness see above, sec. 1.3.

⁶⁸² Cf. above, p. 97.

⁶⁸³ See below, sec. 10.

interpretation⁶⁸⁴. A possibility, then, would be to consider it an objective genitive, and the whole formula to refer to a specific kind of stones used to grind leaden objects, *i.e.* «whetstones of lead»⁶⁸⁵. This interpretation is not absurd, not only because leaden objects of everyday use like cooking vessels and other kitchenware, common in the Roman period⁶⁸⁶ and not necessarily devoid of artistic grace, may perhaps need to be smoothed on their surface at the end of their casting procedures⁶⁸⁷, but also because Plutarch does use, precisely in *QConv.* VI 5 (691^B), the verb *τριβειν* (“rub”) in association with lead: lead is «among the naturally cold [substances]» —he claims—, so much that it, «when rubbed with vinegar (*τριβόμενος ὄξει*), sends forth the most cooling (*ψυκτικώτατον*) of deadly poisons: the *psimúthion*», *i.e.*, lead white (in Latin, *cerussa*) or basic lead carbonate⁶⁸⁸. This technical reference is highly compressed and apparently deforming. In fact, in more reliable and detailed sources, the “rubbing” action is placed at the end of the procedure, while vinegar figures as the reagent priorly used to convert the external layers of the piece lead into lead white, a process in which «lead is always kept above the surface of the vinegar and exposed only to its vapors»⁶⁸⁹. The resulting *psimúthion* must then be separated from the lead by means of *τριβειν*. This action, perhaps, is more intuitively imagined in the form of scraping or mortar pounding than stone grinding, but Dioscorides, in illustrating the preparation of *psimúthion* in *MM* V, did offer the possibility of a choice, leaving much indeterminacy in his instructions: after the substance has been formed and dried under the sun —he wrote—, «it must be ground (*ἀλεστέον*) in a hand-mill (*ἐν χειρομυλίῳ*) or scraped (lit. smoothed, *λεαντέον*) in any other way (*ἄλλως*) and sifted» (88.2). The verb *λεαίνειν* (“smooth”) embedded in Dioscorides’s *λεαντέον* might have been meant to allude to the use of whetstones, and a passage in Galen’s *Simpl. med. fac.* IX corroborates that whetting might have existed as an alternative, since he introduces his section on medical “juices” (*χυλοι*) extracted from

⁶⁸⁴ Limiting ourselves to lead, the only other Plutarchan occurrence of *τοῦ μολίβδου* as a genitive of material would be that in *Vind.* 30 567^C, where it is referred, however, to a mythic «lake» already introduced earlier in the passage with the syntagm *τὴν δὲ μολίβδου*, *i.e.* with a genitive devoid of article. *Septuaginta*, *Zach.* V 5.8 seems to be the only other *locus* in the ancient Greek literature attesting of a *τοῦ μολίβδου* of material (excluding Cyrillus’s quotations of the passage, *e.g.* in *Ador.* 68 296.54-297.10), and also there it is the second mention of an already introduced object (*τάλαντον μολίβδου*, without the article in 5.7, becomes *τὸν λίθον τοῦ μολίβδου*). On the functions of the Greek article see MICHELAZZO 2006, 84–93.

⁶⁸⁵ Cf. Fetherston’s translation in GOODWIN [1874D] 1878: «whetstones of lead [?]» (his brackets). The translation in DÜBNER 1877 is ambiguous («cotes plumbi»), but he clearly interprets the parallel without article in *QConv.* VI 8.6 695^D to be a genitive of material: «cotes plumbeæ».

⁶⁸⁶ See *e.g.* ROSEN AND GALILI 2007, 301.

⁶⁸⁷ Such finishing touches were applied on cast bronze artifacts, as claimed by CHARBONNEAUX [1958] 1962, 34: «a metal surface after casting looks to some extent porous, crusty and non-metallic. This ‘skin’ is removed first by filing, relatively little used in antiquity, and then with a kind of scraper [...]. The scraping was followed by polishing [...]. The bronze was smoothed with soft fine-grained stone [!] or with cuttle-bone».

⁶⁸⁸ Some scholars prefer to identify this substance with lead acetate rather than lead carbonate, and the debate is still ongoing. See PRINCIPE 2018 for an excellent discussion of the problem and successful laboratory replications of the ancient recipes (producing lead carbonate). See TEODORSSON 1989b, n. *ad loc.* for passages attesting to the medical and cosmetic use of *psimúthion*; on its well known «poisonous action» he refers to Dioscorides, *MM* V 88.6, Pliny, *NH* XXXIV 176, Celsus, *Med.* V 27.12, and Scribonius Largus, *Comp.* 184.

⁶⁸⁹ PRINCIPE 2018, 160.

minerals by writing of «stones such that when ground along (παρατριβόμενοι) by means of mortars (θυίαις) or whetstones (ἀκόναις) dissolve into a juice» (2.1, XII p. 195 Kühn). In the following pages, Galen never mentions the *psimúthion* or lead—he is in fact only concerned with stones—but we seem to have no reasons to suppose that *akónai* could not be used for this metal too. After all Plutarch knew about the medical applications of what Dioscorides referred to as «scraped verdigris» (ἰός ξυστός, 79), which the physician prescribed to “scrape off” (ἀπόξυε) from copper after its artificial formation using an unnamed tool (surely not a mortar, but, admittedly, more probably an iron scraper than a whetstone); Dioscorides reported that this substance also formed naturally in Cypriot mines (79.3), consistently with Plutarch’s reference, in *QConv.* III 10.3 (659^C), to the «foam» (ἄχνη) coming out of copper ore which heals the miners’ eyes.

On this subject, it is interesting to note that Plutarch not only uses the verb *χαράσσειν* (“scrape”) in *Aet. phys.* 6 to refer to a harmful «foam» emitted by green plants as a result of a hypothetical “scraping” action exercised by dew (ὑπὸ τῆς δρόσου... ἀναχαρασσομένων, in analogy with the formation of ἐρυσίβη, *i.e.* “rust of corn”, on seed, 913^E), but also in *Pyth.* 4, through the mouth of Theon, to describe the “scraping” that bronze statues in the Delphic sanctuary might suffer from the local air, which might be able to make their «rust», *i.e.* verdigris, come out (τὸν ἀέρα... ἀναχαράσσειν πολὺν ἰὸν ἐξ αὐτοῦ, 396^A)⁶⁹⁰. This verb is also associated with iron in *Cohib.*, to refer to the metal’s degradation and “thinning” (ἀσθενῆς καὶ λεπτός ἀναχαρασσόμενος) happening over time due to its excessive use (3 454^C)⁶⁹¹. Now, such a scraping and thinning can be also presented with positive connotations, and when it does it is normally associated with whetting: this is the case in *Sollert.* 20, in which the serpent’s instinctive medical use of fennel is visualized by Aristotimus as the animal’s way to “thin” (λεπτύνων) and “scrape throughout” (διαχαράττων) its «weak-sighted eye» (ὀφθαλμὸν ἀμβλυώττοντα, with an etymological play on ἀμβλύς, *i.e.* “blunt”, 974^B); this image relies clearly on an implicit association between the eye and pointed weapons to be whetted, and the verb *χαράσσειν* is indeed used by Plutarch in reference to arrows both in *Praec.* (32 825^{E-F}) and in *Demetr.* (20.4), here in couple with *παραθήγειν* (“whet along”), confirming the semantic closeness of the term with whetstones⁶⁹². This terminological association is paralleled in two further passages: (1) in *Util.*, in a metaphor for the increase and stimulation of «contentiousness» (τὸ φιλόνηικον) which, incidentally, also proves that the lexicalized use of *παροξύνειν* for “provocations” and “irritations” did not prevent Plutarch from perceiving its etymological meaning of “to point along [a tool’s or weapon’s end]” (καὶ παροξύνει καὶ χάραττε τὸ φιλόνηικον ἐν ἐκείνοις θηγόμενον, 92^{A-B})⁶⁹³; (2) in *An seni*, in which the «blunted» (ἀπημβλυμμένας) and “toothless” yearnings of old people for drinking and eating are described

⁶⁹⁰ I have also quoted this passage above, p. 94.

⁶⁹¹ I also comment on this passage below, p. 180.

⁶⁹² On sharpened projectiles, cf. *Comp. Arist. CMA.* 3.3, in which, among others, Plutarch quotes the Homeric verse «and wars and well-scraped (εὔξεστοι) javelins and arrows» (*Od.* XIV 225).

⁶⁹³ Cf. *QConv.* VII 716^B: ἀμβλύνων... μάλλον ἢ παροξύνων.

to be, so to speak, “whetted on top” and “scraped” only with great difficulty (μόλις οἶον ἐπιθήγουσι καὶ χαράττουσιν, 5 786^{A-B}; a similar metaphor is found in *Isid.* 5 352^A). The most eloquent passage on Plutarch’s tendential association of these terms is in *Glor. Ath.*, in which the peaceful conduct of Isocrates up to his old age, entirely dedicated to perfecting the style of his speeches, is contrasted with the value of soldiers risking their lives in war: «he had not grown old rubbing his sword with the whetstone (participle ἀκονῶν!) nor scraping (χαράττων) his spear-point nor shining (λαμπρύνων) his helmet nor campaigning nor pulling at the oar, but in gluing (or welding, κολλῶν) and putting together (συντιθεῖς) antitheses, balanced clauses, and inflexional similarities, all but smoothing off (ἀπολεαίνων) and proportioning (ῥυθμίζων) his periods with chisel (κολαπτήρ) and file (ξυστήρ)» (8 350^{D-E})⁶⁹⁴. The ending reference to such tools gives us an opportunity to note that in almost all of the other non-metaphorical occurrences in Plutarch’s *corpus* of the verb χαράσσειν it relates to the action of engraving or stamping on coins⁶⁹⁵ or on other metal surfaces⁶⁹⁶, or more rarely on stone⁶⁹⁷ or wood⁶⁹⁸; only four times —perhaps with a tinge of perceived metaphoricity— is it used for scratching, scarring, or corrugations on living animal tissue⁶⁹⁹. With this verb, we are almost always in the sphere of metalworking, and thus of whetting and smoothing —possibly by means of whetstones—, and engraving, which overlaps with stone masonry⁷⁰⁰ and carpentry⁷⁰¹.

This might be a sign that Plutarch could indeed think that bronze, for its medical use, required to be “scraped” or “whetted” (remember Galen’s *akónai*) to extract its «foam»; if this is true, he might have thought the same, like Dioscorides, about the rubbing-off of *psimúthion* from lead. It is not absurd, then, to suppose that literal «whetstones of lead» —whether refrigerating or not— might have existed, at least in Plutarch’s mind. Nonetheless, I prefer to discard this interpretation for the occurrences in *Frig.* 11 (despite the syntactic anomaly)⁷⁰², *QConv.* VI 5 and *QConv.* VI 8.6, not only because a reference to stone —as I will show— would be incoherent with the subject of these passages and with their probable Aristotelian sources (clearly concerned with lead rather than stone)⁷⁰³, but also because it would perhaps make little sense to refer to whetstones for lead with a special expression: it seems unlikely that the ancient market offered whetstones

⁶⁹⁴ Transl. based on BABBITT 1936A, modified.

⁶⁹⁵ See *Thes.* 25.3; *Publ.* 11.6; *Alex.* 4.9; *Aet. Rom.* 41 274^E; *Alex. fort.* 10 332^C.

⁶⁹⁶ See *Rom.* 7.8; *Per.* 21.3; *Alex. fort.* 9 331^A; *Herod.* 39 870^E; 42 873^D and 873^E.

⁶⁹⁷ See *Them.* 9.2; *Alex.* 69.4; *Herod.* 42 873^B.

⁶⁹⁸ See *Mar.* 27.8; *Max cum princip.* 4 779^B.

⁶⁹⁹ See *Gen. Socr.* 24 593^B; *QConv.* III 4.3 651^E; VII 1.1 698^C; *Sollert.* 30 980^C.

⁷⁰⁰ On stone masonry see also above, sec. 3.2.

⁷⁰¹ Cf. also *Frig.* 17 953^B, in which Plutarch refers to the operation of “sawing” (πριεῖν) and “scraping down” (καταξεῖν) animal skins and horns, though without mentioning the tools used for this purpose.

⁷⁰² This, finally, might be perhaps solved through philological intervention: τὰς ἀκόνας τοῦ μολίβδου could be corrected in τὰς ἀκόνας τὰς μολίβδου, i.e. «the whetstones, the leaden», with exegetic τὰς μολίβδου; the deformation of τὰς into τοῦ is not unlikely on a paleographical level. This syntactic form has a parallel in *Pel.* 25.7: τὰς στρατηγίας τὰς ἐκείνου.

⁷⁰³ See below, sec. 10.

destined for use in lead refining, if we consider the extremely low level of this metal's hardness (1.5 on the Mohs scale, slightly below tin's)⁷⁰⁴; any appropriate whetstone for metals of superior hardness would also work with lead, as well as any mineral of superior hardness than graphite (including gypsum)⁷⁰⁵.

It is in any case useful to complete this overview of whetting by referring to the remaining Plutarchan references to the operation, all connected with quotations. In none of these, unfortunately, is the whetstone's composition or geographical origin ever specified, depriving us of any hint on its material⁷⁰⁶. In *Apophth. Lac.* 53.26, we read of a metaphor used by Lycurgus to argue against the elimination of a city which had shown repeated hostility towards the Laconians: «you must not abolish nor remove the whetstone (ἀκόνη) of our youth» (233^E); the whetstone metaphor is hardly unexpected in contexts of militarist rhetoric (compare its use above, in *Glor. Ath.* 8 350^D), but it is also used in connection with another type of harm, namely, verbal harm, in *Comp. Lys. Sul.*, in which Plutarch quotes a tragic verse to refer to the defamatory operations of the demagogue Philocles: «obscure, [his] upper tongue rubbed with the whetstone» (ἀδοξον, ἄκραν γλώσσαν ἠκονημένον, 4.8 = Adesp. Fr. 423 Nauck²). Poetic verses mentioning the sharpening of a (literal) blade «with hard whetstone» (ἀκόνη σκληρᾶ) are also quoted, from Hermippus, in *Per.* (33.8), and Plutarch takes inspiration from an image used by Pyrrus with his sons to introduce it through a metaphor for education in *Pyr.* 9 (4-5): «he brought them all up to be brave in arms and fiery (lit. incandescent, διάπυροι), being whetted (θηγόμενοι) for this from their very birth. It is said, for instance, that when he was asked by one of them, who was still a boy, to whom he would leave his kingdom, he replied: “To that one of you who keeps his sword the sharpest (όξυτέρα)”. This, however, meant nothing less than the famous curse of Oedipus in the tragedy; that “with whetted iron” (θηκτῶ σιδήρῳ) the brothers should “divide the house”⁷⁰⁷ (with quotation from Euripides, *Ph.* 68).

The only remaining quotation is an Aeschylean fragment of unknown origin (Fr. 356 Nauck²), containing a composite adjective derived from the verb θήγειν (“sharpen”) which, in addition to being a *hapax*, can be

⁷⁰⁴ On lead see <https://www.mindat.org/min-2358.html>; (last accessed May 15, 2022) on tin, whose hardness is between 1.5 and 2, <https://www.mindat.org/min-3965.html> (last accessed May 15, 2022).

⁷⁰⁵ The hardness of graphite is between 1 and 2: see <https://www.mindat.org/min-1740.html> (last accessed May 15, 2022); the hardness of gypsum is 2: <https://www.mindat.org/min-1740.html> (last accessed May 15, 2022).

⁷⁰⁶ On the composition of ancient whetstones see e.g. RICHARDS AND CALEY 1956, n. to *Lap.* 44, who claim that «though it is likely that the ancients generally used siliceous stones of various sorts for whetstones, it is possible that massive emery was also used for the purpose». On emery and its connection with Naxos as a possible export centre (note that the *Naxia akonē* is a paradigmatically outstanding abrasive since at least Pindar, *I.* VI 106), cf. DWORAKOWSKA 1975, 85, 127; she explains in p. 125 n. 158 that «emery is corundum with margarite, magnetite and muscovite etc. impurities», and that its hardness, compared with that of all the other minerals, is only inferior to diamond.

⁷⁰⁷ Transl. PERRIN 1920, slightly modified.

faithfully described as puzzling: ἀυτόθηκτον (“self-sharpened”)⁷⁰⁸. In *Def. orac.* 43, as we have seen⁷⁰⁹, Lamprias presents us with a few examples of mines which ended up being depleted over time. In presenting the «copper ore [mine] in Euboea from which they used to produce the cold-forged (ψυχρήλατα) swords», he decides to adorn his illustration with the tragedian’s testimony: «as Aeschylus said, “taken a self-sharpened Euboean sword” (λαβὼν γὰρ ἀυτόθηκτον Εὐβοικὸν ξίφος)⁷¹⁰» (434^A). It is curious to see a “sharpening” —which implies a whetstone— appearing again in connection with cold (in ψυχρήλατα), just like the *akónai* —which imply a sharpening— were related to cold in *Frig.* 11, *QConv.* VI 5 and *QConv.* VI 8.6, but the correspondence is only superficial. In fact, the adjective ψυχρήλατος was simply used to indicate that the metal from which swords were forged was not heated during hammering to increase its malleability⁷¹¹, which may imply, in the case of copper weapons, that the metal did not require to be annealed due to a remarkably low level of natural brittleness: even under the stress of the hammer blows, each increasing its hardness and stiffness, it would not fracture⁷¹². The excellence of Euboean copper might have consisted in such exceptional toughness, which in addition to making annealing superfluous would imply that the copper was receptive enough to hammer working —in readily increasing its hardness— and did not need to be alloyed with tin and become bronze. Indeed, R. F. Tylecote, in trying to explain why «many of the products of the Calcolithic smelting era [*i.e.* the most primitive phase of copper working], as well as some of those produced by melting native copper, contain high levels of arsenic», proposed that arsenical copper —either native or smelted— might have been preferred due to its properties, which made it specially suited for hammering: «the mechanical properties of arsenical copper in the cast condition are not much better than those of pure copper. There is, however, a great difference in the wrought condition owing to the more rapid work hardening of Cu-As alloys. This effect is also shown by the tin bronzes»⁷¹³. Since he remarks that «arsenic is lost at appreciable rates only when arsenical copper

⁷⁰⁸ Many corrections have been proposed by philologists in the last two centuries, including ὑδρόθηκτον (“sharpened in water”), by Valckenaer, and ὑγρόβαπτον (“quenched in water”) by von Herwerden: on the supposed ancient technique of “tempering” bronze I will comment below, p. 179. RESCIGNO 1995, n. 410 rightfully points out the ‘violent’ character of such textual interventions, which we have no reason to accept.

⁷⁰⁹ See above, 5.

⁷¹⁰ HARTUNG 1855, 93 (and only him) ascribed this fragment to the lost *Thrēssai* («Thracian women»), supposing that it referred to Ajax’s self-inflicted death.

⁷¹¹ On this meaning of the ἐλάυνω-composites and of ψυχρήλατος see BLÜMNER 1887, IV:241–42.

⁷¹² On the effects of cold hammering on native or smelted copper —which is the most primitive way of working it— and on annealing —perhaps discovered in the period between 5000 and 4500 BCE— see FORBES 1964a, 28–31; MARYON AND PLENDERLEITH 1954, 624–25. The adjective ψυχρήλατος is taken to refer to iron by BAKHUIZEN 1976, 64 n. 76, on whose interpretation I comment below, p. 176 n. 714.

⁷¹³ TYLECOTE [1976] 1992, 9–10, who concludes that «it is probable that the preference for working rather than casting developed out of the working of native copper. It was a good technique for the material available and clearly persisted until the development of tin bronzes». Cf. GALE AND STOS-GALE 1989, 30: «arsenical copper possesses remarkable ductility and can be worked hot or cold to any extent by hammering without cracking; work-hardened arsenical copper can give strengths and hardness equivalent to tin bronze». In their paper, Gale and Stos-Gale comment on the remarkably high presence of arsenic copper in sharp and pointed artifacts found

is hot forged», we seem to have quite a strong reason to suppose that native arsenic copper was preferably wrought cold, and that its annealing was not simply redundant, but actively avoided by the smiths to preserve the copper's appreciated natural properties. Lamprias's words may therefore refer to such a 'special' copper, which was mined, wrought, and celebrated until it completely ran out, leaving empty the famous Euboean mines whose extinction was already known to Strabo; the geographer, indeed, in *Geog.* X reports on an extinguished mine located in the Lelantine Plain above the city of the Chalcidians, just before mentioning, like Lamprias, the additional example of the Athenian silver mines (1.9)⁷¹⁴.

Now that the reference to these ancient-era (perhaps even archaic or primitive) copperworks is understood, it remains to explain the way in which Plutarch could relate them to Aeschylus's «self-sharpened Euboean sword». The first thing to note, in the absence of any context to infer the original meaning of the Aeschylean fragment, should be that Plutarch might have merely quoted it as it associated the toponymical Εὐβοϊκός with

on the Cyclades dating back to the Early Cycladic period (roughly 3000 to 2500 BCE), and argue at p. 30-4 that the copper-arsenic alloy was probably not artificial, but obtained through the smelting of copper ore naturally containing arsenic minerals, and «deliberately selected for its desirable properties for the manufacture of particular artifacts». On native copper and its early usage see also CRADDOCK 1995, 93–101, and on the presence of arsenic in blades from the Chalcolithic and Early Bronze Age p. 287-8 («increasing the arsenic content would increase the hardness of the alloy, which in turn would make the metal better able to take and retain a sharp cutting edge»); see also p. 289-92 on the production of arsenical copper, in which Craddock remarks that «the simplest method [to obtain arsenical copper] would have been to smelt a natural arsenic-rich copper ore or more rarely a mixed copper-arsenic mineral such as olivenite (Cu₂AsO₄OH), which is not uncommon in the upper oxidised zones of copper deposits [...]. Many such ores are quite distinctive in appearance, and where this was not the case arsenic could be detected by the strong smell of garlic when a specimen was strongly heated» (p. 289); to explain the fact that the arsenic-rich cast surface of Early Bronze Age copper daggers could survive hammering and shaping he notes that «the silvery arsenic-rich phase which usually forms on the surface is the intermetallic compound Cu₃As, which is surprisingly ductile and can be cold worked without extensive cracking or peeling» (p. 292).

⁷¹⁴ Strabo equally considers the Euboean mine «marvelous», but for another reason: namely, because it is the only known mine to contain both copper and iron (μέταλλον... θαυμαστόν χαλκοῦ καὶ σιδήρου κοινόν, ὅπερ οὐχ ἱστοροῦσιν ἀλλαχοῦ συμβαῖνον): the excellence of Euboean copper is here not evoked. BAKHUIZEN 1976, 48–49 claims without evidence —based on a «personal communication» by his collaborator R. Kreulen— that the geological situation around Chalcis excludes the possibility of copper ores forming in the zone, and argues at p. 11 that Strabo probably derived his information from Posidonius. At p. 59-64, referring to Lamprias's report in *Def. orac.* 43 434^A, Bakhuzen assumes that «the words of Plutarch —at least in part— go back to Posidonius, to the very passage(s) apparently that had been used by Strabo when he wrote on the miraculous mine of copper and iron», and that «Plutarch seems to have selected copper, omitting a reference to iron, because of the well-known tradition that connected Euboean Chalcis with copper». These assumptions are unjustified, and do not take into account two important details. First, that in Plutarch's passage no mention is made of the city of Chalcis, which implies that in his sources the copper ores might have been located in any other place of the vast Euboean region (*i.e.* not necessarily on the Lelantine Plain). Second, that the alleged 'marvelous' character of the mine varies significantly in Strabo's and Plutarch's reports: if Plutarch had depended on Strabo's source, it is unlikely he would have glossed over iron, which is given central relevance in Strabo's passage. The two authors, therefore, seem to follow two different traditions on the topic of the depleted Euboean mine (perhaps for centuries no longer known with certainty and precision). Bakhuzen, at p. 64 n. 76, also takes Plutarch's ψυχρήλατος as a sign of the original relevance of iron in his source, because the adjective «seems to apply to the hardness of iron» (as attested in Athenaeus Mechanicus, Fr. 17 Schneider, where it is coupled with σιδηραῖς λεπίσι), suggesting a mistake on Plutarch's part: «he did not assume that Aeschylus' Euboean sword should have been of iron». Rather, we should be the ones not assuming that Aeschylus referred to an iron sword —if the tragedy, like most, had an epic, Mycenaean-period subject, which was also speculated by Hartung (see above, p. 175 n. 710), the sword would have been most likely visualized as copper-made or bronze—, and avoiding hasty conclusions like Bakhuzen's: «the original Chalcidian industry of iron swords is represented by Aeschylus' αὐτοθηκτον Εὐβοϊκὸν ξίφος» (?). My explanation of the adjective ψυχρήλατος and of its association with αὐτοθηκτος —on which I immediately comment below— seems better founded.

ξίφος, attesting to the excellence of Euboean swords: the adjective *αὐτόθηκτον* —which originally might also have alluded to a supernatural or miraculous scenario (e.g. the discovery in a copper mine of a ready-made sharp blade)— might be simply irrelevant to Lamprias’s discursive ends, and quoted for completeness (like the participle *λαβών*). If we prefer to assume that this is not the situation, there is in any case a way to explain how Plutarch understood the *αὐτόθηκτος*, which has been already proposed by J. J. Reiske in 1759, although he wrote of «ferrum»: a “self-sharpened” iron —he claimed— is one that is wrought cold (consistently with *ψυχρήλατος*), and that is sharpened «solum merum per se», without fire, because «candefieri non debet ut emollescat»⁷¹⁵. In order for the “sharpening” part to participate in the term’s meaning, of course, it is necessary to assume that its implicit allusion to hammering does not refer, in the smithing process, to the phase in which the metal is shaped or toughened on the anvil, but to the localized working of the metal on its edge to make it thinner and harder than the rest of the blade⁷¹⁶. Since, thanks to its arsenic content, the copper —not iron— which the blade was made of was tough enough to resist hammering even on its thin ends —of course, with the usual mythic exaggeration of a tragedy—, the blade could be “sharpened” efficiently by the sole action of cold smiting, without requiring any annealing. Perhaps, its resistance was assumed to be so extreme to make redundant even the whetstone’s finishing touch: hammering would make the edge so thin that it would become cutting without the participation of whetting — it was already “sharpened”, so to speak, “by itself”.

In the sole other Plutarchan occurrence of *ψυχρήλατος*, in a commonly mistranslated passage at the beginning of *Brut.*, the reference seems, in contrast, to be to “cold forging” as a means of shaping and toughening, without any allusion to the sharpening phase; this passage, in any case, reinforces the connection between cold hammering and naturally tough copper. In fact, just after mentioning the bronze statue (*χαλκοῦς*!) of Junius Brutus —the archaic (!) Roman hero who contributed to the dethronement of the Tarquinians—, a statue representing him with a drawn sword (*ξίφος*!), Plutarch contrasts his character with that of his descendant Marcus Brutus, with this introduction (1.2-3):

ἀλλ' ἐκεῖνος μὲν, ὡσπερ τὰ ψυχρήλατα τῶν ξιφῶν, σκληρὸν ἐκ φύσεως καὶ οὐ μαλακὸν ἔχων ὑπὸ λόγου τὸ ἦθος, ἄχρι παιδοφονίας ἐξώκειλε τῷ θυμῷ τῷ κατὰ τῶν τυράννων· οὐτοσί δ' ὑπὲρ οὗ γράφεται ταῦτα, παιδεία καὶ λόγῳ διὰ φιλοσοφίας καταμειξας τὸ ἦθος, καὶ τὴν φύσιν ἐμβριθῆ καὶ πραεῖαν οὔσαν ἐπεγείρας ταῖς πρακτικαῖς ὁρμαῖς, ἐμμελέστατα δοκεῖ κραθῆναι πρὸς τὸ καλόν, [...].

⁷¹⁵ REISKE 1759, n. to 434.1f.

⁷¹⁶ *Contra* SCHÜTZ 1821, n. to Fr. 377, who endorses Reiske’s interpretation by paraphrasing it as «αὐτόθηκτον ξίφος est idem quod ψυχρήλατον». The two terms are surely not synonymous: an *αὐτόθηκτος* sword is rather a sub-type of a *ψυχρήλατος*, whose sharpening may always be obtained by filing and whetting.

[...] but that [Brutus, *scil.* Junius], having a hard character by nature like the cold-forged swords, and not soft for the work of reason, was made to drift by his animosity against the tyrants up into murdering [his own] children; this [Brutus] here [*scil.* Marcus], instead, having intermixed [his] character with culture and reason through philosophy, and having woken up [his] nature, which was weighty and meek, with practical impulses, appears to have been mixed to the good in the most harmonious way, [...].

The first analogy with natively hard swords —followed by metaphors probably evoking wine dilution— is evidently inspired by the bronze simulacrum of Junius Brutus's ξίφος⁷¹⁷. In the structure of this analogy, the implicit *comparans* of «reason» is the fire used by blacksmiths to anneal copper: if Brutus's character, like the metal, had been made malleable by reason, it would have never driven him to the excess of children-murdering⁷¹⁸, but instead, because it was forged cold, it remained hard as it was naturally, and accommodated, rather than muffling, the impetus of his θυμός⁷¹⁹.

⁷¹⁷ Ghilli in PIERANGIOLO FABRINI, MUCCIOLI, AND GHILLI 2000, n. 2 remarks that the detail of the drawn ξίφος is not paralleled in the other sources on the statue (*i.e.* Pliny, Suetonius, Cassius Dio); we may take this as a corroboration of the relevance of the sword to Plutarch's analogical ends.

⁷¹⁸ For other smithing metaphors, applied to souls or characters, see above, sec. 7.1 and below, p. 176.

⁷¹⁹ Cf. the translations by PERRIN 1918: «but that Brutus, like the tempered steel of swords, had a disposition which was hard by nature and not softened by letters, so that [...]»; FLACELIÈRE AND CHAMBRY 1978: «mais ce premier Brutus, comme les glaives bien trempés, avait un caractère naturellement dur et non adouci par la culture, au point de [...]»; AMERIO AND ORSI [1998] 2016: «mentre, tuttavia, il suo antenato aveva un carattere duro come un spada battuta a freddo e talmente inflessibile da [...]» (notice the disappearance of ὑπὸ λόγου); Fabrini in PIERANGIOLO FABRINI, MUCCIOLI, AND GHILLI 2000: «ma quel Bruto aveva un carattere per natura duro come la lama temperata delle spade, e non addolcito dalla ragione, al punto che [...]».

9. The strengthening and weakening of iron

In Plutarch's time, obviously, copper and bronze had long been substituted with steel as the best choice for cutting weapons and resistant armour. In his scholium to Hesiod's description, in *Op.*, of the belligerent generation of copper (or bronze, *χάλκειος*), Plutarch —with charitable idealization— suggests that these ancestors must have known a special quenching technique (*βαφή*) by which they could harden this naturally «soft» metal, leading them to choose it for their weapons over iron, which they only used in agriculture: «as the [technique of this] immersion (*βαφή*) was lost (*ἐκλειπούσης*), they turned to iron to also use it in war» (Fr. 30 Sandbach, scholium to Hesiod, *Op.* 148-9)⁷²⁰. This suggestion is repeated as a question by the «foreigner» in *Pyth.* 2, when he begins to show his wonderment at the unusual blue patina of the bronze statues in the Delphic precinct: «was there not [...] some mixture (*κράσις*) and treatment (*φάρμαξις*) for bronze (or copper, *χάλκος*), [known to] the ancient technicians, similar [in its effect] to the so-called *stómōsis* of swords, whose loss (*ἤς ἐκλειπούσης*) gave a truce to bronze (or copper) in warfare?» (395^B). We can clearly see in these two passages that Plutarch preferred to mythologize this historical development in metallurgy as a degradation of technical knowledge, without which the general turn to the iron age would not have been understandable⁷²¹; what is especially interesting, however, is that he shows to conceive the lost hardening technique in the terms of an analogy with iron quenching and *stómōsis*, which in turn he regards —with good reasons— to be necessary for the employment of iron in war. In the previous sections, I have commented multiple times on these and on other procedures of ironworking⁷²², as well as on some of the properties Plutarch attributes to iron⁷²³, as they have appeared in various contexts in association with minerals and in analogies. It is appropriate, now, to return to the subject of iron's hardness and utility and finally collect the relevant material on Plutarch's conception of the two, and return to his presentations of quenching to reach a conclusion on how he understood the process⁷²⁴.

⁷²⁰ I have already quoted this passage above, p. 97 n. 394. On the supposed archaic technique of copper (or bronze) quenching see FORBES 1964C, 148–49.

⁷²¹ Cf. VALGIGLIO 1992, n. 20: «quanto al concetto, esso non è del tutto perspicuo: la tempra delle spade non è detto che cessi coll'intervento della tempra del bronzo delle statue [*sic*]; l'arte non elimina la guerra».

⁷²² See above, spec. sec. 6 and 7.1.

⁷²³ See above, spec. p. 163-70.

⁷²⁴ As I have anticipated above, p. 91 with n. 370, in a number of passages Plutarch closely associates quenching (*βαφή*) with steeling or edge preparation (*stómōsis*). I reserve for the future an accurate analysis of all Plutarchan references to *stómōsis*, which is necessary to understand whether he really distinguished this operation from quench hardening or not, and in which way. In sec. 6, I have shown that he might have understood *stómōsis* as a form of purification, compatibly with the Aristotelian etiology of the process: further traces of this conception, although faint, might perhaps be found in *Def. orac.* 41 432^F-433^B, where *stómōsis*, associated with quenching, is presented in analogy with the “thinning”, “tightening” and “cleansing” of the Pythia's *pneūma*, also compared to the “cleansing” enacted by tin on copper during alloying; see also 47 436^C, where the iron receiving *stómōsis* is described to be quenched «in pure water» (*εἰς ὕδωρ ἀκραίφνης*), and the puzzling analogy in *Lun.* 28 943^D between *stomōúmena* receiving quenching and the

We may begin by remarking that iron, without further qualifiers, is culturally regarded to be a paradigmatic hard substance. We have seen that in *Stoic. rep.* 43 (1053^F-1054^A), among the examples made by Chrysippus to illustrate the qualities provided by «airs» to all bodies, iron is mentioned too, obviously in association with «hardness» (σκληρότης)⁷²⁵; this example lends itself easily to Plutarch’s *reductio ad absurdum*, since air is clearly not hard and rather «soft» (μαλθακός), which is the opposite of hard. This paradigmatic character of iron is what allows the other usual adversaries of Plutarch, *i.e.* the Epicureans, to insultingly refer to Epaminondas with the nickname «iron entrails» (σιδηροῦν σπλάγχνον, *Col.* 33 1127^{A-B}), clearly implying that if his stomach did not break from his excessive eating it was thanks to its remarkable hardness. Such hardness, however, does not make the iron immune to wear, and we have seen in *Cohib.* 3 that the excessive use of iron is correlated with an unrelenting loss of thickness (454^C)⁷²⁶, correlated with its “weakening” (see ἀσθενής). This is stated as part of an analogy with excessive irascibility, in which «animosity» (θυμός) figures as the analogue of the overstimulated iron (progressively becoming more susceptible at every use): as we read in the completion of the analogy, «but if judgement at once opposes the fits of anger and represses (πιέζουσα) them, it not only cures them for the present, but for the future also it renders the soul strong (lit. well-strung, εὔτονος) and difficult to affect (δυσπαθής)»⁷²⁷. We see that an unweakened piece of iron is conceived to be εὔτομος, which surely implies that the iron has a sufficient thickness, solidity and density not to bend or fracture on reception of heavy blows, *i.e.* it is δυσπαθής. Iron’s exposure to wear is also reminded rhetorically to Caesar, in *Caes.* 37, by his tired army, who points out that «even iron is tired out (ἐξέκαμει) by blows, and in so long a time there is some sparing (φειδώ) for shield and corslet too» (6). Such consideration would have probably been superfluous with the exceptional steel of the «adamant» variety (ἀδάμας, ἀδαμάντινος), whose Plutarchan mentions are all framed as quotations: at the beginning of *Stoic. absurd.*, Plutarch comically assimilates the “impassible” wise man of the Stoics with Pindar’s unbelievable presentation of Caeneus, whom the poet “invented” (lit. “shaped”, see πλασσόμενος) to have a body «unbreakable with iron» (ἄρρηκτος σιδήρω) and «impassible» (ἀπαθής, cf. δυσπαθής above), just as the Stoic wise man appears to be «forged» (κεχαλκευμένος)

souls being “strengthened” and increasing their “transparence” when they reach the moon. In some passages, the term *stómōma* appears without connection to quenching: see above, p. 112-5 on *Symp.* 13 156^B, and p. 99-100 on *Garr.* 17 510^E-511^A, *QConv.* VI 7.1 692^D and 2 693^A, I 7.1 625^C; in these latter passages, the *stómōma* is consistently opposed to a kind of “earthiness” or “dirt”. Notwithstanding this evidence, in other passages *stomōseis* (or *stomōmata*) do not seem to be distinguished from quench hardenings (or quenched pieces of iron): see *Bruta anim.* 4 988^D, *Adul.* 36 73^D, *QConv.* VIII 9.3 734^A, *Frig.* 2 946^C (with *Stoic rep.* 41 1052^F-1053^D, *Comm. not.* 46 1084^{D-E}).

⁷²⁵ See above, p. 30-1.

⁷²⁶ See above, p. 172.

⁷²⁷ Transl. HELMBOLD 1939, slightly modified. Cf. *Garr.* 17 510^E-511^A (analysed above, p. 99-100), where the action of πιέζειν may be implicitly associated with the formation of *stomōmata*, in the metaphorical and analogical frame of Spartan rhetorical education.

from «adamantine matter» (1 1057^D)⁷²⁸. Adamant's alleged resistance is also what allowed Dionysius to metaphorize the solid «bounds» with which he claimed to have secured his tyranny as *ἀδαμάντινοι δεσμοί* (*Di.* 7.6; 10.4)⁷²⁹; if his tyranny, from *ἀδαμαντίνη* and *ἄρρηκτος* (*Garr.* 13 508^F), came to its end, it is because his son Dionysius II “softened” it (see *μαλασσομένη*) with his own «relaxation» (*ἄνεσις*)⁷³⁰, which led to the “melting” (*ἐξέτηξε*) and destruction of its bounds (*Di.* 7.5-6). Even the resistance of the proverbial adamant, it is clear, can be supposed by Plutarch to be lost with heating.

For normal iron, no prior heating is required to expose it to wear, and in *Aq.* 9 we even read that razors' edges, if used on corpses, «become blunted due to the excess of coldness» (957^E); probably, it is not coldness itself to be conceived as the agent of the blunting, but the excessive hardness it confers to the corpses' tissues, which is supposed to be, in part, even superior to the hardness of the iron's edge. In any case, iron blades and points must have been believed in general to be particularly hard, since otherwise it would have not been possible to use them as extreme terms of comparison to describe “indissoluble” and “unpierceable” textures: we already know that Plutarch mentioned iron with this role in both *Am. prol.* (2 494^B) and *Sollert.* (35 983^D), in couple with the equally paradigmatic stone, to convey a good idea of the halcyon's nest as something *δυσδιαίρετον*, *δυσδιάλυτον* and *δύστροπον*⁷³¹; in this function it is also coupled with fire in *Coniug.* 3, when Plutarch explains that the bond of a married couple, with time, comes to reach such a tight «interlocking» (*σύμπηξις*) that «it is hardly dissolved (*διαλύεται*) by fire and iron» (183^F). The metonymic couple «fire and iron» also appears in *Gen. Socr.* 3 (576^F) in reference to the paradigmatic medical operations of «cutting» (*τέμνειν*) and «cauterizing» (*ἀποκάειν*)⁷³², while in *Comp. Lys. Sul.* it refers to general acts of violence (1.4)⁷³³. In most of its metonymic occurrences, indeed, iron refers to cutting weapons and to their use in war⁷³⁴, but in war, due to its hardness, it was obviously also used for armours and shields: we have already seen iron in this role above, in *Caes.* 37, but the most interesting passages, focusing specifically on its impact resistance, are in *Cam.* 40 (4, of smooth iron helmets), 41 (5, of armour, breaking the swords of the enemies as these are «soft» and «forged thin»), and *Demetr.* 21 (5-6, of an exceptional armour resisting a projectile thrown by a

⁷²⁸ In this incipit, Plutarch includes a poetical quotation from Pindar (Fr. 167 Snell). For references to other passages on Caeneus see CHERNISS 1976b, n. a *ad loc.* Plutarch also quotes the Pindaric lines «from adamant / or iron was your black heart forged» (Fr. 123.5-6 Snell) in *Vind.* 13 558^A and *Util.* 9 90^F. Another quotation is in *Lun.* 6 923^C (*ἀδαμαντοπέδλοι κίονες*, Fr. 33c.7 Snell), concerning adamant's extraordinary resistance to weight.

⁷²⁹ This quotation from Dionysius is also reported in Diodorus Siculus, *BH* XVI 5.4 (cf. 70.2, where it is attributed to unspecified people, *ὡς ἐφασσαν*) and Aelian, *VH* VI 12.

⁷³⁰ On this term see my considerations above, p. 123-4.

⁷³¹ See above, p. 34.

⁷³² Without fire, iron appears in this role also in *TG et CG* 44.3.

⁷³³ See also the Pindaric verse quoted in *Marc.* 29.12: «allotted fate not fire, not wall of iron, will check» (Fr. 232 Snell, transl. PERRIN 1917).

⁷³⁴ See e.g. *Pyr.* 9.4-5 (quoted above, p. 174), 14.2-3 (with a quotation from *Phoen.* 516-7); *Lyc.* 21.6 (with a quotation from Alcman); *Sul.* 8.5; *Caes.* 45.4, 66.10; *Galb.* 10.4.

catapult, tested at a distance of twenty feet). A hard piece of iron, however, may always prove to be unexpectedly brittle, and this quality, in Plutarch's understanding as well as in Plato's, would be interpreted to depend on the presence of a hidden «seam» or «fold» (lit. «doubling», διπλόη) inside it⁷³⁵: the removal of such a «treacherous» (ὑπουλος, lit. «suppurated», *Per.* 10.3) fault is implied in *Praec.* 5 (802^B) to be accomplished by means of “softening” (see μαλάσσω), and therefore by heating the metal. If we assume that Plato and Plutarch referred to faults actually observable inside the iron (e.g. by the examination of the fractures' outlines), these might be correctly identified as «seams» between two of its internal layers, not fully jointed by the hammering during a welding procedure⁷³⁶. It is also possible, on the other hand, that the presence of διπλόαι was only inferred without empirical confirmation, and in this case the brittleness might have simply depended on a successful quenching of high-carbon steel, since its increase in hardness determined by the immersion would be always positively correlated with an increase in brittleness, which the blacksmith may then reduce through annealing (a most literal “softening”)⁷³⁷. The event of the iron's softening, as expected, is often presented to determine its loss of hardness and rigidity, and is associated with a mechanical “distension” (ἀνιέναι or ἄνεσις⁷³⁸, διαχεῖν⁷³⁹, χαλᾶν⁷⁴⁰, becoming διάλυτος⁷⁴¹), which in three passages is compared to an increase of “fluidity” or “moistness” (τήκειν⁷⁴², ὑγραινειν or becoming ὑγρός⁷⁴³, ῥεῖν⁷⁴⁴): in all three passages, we should note, these liquefactions are not attributed to the softening iron itself, but only to its *comparandum* in the analogy. In analogies, the image of the iron's softening is sometimes used with positive connotations (e.g. to describe the overcoming of a rigidity of character)⁷⁴⁵, and other times with a negative value (for the obfuscation of reasoning and loss of control)⁷⁴⁶.

In contrast, the only two survived analogies with the iron's loss of «quench-hardening» (metonymical use of βαφή, “quenching”, to refer to its product) have unambiguously negative connotations⁷⁴⁷: differently from the iron's generic «hardness», a «quench-hardening» is intuitively something desirable to retain. In *Cohib.*, in a further development of the analogy between «irascibility» and a piece of iron exposed to wear (which we have seen above), we read that «some barbarians poison (φαρμάσσουσι) the iron, but bravery needs no bile

⁷³⁵ For Plato, see *Soph.* 267^E, in which the iron «having a seam» is opposed with «sound» iron (or «healthy», ὑγιής).

⁷³⁶ This would both apply to the welding of multiple pieces or strips of iron into a single piece and to the folding and compression of an individual piece. See above, p. 90 n. 366 and 367 and p. 91 n. 369.

⁷³⁷ See above, p. 118 n. 488.

⁷³⁸ *QConv.* I 5.1 622^D, *Amat.* 17 762^C, *Di.* 7.5-6 (quoted above); *Adul.* 36 73^D (quoted above, p. 102).

⁷³⁹ *QConv.* VII 8.3 712^C, *Adul.* 36 73^D (quoted above, p. 102).

⁷⁴⁰ *Def. orac.* 47 336^C.

⁷⁴¹ *Sanit.* 25 136^B.

⁷⁴² *Ib.*

⁷⁴³ *QConv.* I 5.1 622^D, *Sanit.* 25 136^B.

⁷⁴⁴ *QConv.* VIII 9.3 734^A.

⁷⁴⁵ See *QConv.* I 5.1 622^D, *Amat.* 17 762^C, *Nu.* 8.1, *Isid.* 62 376^B (partly quoted above, p. 161-2), *QConv.* VII 8.3 712^C.

⁷⁴⁶ See *Alex. Fort.* II 1 334^B and 7 339^E.

⁷⁴⁷ See *Vit. pud.* 4 530^E; *Gen. Socr.* 14 583^D.

(χολή), for it is quenched (also immersed, a play on βέβαπται) by reason, while the irascible and mad [element of the soul] is easy to break (εὐπερίθραυστον) and defective (σαθρός)» (10 458^E). Here, what has been quench-hardened is clearly opposed to a brittle object, whose qualification as σαθρός appears to be appropriate to a piece of bad iron which has not received proper treatment⁷⁴⁸. A good quench-hardening can also result in an extraordinary cutting power: in *Pyr.* 25 (5), it is the «quality» (ἀρετή) of the βαφή of his sword that allows Pyrrus, in concurrence with the strength of his hand, to cut vertically in half the entire body of an enemy.

Quenching, to be sure, had to be executed skillfully, as the excessive cooling of a piece of iron may always have disastrous results: it is for this reason —as Plutarch informs us— that «they quench (βάπτουσι) needles, iron clasps, and all delicate artifacts in oil rather than in water, fearing that the water’s excessive frigidness may distort them» (*Frig.* 13 950^C)⁷⁴⁹. A special form of quenching, presented by Plutarch to be specifically aimed at the degradation of the metal, was allegedly practiced in archaic Sparta on the «heavy» iron money introduced by Lycurgus as the only accepted currency (we have already seen it earlier in *Lyc.* 19.2, contrasted with the small and pregnant diction of Laconic speech)⁷⁵⁰. To eliminate all inequality and luxury in the Laconian population, not only did Lycurgus deprive all gold and silver of any economic value, but also made the iron currency itself intrinsically less valuable by “ruining” it «with fire» (see διεφθαρμένου πυρί, *Comp. Arist. CMA.* 3.1). How this damaging took place according to Plutarch is specified more clearly in *Lyc.* (9.2-3) and *Lys.* (17.4): in the latter text he reports that the iron of this currency «was submerged (or quenched, καταβαπτόμενον) in vinegar [directly] from the fire, so that it might not be worked over (καταχαλεύοιτο), but be made *ástomon* and impotent (ἀδρανές) by the quenching (βαφή)»⁷⁵¹; and he writes in *Lyc.* that «as they say, [Lycurgus,] by extinguishing (κατασβέσας) the *stómōma* of the incandescent iron, removed its utility and value (δύναμις) for the other ends, as it became impotent (ἀδρανής) and difficult to work (δυσέργου)» (9.3). These texts are the earliest surviving sources on the practice, as the parallel report in the Pseudo-Platonic *Eryxias* (400^A), albeit mentioning that the currency was only made of «useless» (ἀχρεῖος) iron, does not refer to its quenching in vinegar⁷⁵². The original source might be perhaps identified in Ephorus of Cyme (IV cent. BCE), whom Plutarch cites in *Lys.* 17 just after introducing the quenching technique (3)⁷⁵³. It has long been pointed out that such immersion would have no unusual effects on the incandescent iron⁷⁵⁴, which is a reason to either

⁷⁴⁸ On this adjective cf. above, p. 168-9. It is also used for iron in *Vind.* 11 555^F-556^D and *QConv.* VIII 3.2 721^F; see also *Adul.* 23 64^E.

⁷⁴⁹ Transl. Helmbold in CHERNISS AND HELMBOLD 1957, adjusted on βάπτουσι.

⁷⁵⁰ See above, p. 100-1.

⁷⁵¹ Transl. based on PERRIN 1916, modified.

⁷⁵² The later Pollux, *Onom.* IX 79 does, substituting *stómōma* and *ástomon* with ἀκμή (“point”) and ἄτομον (“uncut”).

⁷⁵³ So GANSINIEC 1956, 372. On this historian see Piccirilli in ANGELI BERTINELLI ET AL. 1997, n. *ad loc.*

⁷⁵⁴ See MICHELL 1964, 300–301: «to say that immersion in vinegar had any particular effect is nonsense. [...] As a matter of fact, tempering in this way only gives a thin surface hardness and the iron beneath is unaffected. The whole account is absurd and may be disregarded».

dismiss Plutarch's report as completely wrong or try to interpret it in our terms. In 1987, R. Halleux, in an article dedicated to these passages⁷⁵⁵, rightly pointed out that «en attribuant le résultat final à l'action du vinaigre, Plutarque ne diffère pas d'autres auteurs qui créditent de vertus exceptionnelles la trempe dans certaines eaux, le sang de bouc ou le sang menstruel»⁷⁵⁶; then, before proposing his interpretation, he made some interesting connections with *loci* in the (late) medical literature attesting to the use, in some recipes, of vinegar «où on a immergé une loupe [*i.e.* iron bloom] incandescente»⁷⁵⁷; these connections, however, only faintly influenced his conclusion: in fact, after illustrating that when iron is left in vinegar one can easily see small films of rust detaching from its surface⁷⁵⁸, he preferred to suppose that vinegar had no role in the procedure, and that the iron's alleged uselessness simply resided in the presence of slag incursions into its mass, which thus required further forging and hammering «pour être utilisable»⁷⁵⁹. The main problem of this interpretation is that it seems to ignore that the alleged quenching in vinegar was specifically instrumental to making the iron «difficult to work» (*Lyc.*) «so that it might not be worked over» (*Lys.*), while an iron bloom full with impurities would be difficult to forge as any other, and perfectly suited for re-purposing. We should pay adequate attention to the presence in our passages of the word *stómōma* (translated by Halleux as «tranchant») and of its opposite adjective *ástomon* (“without *stóma*”, probably in the sense of “without *stómōma*” or “not being a *stómōma*” — note that this is the only occurrence of the term in Plutarch's *corpus* in a metallurgic context). These terms, of course, do not refer to the “edge” of the iron money and to its cutting power, but clearly to its “reinforced” constitution, whose loss makes the iron «impotent» (compare with the ἀσθενής in *Cohib.* 3, quoted above). If the money is «difficult to work», it must be due to this impotence, and this impotence, if determined by a loss of *stómōma*, must correspond to a lack of resistance. Now, a soft mass of iron can surely qualify as non-resistant, but this would be easier to work than an unsoftened *stómōma*⁷⁶⁰; the iron's non-resistance, therefore, can only be interpreted to depend on its brittleness: that is, if the money is difficult to work, it is because it is too weak to endure hammering without breaking even if it is brought to incandescence. If this is the correct interpretation, it would make sense to assume that this brittle money

⁷⁵⁵ HALLEUX 1987.

⁷⁵⁶ He refers to Pliny, *NH* XXXIV 144, XXVIII 148, XXVIII 79.

⁷⁵⁷ Nicander, *Al.* 50; Columella, *Rust.* XII 5.2; which he compares with the earlier Celsus, *Med.* IV 16.2.3 (who mentions water rather than vinegar).

⁷⁵⁸ Compare with Alexander, *Quaest.* p. 73 Bruns (= DK 64 A33), where Diogenes of Apollonias is reported to have used the notion that ductile metals (ἐλαττά) —like copper and iron— «rust» (λοῦσθαι) when they are anointed «in vinegar and oil» (ὄξει καὶ ἐλάτῳ) as evidence of the fact that they both emit moisture and draw it from their surroundings. According to him, in fact, their rusting happens «because vinegar draws (ἐλκεῖν) from them (their) moisture (ἰχμάς). [...] penetrating (εἰσδύμενον) inside each, [it] draws and consumes (ἀναλίσκειν) the moist (τὸ ὑγρὸν) inside them». A rusted piece of iron may be surely interpreted as ‘weaker’ than a non-rusted *stómōma*: cf. Diodorus's Siculus's report of the Celtiberian way of making *stomōmata* by rusting (*BH* V 33.4) analysed above, p. 99-100 along with Plutarch's version in *Garr.* 17 501^F-511^A. The Spartan iron money might have indeed been made worthless by deliberate rusting, but Plutarch's reports focus on the operation of quenching, which is difficult to relate to such end, and they never mention rust.

⁷⁵⁹ On the bloomery process see above, p. 89 n. 361.

⁷⁶⁰ Cf. *QConv.* VII 2.3 701^{B-C} (analysed above, sec. 4), where stones which are kept soft by heat are opposed to those which turn «resistant, not easily transformed, and unyielding in stonework» as an effect of cold.

(whether it historically existed or not) was made from cast iron, which apparently was still difficult to work even for Imperial Age Romans, who are likely to have only considered it a scrap material⁷⁶¹. It is hard to explain how the Spartans could succeed in the production of cast iron —perhaps by excessive carburization of their coins, small and thin enough to allow for a thorough penetration of the carbon particles⁷⁶²— but, if they believed that it was vinegar to make the difference, they would be wrong. This mistake is easily justified, though, because the process would always end with fast cooling in the liquid, so that there would be no way to isolate the cause of the embrittlement.

We may even suppose that the role of vinegar in this procedure was inferred by the later authors in their attempt to justify the increase in the iron’s fragility: in fact, it seems to have been a common Hellenistic and Imperial age notion that vinegar was more effective than water in extinguishing fire (see Theophrastus, *Ign.* 25 and Pliny, *NH* XXXIII 94)⁷⁶³, and the presence of this analogical frame of reference might be suggested by Plutarch’s use of the verb *κατασβεννύειν* (“extinguish”) for the removal of the money’s *stómōma* (*Lyc.* 9.3). Plutarch’s character himself, indeed, claims in *QConv.* III 5.2 that «none of the extinguishers is more belligerent (*μαχιμώτερος*) to fire than vinegar, which (lit. but, *ἀλλά*) wins over [fire] more than all [the others] and compresses (*συμπιέζει*) the flame through excess of coldness» (652^F). This explanation relies on the usual Platonic frame of elementary “dominance” expounded in *Tim.* (57^{A-B})⁷⁶⁴, perhaps with a contamination from the Theophrastean model of thermic *antiperistasis* (of which we will see an example below)⁷⁶⁵. It is worth noting that Theophrastus’s etiology is different, as he assumed that vinegar had rather a hot nature (*Ign.* 25); Plutarch, in choosing to assume its coldness, was following the more recent trends in medical thought⁷⁶⁶. Now, it is interesting to see that he uses the verb *συμπιέζειν* (“compress”) to refer to the cold’s extinguishing (and suffocating) action on the flame, because he also uses the verb *πιέζειν* (“press”) —as we know⁷⁶⁷— to describe the effects of Socrates’s dialectics on young Alcibiades when “softened” by his own delicacy, all presented in analogy with iron quenching (*Alc.* 6.5); and he also uses *πιέζειν* for Lycurgus’s rhetorical education on the youth, in turn likened to the Celtiberian way of making *stomōmata* by burying iron (*Garr.* 17 510^E-511^A). It does seem that there exists some systematic, physical coherence in Plutarch’s understanding of the effect of cold on heated matter, which also encompasses the explanation of the iron’s abrupt cooling: the colder the quenching medium is, the stronger the compression of the iron’s dilated texture is, just as the colder the

⁷⁶¹ See above, p. 89 n. 361.

⁷⁶² On carburization see above, p. 90 n. 366.

⁷⁶³ GANSINIEC 1956, 372 has the merit of drawing attention to these passages (and the following) in the context of the vinegar quenching of the iron money: «rola octu przy temperowaniu stoi niewątpliwie w związku z drugim, często spotykanym zdaniem uczonych starożytnych, że ocet daleko szybciej od wody gasi ogień».

⁷⁶⁴ See above, p. 52 n. 196.

⁷⁶⁵ See below, p. 192-3.

⁷⁶⁶ TEODORSSON 1989a, n. to 652 F cites in this regard Dioscorides, *MM* V 13, Pliny, *NH* II 132, and Aulus Gellius, *NA* XVII 8.14. Galen discusses the controversy in *Simpl. med. fac.* I 19, XI p. 413-5 Kühn.

⁷⁶⁷ See above, p. 101-2.

extinguishing agent is, the stronger the suffocation of a flame will be. That coldness, in its own, produces hardness, while its excess embrittlement, Plutarch makes explicit in *Frig.* 18: «cold, indeed, is perceptibly one of the hardest (μάλιστα... σκληρός) of things, and hardness-inducing (σκληροποιός) and resistant (ἀντίτυπος)», after which he mentions Theophrastus’s report of frozen fish “breaking” and “shattering”, when dropped, «in the same way as glass or earthenware bodies», and an anecdote heard in Delphi about a case of mantles becoming «so hard (σκληραὶ) and woody (ξύλωδης), due to the freezing cold (πάγος), that when they were opened out they broke and split apart» (953^{C-D}). It is not surprising, then, that the choice of an excessively cold quenching medium could be conceived to damage the iron and destroy its *stómōma*, because the *stómōma* can only be produced by a moderate, skilful βαφή (preceded by an appropriate carburization, probably understood in terms of a purification)⁷⁶⁸; such a damage, in the case of cast iron, would be irreversible and impossible to fix by annealing (as the technology of cast iron fining was most likely to be unknown in archaic Sparta)⁷⁶⁹, and this irreversibility could only be explained by Plutarch, by his source, or by the Spartans to be determined by the quality of the quenching vinegar. Not every act of βαφή, we may conclude, results in the iron’s acquisition of βαφή (“quench hardening” in the good sense), and not every act of βαφή matches a *stómōsis*, as immoderately cold immersions can even provoke the permanent deterioration of a *stómōma*.

⁷⁶⁸ See above, p. 98-111.

⁷⁶⁹ On fining see above, p. 90 n. 366.

10. Lead's marvellous cold fusion

It is time to complete our analysis of the behaviour of leaden *akónai* with the last Plutarchan passage which mentions them, *i.e. Frig.* 11 (949^{B-C}). This does not refer in any way to their refrigerating effect on water (as in *QConv.* VI 5), but reports on an anomalous liquefaction happening under freezing cold, again framed as an Aristotelian indirect quotation. This chapter is part of the section of *Frig.* in which Plutarch argues provisionally in favour of air as the principle of cold, and is centred on the argument that even in the determination of the quintessential effect of coldness, *i.e.* freezing, which we would intuitively associate with water—since it is water changing its state—, it is air to be the true active cause⁷⁷⁰:

Καὶ μὴν ἀπάντων γε τῶν γινομένων ὑπὸ ψυχρότητος ἐν τοῖς σώμασι σφοδρότατον καὶ βιαιότατον ἢ πῆξις οὕσα πάθος μὲν ἐστὶν ὕδατος ἔργον δ' ἀέρος· αὐτὸ μὲν γὰρ καθ' ἑαυτὸ τὸ ὕδωρ εὐδιάχυτον καὶ ἀπαγές καὶ ἀσύστατόν ἐστιν, ἐντείνεται δὲ καὶ συναγεται τῷ ἀέρι σφιγγόμενον ὑπὸ ψυχρότητος.

Διὸ καὶ λέλεκται 'εἰ δὲ Νότος Βορέην προκαλέσσειται, αὐτίκα νείψει'· τοῦ γὰρ νότου καθάπερ ὕλην τὴν ὑγρότητα παρασκευάσαντος, ὁ βόρειος ἀήρ ὑπολαβὼν ἔπηξε. Καὶ δῆλόν ἐστι μάλιστα περὶ τὰς χιόνας· ἀέρα γὰρ μεθεῖσαι καὶ προαναπνεύσασαι λεπτόν καὶ ψυχρόν οὕτω ρέουσιν.

Ἀριστοτέλης δὲ καὶ τὰς ἀκόνας τοῦ μολίβδου τήκεσθαι φησὶ καὶ ρεῖν ὑπὸ κρύους καὶ χειμῶνος, ὕδατος μόνου πλησιάζοντος αὐταῖς· ὁ δ' ἀήρ, ὡς ἔοικε, συνελάνων τὰ σώματα τῇ ψυχρότητι καταθραύει καὶ ῥήγνυσιν.

And surely, freezing, which among all things that happen in bodies for the work of cold is the strongest and most violent, is an affection of water, but an effect of air. In fact, water in itself is easily diffused, non-solid, and non-cohesive, but contracts (lit. tightens) and gathers if bound tight by coldness by means of air.

For this reason it was also said “if Notus will challenge Boreas, it will snow immediately”: in fact, as the south wind had prepared the moisture like matter, the northern air, coming upon [it], froze it. And this is most evident in snow: in fact, after emitting and blowing forth a thin and cold air, in this way it liquefies (lit. flows).

And Aristotle says that even lead *akónai* liquefy and flow for the work of freezing cold and winter, if only water is in contact with them; while air, as it seems, compressing (lit. driving together) the bodies by means of coldness, crushes and breaks them.

⁷⁷⁰ Paragraphing mine.

The last sentence, in addition to apparently breaking the flow of the argumentation and reporting a phenomenon which is chemically unlikely (as I will show below), raises some interpretative issues. The first, as we have already seen, is the mention of «*akónai* of lead», with the unusual article introducing the genitive: we may ignore the anomaly and just consider *μολίβδου* a genitive of material, also assuming for the term *akónai* a metaphorical interpretation⁷⁷¹. Then, the verb *πλησιάζειν* is ambiguous: unlike the other interpreters I have interpreted it in the sense of “to be in contact”: although its usual meaning is rather “to be close” or “to approach”, in fact, it seems that Plutarch, in ‘chemical’ contexts as well as later in *Frig.*, uses it to denote a kind of proximity which includes contact⁷⁷². A further problem is raised by the adjective *μόνου*, which despite its clear concordance with ὕδατος is translated by all the other interpreters as an adverb (e.g. Nuzzo: “se solo ci sia dell’acqua vicino a loro”)⁷⁷³. Rather, it indicates that, in order for the lead to melt, nothing but water must come into contact with it: whether this is to be understood in as a limiting condition (only water should touch lead, so that e.g. air remains isolated outside) or an inclusive (water would suffice to liquefy lead, even if this is exposed to other agents) is ambiguous. As for the reference to Aristotle, the information is not contained in any of his extant works, just like the *ákmones* in *QConv.* VI 5. Halleux supposed that the fragment may have been contained in one of the «“fichiers” de documentation» of the Peripatos⁷⁷⁴; Plutarch might have also been told about it, in writing or verbally, by a pro-Aristotelian friend (one of these, described elsewhere by Plutarch as an «enthusiastic admirer of Aristotle»⁷⁷⁵, is precisely the dedicatee of *Frig.*, i.e. Favorinus, addressed at the beginning, middle and end of the text⁷⁷⁶).

Whatever the origin of the fragment reported by Plutarch, some scholars associated it⁷⁷⁷ with a passage of Pseudo-Aristotle’s *Mir. ausc.* (50 834^A6-11):

Τὸν κασσίτερον τὸν Κελτικὸν τήκεσθαι φασι πολὺ τάχιον μολύβδου. σημεῖον δὲ τῆς εὐτηξίας, ὅτι τήκεσθαι δοκεῖ καὶ ἐν τῷ ὕδατι· χρώζει γοῦν, ὡς ἔοικε, ταχύ. τήκεται δὲ καὶ ἐν τοῖς ψύχεσιν, ὅταν γένηται πάγη, ἐγκατακλειομένου ἐντός, ὡς φασί, καὶ συνωθουμένου τοῦ θερμοῦ τοῦ ἐνυπάρχοντος αὐτῷ διὰ τὴν ἀσθένειαν.

⁷⁷¹ See above, p. 170-4.

⁷⁷² See *Frig.* 12 949^D (ψαύων καὶ πλησιάζων) and 13 950^{A-B} (πλησιάζει – here, Nuzzo in D’IPPOLITO AND NUZZO 2012 translates «a contatto»). Definitive proof can be found in *QConv.* VII 3.2 701^F-702^A, in which Plutarch, after writing that the bottom of the wine is bad due to the dregs, while «the one [taken] from the surface is ruined because the air is near (πλησιάζοντος!)», reports on the custom of burying and covering the wine-jars «so that the least amount of air touches them on the surface (ἐπιψάυη)». All the three cited examples concern a relationship between a liquid and air, which are also the protagonists of *Frig.* 11. Cf. also *QConv.* VI 1 686^F (πλησιάζων); *Pyth.* 395^D (μηδὲν [...] πλησιάζη μηδ’όμιλη), 395^E (πλησιάζων).

⁷⁷³ Helmbold in CHERNISS AND HELMBOLD 1957, as I will show below, emends *μόνου* into *μὲν οὐ*.

⁷⁷⁴ HALLEUX 1974, 121 n. 25.

⁷⁷⁵ See *QConv.* VIII 9.2 734^F. On the relationship between Plutarch and Favorinus see ZIEGLER [1951] 1965, 54–55; GLUCKER 1978, 280–93.

⁷⁷⁶ In 1 945^F, 12 949^F, 23 955^C.

⁷⁷⁷ Helmbold in CHERNISS AND HELMBOLD, 1957, *ad loc.*; HALLEUX, 1974, 121 n. 25.

They say that Celtic tin liquefies much faster than lead; a sign of [its] easiness to liquefy, [they say that it is / it is] the fact that it appears to liquefy even in water: indeed, as it seems, it tinges [it] quickly. And it also liquefies in [intense] cold, when ice forms, because, as they say, the heat present inside it is closed in and pushed together, due to the weakness.

Leaving aside the ‘thermodynamic’ explanatory closure, the points of contact with Plutarch’s passage are already evident from the mention of lead, albeit this being here only used as a term of comparison. The subject of the *mirabile*, this time, is tin, but the theme is still an anomalous liquefaction: this, which in the passage takes various forms, is presented to be in part related to water, and in part caused by cold. It is interesting that the author, unlike Plutarch’s «Aristotle», takes distance from the information by accumulating cautionary forms such as «they say» and «it seems»: it is clear that he did not have a clear direct experience of the phenomenon, and that he was not completely convinced by it. The γοῦν in the Greek text, then, which like Henderson I have understood as epexegetic⁷⁷⁸, might also be interpreted to have a limiting function («at least [...] it tinges»); if this were the case, the reference to tinging would not count as empirical proof of the liquefaction of the tin, but as a weakened reformulation of the *mirabile*: unconvinced about the information, the author might have wanted to refer to the most similar actual phenomenon. This is how Steinmetz and Flashar⁷⁷⁹ understood this move, but they interpreted χρῶζει to refer to a chromatic alteration of the metal itself, and therefore to its oxidation⁷⁸⁰. This interpretation is unlikely, because the active voice of the verb, despite the ellipsis of the object, leaves little room for a reflexive meaning. If the text does not refer to a process of oxidation, nothing excludes that γοῦν might have an epexegetic function⁷⁸¹: the piece of tin should be probably imagined to be immersed in water, and the fact that this becomes tinged (perhaps in grey) to be a sign of a partial melting of the metal. As for the additional statement on its ‘cold’ fusion, it is uncertain whether the mention of «ices» only serves as an indicator of the intensity of the coldness—which to me, in absence of further clarifications, seems more likely⁷⁸²—or they play a causal role in the occurrence of the liquefaction: this uncertainty is evident in the commentary by Gohlke, who imagines the pieces of tin to be embedded in blocks of ice, whose singular refraction of light would have perhaps contributed to an impression of liquidity on the metal’s surfaces⁷⁸³.

⁷⁷⁸ HENDERSON 1936.

⁷⁷⁹ STEINMETZ 1964, 304; Flashar in FLASHAR AND KLEIN 1972.

⁷⁸⁰ Flashar: «Wenigstens verfärbt es sich schnell». He is followed by VANOTTI [1997] 2007. HENDERSON, 1936 is ambiguous: «it stains very quickly». Cf. the good translation in GIANNINI, 1965: “colorat”.

⁷⁸¹ *Contra* GIANNINI, 1965: “idcirco”; VANOTTI, [1997] 2007: “inoltre”.

⁷⁸² The form ἐν τοῖς ψύχεσιν, ὅταν γένηται πάγη can be also explained as a redundant periphrastic form of a reference to πάγος alone. This ambiguous term, here clearly designating «ice», is often used in the Aristotelian literature (see e.g. Pseudo-Aristotle, *Pr.* III 26 874^B37-875^A1, in which a similar ‘thermodynamic’ phenomenon is described) with the meaning of «frost» or «intense cold» (i.e., probably, cold enough to generate ice). In this sense it is used by Theophrastus in *Ign.* 17, which I quote below.

⁷⁸³ GOHLKE 1961, n. *ad loc.*; Flashar quotes him in FLASHAR AND KLEIN, 1972, *ad loc.*

Faced with such reconstructions of the phenomenon, the reader might wonder why is so much interpretative creativity necessary for those who want to believe the report. It is the fact that, according to our chemical knowledge, it is impossible for both tin and lead to melt by simple cooling. In reconstructing the phenomenon, therefore, all the commentators who assumed that the *mirabile* contained some truth went beyond the letter of the text, and the interpretation which has met with most success is the one which refers to the so-called “tin pest”⁷⁸⁴: tin, which in warm seasons is normally found in its allotropic form Sn- β , *i.e.* as “white tin”, below +13 °C (at atmospheric pressure) begins its transition into its allotropic form Sn- α , or “grey tin”, which is much more brittle and friable than the first. When the temperature is very low, at about -40 °C, this allotrope can even, quoting Mottana: «disgregarsi spontaneamente e quasi tumultuosamente in una polvere grossolana»⁷⁸⁵. Various interpreters, therefore, supposed that the ancient observers of this phenomenon mistook it for a liquefaction (I do not understand how)⁷⁸⁶ or presented it in terms of a liquefaction. This led Helmbold to mention the allotropic transition of tin in a footnote to Frig. 11 949^C and then write that the «more nearly correct statement» —*i.e.* the information which is closer to the truth, with respects to that on «lead *akónai*»— is found in the Pseudo-Aristotelian *mirabile*⁷⁸⁷. In addition to the similarities mentioned above, the fact that in certain ancient languages existed a partial lexical overlap between lead and tin⁷⁸⁸ would legitimize the comparison between the two passages, to be interpreted as an indication that the two materials tended to be confused in antiquity: in the same footnote, Helmbold himself points out that the Latin word *stannum* referred to both metals. Actually, as noted by Halleux⁷⁸⁹, the word came to designate tin at a very late stage, and initially it was only used for “bullion lead” (*i.e.* argentiferous lead, the alloy between lead and silver). This is the sense in which Pliny still understood it, but nevertheless, in the same pages in which he uses the term⁷⁹⁰, he gives further evidence of the confusion: dealing with both metals in the same section, in fact, he introduces tin—which he also calls *cassiterum* in correspondence with the Greek *κασσίτερος*— as a ‘genus’ of *plumbum* called *plumbum candidium* or *album* (lit. «white lead»), referring instead with *plumbum*, without qualifiers or with the adjective *nigrum* («black»), to our lead; this lexical distinction might have had a parallel in the Egyptian language⁷⁹¹. Halleux, then, together with the Latin *plumbum*, mentions the Akkadian

⁷⁸⁴ See STEINMETZ, 1964, 304; Helmbold in CHERNISS AND HELMBOLD, 1957, 250 n. a (suggested by O.T. Benfey); TEODORSSON 1989b, n. to 695^D, who cites Helmbold; HALLEUX, 1974, 121; MOTTANA 2001, 158, who cites Halleux but provides more chemical details.

⁷⁸⁵ MOTTANA, 2001, 158.

⁷⁸⁶ Disintegrated Sn- β , which is granular-looking, can hardly be mistaken for a liquid, and when placed in water does not resemble a dye, but hangs on its surface in solid-looking sandy piles.

⁷⁸⁷ CHERNISS AND HELMBOLD, 1957, *ad loc.*

⁷⁸⁸ See FORBES 1964c, 200; 1964b, 155–57.

⁷⁸⁹ HALLEUX, 1974, 18 e 122 n. 31.

⁷⁹⁰ Pliny, *NH* XXXIV 156-159.

⁷⁹¹ FORBES 1964b, 156-7. Cf. PENHALLURICK 2008, 10, who is less cautious. In any case, it is probable that the Egyptian term *dh(y)*, which in the Harris papyrus (mid-twelfth century BCE, end of the reign of Ramses III - see GRANDET 1994, 119–22) appears twice

word *anaku*, which «semble désigner les deux [métaux]»⁷⁹², but there seems to be no unanimity among Assyriologists, and B. Landsberger—who adds the Sanskrit *nāga(m)*⁷⁹³ to the list of ambiguous terms—besides opting for an unambiguous interpretation of *anaku* as «tin», takes a stand against the tendency of other scholars to believe, without good reason, in an alleged ancient confusion between this and lead: «anyone who has ever observed their appearance or who has considered the great difference in their use for metallurgy, or their difference in value, cannot imagine that the two were ever confused»⁷⁹⁴. Here, more cautiously, we could simply note that, whatever the degree of confusion between the two metals in other cultures, ancient Greek shows no ambiguity in terminology: lead is always called μόλυβδος (with the variants μόλιβδος, μόλιβος and μόλυβος), and tin κασσίτερος (or καττίτερος), with no obvious overlapping.

It is therefore unlikely that Plutarch confused lead with tin, if we assume that he depended on a Greek tradition; it is possible, however, that the confusion was introduced by one of Plutarch's direct or indirect informants on Aristotle's report, as he might have been a Latin speaker. This hypothesis, being it entirely speculative, is not sufficient to legitimize a strong connection of Plutarch's passage with the *mirabile* in Pseudo-Aristotle, two *loci* that moreover, along with the obvious similarities, bear a significant difference in the role of water. In the *mirabile*, in fact, nothing guarantees that the water in which the melting is said to occur was understood to be cold⁷⁹⁵, and in the additional information on frost no role is assigned to water (except, hypothetically, in the form of ice). Helmbold, on the other hand, together with Post (whom he credits in the critical apparatus), is so convinced about the connection between the two passages that he considers it sufficient justification to correct the μόνου of the Plutarchean text—against the unanimity of the manuscripts and other editors—in μὲν οὐ, thus denying to water any involvement in the phenomenon, and translating: «when no water is anywhere near them». In this way, however, Plutarch's reference to the liquefaction would appear gratuitous in the argumentative economy of *Frig.* 11, which—as I have shown above—is based entirely on an opposition between the fluidity of water and the freezing coldness of air. If Plutarch had meant that lead melts because of cold without contact with water, it is obvious that air would have been involved in the melting, and Plutarch, by reporting this, would have provided evidence that was irrelevant to, if not in fact contradictory towards, the thesis he intended to support: in the text, the role of the watery element is clearly opposed to the airy, which, instead of dilating and liquefying the bodies like the former, contracts them to the point of shattering them. This, in itself, could be also used as counterevidence against the interpretation of the

immediately after *dh̄ty*, referred to tin, in which case the terminological similarity between the two metals would be remarkable: see FORBES 1964b, 156.

⁷⁹² HALLEUX 1974, 122 n. 31. So also FORBES, 1964d, 200-1.

⁷⁹³ LANDSBERGER 1965, 287.

⁷⁹⁴ *Ib.*, 286.

⁷⁹⁵ *Contra e.g.* HALLEUX, 1974, 176 («dans l'eau froide»).

“melting” as a pulverization (as in the case of the “tin pest”)⁷⁹⁶, but it also encourages us to compare Plutarch’s account with a very similar passage in Theophrastus’s *Ign.* In Theophrastus, scholars have even recognized the (at least partial) source of much of the information in *Mir. ausc.*, including that on Celtic tin⁷⁹⁷. Whether this assumption is true or not⁷⁹⁸, we cannot fail to notice that *Ign.* 17 bears certain similarities with both Pseudo-Aristotle’s *mirabile* and the Plutarchan report:

ὅτι δὲ ἰσχυρόν <τὸ ψυχρόν> εἰς τὸ συναγαγεῖν καὶ συναθροῖσαι τὸ θερμόν, σημεῖον καὶ τὰ τηκόμενα καὶ τὰ ῥηγνύμενα τῶν ἐλατῶν καὶ χυτῶν ([καὶ γὰρ φασὶ] καττίτερον καὶ μόλιβδον ἤδη τακῆναι ἐν τῷ Πόντῳ πάγου καὶ χειμῶνος ὄντος νεανικοῦ, χαλκὸν δὲ ῥαγῆναι. τοῦτο δὲ δῆλον ὡς διὰ τὸ ἐκπνευματωθῆναι τὴν ὑγρότητα συστελλομένου καὶ συνιόντος τοῦ θερμοῦ, τὸ γὰρ πνεῦμα διεκπίπτον ποιεῖ τὴν ῥῆξιν).

And a sign that cold is violent in gathering and assembling heat are also those of the ductile and fusible [bodies] which melt and those which break ([they say in fact that] tin and lead, in Pontus, liquefy as soon as freezing cold and winter are vigorous, while bronze (or copper) breaks. And it is manifest that this is due to the evaporation (lit. turning into *pneûma*) of the moisture, as the heat puts [itself] together and comes together; steam (*pneûma*), in fact, produces the break by leaking out).

Although water is here not present, it is noticeable that just as in Plutarch’s fragment a form of melting is opposed to a shattering, and this time it is explicit that it is a metal to break. This clear distinction between the two alterations makes it even more unlikely that the pulverization of grey tin hid behind the reported liquefaction of tin and lead. However, since this text too, if interpreted literally, informs on an impossible phenomenon, also in this case scholars have referred to the phenomenon of “tin pest”. For Halleux, while the information on tin would be in this specific sense «partialement exact», the mention of lead, on the other

⁷⁹⁶ Further counterevidence is the correspondence of the form *τήκεσθαι καὶ ῥεῖν* in other Plutarchean *loci* where it more clearly designates a liquefaction: see above, p. 110 n. 455.

⁷⁹⁷ See ROSE 1863, 254–56; MÜLLENHOFF 1870, 426–27; GEFFCKEN 1892, 88–89; JOACHIM 1892, 15; REGENBOGEN 1940, cols 1406–7; STEINMETZ 1964, 299–304; Flashar in FLASHAR AND KLEIN, 1972, 39–40 e 44; GIANNINI, 1965, note to *Mir. ausc.* 42 and 50. According to all these scholars (except Müllenhoff e Geffcken, who do not cite the title), the news reported in *Mir. ausc.* 50 (which is also true for other *mirabilia*) derives from the Theophrastian *Peri metallōn* («On metals»), which has come down to us only in fragments (on which see MOTTANA 2001, esp. p. 142–54), but see also the next footnote.

⁷⁹⁸ ROSE, 1863, although presenting with certainty his hypothesis of derivation from Theophrastus («pro certo habeo», 255), just like MÜLLENHOFF, 1870 and GEFFCKEN, 1892 does not offer any argument to support it (relying on the assumption that *Mir. ausc.* is nothing but a collection of partially discontinuous *excerpta* from several earlier works, including those of Theophrastus); JOACHIM 1892, 15 and STEINMETZ, 1964, 299 depend on Rose without showing any hesitation, and REGENBOGEN, 1940, coll. 1406–7 refers to Joachim together with Geffcken, 1940, while Flashar (in FLASHAR AND KLEIN, 1972) takes care to highlight the hypothetical character of the reconstruction (p. 39). He, in fact, takes into account the analysis of SCHRADER 1868, who had already problematised Rose’s simplicisms, moreover implicitly excluding *Mir. ausc.* 50 from the passages attributable to Theophrastus (*Ib.*, 229). Flashar, despite his caution, attributes the entire block *Mir. ausc.* 42–50 to the *Peri metallōn* (see FLASHAR AND KLEIN, 1972, 40–1, 44; n. to *Mir. ausc.* 42). So does GIANNINI, 1965, without argumentation. MOTTANA, 2001, 176 is appreciably more cautious.

hand, could be derived from a «confusion dans la source», perhaps caused by the ancient lexical overlap between the two metals⁷⁹⁹: that Theophrastus here depends on an external informant is implied by the indirect presentation of the information, by means of infinitives. Furthermore, just like lead, also bronze is never mechanically altered by cold, and so Halleux, inspired by Plutarchan passages, speculates that the implicit reference may be to bronze vessels filled with snow (mentioned by Plutarch in *QConv.* VI 8. 6 695^B) in which fractures would have occurred due to the freezing of their content and its resulting expansion⁸⁰⁰: in *Frig.* (16 952^{A-B}) Theophrastus himself is criticized by Plutarch because, in explaining the cause of the shattering (ρήγγυεiv) of bronze and earthenware vessels exposed to the cold, he attributed it to the surrounding air, rather than to the «violence» exerted by the cold water inside them (note that Plutarch does not refer to the water's expansion in its change of phase). If this is true, we do not necessarily have to assume that lead and tin were visualized as well in the form of vessels: it is also possible that Theophrastus, in his exposition, combined information about different phenomena into a single report.

Returning to *Mir. ausc.* 50, we may similarly suppose that it contains different bits of information which were not originally associated. In fact, while it seems plausible that the information on the cold melting of tin might have been derived, perhaps indirectly, from this Theophrastean *locus*⁸⁰¹ —also considering the common reference to *antiperistasis* for the ‘thermodynamic’ explanation⁸⁰²—, it would be little justified to assume the same for the information on Celtic tin: it is possible that one of the compilers of *Mir. ausc.*, knowing about Theophrastus's report and recognizing its relevance to the information on Celtic tin, decided to attach it to this latter as further evidence on the tin's anomalous fusibility. Such decision to conflate information about tin in general (if not about tin mined in Pontus) to the special Celtic tin, probably of Hispanic or Britannic origin⁸⁰³, may appear to be unwarranted. Moreover, if we focus on the distinct toponyms, we may also speculate that the two reports had different geographical origins —western the Pseudo-Aristotelian and

⁷⁹⁹ HALLEUX, 1974, 121-2 with n. 31, followed by SHARPLES 1998, 124.

⁸⁰⁰ Cf. SHARPLES, 1998, 124, who transforms the hypothesis, while also expanding it, in certainty: “In *On Fire* 17, Theophrastus speaks of vessels of tin and lead”.

⁸⁰¹ This is not the opinion of most interpreters, who instead refer to the lost *Peri metallōn* (on which see above, p. 192 n. 798); it is consistent with MOTTANA, 2001, 176.

⁸⁰² This is the reason why BURNIKEL 1974, 169 n. 48 assimilates the two passages. In *Mir. ausc.* 50, heat, being (more) ‘weak’, is overcome by cold, which thus makes it recede (this is what *antiperistasis* consists of). The «as they say» can only refer to Theophrastus or to thinkers influenced by him: on Theophrastean *antiperistasis* see *Ign.* 14 and Plutarch, *Aet. phys.* 13 915^B with SHARPLES, 1998, 122-3 and BATTEGAZZORE 1984, 63–67.

⁸⁰³ MOTTANA, 2001, 227-8 opts for Brittany or Cornwall, excluding the Iberian Peninsula and Galatia (in Asia Minor) for reasons of chronology: these turn out to be fallacious, as they depend on the assumption that all information in *Mir. ausc.* 50 is derived from Theophrastus and must therefore precede his death (287 BCE). Removed this limitation, to interpret the «Celtic» toponym consider Posidonius, who in *Fr.* 89.38 Theiler mentions the numerous Iberian tin deposits, its extensive importation from Brittany into Gaul («the Galatia in front of it»), and the fact that the latter involved a long transport of the metal «for the Celtic continent (Κελτικῆς)». On Iberian tin see also Posidonius, *Fr.* 19 Theiler and Pliny, *NH* XXXIV 156. On Iberian, British and French deposits see FORBES 1964C, 134–36 and 155; PENHALLURICK, 2008, 95-103.

eastern⁸⁰⁴ the Theophrastean—, thus weakening further the hypothesis that the two were linked by any sort of textual dependency. In any case, we may justify the compiler who chose to attach the Theophrastean information on tin to our hypothetical older version of *Mir ausc.* 50 (concerning only the melting in water of Celtic tin), because if he lived, as it is likely, after 278 BC, by his time Galatia, a region adjacent to Pontus, was already inhabited by Celtic populations⁸⁰⁵: it would not be reproachable if he had decided to assimilate Theophrastus' Pontic tin to the tin extracted or worked in Galatia, which by then would be correctly referred to as Celtic⁸⁰⁶.

As for the Theophrastean report, it should be noted that, although lead was also mined in western regions, it is probable that in Theophrastus's times, as well as before, the main centres of extraction of the metal were in Asia Minor⁸⁰⁷. We could therefore assume, always with caution, that there already existed some cultural association between lead and Pontus, rooted in the historical-economic context of the real metallurgical production⁸⁰⁸; the same cannot be said for tin, as Asia Minor is poor in deposits of cassiterite⁸⁰⁹. Perhaps, we have thus found a further reason to reject the supposition that the reference to lead, already in the original report, was added to the reference to tin because of the ancient confusion between the two metals: if there was any confusion, once the interpretation of melting in terms of pulverization is removed, it is more likely that it was tin to be added to the other.

Whatever the original information, it is yet significant that in the Theophrastean version, differently from in Plutarch's, water does not play any role. Nevertheless, it is possible to corroborate the importance of water in Plutarch's report by referring to parallel *loci*⁸¹⁰. While S.-T. Teodorsson, following W. C. Helmbold, decided to explain these starting from the parallel passage in *Frig.*, to the point of even removing in one of them the reference to lead and replacing it with tin⁸¹¹, it seems to me more appropriate to follow the opposite direction. Of these passages, the least useful is in *QConv.* VI 8, a *quaestio* on the cause of bulimia. Shortly after the mention of snow-vessels, already quoted above, Plutarch claims that sweats, in cold climate, are caused by a thin *pneūma* emitted by the snow (compare with *Frig.* 11, where it is called ἀήρ): this, which «cuts» the flesh, facilitates the outflow of body heat in combination with moisture, and this latter remains on the body's surface in the form of droplets; in this context, perhaps anticipating that explaining an expansion by reference to a

⁸⁰⁴ Cf. VALLANCE 1988, 37 with n. 20.

⁸⁰⁵ Cf. MOTTANA, 2001, 228.

⁸⁰⁶ On the few deposits of cassiterite in Asia Minor see FORBES 1964C, 130.

⁸⁰⁷ See FORBES 1964C, 204-26.

⁸⁰⁸ On the possible Pontic origin of the techniques of silver extraction from argentiferous lead see FORBES 1964b, 196, 198, 216. The Laurium deposits probably had a stronger cultural relevance, but were more famous as silver mines than as lead mines, due to the high quantity of silver in their ores: see *Ib.*, 224-5.

⁸⁰⁹ See above, n. 806.

⁸¹⁰ These are connected to *Frig.* 11 by *e.g.* Hoffleit in CLEMENT AND HOFFLEIT, 1969, 481 n. a, 505 n. a; FUHRMANN, 1978, 109 n. 3 e 120 n. 2; TEODORSSON, 1989b, n. to 691^B e 695^D; VOLPE CACCIATORE, 2007.

⁸¹¹ TEODORSSON, 1989b, n. to 695^B («the 'melting' of tin») and 695^D.

cold agent might be counterintuitive, he adds as empirical evidence «that cooling not only condenses bodies, but also melts them» (695^D), here mentioning the liquefaction of the «lead *akónai*» (without article) in harsh winters. Water does not play a role in this passage, but its mention would not have been useful for the argument, which only aims at confirming the possibility of a causal relationship between cold bodies and dilative alterations. The best connection, indeed, is with the etiology of pebbles and *ákmones* or *akónai* in *QConv.* VI 5, which we know very well; although liquefaction is not discussed in this passage, we are justified in connecting it with the Aristotelian fragment in *Frig.* 11 both due to the common presence of *akónai* and due to the centrality of water. Therefore, in contrast with the *quaestio*, which concerns the ‘regular’ effect of pebbles and *akónai* on the water in which they are immersed, the report in *Frig.* 11 might refer to their ‘irregular’ behaviour, which occurs when they remain in water in an excessively cold climate. The source of the information is the same for both, as Plutarch himself claims: «Aristotle». Whether Plutarch’s knowledge of the phenomenon depended indirectly on the passage in *Ign.* 17 or on the material on which it was based, it is possible that there existed a more specific formulation of the news than the Theophrastean, in which the role of both *akónai* and water was explicit. Whether Theophrastus knew of this integral form, and decided to refer to it in a succinct and partial way (similarly to Plutarch in *QConv.* VI 8.6 695^D), or the longer form was the result of a Peripatetic effort of interpretation and correction which took place in the centuries separating Theophrastus’ and Plutarch’s life, it is impossible to say.

In concluding this analysis, I can only suggest, to those who intend to believe in Theophrastus’ and «Aristotle»’s reports, an alternative path to the one leading to “tin pest”, for an interpretation which maintains and gives proper relevance to the role of both lead and water in the sources. Drawing on the “tinging” of water by tin in *Mir. ausc.* 50, interpreted as evidence of the tin’s liquefaction, it may be assumed that if lead was believed to have melted, it was because it was observed to colour the water in which it was immersed. Since lead and tin are not soluble in water, a plausible hypothesis is that it was not the metal itself that tinged the water, but a mineral impurity (perhaps grey or black in colour). After all, none of our passages inform on the degree of purity of the metals they refer to; on the contrary, the mention of Pontus in Theophrastus, as well as the adjective «Celtic» in Pseudo-Aristotle, could be an indication that lead and tin were in fact impure: the geographical origin of a well-purified metal, in fact, does not influence its chemical behaviour, and Pliny himself, when listing some kinds of «black lead» —*Iovetanum, Caprariense, Oleastrense*— adds that «there is no difference if only the slag has been diligently removed in an oven (*excocta*)» (*NH* XXXIV 164). As Plutarch is the only one informing us on «lead *akónai*», there is no way to infer their full chemical composition, nor do we have any reason to assume their metallic purity⁸¹².

⁸¹² Cf. the translation of *Frig.* 11 949^C by Castello in LELLI, PISANI, ET AL. 2017: «le pietre di piombo».

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Appendix:

Definitions of the *TheSu* XML elements and attributes

The definitions in this appendix, extracted from the XML Schema Definition (XSD) document of *TheSu* 0.72, presuppose a basic knowledge of the XML tree structure and of the terminology of relationship used for its components (e.g. “parent”, “child”, “sibling”, etc.)¹, as well as a basic understanding of the most common data types used for attribute values (e.g. “xs:string”, “xs:boolean”, “xs:ID”, etc.)², with the addition of xlink:href³.

The schema components are grouped in five categories and presented in alphabetical order in each (note that upper case letters precede lower case letters):

Elements	(pages 210-260)
Element Groups	(page 261)
Complex types	(pages 262-265)
Attributes	(pages 266-285)
Attribute Groups	(page 286)

Element groups and attribute groups function as shortcuts for the simultaneous inclusion of multiple children elements or attributes in the same elements. Elements are distinguished from Complex types as these are types of elements (which include children elements and attributes) and can be assigned to multiple elements of different names. In this appendix, some of the Elements, Element Groups, and Complex types are followed by Elements whose title is preceded by a slash (e.g. ‘/scholarContra’): such elements exist only as children of the element by which they are preceded (hence they are not listed alphabetically as individual schema components), and are all assigned with a Complex Type.

The rubric “Children:” in every Element and Complex Type, as well as the rubric “Contains:” in every Element Group, lists the allowed or required children elements in their order of succession.

- When the name of a child element is not followed by any character (e.g. “text”), that element *must* occur once inside its parent element, and cannot be repeated;
- When the name of a child element is followed by “+” (e.g. “elementRef+”), that element *must* occur once inside its parent element, and can be repeated without limitations;
- When the name of a child element is followed by “{0,1}” (e.g. “relationships{0,1}”), that element *can* occur once inside its parent element, but cannot be repeated;
- When the name of a child element is followed by “*” (e.g. “externalRef*”), that element *can* occur once inside its parent element, and can be repeated without limitations.

Under the rubric “Attributes:” in every Element and Complex Type, as well as under the rubric “Contains:” in every Attribute Group, no distinction has been indicated between required and optional attributes. All required attributes are signaled in the readable definition of each component.

In the readable definitions, the following graphical conventions have been adopted:

- opening and closing apostrophes (‘example’) signal the name of an XML or HTML element;
- opening and closing apostrophes delimiting a string starting with the at sign (@example) signal the name of an XML attribute;
- opening and closing quotation marks (“example”) can signal: [a.] an attribute value, [b.] a freeform interpretation of an attribute value, [c.] an element as characterized by the value of one of its attributes or of one of its prominent descendant elements’ attributes (e.g. “base edition” as referred to a ‘bibliographyRef’ whose ‘@baseEdition’ is specified as “true”, or “argumentative” as referred to a ‘SUPPORT’ whose descendant ‘argumentation’ has a ‘@rank’ value superior to that of its siblings in the highest ranking ‘supportFunctionsGroup’), [d.] a quotation;
- rightwards arrow between two element names [‘example’ → ‘example’] signals that the element on the right is a child of the element on the left.

I recommend beginning the reading of this appendix from the element 'TheSu', which is the root element of a TheSu document, and to then focus on the elements 'THESIS', 'SUPPORT' and 'PROPOSITION' — which are the most important— exploring their attributes and children or descendant elements after reading their individual definitions.

¹ For a fast and easy introduction, I recommend reading the tutorial at https://www.w3schools.com/xml/xml_what_is.asp.

² See e.g. https://www.w3schools.com/xml/schema_simple_attributes.asp.

³ See e.g. https://www.w3schools.com/xml/xml_xlink.asp.

Element : AEsystem**Attributes:**

comment, doubleChecked, extrinsic, id, implicit, polarity, quantity, uncertain

Children:

THESIS*, MISC*, SUPPORT*, keyword*, lectio*

Parents:

source

Definition:

This is to annotate the argumentative-expository system of a 'source' —i.e. the network of its theses and supports, connected in correspondence with their functional relations— and other TheSu elements based on its text. Any number of 'THESIS', 'MISC', 'SUPPORT', 'keyword', and 'lectio' elements may be added in any order, but it is recommended that their succession reflects the succession of the beginnings of their corresponding text spans in the primary text associated with the 'source', to make the isolated TheSu document more easily readable for a human.

Element : MISC**Attributes:**

comment, doubleChecked, id

Children:

includedRefsGroup{0,1}, speakersGroup{0,1}, limitationsGroup{0,1}, macroThemesGroup{0,1}, microThemesGroup{0,1}, keywordsGroup{0,1}, metaphorsGroup{0,1}, text, paraphrasis{0,1}, externalRef*, alternativeTo{0,1}, customElement*

Parents:

AEsystem

Definition:

This is to annotate any span of text and provide it with similar details as those that are included in 'THESIS' elements, regardless of the text span's functionality or homogeneity of meaning; or to indicate the extent of a text span targeted by a non-argumentative support, in order to allow it to be referenced in one of the 'SUPPORT's descendant 'target' elements; or to connect a text span to relevant secondary literature. Every 'MISC' must be given its own ID in '@id', and associated with a span of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') via 'text'. The annotator may provide a clear and concise paraphrasis, in the language that has been chosen for the TheSu corpus, of the semantic content of a 'MISC' in 'paraphrasis', in a form that is coherent with all the other annotated details. When the associated text span is ambiguous enough to allow for multiple interpretations, and thus for the annotation of more than one distinct, mutually exclusive 'MISC' elements, all of these may be added to the TheSu document, but one of them will always have to be favoured by the annotator, and referred to by each of its alternative 'MISC' elements in their respective 'alternativeTo' children elements. For every 'MISC', one or more individuals or groups, presented in the text to be the speakers of the associated text span, can be specified in 'speakersGroup'; if the text span corresponds to a section, in its whole, towards whose claims the actual or full commitment of its speakers is generally limited (as its character is e.g. hyperbolic, joking, fictitious, etc.), such limitations can be specified in 'limitationsGroup'. The broad theme (e.g. "historical", "axiological", etc.) of the annotated text span can be specified in 'macroThemesGroup'; to specify the theme in more detail (e.g. "military", "psychological", etc.) 'microThemesGroup' may be used. Any of the words composing the semantic content of the 'MISC' —both those that are

explicit in the text span referred to in 'text' and those that are implicit and inserted in its 'paraphrasis'— can be annotated as keywords in 'keywordsGroup' by referring to corresponding, separately-annotated 'keyword' elements. If the annotated text span includes metaphors, details on their structure, meaning, and status may be annotated in 'metaphorsGroup'. In the case the annotated text span includes references to passages in a text—whether in the same work or in another—, the annotator may provide links to such passages, the coordinates of their loci, or links to their corresponding TheSu elements (if any) in 'includedRefsGroup'. References to secondary literature commenting on the annotated text span can be included via 'externalRef' elements. Custom elements can be added through 'customElement'.

Element : PROPOSITION

Attributes:

doubleChecked, id, polarity

Children:

relationships{0,1}, propositionType, paraphrasis, externalRef*, customElement*

Parents:

includedPropositions, newPropositions

Definition:

A proposition is the abstract, semantic content of a declarative sentence, i.e. the uninstantiated version of a thesis, which is synonymous (enough) with it. The element 'PROPOSITION' is used to connect between them, by means of their common reference in 'matchingProposition', multiple 'THESIS' elements that are recognized by the annotator to be synonymous or very similar in meaning. Every 'PROPOSITION' must be given its own ID in '@id', and also provided with a 'paraphrasis' describing its meaning, since none is linked to a text span in a work. The affirmative or negative character of the proposition may be specified in '@polarity'. Each 'PROPOSITION' can also be connected to other 'PROPOSITION' elements whose meanings are e.g. logically equivalent, similar, or opposed to theirs by using 'relationships'. Further formal and thematic annotation may be added in 'propositionType'. The annotator may use 'externalRef' to refer to secondary literature of any kind concerning the present proposition (e.g. historical accounts of philosophers claiming it, current scientific confutations of it, etc.). Custom elements can be added through 'customElement'.

Element : SUPPORT

Attributes:

comment, doubleChecked, extrinsic, id, implicit, uncertain

Children:

targetsGroup, marker, includedRefsGroup{0,1}, speakersGroup, assent, supportType, employedElements, text, paraphrasis, externalRef*, scholarPro*, scholarContra*, alternativeTo{0,1}, customElement*

Parents:

AEsystem

Definition:

A support is a segment of text that is presented by its speaker in function of a part of the discourse that is conveyed by the same text. A support can be: argumentative, when it provides justifications for the acceptance or refusal of a thesis or of another support; expository, when it explains more clearly, stylistically, or in depth the meaning of another segment of text containing theses or

supports; expansive, when it expands on an information conveyed by a thesis, favouring a more complete knowledge and understanding of it (thus corresponding to an excursus); or contextualizing, when it contextualizes the interpretation and reception of another segment of text containing theses or supports. These four functions may be cumulative. Every 'SUPPORT' must be given its own ID in '@id', associated with a span of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') via 'text', and linked to one or more 'THESIS', 'MISC', or 'SUPPORT' elements in 'targetsGroup', in correspondence with all the parts of the discourse they are supports of. In the case of implicit supports (e.g. implicit arguments expressed by directly mentioning examples, without their cogency being made explicit), the attribute '@implicit' must be specified as "true", and the text span linked in 'text' used to provide all the possible evidence of the implicit presence of such supports at these referenced points of the discourse. If the presence of "implicit" supports in their corresponding text span is notably uncertain, '@uncertain' may be specified as "true". Since the recognition of their presence can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'; the neutral 'externalRef' can be added to "extrinsic" supports too. If the support makes use of specific annotated elements of the discourse —occurring in the text span indicated to be its 'text'— in order to fulfill its functions (e.g. theses used as premises), these must be referred to in 'employedElements'. In the case of "explicit" supports, the annotator may refer to the textual marker signalling their presence and supportive function (e.g. "because", "namely", etc.) in 'marker'. It is also allowed to annotate supports that are neither explicit nor implicit, but recognized to be extraneous to the speakers' intent at a certain point of the text, and yet relevant to the annotation for any reason: for such 'SUPPORT' elements, '@extrinsic' must be specified as "true". The annotator may provide a clear and concise paraphrase, in the language that has been chosen for the TheSu corpus, of the semantic content of a 'SUPPORT' in 'paraphrase', in a form that is coherent with all the other annotated details; in the case of "implicit" and "extrinsic" theses, the 'paraphrase' must be included necessarily, since the meaning of the referenced text will never be identical with that of the annotated support. When the passage is ambiguous enough to allow for multiple interpretations, and thus for the annotation of more than one distinct, mutually exclusive 'SUPPORT' elements, all of such supports may be added to the TheSu document, but one of them will always have to be favoured by the annotator, and referred to by each of its alternative supports in their respective 'alternativeTo' children elements. For each 'SUPPORT', at least one individual or group, presented by the text to be its speaker, must be specified in 'speakersGroup'; in the case of non-dialogic works, the speakers of most supports —except those in quotations— will generally be identical with the work's authors. Since not every support is presented by its speakers with actual or full commitment (but some only provisionally, hypothetically, jokingly, etc.), and supports are sometimes expressed only to be attacked (e.g. expected counter-arguments), the annotator may provide details on the extension of their speakers' assent —as can be inferred by the associated text—, in 'assent'; if these speakers are distinct from the work's authors or from superordinate speakers reporting on the support, the assent of these latter may be also specified here. Details on the support's function (i.e. argumentative, expository, expansive, contextualizing) and form (e.g. deductive reasoning, analogy, etc.) may be added in 'supportType'. In the case the annotated support includes references to passages in a text —whether in the same work or in another—, and these passages are neither among its targets nor among its employed elements, the annotator may provide links to such passages, the coordinates of their loci, or links to their corresponding TheSu elements (if any) in 'includedRefsGroup'. Custom elements can be added through 'customElement'.

Element : / marker — Complex Type: proof

Definition:

This is to refer, in the case of "explicit" 'SUPPORT' elements, to textual markers signalling their presence and supportive functions in the discourse (e.g. "because", "namely", etc.), by providing links to their corresponding text spans in the digital source in 'locusRef' → 'locusLink'. The referenced text segments can be reported in 'snippet' in their full form, to make the isolated TheSu document more easily readable for a human.

Element : THESIS

Attributes:

comment, doubleChecked, extrinsic, id, implicit, polarity, quantity, uncertain

Children:

matchingPropositionsGroup, entailment{0,1}, includedRefsGroup{0,1}, speakersGroup, assent, thesisType, text, paraphrase, externalRef*, scholarPro*, scholarContra*, alternativeTo{0,1}, customElement*

Parents:

AEsystem

Definition:

A thesis is an explicit or implicit instantiation of a single proposition in a text, i.e. a minimal declarative sentence representing the stance of its speakers, independently of the stance's character (e.g. definitive or temporary, or sincere or simulated). Every 'THESIS' must be given its own ID in '@id', and associated with a span of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') via 'text'. In the case of implicit theses (e.g. implicit declarative sentences suggested by means of rhetorical questions), the attribute '@implicit' must be specified as "true", and the text span linked in 'text' used to provide all the possible evidence of the implicit presence of such theses at these referenced points of the discourse. If the presence of "implicit" theses in their corresponding text span is notably uncertain, '@uncertain' may be specified as "true". Since the recognition of their presence can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'; the neutral 'externalRef' can be added to "extrinsic" theses too. When more than one semantically-distinct statements —with respects to their autonomous informativity— in syntactic continuity (e.g. "the sun sends us heat and light", which can be split in "the sun sends us heat" and "the sun sends us light" without changes in meaning) are recognized to share most of the features that will be specified in their annotation —i.e. all except some micro-themes and keywords—, the annotator may decide, for convenience, to include all of them in the same 'THESIS' element, thus creating an aggregate-thesis: in such cases, the number of the so-combined individual statements will have to be specified in '@quantity'. Each 'THESIS' element may be linked to the abstract propositions they are recognized to be instances of, i.e. synonymous with them or very similar in meaning, by referencing their corresponding 'PROPOSITION' elements in 'matchingPropositionsGroup': this is used to connect between them, by means of their references to the same 'PROPOSITION' elements, all theses in one or more TheSu corpora that appear to be synonymous (enough) with each other. Each 'THESIS' can also be connected to other 'THESIS' elements that logically entail them in any way by using 'entailment'. It is also allowed to annotate theses that are neither explicit nor implicit, but recognized to be extraneous to the speakers' intent at a certain point of the text, and yet relevant to the annotation for any reason: for such 'THESIS' elements, '@extrinsic' must be specified as "true". The affirmative or negative character of the thesis may be specified in '@polarity'. The annotator may provide a clear

and concise paraphrase, in the language that has been chosen for the TheSu corpus, of the semantic content of a 'THESIS' in 'paraphrase', in a form that is coherent with all the other annotated details; in the case of "implicit" and "extrinsic" theses, the 'paraphrase' must be included necessarily, since the meaning of the referenced text will never be identical with that of the annotated thesis. When the passage is ambiguous enough to allow for multiple interpretations, and thus for the annotation of more than one distinct, mutually exclusive 'THESIS' elements, all of such theses may be added to the TheSu document, but one of them will always have to be favoured by the annotator, and referred to by each of its alternative theses in their respective 'alternativeTo' children elements. For each 'THESIS', at least one individual or group, presented by the text to be its speaker, must be specified in 'speakersGroup'; in the case of non-dialogic works, the speakers of most theses —except those in quotations— will generally be identical with the work's authors. Since not every thesis is presented by its speakers with actual or full commitment (but some only provisionally, hypothetically, jokingly, etc.), and theses are sometimes expressed only to be attacked, the annotator may provide details on the extension of their speakers' assent —as can be inferred by the associated text—, in 'assent'; if these speakers are distinct from the work's authors or from superordinate speakers reporting on the statement, the assent of these latter may be also specified here. Further formal, thematic, and intertextual annotation may be added in 'thesisType'. In the case the annotated declarative sentence includes references to passages in a text —whether in the same work or in another—, and these passages are not the objects of the present 'THESIS' —as either objects of a "metatext" or of a "historical" report—, the annotator may provide links to such passages, the coordinates of their loci, or links to their corresponding TheSu elements (if any) in 'includedRefsGroup'. Custom elements can be added through 'customElement'.

Element : TheSu

Attributes:

comment, id

Children:

/

Parents:

TheSu

Definition:

This is the root element of a TheSu corpus. The corpus can be given its own ID in '@id'. The authority records listing all of the allowed spellings of the tags used in the corpus must be referenced in 'authorizedTags'. If the corpus includes any 'THESIS' element that the annotator intends to connect to 'PROPOSITION' elements, these 'PROPOSITION' elements must be included in 'propositions'. One or more 'source' elements must be added, in correspondence with each of the distinct primary texts that the annotator intends to annotate in the TheSu corpus.

Element : alternativeTo

Attributes:

comment, rank

Children:

elementRef+, externalRef*, scholarPro*, scholarContra*

Parents:

MISC, SUPPORT, THESIS, keyword

Definition:

This is to refer, via one or more 'elementRef' elements, to the 'THESIS', 'MISC', 'SUPPORT', or 'keyword' elements a 'THESIS', 'MISC', 'SUPPORT', or 'keyword' is an alternative interpretation of in relation to its associated text, only in the case this element has not been chosen by the annotator as part of the likeliest interpretation. The only elements referred to via 'elementRef' must be the ones that have been chosen as part of the favoured interpretation. Since it is possible to include in the TheSu document more than one alternative interpretations to the favoured, the annotator may rank the likelihood of each in '@rank', by using a number between "1" (likeliest alternative to the favoured interpretation) and "4" (less likely alternative to the favoured interpretation). When multiple "alternative" elements share the same rank, it is assumed that they are part of the same interpretation and would thus be valid at the same time, if their corresponding interpretation were the correct (note that each of these, in turn, may also be referenced by further "alternative" elements). Since the annotator's can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : ambiguous**Attributes:**

comment, uncertain, value

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

metaphorConsciousness

Definition:

This is to specify, through '@value', whether an annotated 'metaphor' in a 'THESIS' or 'MISC' corresponds to a metaphor or metonymy that is meant by its speakers to be ditropically ambiguous—i.e. activating its metaphorical or metonymic sense (with respects to the same 'THESIS' or 'MISC') simultaneously with its literal meaning— or univocally a metaphor or metonymy (inasmuch as can be inferred from the full discourse it is included in). The annotator's choice may be supported, through 'proof', by referring to relevant textual evidence. In the case the recognition of the ambiguity is notably uncertain, '@uncertain' may be specified as "true". Since it can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : analogiesGroup**Attributes:**

comparison

Children:

analogy*

Parents:

propositionType

Definition:

If this element's ancestor 'THESIS' or 'PROPOSITION' includes analogies or comparisons, the structure of each may be annotated here via 'analogy'. One 'analogy' may be added for each distinct analogical or comparative relationship, as present in the text of the corresponding 'THESIS' or 'PROPOSITION'.

Element : analogy**Attributes:**

comparison

Children:

marker, analogyMember+, comparisonDomain, customElement*

Parents:

analogiesGroup

Definition:

This is to annotate the structure of an analogy or of a comparison, as it occurs in the text of this element's ancestor 'THESIS' or 'PROPOSITION'. To specify that the analogical structure, rather than simply assimilating one or more features of its members (e.g. "the moon sends us heat like the sun"), is used to compare them, expressing that in one member they are present with a lesser or higher degree than in the others (e.g. "the moon sends us less heat than the sun"), specify '@comparison' as "true". In the case of 'THESIS' elements, the annotator may prove the analogy's presence in their text via 'marker', by referring to textual evidence (i.e. text segments in a digital source) in which the analogical (e.g. the word "like") or comparative (e.g. the expression "more than") relationship between its members is expressed. At least one 'analogyMember' must be added, in correspondence with each member of the analogy or comparison; it is allowed to include only one 'analogyMember' in the case of single-term comparisons, i.e. superlative sentences (e.g. "the sun sends us the most heat"). The annotator may specify the quantificational domain of such comparisons, i.e. the limited reference group in which the superlative sentence is regarded to be true (e.g., implicitly, "celestial bodies" in the last example) via 'comparisonDomain'. Custom elements can be added through 'customElement'.

Element : / marker — Complex Type: proof

Definition:

This is to refer, in the case the 'analogy' has an ancestor 'THESIS' element, to a textual marker of the annotated analogical structure (e.g. the word "like"), by providing a link to its corresponding text span in the digital source in 'locusRef' → 'locusLink'. The referenced text segment can be reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human.

Element : analogyMember**Attributes:**

comment, comparans, comparisonRank, uncertain

Children:

textRef, themedTextRef, elementRef, themedFreeText

Parents:

analogy

Definition:

This is to annotate the details of a member of an analogy or of a comparison. In the case of comparisons, each member may be ranked in relation to its siblings in '@comparisonRank', according to the lesser or higher degree of the compared features that are attributed to it (e.g. in the comparison "the moon sends us less heat than the sun" the member "the sun [sends us heat]" may be ranked as "1", and "the moon sends us... heat" as "2"). If this member is assumed by the speaker to

be better known than another, and is thus used as a source of features to be projected onto another member (i.e. this is a "comparans" in relation to a "comparandum", or, in Perelman's terminology, a "phoros" in relation to a "theme" — e.g., in the analogy "the moon sends us heat like the sun", the member "sun [sends us heat]" in relation to the member "the moon sends us heat"), the annotator may specify '@comparans' as "true". If no member is specified as "source", the analogy or comparison will be assumed to be homogeneous in its informative content, i.e. rhematic in its entirety (e.g. the analogy "the moon and the sun behave in similar ways"). If the identification of this member as either "source" or not is uncertain, specify '@uncertain' as "true". The text of the 'analogyMember' may be specified in different ways. In the case of "explicit" 'THESIS' elements, the annotator may: refer to the exact segments of text—in the limits of the 'THESIS's 'text'— that correspond to the present member (including its predicates, e.g. in the analogy "the moon sends us heat like the sun" one member will be "the moon sends us heat" and the other "sends us heat... the sun") via 'textRef' (note that in this case the keywords corresponding to the text span will be assumed to be relevant to this 'analogyMember', and not to the others which do not refer to it); or again refer to the exact segments of text that correspond to the present member (including its predicates) but also provide them with their own (micro-)thematic annotation, via 'themedTextRef' (which is useful when the annotator wants to specify the most relevant narrow themes of a member without presenting them as central to the whole analogy, i.e. without specifying them in the 'thesisType's child 'microThemesGroup'); or refer to another annotated 'THESIS' or 'MISC'—figuring in its whole in this analogy or comparison as a member— via 'elementRef'; or freely type in the span of text corresponding to the member (including its predicates) as it is specified in the 'paraphrasis' of the 'THESIS' (which is especially useful when the member includes implicit keywords, not corresponding to any segment of text), and again, possibly, provide it with its own (micro-)thematic annotation, via 'themedFreeText' (note that in this case the keywords corresponding to the text span of the "paraphrasis" will be assumed to be relevant to this 'analogyMember', and not to the others which do not refer to it). In the case of "implicit" 'THESIS' elements, the annotator may: refer to another annotated 'THESIS' or 'MISC'—figuring in its whole in this analogy or comparison as a member— via 'elementRef'; or freely type in the span of text corresponding to the present member (including its predicates), as it is specified in the 'paraphrasis' of the "implicit" 'THESIS', and possibly provide it with its own (micro-)thematic annotation, via 'themedFreeText' (in this case, the annotator will be able to specify the most relevant narrow themes of this member without presenting them as central to the whole analogy, i.e. without having to specify them in the 'thesisType's child 'microThemesGroup' — also note that in this case the keywords corresponding to the text span of the "paraphrasis" will be assumed to be relevant to this 'analogyMember', and not to the others which do not refer to it). In the case of 'PROPOSITION' elements, the annotator may: refer to another annotated 'PROPOSITION'—figuring in its whole in this analogy or comparison as a member— via 'elementRef'; or freely type in the span of text corresponding to the present member (including its predicates), as it is specified in the 'paraphrasis' of the 'PROPOSITION', and possibly provide it with its own (micro-)thematic annotation, via 'themedFreeText' (in this case, the annotator will be able to specify the most relevant narrow themes of this member without presenting them as central to the whole analogy, i.e. without having to specify them in the 'propositionType's child 'microThemesGroup' — also note that in this case the keywords corresponding to the text span will be assumed to be relevant to this 'analogyMember', and not to the others which do not refer to it).

Element : argumentation**Attributes:**

for, rank

Children:

proof

Parents:

supportFunctionsGroup

Definition:

This is to specify, in '@rank', how prominent is the argumentative function in a support with respects to the others, as indicated in the ranks of this element's siblings 'exposition', 'expansion', and 'contextualization'. If the chosen rank is higher than "4" —i.e. closer to "1"—, this means that the support is (also) used by its speakers to argue for or against the content of one or more 'THESIS' or 'SUPPORT' elements. The argument's aim towards its target must be specified in '@for' by using the following values: "acc" if it supports the acceptance of its target theses or supports; "rej" if it supports their rejection (and is therefore a refutation); or "mix" if it supports both their acceptance and refusal at the same time (rather examining or problematizing them). To prove the prominence that has been indicated for this function, the annotator may use 'proof' and refer to textual evidence of the support's argumentative function.

Element : assent**Attributes:**

assentValue, comment, uncertain

Children:

assentSpeaker, assentSupSpeakersGroup, assentAuthor, customElement*

Parents:

SUPPORT, THESIS

Definition:

This is to provide details on the extension of the assent of the speakers of a 'THESIS' or 'SUPPORT' towards the content of the same 'THESIS' or 'SUPPORT', inasmuch as can be inferred from the full discourse this is included in, as well as on the assent of the work's authors (if distinct from these speakers) and of any superordinate speaker reporting on the 'THESIS' or 'SUPPORT' without themselves committing to it. Information on the assent of the speakers of the 'THESIS' or 'SUPPORT' can be annotated in 'assentSpeakers', in which it is also possible to specify the presence in the text of any limitations to the speakers' full commitment — i.e. signals that the 'THESIS' or 'SUPPORT' should be understood as a weakened claim (e.g. "it is likely that..."), as hyperbolic, as humorous, as hypothetic and provisional, or as fictitious (note that these limitations may be cumulative). The assent of all superordinate speakers (if any) can be specified in 'assentSupSpeakersGroup'; and the assent of the work's authors in 'assentAuthor'. Custom elements can be added through 'customElement'.

Element : assentAuthor**Attributes:**

assentValue, comment, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

assent

Definition:

This is to specify the assent of the authors of the work containing this element's ancestor 'THESIS' or 'SUPPORT' towards its content, inasmuch as can be inferred from the full macrotext this is included in. The assent can be specified in '@assentValue' by using the following values: if the authors agree with the 'THESIS' or 'SUPPORT' they report, choose "aff" (affirmative assent); if they do not agree with it, choose "neg" (negative assent); if they not only do not agree with it, but also refute it somewhere in the same macrotext, choose "att" (attack). If no value is specified, it is assumed that the authors' assent is indiscernible. If a value has been chosen, but the determination of the authors' assent is notably uncertain, specify '@uncertain' as "true". The annotator's choice may be supported, through 'proof', by referring to textual evidence of the indicated authors' assent. Since the annotator's choice can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : assentSpeaker**Attributes:**

assentValue, comment, uncertain

Children:

limitationsGroup, proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

assent

Definition:

This is to provide details on the extension of the assent of the speakers of this element's ancestor 'THESIS' or 'SUPPORT' towards the content of the same 'THESIS' or 'SUPPORT', inasmuch as can be inferred from the full discourse this is included in. The assent can be specified in '@assentValue' by using the following values: if the speakers present the 'THESIS' or 'SUPPORT' with positive commitment, choose "aff" (affirmative assent); if they present it without believing in it, choose "neg" (negative assent); if they not only do not believe in it, but also refute it somewhere in the same discourse, choose "att" (attack). If no value is specified, it is assumed that the speakers' assent is indiscernible. If a value has been chosen, but the determination of the speakers' assent is notably uncertain, specify '@uncertain' as "true". The annotator's choice may be supported, through 'proof', by referring to textual evidence of the indicated speakers' assent. Since the annotator's choice can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. It is also possible, in 'limitationsGroup', to specify the presence in the text of any limitations to the speakers' full commitment towards the 'THESIS' or 'SUPPORT' at the moment they make the claim — i.e. signals that the 'THESIS' or 'SUPPORT' should be understood as a weakened claim (e.g. "it is likely that..."), as hyperbolic, as humorous, as hypothetical and provisional, or as fictitious (note that these limitations may be cumulative).

Element : assentSupSpeaker**Attributes:**

assentValue, comment, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

assentSupSpeakersGroup

Definition:

This is to specify the assent of a superordinate speaker (whether individual or plural) reporting on this element's ancestor 'THESIS' or 'SUPPORT' —without themselves committing to it— towards the content of the same 'THESIS' or 'SUPPORT', inasmuch as can be inferred from the full macrotext this is included in. The assent can be specified in '@assentValue' by using the following values: if the superordinate speakers agree with the 'THESIS' or 'SUPPORT' they report, choose "aff" (affirmative assent); if they do not agree with it, choose "neg" (negative assent); if they not only do not agree with it, but also refute it somewhere in the same macrotext, choose "att" (attack). If no value is specified, it is assumed that the superordinate speakers' assent is indiscernible. If a value has been chosen, but the determination of the superordinate speakers' assent is notably uncertain, specify '@uncertain' as "true". The annotator's choice may be supported, through 'proof', by referring to textual evidence of the indicated superordinate speakers' assent. Since the annotator's choice can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : assentSupSpeakersGroup**Attributes:**

assentValue, comment, uncertain

Children:

assentSupSpeaker*

Parents:

assent

Definition:

This is to specify, via one or more 'assentSupSpeaker' elements, the assent of all superordinate speakers (if any) reporting on this element's ancestor 'THESIS' or 'SUPPORT' —without themselves committing to it— towards the content of the same 'THESIS' or 'SUPPORT', inasmuch as can be inferred from the full discourse this is included in. If the report of the 'THESIS' or 'SUPPORT' is nested in another report (and so on), an 'assentSupSpeaker' may be added for the superordinate speakers of each nested report; the order of succession of these elements must correspond to the order of the nested reports, from the inner to the outer — e.g. if a 'THESIS' from Gorgias is quoted by Protagoras in a speech that is reported by Socrates, the first 'assentSupSpeaker' of Gorgias's 'THESIS' will correspond to Protagoras's assent, and the second to Socrates's. All of the speakers matching the succession of 'assentSupSpeaker' elements must correspond to speakers associated with 'THESIS' or 'MISC' elements in which this element's ancestor 'THESIS' or 'SUPPORT' is nested, i.e. 'THESIS' or 'MISC' elements of the "historical" or "metatextual" kind — e.g. the aforementioned 'THESIS' from Gorgias will have to be annotated as part of a "historical" or "metatextual" 'THESIS' or 'MISC' with Protagoras as its speaker, and this latter 'THESIS' or 'MISC' annotated as part of a "historical" or "metatextual" 'THESIS' or 'MISC' with Socrates as its speaker.

Element : author**Attributes:**

comment, name, rank

Children:

/

Parents:

authorsGroup

Definition:

Please refer to the 'name' complexType. In the case the annotator (or any scholar) judges the attribution of the text to the specified author to be pseudoepigraphical, or considers this possibility or rejects it, this may be specified and connected with relevant literature in 'spurious'.

Element : authority**Attributes:**

rank

Children:

elementRef{0,1}, authorityName{0,1}, authorityLocus{0,1}, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

authorityDetails

Definition:

This is to provide the details of an authority that is referenced in an argument from authority. In the case the authoritative information corresponds to a 'THESIS', 'MISC', or 'SUPPORT' in a TheSu document, the annotator may simply use 'elementRef' to link to it. Otherwise, the annotator may specify the name or group designator of the authority in 'authorityName'. Then, in the case the argument from authority mentions or alludes to a specific text passage, the annotator may provide its coordinates (whether in the free form of a written reference or by linking to a text segment in a digital source) in 'authorityLocus'. To prove the relevance of the referenced element or name of authority and segment of text, the annotator may use 'proof' and refer to textual evidence of the citation or allusion. Since the identification of the relevant authority can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The identification of the authority referenced in the argument from authority may sometimes be uncertain due to an ambiguity in the latter's phrasing: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'authority' to be the truly relevant one with respect to its siblings, by giving it a value between "1" (most likely) and "4" (least likely). Custom elements can be added through 'customElement'.

Element : / authorityLocus — Complex Type: textLocus

Definition:

Please refer to the 'textLocus' complexType.

Element : / authorityName — Complex Type: speakersGroup

Definition:

Please refer to the 'speakersGroup' complexType.

Element : authorityDetails**Attributes:**

comment, uncertain

Children:

authority+, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

supportForm

Definition:

This it to add further details in the case a 'supportForm' has been annotated as an argument from authority. To specify the name or group designator of each of the referenced authorities, along with the text passages mentioned or alluded to in the argument from authority (if any), the annotator may use an 'authority'. If their identification is uncertain, specify '@uncertain' as "true". In the case the reference is ambiguous enough to support an identification with more than one authorities or groups of authorities, the annotator can decide to provide the details of all, but must choose one or more as the most likely to be the truly referenced ones by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'authority' elements, and specifying as e.g. "2" that of the others. When multiple 'authority' elements are provided with the same rank, it is assumed that the annotator understands the argument from authority to refer to all their corresponding authorities at the same time. In the case no 'authority' element is provided with rank "1", this means that the ambiguity is too high to propose a reasonable identification (but note that at least one authority, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the authorities; this can be proven via the child element 'proof' of each 'authority'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. Custom elements can be added through 'customElement'.

Element : authorityRecord**Attributes:**

bibliographicRecords, entailmentTags, formTags, historyTags, keywordTags, macroThemeTags, microThemeTags, nameTags, oppositionTags, ref

Children:

/

Parents:

authorizedTags

Definition:

This links through '@ref' to the URL of an authority record that is referenced by the tags in the corpus. An authority record can be referenced by one or more kinds of tags: if it contains the authorized spellings of the tags in '@bibliographyRef', specify '@bibliographyTags' as "true"; if '@entailedAs', '@entailmentTags'; if '@namely', '@keywordTags'; if '@formTag', '@formTags'; if '@historyTime' and '@historyType', '@historyTags'; if '@macroThemeTag', '@macroThemeTags'; if '@microThemeTag', '@microThemeTags'; if '@name', '@nameTags'; if '@opposedAs', '@oppositionTags'.

Element : authorizedTags**Attributes:**

bibliographicRecords, entailmentTags, formTags, historyTags, keywordTags, macroThemeTags, microThemeTags, nameTags, oppositionTags, ref

Children:

authorityRecord*

Parents:

TheSu

Definition:

This is to list the URLs of the authority records referenced in the corpus by the tags in: '@bibliographyRef', '@entailedAs', '@namely', '@formTag', '@historyTime', '@historyType', '@macroThemeTag', '@microThemeTag', '@name', '@opposedAs'.

Element : authorsGroup**Attributes:**

anonymousNickname, comment, uncertain

Children:

author*, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

sourceInfo

Definition:

This is to specify the authors of a primary text corresponding to a 'source', whether certain, alleged, or merely hypothetical. For each of such authors, the annotator may add an 'author'. If their identification is uncertain, '@uncertain' may be specified as "true". In the case the uncertainties are such that the authorship of the text may be attributed to more than one author or group of authors, the annotator can decide to provide the details of all, but must choose one or more as the most likely to be the actual authors by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'author' elements, and specifying as e.g. "2" that of the others. The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the alleged authors; this can be proven via the child element 'proof' of each 'author'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. When multiple 'author' elements are provided with the same rank, it is assumed that the annotator understands all of their corresponding individuals or groups to share the authorship of the text. In the case no 'author' element is provided with rank "1", or the 'authorsGroup' includes no 'author' elements at all, it is assumed that the uncertainty is too high to propose a reasonable identification. In this circumstance, the text, rather than being associated with any specific author, is just taken to be anonymous, and the annotator may use 'anonymousNickname' to specify a name with which to refer to the anonymous author or group of authors (e.g. "Pseudo-Aristotle", "Anonymous of Canterbury", etc.).

Element : biblQuote**Attributes:**

from, to

Children:

/

Parents:

externalRef

Definition:

This is to quote a relevant passage in a referenced work.

Element : bibliography**Attributes:**

comment

Children:

bibliographyRef*, externalRef*, customElement*

Parents:

sourceInfo

Definition:

This is to include information on the relevant bibliography on a 'source'. Any number of bibliographical references may be added via 'bibliographyRef' elements; in the case the source is a digital edition of a text —meaning that the primary text, rather than being identifiable with the digital source itself, is reported in it—, the annotator must provide a 'bibliographyRef' referred to its corresponding bibliographic record and specify it as the "base edition" for the 'source'. References to specific sections or passages in any work of secondary literature commenting on the source as a whole may be added via 'externalRef' elements. Custom elements can be added through 'customElement'.

Element : / externalRef — Complex Type: externalRef

Definition:

This is to refer to specific sections or passages of any work of secondary literature commenting on the primary text of a 'source' as a whole. Please refer to the 'externalRef' complexType.

Element : bibliographyRef**Attributes:**

baseEdition, completeEdition, digitalEdition, id, philologicalNotes, ref, translation

Children:

/

Parents:

bibliography

Definition:

This is to refer, via '@ref' in the form of an href, to a bibliographic record in the bibliography authority record associated with the TheSu document (i.e. whose URI is referred to in an 'authorityRecord' with '@bibliographicRecords' specified as "true". If a digital edition of the

referenced work exists, its URI may be referred to in '@digitalEdition' in the form of an href. In the case the referenced work corresponds to the digital source associated with the 'source', and this is a digital edition of a text (i.e. it is not identifiable with the primary text itself, but reports it), 'baseEdition' must be specified as "true". If the referenced work is or contains a complete edition of the primary text corresponding to the 'source', 'completeEdition' may be specified as "true"; if it is or contains a collection of philological notes on the text, 'philologicalNotes' may be specified as true; if it is or contains a translation of the text, 'translation' may be specified as "true". Every 'bibliographyRef' can be provided with its own ID in '@id': this allows the annotator to reference them —rather than their corresponding bibliographic records— in the 'externalRef', 'scholarPro', and 'scholarContra' elements in the TheSu document, thus simplifying the annotation and shortening the links.

Element : comparisonDomain

Attributes:

comment, uncertain

Children:

keywordSubRef{0,1}, keywordTagRef*, themedFreeText{0,1}, proof, externalRef*, scholarPro*, scholarContra*

Parents:

analogy

Definition:

This is to specify the quantificational domain of a superlative comparison, i.e. the limited reference group in which the superlative sentence is regarded to be true (e.g., implicitly, "celestial bodies" in the statement "the sun sends us the most heat"). This may be specified in three different ways: in the case the reference group corresponds to one or more of the keywords annotated for the 'THESIS' or 'PROPOSITION', by referring to them via 'keywordSubRef'; in the case the group corresponds to one or more keywords whose tags are present in the "keywordTags" authority record associated to the TheSu corpus, and which have not been used to label any of the keywords included in the 'THESIS' or 'PROPOSITION', by referring to them in one or more 'keywordTagRef' and specifying their micro-themes; otherwise, in the case the reference group is hardly associated with any specific keyword, by freely designating it in 'themedFreeText' as a string, while also providing it, if possible, of its own micro-thematic annotation. In the latter two cases, the annotator may prove the relevance of the specified quantificational domain by referring to textual evidence (i.e. text segments in a digital source) in which the reference group is alluded to. Since the annotator's choice can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. If the identification of the reference group is notably uncertain, specify '@uncertain' as "true".

Element : conscious

Attributes:

comment, uncertain, value

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

macroTheme, metaphorConsciousness, microTheme

Definition:

This is to specify, through '@value', whether an annotated 'microTheme', 'macroTheme', or 'metaphor' reflects the ideas or intentions of the speakers of its ancestor 'THESIS' or 'MISC' or not; i.e. whether they are aware (inasmuch as can be inferred from the full discourse or macrotext that includes their statements) of its core annotated detail or not. The annotator's choice may be supported, through 'proof', by referring to relevant textual evidence. In the case of 'metaphor' elements, if the speakers of the 'THESIS' or 'MISC' that includes the corresponding metaphor or metonymy match any of speakers that have been indicated in 'metaphorRecognition' to be the ones manifesting to recognize its metaphorical or metonymical character (if any), and a text span has been associated with the annotation of their recognition, the use of 'proof' is here redundant and avoidable. In the case the recognition of the speakers' awareness is notably uncertain, '@uncertain' may be specified as "true". Since it can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : contextualization**Attributes:**

rank, reciprocal

Children:

proof

Parents:

supportFunctionsGroup

Definition:

This is to specify, in '@rank', how prominent is the contextualizing function in a support with respects to the others, as indicated in the ranks of this element's siblings 'argument', 'exposition', and 'expansion'. If the chosen rank is higher than "4" —i.e. closer to "1"—, this means that the support is (also) used by its speakers to contextualize the interpretation and reception of the content of one or more 'THESIS', 'MISC', or 'SUPPORT' elements. To prove the prominence that has been indicated for this function, the annotator may use 'proof' and refer to textual evidence of the support's contextualizing function. In the case the targets of a "contextualizing" support are themselves used, by the same speakers, to contextualize the content of the first —i.e. the contents of multiple, reciprocal, "contextualizing" supports are presented in a symmetrical structure in which they are all equally rhematic and none thematic with respects to the others—, the annotator can avoid to annotate further "contextualizing" 'SUPPORT' elements in correspondence with the reciprocating targets of the first, and indicate that the contextualization is reciprocal by specifying "@reciprocal" as "true". This situation may occur, for instance, when a contextualizing support is used to introduce a contrast (e.g. the phrase "differently than the sun" in the sentence "differently than the sun, the moon radiates reflected light"), but the annotator recognizes the target it contrasts with to be equally presented by the speakers to contrast the content of that support (e.g. in "the sun radiates its own light, but the moon reflects that of the sun"); in such cases, the contrasts are symmetrical in the sense that all their poles are equally rhematic, and the contextualization of each is reciprocated.

Element : customElement**Attributes:**

from, to

Children:

/

Parents:

elementRef, externalRef, name, proof, MISC, PROPOSITION, SUPPORT, THESIS, analogy, assent, author, authority, authorityDetails, authorsGroup, bibliography, definition, etiology, historyDetails, historyOnPersons, historyTime, historyType, keyword, lectio, limitation, macroTheme, matchingProposition, metaphor, metaphorConsciousness, metatext, metatextDetails, microTheme, paraphrasis, proof, relationships, sourceInfo, supportForm, supportFunctionsGroup, supportType, target, text, textRef, title, uncertainties, propositionType

Definition:

This is to include custom annotations in the TheSu document. This element can be provided freely with any attribute and child element.

Element : definition**Attributes:**

value

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

propositionType

Definition:

This is to specify whether the annotated 'THESIS' or 'PROPOSITION' has the structure of a definition or not. In the case of 'THESIS' elements, the annotator may prove that they are regarded by their speakers to be definitions or not via 'proof', by referring to textual evidence of the same speakers' presentation of them as definitions or denial to them of such status. Since the annotator's choice can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. Custom elements can be added through 'customElement'.

Element : deliberate**Attributes:**

comment, uncertain, value

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

metaphorConsciousness

Definition:

This is to specify, through '@value', whether an annotated 'metaphor' in a 'THESIS' or 'MISC' corresponds to a metaphor or metonymy that has been deliberately used by its speakers or not (inasmuch as can be inferred from the full discourse it is included in). The annotator's choice may be

supported, through 'proof', by referring to relevant textual evidence. In the case the recognition of the speakers' intentionality is notably uncertain, '@uncertain' may be specified as "true". Since it can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : differences

Attributes:

partialRef

Children:

lectioRef+

Parents:

text

Definition:

This is to specify that the spelling of the text that is referenced in this element's parent 'text' (as contained in the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') is taken to be partially or completely different for the purposes of the TheSu annotation, which assumes one or more divergent variant readings. These must be included in the same 'AESystem' as 'lectio' elements and referenced under this element through 'lectioRef'. If only a segment of the variant reading is meant to substitute the text, use '@partialRef' to specify its extent.

Element : employedElements

Attributes:

ref

Children:

elementRef*

Parents:

SUPPORT

Definition:

This is to refer, via one or more 'elementRef' elements, to all the 'THESIS', 'MISC', and 'SUPPORT' elements, corresponding to parts of the discourse occurring in the text span indicated as 'text' for a 'SUPPORT', that this same support uses to fulfill its functions (e.g. theses used as premises).

Element : entailedBy

Attributes:

comment, entailedAs, ref

Children:

/

Parents:

entailment

Definition:

The ID of the 'PROPOSITION' or 'THESIS' whose content entails that of this element's ancestor 'PROPOSITION' or 'THESIS' must be referenced via href in '@ref'. The annotator can specify the kind of entailment (e.g. inclusion or logical subalternity) by using '@entailedAs'.

Element : entailment**Attributes:**

comment, entailedAs, ref

Children:

entailedBy+

Parents:

THESIS, relationships

Definition:

This is to connect a 'PROPOSITION' or 'THESIS' to others that logically entail it. Use an 'entailedBy' for each.

Element : etiologiesGroup**Attributes:**

comment

Children:

etiology*

Parents:

propositionType

Definition:

If this element's ancestor 'THESIS' or 'PROPOSITION' includes etiologies —i.e. statements on the causes or ends of one or more events—, the structure of each may be annotated here via 'etiology'. One 'etiology' may be added for each distinct causal or telic link, as present in the text of the corresponding 'THESIS' or 'PROPOSITION'.

Element : etiology**Attributes:**

comment

Children:

marker{0,1}, etiologyMember{2,unbounded}, customElement*

Parents:

etiologiesGroup

Definition:

This is to annotate the structure of an etiology —i.e. a statement on the causes or ends of one or more events—, as it occurs in the text of this element's ancestor 'THESIS' or 'PROPOSITION'. In the case of 'THESIS' elements, the annotator may prove the etiology's presence in their text via 'marker', by referring to textual evidence (i.e. text segments in a digital source) expressing the causal or telic link (e.g. the word "because"). At least two 'etiologyMember' elements must be added, in correspondence with each linked event, cause, and end constituting the etiology. Custom elements can be added through 'customElement'.

Element : / marker — Complex Type: proof

Definition:

This is to refer, in the case the 'etiology' has an ancestor 'THESIS' element, to a textual marker of the annotated etiological structure (e.g. the word "because"), by providing a link to its corresponding text span in the digital source in 'locusRef' → 'locusLink'. The referenced text segment can be reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human.

Element : etiologyMember

Attributes:

cause, comment, end, uncertain

Children:

textRef, themedTextRef, elementRef, themedFreeText

Parents:

etiology

Definition:

This is to annotate the details of an event, cause, or end in an etiology (i.e. a statement on the causes or ends of one or more events). If this event is one of the reported causes in the etiology, specify '@cause' as "true"; if it is one of the reported ends, specify '@end' as true; if specified to be neither a cause nor an end, this is assumed to be among the events whose sibling (causal or telic) 'etiologyMember' elements are the reported causes or ends of. If the identification of this member as either cause or end is uncertain, specify '@uncertain' as "true". The text of the 'etiologyMember' may be specified in different ways. In the case of "explicit" 'THESIS' elements, the annotator may: refer to the exact segments of text—in the limits of the 'THESIS's 'text'— that report on the present event, cause, or end via 'textRef' (note that in this case its corresponding keywords will be assumed to be only relevant to this 'etiologyMember', and not to the others which do not refer to it); or again refer to the exact segments of text that report on the present event, cause, or end, but also provide them with their own (micro-)thematic annotation, via 'themedTextRef' (which is useful when the annotator wants to specify the most relevant narrow themes of an event, cause, or end without presenting them as central to the whole etiology, i.e. without specifying them in the 'thesisType's child 'microThemesGroup'); or refer to another annotated 'THESIS' or 'MISC'—figuring in its whole in this etiology as either event, cause, or end— via 'elementRef'; or freely type in the span of text reporting on the present event, cause, or end, as it is specified in the 'paraphrasis' of the 'THESIS' (which is especially useful when the reported event, cause, or end includes implicit keywords, not corresponding to any segment of text), and again, possibly, provide it with its own (micro-)thematic annotation, via 'themedFreeText' (note that in this case the keywords corresponding to the text span of the "paraphrasis" will be assumed to be relevant to this 'etiologyMember', and not to the others which do not refer to it). In the case of "implicit" 'THESIS' elements, the annotator may: refer to another annotated 'THESIS' or 'MISC'—figuring in its whole in this etiology as either event, cause, or end— via 'elementRef'; or freely type in the span of text reporting on the present event, cause, or end, as it is specified in the 'paraphrasis' of the "implicit" 'THESIS', and possibly provide it with its own (micro-)thematic annotation, via 'themedFreeText' (in this case, the annotator will be able to specify the most relevant narrow themes of this member without presenting them as central to the whole etiology, i.e. without having to specify them in the 'thesisType's child 'microThemesGroup'— also note that in this case the keywords corresponding to the text span of the "paraphrasis" will be assumed to be relevant to this 'etiologyMember', and not to the others which do not refer to it). In the case of 'PROPOSITION' elements, the annotator may:

refer to another annotated 'PROPOSITION' —figuring in its whole in this etiology as either event, cause, or end— via 'elementRef'; or freely type in the span of text reporting on the present event, cause, or end, as it is specified in the 'paraphrasis' of the 'PROPOSITION', and possibly provide it with its own (micro-)thematic annotation, via 'themedFreeText' (in this case, the annotator will be able to specify the most relevant narrow themes of this event, cause, or end without presenting them as central to the whole etiology, i.e. without having to specify them in the 'propositionType"s or 'thesisType"s child 'microThemesGroup' — also note that in this case the keywords corresponding to the text span of the "paraphrasis" will be assumed to be relevant to this 'etiologyMember', and not to the others which do not refer to it). .

Element : expansion

Attributes:

rank

Children:

proof

Parents:

supportFunctionsGroup

Definition:

This is to specify, in '@rank', how prominent is the expansive function in a support with respects to the others, as indicated in the ranks of this element's siblings 'argument', 'exposition', and 'contextualization'. If the chosen rank is higher than "4" —i.e. closer to "1"—, this means that the support is (also) used by its speakers as an excursus, i.e. to expand on the content of one or more 'THESIS', 'MISC', or 'SUPPORT' elements favouring a more complete knowledge and understanding of it. To prove the prominence that has been indicated for this function, the annotator may use 'proof' and refer to textual evidence of the support's expansive function.

Element : exposition

Attributes:

rank

Children:

proof

Parents:

supportFunctionsGroup

Definition:

This is to specify, in '@rank', how prominent is the expository function in a support with respects to the others, as indicated in the ranks of this element's siblings 'argument', 'expansion', and 'contextualization'. If the chosen rank is higher than "4" —i.e. closer to "1"—, this means that the support is (also) used by its speakers to explain more clearly, stylistically, or in depth the meaning of one or more 'THESIS', 'MISC', or 'SUPPORT' elements. To prove the prominence that has been indicated for this function, the annotator may use 'proof' and refer to textual evidence of the support's expository function.

Element : freeText**Attributes:**

comparison

Children:

/

Parents:

themedFreeText

Definition:

This is to select a portion of the text of this element's ancestor 'PROPOSITION' or "implicit" 'THESIS', as annotated in its 'paraphrasis', by typing it in the free form of a string. The annotator should make sure that the wording corresponds exactly to a text span in the associated 'paraphrasis'. To signal points of discontinuity in the quotation use '...!'.

Element : historyDetails**Attributes:**

comment, historyTypeTag, uncertain

Children:

historyType, historyTime, historyOnPersons*, customElement*

Parents:

macroTheme

Definition:

This is to add further details in the case a 'macroTheme' has been annotated as "historical", i.e. narrative. The kind of historical information (e.g. concerning "actions", "ideas", etc.) may be specified via a tag in 'historyType'. The time in which the reported events take place (e.g. "past", "present", etc., with respects to the time of the narrative statements) may be specified via a tag in 'historyTime'. If the narration concerns one or more specific individuals, their names or group designators may be specified in 'historyOnPersons'. Custom elements can be added through 'customElement'.

Element : historyOnPersons**Attributes:**

comment, uncertain

Children:

name+, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

historyDetails

Definition:

This is to specify, via one or more 'name' elements, which individuals an element that has been annotated as "historical" (i.e. narrative) in theme reports on. If this is uncertain, specify '@uncertain' as "true". In the case the statements are ambiguous enough to support an identification with more than one individuals, the annotator can decide to specify the names of all, but must choose one or more as the most likely to be referred to in the historical statements by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'name' elements, and specifying

as e.g. "2" that of the others. When multiple 'name' elements are provided with the same rank, it is assumed that the annotator understands the historical statements to report on all of their corresponding individuals at the same time. In the case no 'name' element is provided with rank "1", it is assumed that the ambiguity is too high to propose a reasonable identification (but note that at least one individual, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the individuals' names; this can be proven via the child element 'proof' of each 'name'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro' and 'scholarContra'.

Element : historyTime

Attributes:

comment, historyTimeTag, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

historyDetails

Definition:

This is to specify, via '@historyTimeTag', the time in which the events reported by an element that has been annotated as "historical", i.e. narrative, in theme take place (e.g. "past", "present", etc., with respects to the time of the narrative statements). If this is uncertain (e.g. a report in present tense may sometimes ambiguously refer to the past), specify '@uncertain' as "true". In the case of such ambiguity, the annotator's choice may be supported, through 'proof', by referring to relevant textual evidence. Since the recognized time of the events can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : historyType

Attributes:

comment, historyTypeTag, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

historyDetails

Definition:

This is to specify, via '@historyTypeTag', what kind of historical information (e.g. concerning "actions", "ideas", etc.) is conveyed by an element that has been annotated as "historical", i.e. narrative, in theme. If this is uncertain (e.g. an ambiguous reference to what a philosopher «said» may be sometimes interpreted as either a report on "sayings" or on "writings", depending on the availability of other information), specify '@uncertain' as "true". In the case of such ambiguity, the annotator's choice may be supported, through 'proof', by referring to relevant textual evidence. Since the recognized kind of history can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : includedPropositions**Attributes:**

comment, xml:base

Children:

PROPOSITION*

Parents:

propositions

Definition:

This is the root element of an included document containing only 'PROPOSITION' elements.

Element : includedRef**Attributes:**

comment, implicit, uncertain

Children:

locusRef{0,1}, elementRef{0,1}, proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

includedRefsGroup

Definition:

This is to refer to a text passage that is referenced in the text of this element's ancestor 'THESIS', 'MISC', or 'SUPPORT'. If the reference to such passage is not explicit in the text, but only alluded to, '@implicit' must be specified as "true". The annotator may report the reference in various ways: either by providing links to a text span in a digital source, which can be done in 'locusRef', or by freely writing the coordinates of its locus, which can as well be done in 'locusRef', or by providing a link to a TheSu element that corresponds with it (if any), which can be done in 'elementRef'. To prove that the reference, in the text, does concern the passage that has been specified, the annotator may use 'proof' and point to textual evidence of the indicated reference. Since the identification of the referenced passage can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : includedRefsGroup**Attributes:**

comment, implicit, uncertain

Children:

includedRef+

Parents:

MISC, SUPPORT, THESIS

Definition:

This is to refer, via one or more 'includedRef' elements, to text passages that are referenced in the text of a 'THESIS', 'MISC', or 'SUPPORT'. In the case of 'THESIS' and 'MISC' elements, the references may be included here only if the passages that they refer to are not their objects, neither as objects of "metatextual" statements (as e.g. in the thesis, in a dialogue, "Glaucus's idea that the moon sends us heat like the sun is trivial", for which the details of the commented sentence would be provided in 'thesisType' → 'macroThemesGroup' → 'macroTheme' → 'metaTextDetails'), nor as

objects of "historical" reports (as e.g. in the thesis, in a dialogue, "Glaucus has just claimed that the moon sends us heat like the sun", for which the details of the quotation would be provided in 'thesisType' → 'macroThemesGroup' → 'macroTheme' → 'historyDetails'). To refer to such passages, the annotator may provide links to their corresponding text span in a digital source, the coordinates of their loci, or links to their corresponding TheSu elements (if any).

Element : keyword

Attributes:

comment, doubleChecked, id, implicit, namely, uncertain

Children:

text, microThemesGroup, proof{0,1}, externalRef*, scholarPro*, scholarContra*, alternativeTo{0,1}, customElement*

Parents:

AEsystem

Definition:

This is to annotate a syntagm as a single keyword participating in the meaning one or more 'THESIS' or 'MISC' elements (and which could thus be referenced in a 'keywordRef'); or, more simply, to annotate the narrow theme or semantic domain of a lexically meaningful syntagm (e.g. for the purposes of indexing) or to connect it to relevant secondary literature. Every 'keyword' must be given its own ID in '@id', and associated with a span of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') via 'text'. In the case of implicit keywords in the content of a 'THESIS' or 'MISC' (e.g. entities alluded to by means of pronouns), the annotator must specify '@implicit' as "true", and reference in 'text' the complete text span corresponding to the 'THESIS' and 'MISC' elements whose content implies them. The annotator may provide a clear paraphrase of the keyword, in the language that has been chosen for the TheSu corpus and following standards to optimize the indexing of all alternative spellings or forms of the same keywords under the same labels (i.e. lexemes) in 'paraphrase'. The keyword's narrow themes or semantic domains (e.g. "military", "psychological", etc.) may be specified in 'microThemesGroup'. The keyword's paraphrase and association with micro-themes represents the annotator's interpretation of its corresponding segment of text: if the interpretation is notably uncertain, '@uncertain' may be specified as "true"; the interpretation may be supported, through 'proof', by referring to textual evidence of the keyword's meaning or of its implicit presence. Since the interpretation can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. When a passage is ambiguous enough to allow for multiple interpretations, and thus for the annotation of more than one distinct, mutually exclusive 'keyword' elements, all of such keywords may be added to the TheSu document, but one of them will always have to be favoured by the annotator, and referred to by each of its alternative keywords in their respective 'alternativeTo' child elements. Custom elements can be added through 'customElement'.

Element : keywordRef

Attributes:

focus, namely, object, ref, subQuantity, subject, wordsInParaphrase

Children:

/

Parents:

keywordsGroup

Definition:

The ID of the 'keyword' —included in the same 'source'— which the annotator wants to qualify as particularly relevant in the text of this element's ancestor 'THESIS' or 'MISC' must be referenced via href in '@ref'. In the case of 'PROPOSITION' elements, the keyword must be spelled —in correspondence with one of the terms included in the 'PROPOSITION's 'paraphrasis'— directly in '@namely', without using '@ref'. In the case of "implicit" 'keyword' elements, the annotator must also indicate to which of the words of the 'paraphrasis' the keywords referenced in each 'keywordRef' correspond. To do this, specify in '@wordsInParaphrasis' the numbers of their corresponding words, as delimited by blank space, in their order of appearance in 'paraphrasis'. Although in the case of 'THESIS' and 'MISC' elements each of their keywords will already be provided with a paraphrasis in the attribute '@namely' of the 'keyword' they refer to, the annotator may always decide to also use '@namely' in 'keywordRef' and repeat the paraphrasis, e.g. in order to make the isolated 'THESIS' or 'MISC' more easily readable for a human. In the case the annotator has recognized more keywords to be present at the same time with a different degree of centrality, or one keyword to be somewhat relevant yet not central to the text's intended meaning, and has decided to include them, their centrality should be ranked in relation to the co-occurring keywords —whether annotated or merely potential— and specified in '@focus'. In the case the present 'keywordRef' is specified for an aggregate-thesis (i.e. a 'THESIS' corresponding to more than one statement and in which its '@quantity' has been given a higher value than "1"), but the keyword is not relevant to all of the statements in the aggregate, the precise number of its corresponding statements should be specified in '@subQuantity'. Minimal syntactic annotation may be added for sibling 'keywordRef' elements, in relation to the text of their ancestor 'THESIS', 'MISC', or 'PROPOSITION', via '@subject' and '@object': '@subject' is to specify which co-occurrent keywords are the subjects of the present one (to be used e.g. in the case of adjectives); '@object' to specify which co-occurrent keywords are its objects (e.g. in the case of verbs). It is assumed that the annotated syntactic relationships apply to all 'THESIS' and 'MISC' elements sharing the same corresponding keywords, so it is only necessary to annotate them once. If, however, the syntactic relationships are different in at least two of such 'THESIS' or 'MISC' elements, these will have to be specified for all.

Element : keywordSubRef**Attributes:**

keywordsInSequence, namely

Children:

/

Parents:

comparisonDomain, metaphorComponent

Definition:

This is to refer to one or more keywords of this element's ancestor 'THESIS' or 'PROPOSITION', inasmuch as they are referenced in its annotated 'keywordsGroup'. To select the keywords, specify in '@keywordsInSequence' the numbers of their corresponding 'keywordRef' elements in their order of appearance in 'keywordsGroup'. The keyword's paraphrasis (in correspondence with that included in its '@namely', as an attribute of the original 'keyword' element and possibly also of the 'keywordRef') may be repeated here in '@namely', e.g. in order to make the annotation more easily readable for a human.

Element : keywordTagRef**Attributes:**

comment, ref

Children:

microThemesGroup

Parents:

comparisonDomain

Definition:

This is to refer, via '@ref' in the form of an href, to the authorized spelling of a tag contained in the keyword tags authority record associated with the TheSu document (i.e. whose URI is referred to in an 'authorityRecord' with '@keywordTags' specified as "true"). Just like in 'keyword' elements, the annotator may specify the keyword's narrow themes, inasmuch as they are relevant to its present occurrence (since e.g. the keyword "body" may in some places be "anatomical-physiological" while in others, independently, "chemical-mechanical"), in 'microThemesGroup'.

Element : keywordsGroup**Attributes:**

focus, namely, object, ref, subQuantity, subject, wordsInParaphrasis

Children:

keywordRef+

Parents:

propositionType, MISC

Definition:

This is to qualify, via 'keywordRef' elements, one or more terms in the text of a 'THESIS', 'MISC', or 'PROPOSITION' as particularly relevant keywords: in the case of 'THESIS' and 'MISC' elements, by pointing each 'keywordRef' to the ID of an already-annotated 'keyword'; in the case of 'PROPOSITION' elements, by paraphrasing them directly in each 'keywordRef'. More keywords may be present at the same time with a different degree of centrality, or one keyword recognized to be somewhat relevant yet not central to the text's intended meaning: the annotator may include all such keywords in any order (as long as it is never modified afterwards, which is important since some elements may refer to the number of 'keywordRef' elements in their order of appearance), but should specify their relative centrality (ranked in relation to that of the co-occurrent keywords, whether annotated or not) via the attribute '@focus' of each 'keywordRef'. When the 'text' of a 'THESIS' or 'MISC' refers to text segments containing terms that are annotated as 'keyword' elements in the same 'source', and these 'keyword' elements are not referred to in any of the 'keywordRef' elements of the same 'THESIS' or 'MISC', these are assumed to count, for them, as keywords with '@focus' = "5" (least central), and in the case of aggregate-theses (i.e. 'THESIS' elements corresponding to more than one statement and in which their '@quantity' has been given a higher value than "1") to refer to all of the statements in the aggregate; these should therefore be explicated via 'keywordRef' only in the case the annotator wanted to indicate their higher centrality, limit their '@subQuantity', or specify more details about them.

Element : lectio**Attributes:**

accepted, comment, conjectural, doubleChecked, id, indirectTrad, lacuna, variant

Children:

text, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

AESystem

Definition:

This is to annotate a variant reading of a segment of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source') and deviates from the spelling reported in the "base edition" of its text (i.e. the edition, if any, whose URI is referred to in a 'bibliographyRef' with '@baseEdition' specified as "true"), i.e. to indicate that the spelling of a text segment in the digital source is different from the spelling of a corresponding text segment in another edition of the same text, or to report conjectural corrections of a segment of text. Every 'lectio' must be given its own ID in '@id', and associated with a span of the primary text which corresponds to the 'source' via 'text', in correspondence with the exact segment of text that the variant reading, if accepted, would replace. The spelling of the variant reading must be reported in '@variant'. If the annotator, taking distance from the text of the source, decides to accept the annotated variant reading, '@accepted' may be specified as "true" (note that this will not eliminate the need of referring to this 'lectio' in the children elements 'differences' of all the 'text' elements that assume it). The annotator may use 'scholarPro', and 'scholarContra' to refer to secondary literature in which the acceptance of the annotated variant reading is supported or rejected; 'externalRef' can be used to refer to neutral comments and discussions on the subject. If the variant reading occurs in the indirect tradition of the text, '@indirectTrad' may be specified as "true"; if it is conjectural, '@conjectural' may be specified as "true"; if both of these attributes are specified as "false", it is assumed that the variant reading occurs in direct witnesses of the text. If the variant reading fills a gap in the text of the source, '@lacuna' may be specified as "true". Custom elements can be added through 'customElement'.

Element : lectioRef**Attributes:**

ref

Children:

/

Parents:

differences, uncertainties

Definition:

The ID of the 'lectio' that includes the variant reading relevant to this element's ancestor 'text' must be referenced via href in '@ref'. Please refer to the 'elementRef' complexType.

Element : limitation**Attributes:**

comment, fictitious, humorous, hyperbolic, hypothetic, uncertain, weakened

Children:

marker{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

limitationsGroup

Definition:

This is to specify the presence in the text of this element's ancestor 'THESIS', 'MISC', or 'SUPPORT' of a limitation to the speakers' full commitment towards its content at the moment they speak or make the claim. Its presence in the text should be proven, through 'marker', by referring to textual evidence (i.e. text segments in a digital source) in which the limitation is expressed. If this qualifies the 'THESIS', 'MISC', or 'SUPPORT' as weakened (e.g. "it is likely that...") specify '@weakened' as "true"; if as hyperbolic, specify '@hyperbolic' as "true"; if as humorous, specify '@humorous' as "true"; if as hypothetic and provisional, specify '@hypothetic' as "true"; if as fictitious, specify '@fictitious' as "true". Note that all the chosen values must be coherent with the formula that is referred to in 'marker': if the text includes distinct formulas expressing the limitations of the 'THESIS', 'MISC', or 'SUPPORT' cumulatively but independently, a corresponding 'limitation' element should be added for each of such formulas to the same 'limitationsGroup'. If the interpretation of the formula expressing the limitation is notably uncertain, specify '@uncertain' as "true". Since the annotator's interpretation can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : / marker — Complex Type: proof

Definition:

This is to refer to a textual marker signalling a limitation to the speaker's engagement towards a 'THESIS', 'MISC', or 'SUPPORT' (e.g. the formulas "it is likely that", "let us suppose that", "laughing, he said that", etc.), by providing a link to its corresponding text span in the digital source in 'locusRef' → 'locusLink'. The referenced text segment can be reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human.

Element : limitationsGroup**Attributes:**

comment, fictitious, humorous, hyperbolic, hypothetic, uncertain, weakened

Children:

limitation*

Parents:

MISC, assentSpeaker

Definition:

This is to specify, via one or more 'limitation' elements, the presence in the text of this element's parent 'THESIS', 'MISC', or 'SUPPORT' of any limitations to the speakers' full commitment towards it at the moment they speak or make the claim — i.e. signals that the 'THESIS' or 'SUPPORT' should be understood as a weakened claim (e.g. "it is likely that..."), as hyperbolic, as humorous, as hypothetic and provisional, or as fictitious (note that these limitations may be cumulative); or that the text span associated with a 'MISC' is generally of a weakened, hyperbolic, humorous, hypothetic and provisional, or fictitious character (note these characterizations may also be cumulative).

Element : locus**Attributes:**

comment, rank, title

Children:

locusRef*, proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

textLocus

Definition:

This is to provide the coordinates of one or more relevant segments of the text of a same source. The source's title must be specified in '@title'. To refer to the specific passages, whether in the free form of a written reference or by linking to text segments in a digital source, the annotator may use one or more 'locusRef'. To prove the relevance of the referenced passages, the annotator may use 'proof' and point to textual evidence of the indicated reference. Since the identification of the relevant segments of text can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The identification of the relevant passages may sometimes be uncertain due to an ambiguity in the text: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'locus' to be the truly relevant one with respect to its siblings, by giving it a value between "1" (most likely) and "4" (least likely).

Element : locusFree**Attributes:**

string

Children:

/

Parents:

locusRef

Definition:

This is to provide the coordinates of a referenced segment of text via a free-form, unlinked written reference. The reference must be specified in '@string'.

Element : locusRef**Attributes:**

from, to

Children:

locusLink*, locusFree{0,1}

Parents:

proof, SUPPORT/marker, analogy/marker, etiology/marker, includedRef, limitation/marker, locus, metaphorRecognition/marker

Definition:

This is to provide the coordinates of a referenced segment of text, whether continuous or discontinuous. The annotator may either use one or more 'locusLink', to point to text segments in a digital source by means of an href to the URI of their starting and (if necessary) ending points, or

specify the coordinates of the referenced passage in free form, i.e. as an unlinked written reference, via 'locusFree'.

Element : / locusLink — Complex Type: segment

Definition:

Please refer to the 'segment' complexType.

Element : macroTheme

Attributes:

comment, macroThemeTag, uncertain

Children:

conscious, proof{0,1}, historyDetails*, metatextDetails*, customElement*

Parents:

macroThemesGroup

Definition:

Use '@macroThemeTag' to specify the broad theme (e.g. "historical", "axiological", etc.) of this element's ancestor 'THESIS', 'MISC', or 'PROPOSITION'. If the annotated broad theme for a 'THESIS' or 'MISC' is recognized to be either representative or unrepresentative of the thematic (macro-)distinctions that are held or perceived by its speakers (inasmuch as can be inferred from the discourse or macrotext in which the same 'THESIS' or 'MISC' is included), the annotator may specify this awareness or unawareness on the speakers' part via '@conscious'. If the broad theme of a 'THESIS' or 'MISC' is unclear (e.g. a statement concerning a procedure to prepare a medication may be ambiguous in its speakers' intention to present it as "methodological", i.e. directly instructive, or "historical", i.e. descriptive of an existing procedure, not in itself recommending to follow it), this may be specified in '@uncertain'. In the case of such ambiguity, the annotator's choice may be supported, through 'proof', by referring to relevant textual evidence. If the annotated theme is "historical", i.e. narrative, details on the historical report may be specified in 'historyDetails'; if the annotated theme is "metatextual", i.e. commenting on one or more statements or segments of text, details on the commented texts may be specified in 'metatextDetails'. Custom elements can be added through 'customElement'.

Element : macroThemesGroup

Attributes:

comment, macroThemeTag, uncertain

Children:

macroTheme+

Parents:

propositionType, MISC

Definition:

This is to specify the broad theme (e.g. "historical", "axiological", etc.) of a 'THESIS', 'MISC', or 'PROPOSITION', via 'macroTheme'. More 'macroTheme' elements may be included in hierarchical succession, since some broad themes may specify some others, e.g.: a general indication on how to prepare a medication may be tagged as "methodological", but a proposition describing how an ancient population prepared a medication may be rather tagged as "historical" — in the latter case, the annotator may decide to add a second 'macroTheme' to tag the proposition also, and

subordinately, as "methodological". The meaningful successions of 'macroTheme' elements are established by the inventory of tags that has been chosen by the annotator, as defined in the macro-themes' authority record associated with the TheSu corpus (i.e. whose URI is referred to in an 'authorityRecord' with '@macroThemeTags' specified as "true").

Element : matchingProposition

Attributes:

comment, extended, partial, propRef, quoted

Children:

customElement*

Parents:

matchingPropositionsGroup

Definition:

This is to refer, via '@propRef' in the form of an href, to a 'PROPOSITION' the annotator understands the 'THESIS' to be an instance of. The matching proposition does not have to be identical in meaning with the thesis, but must be similar enough to it to be connected with it usefully and representatively (e.g. the sentence "temperance has the first place, and humbleness the second" may be usefully connected to the proposition "temperance is more important than humbleness", although slightly different in meaning, if the context allows for the connection). It is also allowed to connect theses to propositions that only correspond to a part of them (e.g. the thesis "temperance benefits our intellect by removing superfluous distractions" to the proposition "temperance benefits our intellect"): in such cases, '@partial' must be specified as "true"; theses can then be connected to propositions that include them while also providing additional information (e.g. the thesis "temperance benefits our intellect" to the proposition "temperance benefits our intellect by removing superfluous distractions"): in such cases, '@extended' must be specified as "true"; lastly, quotations of sentences may be connected directly with the propositions that match these sentences (rather than matching the quotations themselves, which are "historical" reports — e.g. the thesis "Aristotle said that temperance benefits our intellect" to the proposition "temperance benefits our intellect"): in such cases, '@quoted' must be specified as "true". All these attributes can be specified as "true" cumulatively (as e.g. in the case of the thesis "Aristotle said that temperance benefits our intellect by accustoming our soul to higher reasoning" towards the "partial", "extended", and "quoted" proposition "temperance benefits our intellect by removing superfluous distractions").

Element : matchingPropositionsGroup

Attributes:

comment, extended, partial, propRef, quoted

Children:

matchingProposition*

Parents:

THESIS

Definition:

This is to refer, via one or more 'matchingProposition' elements, to the abstract propositions the annotator understands the 'THESIS' to be an instance of, to connect it indirectly with all the theses that appear to be synonymous (enough) with it. The matching 'PROPOSITION' elements are not necessarily identical in meaning with the thesis, but are similar enough to it to be connected with it

usefully and representatively (e.g. the sentence "temperance has the first place, and humbleness the second" may be usefully connected to the proposition "temperance is more important than humbleness", although slightly different in meaning, if the context allows for the connection: in a different context, it may be rather connected to e.g. "temperance is more rewarded than humbleness"; in this sense, also the association of a thesis with a matching proposition reflects the annotator's interpretation of the text); it is also allowed to connect theses to propositions that only correspond to a part of them or to propositions that include them while also providing additional information, and quotations of sentences may be connected directly with the propositions that match these sentences (rather than matching the quotations themselves, which are "historical" reports); each of such cases of imperfect matching is signalled via attributes in 'matchingProposition'.

Element : metaphor

Attributes:

comment, id, metonymy, uncertain

Children:

metaphorComponentsGroup, metaphorConsciousness, metaphorRecognitionsGroup, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

metaphorsGroup

Definition:

This is to annotate details on the structure, meaning, and status (in relation to the awareness of its speakers) of a metaphor or metonymy included in the text of a 'THESIS' or 'MISC'. The metaphorically or metonymically used term —i.e. the figure, vehicle, or source— must be referenced in 'metaphorComponentsGroup', where it is also possible to indicate the recipient, in the text, of the metaphorically or metonymically conveyed idea —i.e. the tenor or target—, as well as the meaning of the metaphor or metonymy, in the case this is literalized in any place of the same discourse or macrotext. If the term's metaphorical or metonymic character is notably uncertain, specify '@uncertain' as "true". Since this can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The annotated metaphors or metonymies may be judged —on the basis of the full discourses they are included in— to be sometimes unconscious to their speakers, who take them literally (e.g. when only the annotator recognizes them to be metaphors, as in the case of some cognitive metaphors), and other times to be conscious; and sometimes unintentional (whether also unconscious or not, as in the case of most catachreses and lexicalized metaphors) and others deliberate; and sometimes meant to be ditropically ambiguous, i.e. activating their metaphorical or metonymic sense (with respects to the same 'THESIS' or 'MISC') simultaneously with their literal meaning, and others to be univocally metaphors or metonymies. All of these cases can be specified and proven in 'metaphorConsciousness'. If specific speakers, in the text, appear to recognize or interpret the annotated metaphor or metonymy to be a metaphor or metonymy (as e.g. in explicit declarations of figurative speaking, or in allegorical interpretations of sentences that might have been literal in origin), the annotator may specify their names or group designators in 'metaphorRecognitionsGroup', and refer to the text spans corresponding to their comments on the metaphor or metonymy. In the case such text span includes the terms that have been annotated as the metaphor or metonymy's meaning in 'metaphorComponentsGroup', it is assumed that this meaning is only attributed to the metaphor or metonymy by the speakers associated with this text span. In any case, since metaphors and metonymies can always be the object of comments or explanations in the text that the annotator may want to include in the TheSu document as (e.g.) "metatextual" THESIS elements or "expository" SUPPORT elements, every 'metaphor' can also be provided with its own

ID, to use it as a target for references in other elements. Custom elements can be added through 'customElement'.

Element : metaphorComponent

Attributes:

agency, comment, personhood, role

Children:

keywordSubRef, themedTextRef, themedFreeText

Parents:

metaphorComponentsGroup

Definition:

This is to annotate a textual component of a metaphor or metonymy occurring in a 'THESIS' or 'MISC'. Its text may be specified in three ways: by referring, via 'keywordSubRef', to one or more of the keywords that have been annotated for the 'THESIS' or 'MISC' in its descendant 'keywordsGroup'; by referring, via 'themedTextRef', to the exact segments of text that correspond to the component while also providing them with their own (micro-)thematic annotation (which is useful when the annotator has decided not to annotate the component as one or more 'keyword' elements, but wants to indicate its most relevant narrow themes in the same way as would be done for 'keyword' elements); or by freely typing in, in 'themedFreeText', the span of text corresponding to the component as it is specified in the 'paraphrasis' of the 'THESIS' or 'MISC' while also providing it with its own (micro-)thematic annotation (which is useful when the component corresponds to implicit text which the annotator has decided not to annotate as one or more 'keyword' elements, but wants to indicate its most relevant narrow themes in the same way as would be done for 'keyword' elements). The component's role in the metaphor or metonymy must be specified in '@role' by using one of the following values: "vehicle" if it is the metaphorically or metonymically used term; "tenor" if it is the recipient, in the text, of the metaphorically or metonymically conveyed idea; and "meaning" if it is the meaning of the metaphor or metonymy, literalized in a text. If the metaphor component corresponds to words denoting or implying an action, and thus their subject's ability to be an agent (e.g. "employs", "operation", etc.), '@agency' may be specified as "true"; if the corresponding words are best understood when their subject is a human or any other intelligent being (e.g. "thinks", "dishonest", etc.), '@personhood' may be specified as true. In this way, animistic and anthropomorphic terminology will be indexed independently of the chosen micro-themes.

Element : metaphorComponentsGroup

Attributes:

agency, comment, personhood, role

Children:

metaphorComponent+

Parents:

metaphor

Definition:

This is to specify the textual components of a metaphor or metonymy occurring in a 'THESIS' or 'MISC', which are: the metaphorically or metonymically used term — i.e. the figure, vehicle, or source; the recipient, in the text, of the metaphorically or metonymically conveyed idea — i.e. the

tenor or target; and the meaning of the metaphor or metonymy, if literalized in any place of the same discourse or macrotext. At least one 'metaphorComponent' must be added, to specify the vehicle of the metaphor or metonymy.

Element : metaphorConsciousness

Attributes:

comment, uncertain, value

Children:

conscious, deliberate, ambiguous, customElement*

Parents:

metaphor

Definition:

This is to specify, in 'conscious', whether the speakers of a 'THESIS' or 'MISC' —inasmuch as can be inferred from the full discourse this is included in— are aware of the metaphoric or metonymic character of an expression they have used in it or not (as sometimes it may be taken literally by the speakers, as e.g. in the case of certain cognitive metaphors which are only recognized to be such by the annotator); in 'deliberate', whether this metaphor or metonymy is deliberately used by the speakers or not (as catachreses and lexicalized metaphors are often not); in 'ambiguous', whether this is meant to be ditropically ambiguous —i.e. activating its metaphorical or metonymic sense (with respects to the same 'THESIS' or 'MISC') simultaneously with its literal meaning— or univocally a metaphor or metonymy. Custom elements can be added through 'customElement'.

Element : metaphorRecognition

Attributes:

comment, uncertain

Children:

speakersGroup, marker{0,1}

Parents:

metaphorRecognitionsGroup

Definition:

This is to specify, in 'speakersGroup', the names or group designators of one or more speakers that appear together, in a text, to recognize or interpret an annotated 'metaphor' to be a metaphor or metonymy (as e.g. in explicit declarations of figurative speaking, or in allegorical interpretations of sentences that might have been literal in origin); and to refer, via 'marker', to the text span corresponding to their comment on the metaphor or metonymy.

Element : / marker — Complex Type: proof

Definition:

This is to refer to a comment on a metaphor or metonymy made by a speaker or group of speakers, by providing a link to its corresponding text span in the digital source in 'locusRef' → 'locusLink'. The referenced text segment can be reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human.

Element : / speakersGroup — Complex Type: speakersGroup

Definition:

Please refer to the 'speakersGroup' complexType. Consider the parent 'metaphorRecognition' as if it were a statement on the metaphorical or metonymic character of the annotated 'metaphor'.

Element : metaphorRecognitionsGroup

Attributes:

comment, uncertain

Children:

metaphorRecognition*

Parents:

metaphor

Definition:

This is to specify, via one or more 'metaphorRecognition' elements, the names or group designators of all the speakers that appear, in a text, to recognize or interpret an annotated 'metaphor' to be a metaphor or metonymy (as e.g. in explicit declarations of figurative speaking, or in allegorical interpretations of sentences that might have been literal in origin); and to refer to the text spans corresponding to their comments on the metaphor or metonymy.

Element : metaphorsGroup

Attributes:

comment, id, metonymy, uncertain

Children:

metaphor*

Parents:

MISC, thesisType

Definition:

This is to annotate details on the structure, meaning, and status of any metaphor or metonymy included in the text of this element's ancestor 'THESIS' or 'MISC'. Add a 'metaphor' for each distinct metaphor or metonymy in the text.

Element : metatext

Attributes:

rank

Children:

elementRef{0,1}, quotedSpeaker{0,1}, quotedLocus{0,1}, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

metatextDetails

Definition:

This is to provide the details of a statement or segment of text (whether continuous or discontinuous) that is commented on by a metatextual statement. In the case the metatext concerns a 'THESIS',

'MISC', or 'SUPPORT' in a TheSu document, the annotator may simply use 'elementRef' to link to it. In the case the metatext concerns a segment of text which is not annotated in this way, the annotator may first specify, if this is a quotation, the quoted individuals or groups in 'quotedSpeaker', and then provide its coordinates (whether in the free form of a written reference or by linking to a text segment in a digital source) in 'quotedLocus'. To prove the relevance of the referenced statement or segment of text, the annotator may use 'proof' and refer to textual evidence of the indicated reference. Since the identification of the relevant statement or segment of text can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The identification of the statement or segment of text that is commented on by the metatext may sometimes be uncertain due to an ambiguity in its phrasing: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'metatext' to be the truly relevant one with respect to its siblings, by giving it a value between "1" (most likely) and "4" (least likely). Custom elements can be added through 'customElement'.

Element : / quotedLocus — Complex Type: textLocus

Definition:

Please refer to the 'textLocus' complexType.

Element : / quotedSpeaker — Complex Type: speakersGroup

Definition:

Please refer to the 'speakersGroup' complexType.

Element : metatextDetails

Attributes:

comment, uncertain

Children:

metatext+, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

macroTheme

Definition:

This is to add further details in the case a 'macroTheme' has been annotated as "metatextual", i.e. commenting on one or more statements or segments of text. To provide the details of each distinct statement or segment of text that is commented on, the annotator may use a 'metatext'. If their identification is uncertain, specify '@uncertain' as "true". In the case the metatext is ambiguous enough to support an identification, for its reference, with more than one statement or segment of text (or more than one group of statements or segments of text), the annotator can decide to provide the details of all, but must choose one or more as the most likely to be commented on by the metatext by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'metatext' elements, and specifying as e.g. "2" that of the others. When multiple 'metatext' elements are provided with the same rank, it is assumed that the annotator understands the metatext to comment on all of their corresponding statements or segments of text at the same time. In the case no 'metatext' element is provided with rank "1", this means that the ambiguity is too high to propose a reasonable identification (but note that at least one referenced statement or segment of text, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the referenced statements or segments of text; this can be proven via the child element 'proof' of each 'metatext'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through

'externalRef', 'scholarPro', and 'scholarContra'. Custom elements can be added through 'customElement'.

Element : microTheme

Attributes:

focus, microThemeTag, rank, subQuantity

Children:

conscious, proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

microThemesGroup

Definition:

Use '@microThemeTag' to specify the narrow theme (e.g. "military", "psychological", etc.) of this element's ancestor 'THESIS', 'MISC', or 'PROPOSITION'. If the annotated broad theme for a 'THESIS' or 'MISC' is recognized to be either representative or unrepresentative of the thematic (micro-)distinctions that are held or perceived by its speakers (inasmuch as can be inferred from the discourse or macrotext in which the same 'THESIS' or 'MISC' is included), the annotator may specify this awareness or unawareness on the speakers' part via '@conscious'. In the case the annotator has recognized more narrow themes to be present at the same time with a different degree of centrality, or one narrow theme to be somewhat relevant yet not central to the text's intended meaning, and has decided to include them, their centrality should be ranked in relation to the co-existent micro-themes —whether annotated or merely potential— and specified in '@focus'. To prove the relevance of the present micro-theme to the text of its corresponding 'THESIS' or 'MISC', the annotator may use 'proof' and refer to relevant textual evidence. Since the recognition of a narrow theme can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The thematic attribution to a 'THESIS' or 'MISC' may sometimes be uncertain due to an ambiguity in their text: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'microTheme' to be the truly relevant one with respect to its siblings sharing its '@focus', by giving it a value between "1" (most likely) and "4" (least likely). In the case the present 'microTheme' is specified for an aggregate-thesis (i.e. a 'THESIS' corresponding to more than one statement and in which its '@quantity' has been given a higher value than "1"), but the narrow-theme is not relevant to all of the statements in the aggregate, the precise number of its corresponding statements should be specified in '@subQuantity'. Custom elements can be added through 'customElement'.

Element : microThemesGroup

Attributes:

comment, uncertain

Children:

microTheme+

Parents:

propositionType, MISC, keyword, keywordTagRef, themedFreeText, themedTextRef

Definition:

This is to specify, via 'microTheme' elements, one or more of the narrow themes (e.g. "military", "psychological", etc.) of a 'THESIS', 'MISC', or 'PROPOSITION'. More narrow themes may be present at the same time with a different degree of centrality, or one narrow theme recognized to be somewhat relevant yet not central to the text's intended meaning: the annotator may include all such themes in any order, but should specify their relative centrality (ranked in relation to the co-existent micro-themes, whether annotated or not) via the attribute '@focus' of each 'microTheme'. If the recognition of the narrow themes or of their relative centrality is uncertain, specify '@uncertain' as "true". In the case the text is ambiguous enough to support the recognition of more than one micro-theme or group of micro-themes for the same degree of centrality (e.g. an ambiguous statement about water's behaviour with respect to nutrition may either be "botanical" or "zoophysiological", if not both), the annotator can decide to include them all, but must choose one or more as the most likely to be the truly relevant narrow themes by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'microTheme' elements, and specifying as e.g. "2" that of the others. When multiple 'microTheme' elements are provided with the same rank and with the same '@focus', it is assumed that the annotator understands all of their corresponding narrow themes to be most likely to be the truly relevant ones for their degree of centrality. In the case no 'microTheme' is provided with rank "1", among those which share the same '@focus', it is assumed that the text's ambiguity is too high to propose a reasonable choice for the corresponding degree of centrality (but note that at least one alleged narrow theme, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the alleged micro-themes; this can be proven via the child element 'proof' of each 'micro-Theme'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : newPropositions**Attributes:**

comment, id, ref, xml:base

Children:

PROPOSITION*

Parents:

propositions

Definition:

This is to annotate new 'PROPOSITION' elements to be referred to in the 'matchingProposition' elements of the same corpus.

Element : opposedTo**Attributes:**

comment, opposedAs, ref

Children:

externalRef*, scholarPro*, scholarContra*

Parents:

opposition

Definition:

The ID of the 'PROPOSITION' that is opposed to this element's ancestor 'PROPOSITION' must be referenced via href in '@ref'. The annotator can specify the kind of opposition (e.g. contrariety or contradiction) by using '@opposedAs'. Since the recognized opposition can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : opposition**Attributes:**

comment, opposedAs, ref

Children:

opposedTo+

Parents:

relationships

Definition:

This is to connect the 'PROPOSITION' to others that are opposed to it. The annotator can specify the kind of opposition (e.g.) by using '@entailedAs'. Use an 'opposedTo' element for each.

Element : paraphrasis**Attributes:**

comment, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

MISC, PROPOSITION, SUPPORT, THESIS

Definition:

This is to provide a clear and concise paraphrasis, in the language that has been chosen for the TheSu corpus, of the semantic content of a 'PROPOSITION', 'THESIS', 'SUPPORT', or 'MISC', in the free form of a string. The paraphrasis must always be coherent with all the details the annotator has provided to the parent element, as e.g. the '@polarity' of 'PROPOSITION' or 'THESIS' elements and all the information specified in 'propositionType' or 'thesisType', or, for 'SUPPORT' elements, that specified in 'supportType'. In the case of 'THESIS' and 'SUPPORT' elements, the paraphrasis is representative of the annotator's interpretation of their corresponding text. In the case of 'MISC' elements, the paraphrasis may rather take the form of a short recapitulation (in accordance with the other annotated details) of a passage, and would represent as well the annotator's own understanding of it. For 'THESIS', 'SUPPORT', and 'MISC' elements, the annotator may want to prove the correctness of the interpretative paraphrasis by using 'proof' and referring to textual evidence supporting it. In the case the interpretation is notably uncertain, '@uncertain' may be specified as "true". Since it can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'. Custom elements can be added through 'customElement'.

Element : proof**Attributes:**

comment

Children:

textRef, snippet{0,1}, customElement*

Parents:

proofBundle, argumentation, comparisonDomain, contextualization, expansion, exposition, macroTheme

Definition:

Please refer to the 'proof' complexType.

Element : propositionType**Attributes:**

biblLocusFree, biblLocusRef, bibliographyRef, comment, extrinsic, implicit, locusRef, uncertain

Children:

macroThemesGroup, microThemesGroup, keywordsGroup, definition, etiologiesGroup, analogiesGroup, customElement*

Parents:

PROPOSITION

Definition:

This is to annotate the 'PROPOSITION' thematically and specify some of its formal features. The proposition's broad theme (e.g. "historical", "axiological", etc.) can be specified in 'macroThemesGroup'; to specify the theme in more detail (e.g. "military", "psychological", etc.) 'microThemesGroup' may be used. Each of the words composing the proposition's text—in correspondence with that included in this element's sibling 'paraphrasis'—can be annotated as a keyword directly (i.e. without referring to a 'keyword' that has been annotated in the same 'source', as is necessary in 'THESIS' and 'MISC' elements) in 'keywordsGroup'. If the proposition has the structure of a definition, this may be specified in 'definition'. If the proposition includes etiologies (i.e. reports of the causes or ends of one or more events), their structure may be annotated in 'etiologiesGroup'; if it includes analogies or comparisons, their structure may as well be annotated in 'analogiesGroup'. Custom elements can be added through 'customElement'.

Element : / externalRef — Complex Type: externalRef

Definition:

This is to refer to secondary literature of any kind concerning the present proposition (e.g. historical accounts of philosophers claiming it, current scientific confutations of it, etc.). Please refer to the 'externalRef' complexType.

Element : propositions**Attributes:**

comment, xml:base

Children:

includedPropositions*, newPropositions

Parents:

TheSu

Definition:

This is to contain all the 'PROPOSITION' elements that are referred to in the 'matchingProposition' elements in the corpus: to include a separate document containing only 'PROPOSITION' elements, refer an element 'xi:include' to a document with 'includedPropositions' as root element; to annotate new 'PROPOSITION' elements use 'newPropositions'.

Element : relationships**Attributes:**

comment, equivalent, rank, ref

Children:

entailment{0,1}, similarity{0,1}, opposition{0,1}, customElement*

Parents:

PROPOSITION

Definition:

This is to annotate semantic relationships between different 'PROPOSITION' elements, thereby connecting them. For relationships of entailment use 'entailment'; for similarity use 'similarity'; for opposition use 'opposition'. Other relationships may be added through 'customElement'.

Element : similarTo**Attributes:**

comment, equivalent, rank, ref

Children:

externalRef*, scholarPro*, scholarContra*

Parents:

similarity

Definition:

The ID of the 'PROPOSITION' that is similar to this element's ancestor 'PROPOSITION' must be referenced via href in '@ref'. The degree of similarity can be ranked through '@rank', with a number between "1" (most similar) and "4" (least similar). If the referenced proposition is logically equivalent, specify '@equivalent' as "true". Since the recognized similarity can be open to debate, references to secondary literature may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : similarity**Attributes:**

comment, equivalent, rank, ref

Children:

similarTo+

Parents:

relationships

Definition:

This is to connect the 'PROPOSITION' to others that are similar to it. Use a 'similarTo' element for each.

Element : snippet**Attributes:**

partialRef

Children:

/

Parents:

SUPPORT/marker, analogy/marker, etiology/marker, limitation/marker, metaphorRecognition/marker, proof, text, proof

Definition:

This is to quote a text segment in a digital source, corresponding exactly to the segment referenced in this element's 'textRef' sibling, to make the isolated TheSu document more easily readable for a human. If the quotation is discontinuous, divide its segments with an ellipsis (three dots, '...').

Element : source**Attributes:**

comment, id, ref, xml:base

Children:

sourceInfo, AEsystem

Parents:

TheSu

Definition:

This is to include all the TheSu annotation that is specific to an individual primary text. Every 'source' must be given its own ID in '@id' and referred, via '@ref' in the form of an href, to the URI of a digital source containing all of its base text. Minimal details on the title and authorship of the source can be provided in 'sourceInfo', as well as references to the bibliography which pertains to it. In the case the associated source is a digital edition of a text —i.e. the primary text, rather than being the digital source itself, is reported in it—, the annotator must provide bibliographical details on such edition, elected as the "base edition" of the 'source', in a 'bibliographyRef' included in 'sourceInfo' → 'bibliography'. The argumentative-expository system of the source is annotated in 'AESystem', which includes all the 'THESIS', 'MISC', 'SUPPORT', 'keyword', and 'lectio' elements associated with its text.

Element : sourceInfo**Attributes:**

comment, original, string, uncertain

Children:

title*, authorsGroup{0,1}, bibliography{0,1}, customElement*

Parents:

source

Definition:

This is to provide minimal details on the title and authorship of a source, as well as references to the bibliography which pertains to it. One or more titles associated with the source may be specified via 'title' elements: the first in their sequence is assumed to correspond to the currently preferred title to refer to the source. The authors of the source, whether certain, alleged, or merely hypothetical, may be reported in 'authorsGroup'. Bibliography on the source—including editions and translations of its text—can be reported in 'bibliography'; in the case the source is a digital edition of a text—meaning that the primary text, rather than being identifiable with the digital source itself, is reported in it—the annotator must provide bibliographical details on such edition, elected as the "base edition" for the 'source', in a 'bibliographyRef' included in 'bibliography'. Custom elements can be added through 'customElement'.

Element : spurious**Attributes:**

accepted, comment, uncertain, value

Children:

externalRef*, scholarPro*, scholarContra*

Parents:

author

Definition:

This is to specify, via '@value', whether a text's attribution to a specified author is judged by the annotator or by any scholar to be pseudoepigraphical or not. If the judgement on its authenticity is notably uncertain, '@uncertain' may be specified as "true". If the annotator does not agree with the judgement as specified in '@value', '@accepted' may be specified as "false". References to secondary literature discussing, supporting, or rejecting this same judgement may be added through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : supportForm**Attributes:**

comment, formTag, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, authorityDetails*, customElement*

Parents:

supportType

Definition:

This is to specify, in '@formTag', the form in which a support achieves its functions (e.g. deductive reasoning, analogy, etc.). In the case of arguments from authority, the annotator may specify the details of the referenced authorities in 'authorityDetails'. Custom elements can be added through 'customElement'.

Element : supportFunction**Attributes:**

comment, uncertain

Children:

supportFunctionsGroup+, proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

supportType

Definition:

This is to specify, in 'supportFunctionsGroup', the functions of an annotated support, i.e. whether a support is argumentative, expository, expansive, or contextualizing (or having two or more of these four functions at the same time). If the identification of the support's functions or of their relative prominence is uncertain, specify '@uncertain' as "true". In the case the supportive span of text is ambiguous enough to support an identification with more than one function or group of functions, or of more than one ranking of the functions' respective prominence —from now on referred to as "arrangement of functions"—, the annotator can decide to annotate all by including more than one 'supportFunctionsGroup', but must choose one arrangement of functions as the most likely to be the truly valid for the support by attributing to it a higher rank, i.e. by specifying as e.g. "1" the '@rank' of its corresponding 'supportFunctionsGroup', and specifying as e.g. "2" that of the others. In the case no 'supportFunctionsGroup' element is provided with rank "1", this means that the ambiguity is too high to propose a reasonable identification (but note that one arrangement of functions, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the proposed arrangements of functions; this can be proven via the child element 'proof' of each 'supportFunctionsGroup'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : supportFunctionsGroup**Attributes:**

rank

Children:

argumentation, exposition, expansion, contextualization, customElement*

Parents:

supportFunction

Definition:

This is to rank the respective prominence of the functions in a support, i.e. to specify whether it functions more as an argumentation, as an exposition, as an expansion, as a contextualization, or in two or more of these four ways at the same time, and how prominent is each function with respect to the others. This is indicated in the '@rank' of each function's corresponding element — i.e. 'argumentation', 'exposition', 'expansion', and 'contextualization'. The default value for each functions' '@rank' is "4", meaning that the function has no particular relevance to the support. If only one of the four functions is recognized to be particularly relevant to it, it is only necessary to specify its '@rank' as "1". In the case the support is recognized to have more than one function at the same time —e.g. a supportive example may be both instrumental to persuading and to clarifying, thus being at the same time argumentative and expository—, each of these function's '@rank' must be changed from "4", and used to represent their respective prominence, as long as at least one '@rank' is specified as "1". E.g.

if a supportive example is judged to be equally argumentative and expository, the '@rank' of both 'argumentation' and 'exposition' must correspond to "1"; if it is judged, in its context, to be more argumentative than expository, the '@rank' of 'argumentation' must correspond to "1" and that of 'exposition' could correspond to "2"; the value "3" can be used in the case a further function is prominent —e.g. 'contextualization', for an argumentative and expository example that is also used by its speakers as an introduction to the thesis it argues for and clarifies—, only if neither of the coexisting functions share the same level of prominence. Custom elements can be added through 'customElement'.

Element : supportType

Attributes:

comment, uncertain

Children:

supportFunction, supportForm+, customElement*

Parents:

SUPPORT

Definition:

This is to specify, in 'supportFunction', whether a support is argumentative, expository, expansive, or contextualizing (or having two or more of these four functions at the same time); and, in 'supportForm', the form in which it achieves its functions (e.g. deductive reasoning, analogy, etc.). Custom elements can be added through 'customElement'.

Element : target

Attributes:

rank, ref

Children:

Parents:

targetsGroup

Definition:

This is to refer, via '@ref' in the form of an href, to a 'THESIS', 'MISC', or 'SUPPORT' which is interpreted to be among the targets of a support. To prove the relevance of the referenced part of the discourse, the annotator may use 'proof' and refer to textual evidence of the support's connection with it. Since the identification of the part of the discourse can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The identification may sometimes be uncertain due to an ambiguity in the text: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'target' to be the truly relevant one with respect to its siblings, by giving it a value between "1" (most likely) and "4" (least likely). Custom elements can be added through 'customElement'.

Element : targetsGroup

Attributes:

comment, uncertain

Children:

target+, proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

SUPPORT

Definition:

This is to refer, via one or more 'target' elements, to all the parts of the discourse the annotated 'SUPPORT' is a support of, whether as an argument, as an exposition, as an expansion, or as a contextualization; each of these must correspond to an annotated 'THESIS', 'MISC', or 'SUPPORT'. If the targets' identification is uncertain, specify '@uncertain' as "true". In the case the text is ambiguous enough to support an identification with more than one target or set of targets, the annotator can decide to refer to all, but must choose one or more as the most likely to be the actual targets by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'target' elements, and specifying as e.g. "2" that of the others. When multiple 'target' elements are provided with the same rank, it is assumed that the annotator understands all of their corresponding parts of the discourse to be equally targeted by the support. In the case no 'target' element is provided with rank "1", it is assumed that the ambiguity is too high to propose a reasonable identification (but note that at least one alleged target, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the alleged targets; this can be proven via the child element 'proof' of each 'target'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Element : text**Attributes:**

from, to

Children:

textRef, snippet{0,1}, differences{0,1}, uncertainties{0,1}, customElement*

Parents:

externalRef, MISC, SUPPORT, THESIS, keyword, lectio

Definition:

This is to refer, via 'textRef', to one or more segments of the primary text which corresponds to the 'source' (i.e. the digital source whose URI is referred to in the attribute '@ref' of this element's ancestor 'source'). The elements 'differences' and 'uncertainties' are for philological annotation: if the annotator assumes, for the purposes of the annotation, one or more variant readings that diverge from text of the associated digital source, they must be referred to in 'differences'; if the text is recognized to be uncertain and potentially corrupt (e.g. due to lacunae), this may be specified in 'uncertainties'. The text segment can be also reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human. Custom elements can be added through 'customElement'.

Element : textRef**Attributes:**

from, to

Children:

segment+, customElement*

Parents:

analogyMember, etiologyMember, proof, text, themedTextRef

Definition:

This is to refer, via one or more 'segment' elements, to one or more text segments in a digital source. Custom elements can be added through 'customElement'.

Element : themedFreeText**Attributes:**

comment

Children:

freeText, microThemesGroup

Parents:

analogyMember, comparisonDomain, etiologyMember, metaphorComponent

Definition:

This is to select a portion of the text of this element's ancestor 'PROPOSITION' or "implicit" 'THESIS', as annotated in its 'paraphrasis', by typing it in the free form of a string, while also specifying its narrow themes in 'microThemesGroup'. This should be used when the annotator recognizes that the text portion should be annotated with a different set or focal arrangement of 'microTheme' elements than the one specified in the 'propositionType's or 'thesisType's child 'microThemesGroup'.

Element : themedTextRef**Attributes:**

comment

Children:

textRef, microThemesGroup

Parents:

analogyMember, etiologyMember, metaphorComponent

Definition:

This is to refer, via 'textRef', to one or more text segments in a digital source, while also specifying their narrow themes in 'microThemesGroup'. This should be used when the annotator recognizes that the referenced text span, which is a portion of the text of this element's ancestor 'THESIS', should be annotated with a different set or focal arrangement of 'microTheme' elements than the one specified in the 'thesisType's child 'microThemesGroup'.

Element : thesisType**Attributes:**

comment, macroThemeTag, uncertain

Children:

macroThemesGroup, microThemesGroup, keywordsGroup, definition, etiologiesGroup, analogiesGroup, customElement*, metaphorsGroup

Parents:

THESIS

Definition:

This is to annotate the 'THESIS' thematically and specify some of its formal features. The thesis's broad theme (e.g. "historical", "axiological", etc.) can be specified in 'macroThemesGroup'; to specify the theme in more detail (e.g. "military", "psychological", etc.) 'microThemesGroup' may be used. Any of the words composing the thesis's text —both those that are explicit in the text span referred to in 'text' and those that are implicit and inserted in its 'paraphrasis'— can be annotated as keywords in 'keywordsGroup' by referring to corresponding, separately-annotated 'keyword' elements. If the thesis has the structure of a definition, this may be specified in 'definition'. If the thesis includes etiologies (i.e. reports of the causes or ends of one or more events), their structure may be annotated in 'etiologiesGroup'; if it includes analogies or comparisons, their structure may as well be annotated in 'analogiesGroup'. If it includes metaphors, details on their structure, meaning, and status may be annotated in 'metaphorsGroup'. Custom elements can be added through 'customElement'.

Element : title**Attributes:**

comment, original, string, uncertain

Children:

proof{0,1}, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

sourceInfo

Definition:

This is to specify, via '@string' in the free form of a string, a title associated with a 'source'. To prove that the annotated title exists for that source, the annotator may use 'proof' and refer to textual evidence of its use as a designator of the source. If the title is identified as the source's original title (or as one of its original titles), '@original' may be specified as true. If this identification is notably uncertain, '@uncertain' may be specified as true. Since it can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. Custom elements can be added through 'customElement'.

Element : uncertainties**Attributes:**

accepted, comment, philological

Children:

lectioRef*, externalRef*, scholarPro*, scholarContra*, customElement*

Parents:

text

Definition:

This is to specify that the text annotated in this element's parent 'text' is recognized to be uncertain and potentially corrupt. If it is uncertain due to philological reasons (e.g. presence of lacunae), specify '@philological' as "true". The existence of variant readings, included in the same 'source' as 'lectio' elements, may be taken to corroborate the uncertain character of the text: the annotator can refer to these through 'lectioRef'. The text's uncertainty may be commented on in the secondary literature: use 'externalRef' to refer to neutral discussions of the matter, 'scholarPro' for texts where the uncertainty is argued for or simply accepted, and 'scholarContra' for texts which deny it or do not consider it. The annotator may judge that the text is actually not uncertain (annotating the 'uncertainties' nonetheless, e.g. merely to consider the hypothesis or represent another scholar's point

of view): in this case, '@accepted' may be specified as "false". Custom elements can be added through 'customElement'.

Element Group : proofBundle

Contains:

proof{0,1}, externalRef*, scholarPro*, scholarContra*

Parents:

name, speakersGroup, textLocus, ambiguous, assentAuthor, assentSpeaker, assentSupSpeaker, author, authority, authorityDetails, authorsGroup, conscious, definition, deliberate, historyOnPersons, historyTime, historyType, includedRef, keyword, locus, metatext, metatextDetails, microTheme, paraphrasis, supportForm, supportFunction, target, targetsGroup, title

Element : / scholarContra — Complex Type: externalRef

Definition:

This is to cite a passage in the secondary literature that diverges from the annotation in the parent element, i.e. where its core detail is denied or simply not considered. Please refer to the 'externalRef' complexType.

Element : / scholarPro — Complex Type: externalRef

Definition:

This is to cite a passage in the secondary literature that supports the annotation in the parent element, i.e. where its core detail is argued for or simply accepted. Please refer to the 'externalRef' complexType.

Element Group : propositionType

Contains:

macroThemesGroup, microThemesGroup, keywordsGroup, definition, etiologiesGroup, analogiesGroup, customElement*

Parents:

propositionType, thesisType

Element Group : scholarshipBundle

Contains:

externalRef*, scholarPro*, scholarContra*, proof{0,1}, externalRef*, scholarPro*, scholarContra*, macroThemesGroup, microThemesGroup, keywordsGroup, definition, etiologiesGroup, analogiesGroup, customElement*

Parents:

SUPPORT, THESIS, alternativeTo, comparisonDomain, lectio, limitation, metaphor, opposedTo, similarTo, spurious, uncertainties

Element : / scholarContra — Complex Type: externalRef

Definition:

This is to cite a passage in the secondary literature that diverges from the annotation in the parent element, i.e. where its core detail is denied or simply not considered. Please refer to the 'externalRef' complexType.

Element : / scholarPro — Complex Type: externalRef

Definition:

This is to cite a passage in the secondary literature that supports the annotation in the parent element, i.e. where its core detail is argued for or simply accepted. Please refer to the 'externalRef' complexType.

Complex Type : elementRef**Attributes:**

ref

Children:

customElement

Parents:

alternativeTo/elementRef, analogyMember/elementRef, authority/elementRef, employedElements/elementRef, etiologyMember/elementRef, includedRef/elementRef, lectioRef, metatext/elementRef, proof/elementRef, target

Definition:

This is to refer, via '@ref' in the form of an href, to an element in a TheSu document that is referenced in the parent element. Custom elements can be added through 'customElement'.

Complex Type : externalRef**Attributes:**

biblLocusFree, biblLocusRef, bibliographyRef, comment, extrinsic, implicit, locusRef, uncertain

Children:

biblQuote, customElement, text

Parents:

MISC/externalRef, PROPOSITION/externalRef, bibliography/externalRef, proofBundle/externalRef, proofBundle/scholarContra, proofBundle/scholarPro, scholarshipBundle/externalRef, scholarshipBundle/scholarContra, scholarshipBundle/scholarPro

Definition:

This is to cite a passage in the secondary literature that is relevant to the annotation of the parent element and useful to compare. The bibliographical reference must be inserted in '@bibliographyRef', in the form of an href to either the URI of a bibliographic record in the bibliography associated with the TheSu document (i.e. whose URI is referred to in an 'authorityRecord' with '@bibliographicRecords' specified as "true") or to the ID of one of the 'bibliographyRef' elements annotated in the 'bibliography' of the 'source'; the passage (e.g. page, note, ...) can be specified either in '@biblLocusRef', in the form of the URI of a locus indicator in a digital source, or freely in '@biblLocusFree'; it can also be quoted in 'biblQuote'. If the referenced work cites a specific passage of the text that is being annotated, its beginning can be specified in '@locusRef' in the form of the URI of a locus indicator contained in its digital source (the one whose URI is referred to in the attribute '@ref' of this element's ancestor 'source'), e.g. of a 'tei:milestone' or an HTML 'p'. If the text is also quoted verbatim in the referenced work, in the context that is relevant to this 'externalRef', the quote can be specified in 'text'. In contrast, if the reference is not explicit there, but is only inferred by the annotator to be intended by the author of the scholarly work, specify '@implicit' as "true"; if it is recognized to be actually extraneous to the author's intent (yet relevant to the annotation for any reason), specify '@extrinsic' as "true". If the reference is uncertain, e.g. due to an ambiguity in the text, specify '@uncertain' as "true". Custom elements can be added through 'customElement'.

Complex Type : name**Attributes:**

comment, name, rank

Children:

customElement, externalRef, proof, scholarContra, scholarPro

Parents:

author, historyOnPersons/name, speakersGroup/speaker

Definition:

This is to refer, via '@name' in the form of an href, to the name or group designator of an individual or group that is relevant to the parent element. To prove the relevance of such an individual or group, the annotator may use 'proof' and refer to textual evidence in which the individual or group is mentioned or alluded to. Since the identification of the relevant individual or group can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'. The identification may sometimes be uncertain due to an ambiguity in the text: in such cases, the annotator may use '@rank' to specify how likely is each annotated 'name' to be the truly relevant one with respect to its siblings, by giving it a value between "1" (most likely) and "4" (least likely). Custom elements can be added through 'customElement'.

Complex Type : proof**Attributes:**

comment

Children:

customElement, elementRef, locusRef, snippet

Parents:

SUPPORT/marker, analogy/marker, etiology/marker, limitation/marker, metaphorRecognition/marker

Definition:

This is to refer to textual evidence supporting the core detail of the annotation in the parent element. The annotator may include the reference in various way: either by providing links to a text span in a digital source, which can be done in 'locusRef', or by freely writing the coordinates of its locus, which can as well be done in 'locusRef', or by providing a link to a TheSu element that corresponds with it (if any), which can be done in 'elementRef'. The corresponding text segment can be reported in 'snippet' in its full form, to make the isolated TheSu document more easily readable for a human. Custom elements can be added through 'customElement'.

Complex Type : segment**Attributes:**

from, to

Children:

/

Parents:

locusRef/locusLink, textRef/segment

Definition:

This is to refer to a text segment in a digital source. The segment's beginning must be specified in '@from' in the form of an href to the URI of a point or segment in the text; if the segment is longer than its referenced beginning (e.g. longer than one word), its ending must be specified in '@to' in the same form. It is recommended to refer to IDs of single segments in an already parsed and annotated text (e.g. with a single 'tei:seg' corresponding to each of its words). Positional references through xPointer may

be unreliable on the long term, as the referenced digital source may be modified during or after the annotation (e.g. to correct OCR mistakes it).

Complex Type : speakersGroup

Attributes:

comment, uncertain

Children:

externalRef, proof, scholarContra, scholarPro, speaker

Parents:

MISC/speakersGroup, SUPPORT/speakersGroup, THESIS/speakersGroup,
authority/authorityName, metaphorRecognition/speakersGroup, metatext/quotedSpeaker

Definition:

This is to refer to the individuals or groups that are regarded to be the speakers of the statements or segments of text relevant to the parent element. For each of these speakers, the annotator must add a 'speaker'. If their identification is uncertain, '@uncertain' may be specified as "true". In the case the text is ambiguous enough to support an identification with more than one speaker or group of speakers, the annotator can decide to provide the details of all, but must choose one or more as the most likely to be the actual speakers by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'speaker' elements, and specifying as e.g. "2" that of the others. When multiple 'speaker' elements are provided with the same rank, it is assumed that the annotator understands all of their corresponding individuals or groups to be the relevant speakers at the same time. In the case no 'speaker' element is provided with rank "1", it is assumed that the ambiguity is too high to propose a reasonable identification (but note that at least one alleged speaker, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the alleged speakers; this can be proven via the child element 'proof' of each 'speaker'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Complex Type : textLocus

Attributes:

comment, uncertain

Children:

externalRef, locus, proof, scholarContra, scholarPro

Parents:

authority/authorityLocus, metatext/quotedLocus

Definition:

This is to provide the coordinates of one or more segments of text that are relevant to the parent element, whether in the free form of a written reference or by linking to segments of text in a digital source. The annotator must use a 'locus' for each of such distinct segments of text. In the case the text is ambiguous enough to support the choice of more than one relevant locus or groups of loci, the annotator can decide to provide the coordinates of all, but must choose one or more as the most likely to be the truly relevant ones by attributing to them a higher rank, i.e. by specifying as e.g. "1" the '@rank' in their corresponding 'locus' elements, and specifying as e.g. "2" that of the others. When multiple 'locus' elements are provided with the same rank, it is assumed that the annotator understands all of their corresponding segments of text to be relevant at the same time. In the case no 'locus' element is provided with rank "1", it is assumed that the ambiguity is too high to propose a reasonable decision (but note that at least one relevant segment of text, provided with rank "2", will still have to be favoured by the annotator). The annotator may prove the presence of such uncertainties via 'proof', by referring

to textual evidence of the ambiguity (note that this is not used as evidence for the ranking of the allegedly relevant segments of text; this can be proven via the child element 'proof' of each 'locus'). Since the recognition of the ambiguity can be open to debate, it is also possible to add references to secondary literature, through 'externalRef', 'scholarPro', and 'scholarContra'.

Attribute : @accepted**Type:**

xs:boolean

Used by:

lectio, spurious, uncertainties

Definition:

Generic attribute to specify whether the core detail in the annotation of an element is accepted by the annotator or not.

Attribute : @agency**Type:**

xs:boolean

Used by:

metaphorComponent

Definition:

This is to specify whether a metaphor component corresponds to words denoting or implying an action, and thus their subject's ability to be an agent (e.g. "employs", "operation", etc.), or not. This is useful to index animistic terminology.

Attribute : @anonymousNickname**Type:**

xs:string

Used by:

authorsGroup

Definition:

This is to specify, in the free form of a string, a nickname with which the annotator prefers to refer to the anonymous author or authors of a primary text corresponding to a 'source' (e.g. "Pseudo-Aristotle", "Anonymous of Canterbury", etc.), in the case the annotated 'authorsGroup' includes no 'author' that has been provided with '@rank' = "1".

Attribute : @assentValue**Type:**

xs:string

Used by:

assentAuthor, assentSpeaker, assentSupSpeaker

Definition:

This is to specify the assent of an individual or group towards the content of a 'THESIS' or 'SUPPORT', inasmuch as can be inferred from the full discourse this is included in. The annotator may only use the following values: "aff" (affirmative assent) in the case the individual or group agrees with it; "neg" (negative assent) in the case the individual or group does not agree with it; "att" (attack) in the case the individual or group not only does not agree with it, but also refutes it somewhere in the same discourse or macrotext. If no value is specified, it is assumed that the speakers' assent is indiscernible.

Attribute : @baseEdition**Type:**

xs:boolean

Used by:

bibliographyRef

Definition:

This is to specify whether a source referenced in a bibliography is the "base edition" used for the 'source' or not, i.e. whether the referenced source, being a digital edition of a primary text rather than the primary text itself, has been elected by the annotator as the base text for the annotation in the 'source' or not. If this attribute is specified as "true", the URI referenced in the attribute '@digitalEdition' of the same 'bibliographyRef' must be identical with the URI referenced in the attribute '@ref' of the 'bibliographyRef's ancestor 'source'.

Attribute : @biblLocusFree**Type:**

xs:string

Used by:

scholarRef

Definition:

This is to refer precisely to a locus of a referenced work, e.g. page number or footnote number, in the free form of a string.

Attribute : @biblLocusRef**Type:**

xs:string

Used by:

scholarRef

Definition:

This is to refer, via href, to the URI of a locus indicator in a digital source, specifying which locus, e.g. page number or section number, the annotator is precisely referring to.

Attribute : @bibliographicRecords**Type:**

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@bibliographyRef' or not.

Attribute : @bibliographyRef

Type:

xlink:href

Used by:

scholarRef

Definition:

This is to refer to a source in a bibliography. The reference must be expressed as an href to a bibliographic record in the bibliography authority record associated with the TheSu document (i.e. whose URI is referred to in an 'authorityRecord' with '@bibliographicRecords' specified as "true").

Attribute : @cause

Type:

xs:boolean

Used by:

etiologyMember

Definition:

This is to specify whether an 'etiologyMember' corresponds to one of the reported causes in its parent 'etiology' or not; i.e. whether it is the reported cause of its sibling 'etiologyMember' elements which are specified to be neither causes nor ends or not.

Attribute : @comment

Type:

xs:string

Used by:

MISC, SUPPORT/marker, TheSu, alternativeTo, analogy/marker, bibliography, entailedBy, etiology/marker, includedPropositions, keywordTagRef, lectio, limitation/marker, locus, macroTheme, matchingProposition, metaphorComponent, metaphorRecognition/marker, opposedTo, proof, similarTo, source, themedFreeText, themedTextRef, uncertainties, externalRef, name, proof, uncertainWithComment

Definition:

Generic attribute for comments (normally, to justify or clarify decisions in the annotation).

Attribute : @comparans

Type:

xs:boolean

Used by:

analogyMember

Definition:

This is to specify that a member of an analogy or comparison is assumed by its speaker to be better known than another in the same analogy or comparison, and is thus used as a source of features to be projected onto that member, i.e. that it

is a "comparans" in relation to a "comparandum", or, in Perelman's terminology, a "phoros" in relation to a "theme" (e.g., in the analogy "the moon sends us heat like the sun", the member "sun [sends us heat]" in relation to the member "the moon sends us heat")

Attribute : @comparison

Type:

xs:boolean

Used by:

analogy

Definition:

This is to specify whether or not an analogical structure, rather than simply assimilating one or more features of its members (e.g. "the moon sends us heat like the sun"), is used to compare them, expressing that in one member they are present with a lesser or higher degree than in the others (e.g. "the moon sends us less heat than the sun").

Attribute : @comparisonRank

Type:

xs:integer

Used by:

analogyMember

Definition:

This is to rank a member of a comparison in relation to its siblings, according to the lesser or higher degree of the compared features that are attributed to it, by means of a number, with "1" representing the highest rank (e.g. in the comparison "the moon sends us less heat than the sun" the member "the sun [sends us heat]" may be ranked as "1", and "the moon sends us... heat" as "2").

Attribute : @completeEdition

Type:

xs:boolean

Used by:

bibliographyRef

Definition:

This is to specify whether a source referenced in a bibliography is or contains a complete edition of the primary text corresponding to the 'source' or not.

Attribute : @conjectural

Type:

xs:boolean

Used by:

lectio

Definition:

This is to specify whether the variant reading annotated in a 'lectio' is a conjectural correction of the text segment referenced in the 'text' of the same 'lectio' or not.

Attribute : @digitalEdition

Type:

xlink:href

Used by:

bibliographyRef

Definition:

This is to refer to a digital edition of a source referenced in a bibliography. The reference must be expressed as an href to the URI of the file corresponding to the digital edition, or, if this is not possible, to its DOI or to its most authoritative permalink.

Attribute : @doubleChecked

Type:

xs:boolean

Used by:

MISC, PROPOSITION, SUPPORT, THESIS, keyword, lectio

Definition:

General attribute that may be used by the annotator as a reminder to double-check the annotated elements.

Attribute : @end

Type:

xs:boolean

Used by:

etiologyMember

Definition:

This is to specify whether an 'etiologyMember' corresponds to one of the reported ends in its parent 'etiology' or not; i.e. whether it is the reported end of its sibling 'etiologyMember' elements which are specified to be neither causes nor ends or not.

Attribute : @entailedAs

Type:

xlink:href

Used by:

entailedBy

Definition:

This is to specify through a tag the kind of semantic entailment (e.g. inclusion or logical subalternity) which is annotated in an 'entailedBy'. The tag must be expressed as an href to the URI of an authorized spelling in an authority record

associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@entailmentTags' specified as "true".

Attribute : @entailmentTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@entailedAs' or not.

Attribute : @equivalent

Type:

xs:boolean

Used by:

similarTo

Definition:

This is to specify whether the referenced similar proposition is logically equivalent to this element's ancestor 'PROPOSITION' or not.

Attribute : @extended

Type:

xs:boolean

Used by:

matchingProposition

Definition:

This is to specify whether the meaning of the referenced 'PROPOSITION' includes the meaning of this 'THESIS' while also providing additional information (as e.g. in the proposition "temperance benefits our intellect by removing superfluous distractions" towards the thesis "temperance benefits our intellect") or without adding anything to it.

Attribute : @extrinsic

Type:

xs:boolean

Used by:

scholarRef, SUPPORT, THESIS

Definition:

This is to specify whether the content of an annotated 'THESIS', 'SUPPORT', or 'externalRef' is neither explicitly present in its corresponding text, nor inferred by the annotator to be intended by its speakers or authors, but is recognized to be, in the same text, wholly extraneous to the speakers' or authors' intent and is annotated nonetheless for any reason, or not.

Attribute : @fictitious**Type:**

xs:boolean

Used by:

limitation

Definition:

This is to specify whether a formula in the text which limits the full commitment of a 'THESIS's, 'MISC's, or 'SUPPORT's speakers towards it qualifies that 'THESIS', 'MISC', or 'SUPPORT' as fictitious or not.

Attribute : @focus**Type:**

xs:integer

Used by:

keywordRef, microTheme

Definition:

This is to specify the degree of centrality of this element's annotated core detail to the meaning of the text of its ancestor 'THESIS', 'MISC', or 'PROPOSITION', by means of a rank ranging from "1" (most central) to "5" (least central). The degree of centrality must be ranked in relation to that of the core details of this element's siblings — whether annotated or merely potential. As a strategy to quantify this centrality in absence of elements of comparison, the annotator may try to answer the question: "how much, from "5" to "1", would a reader find the present 'THESIS', 'MISC', or 'PROPOSITION' relevant to, and informative on, (its speakers' point of view on) the annotated core detail of this element?".

Attribute : @for**Type:**

xs:NCName

Used by:

argumentation

Definition:

This is to specify an argumentative support's aim towards the content of its target 'THESIS' or 'SUPPORT' elements. The annotator must use one of the following values: "acc" if the argument supports the acceptance of its target theses or supports; "rej" if it supports their rejection (and is therefore a refutation); or "mix" if it supports both their acceptance and refusal at the same time (rather examining or problematizing them).

Attribute : @formTag**Type:**

xlink:href

Used by:

supportForm

Definition:

This is to specify the form in which a support achieves its functions (e.g. deductive reasoning, analogy, etc.). The tag must be expressed as an href to the URI of an authorized spelling in an authority record associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@formTags' specified as "true".

Attribute : @formTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@formTag' or not.

Attribute : @from

Type:

xlink:href

Used by:

segment

Definition:

This is to refer to the beginning of a text segment in a digital source, in the form of an href to the URI of a point or segment in the text (e.g. the ID of a 'tei:seg').

Attribute : @historyTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@historyTime' and '@historyType' or not.

Attribute : @historyTimeTag

Type:

xlink:href

Used by:

historyTime

Definition:

This is to specify the time in which the events reported by an element that has been annotated as "historical", i.e. narrative, in theme take place (e.g. "past", "present", etc., with respects to the time of the narrative statements). The tag must be expressed as an href to the URI of an authorized spelling in an authority record

associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@historyTags' specified as "true".

Attribute : @historyTypeTag

Type:

xlink:href

Used by:

historyType

Definition:

This is to specify what kind of historical information (e.g. concerning "actions", "ideas", etc.) is conveyed by an element that has been annotated as "historical", i.e. narrative, in theme. The tag must be expressed as an href to the URI of an authorized spelling in an authority record associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@historyTags' specified as "true".

Attribute : @humorous

Type:

xs:boolean

Used by:

limitation

Definition:

This is to specify whether a formula in the text which limits the full commitment of a 'THESIS's, 'MISC's, or 'SUPPORT's speakers towards it qualifies that 'THESIS', 'MISC', or 'SUPPORT' as humorous or not.

Attribute : @hyperbolic

Type:

xs:boolean

Used by:

limitation

Definition:

This is to specify whether a formula in the text which limits the full commitment of a 'THESIS's, 'MISC's, or 'SUPPORT's speakers towards it qualifies that 'THESIS', 'MISC', or 'SUPPORT' as hyperbolic or not.

Attribute : @hypothetic

Type:

xs:boolean

Used by:

limitation

Definition:

This is to specify whether a formula in the text which limits the full commitment of a 'THESIS"s, 'MISC"s, or 'SUPPORT"s speakers towards it qualifies that 'THESIS', 'MISC', or 'SUPPORT' as hypothetical and provisional or not.

Attribute : @id

Type:

xs:ID

Used by:

MISC, PROPOSITION, SUPPORT, THESIS, TheSu, bibliographyRef, keyword, lectio, metaphor, source

Definition:

Generic attribute to associate IDs to elements.

Attribute : @implicit

Type:

xs:boolean

Used by:

scholarRef, SUPPORT, THESIS, includedRef, keyword

Definition:

This is to specify whether the content of an annotated 'THESIS', 'SUPPORT', 'keyword', or 'includedRef', rather than being explicitly present in the corresponding text, is only inferred by the annotator to be intended by its speakers (e.g. a rhetorical question is not explicitly a declarative sentence, but it is meant to be understood as such), or not.

Attribute : @indirectTrad

Type:

xs:boolean

Used by:

lectio

Definition:

This is to specify whether the variant reading annotated in a 'lectio' occurs in the indirect tradition of the text which corresponds to the 'source' or not.

Attribute : @keywordTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@namely' or not.

Attribute : @keywordsInSequence

Type:

xs:integer

Used by:

keywordSubRef

Definition:

This is to refer to one or more keywords inasmuch as they are referenced in a 'keywordsGroup'. To select the keywords, specify the numbers of their corresponding 'keywordRef' elements in their order of appearance in that 'keywordsGroup', starting with 1, and separating each number with a comma (",").

Attribute : @lacuna

Type:

xs:boolean

Used by:

lectio

Definition:

This is to specify whether the variant reading annotated in a 'lectio' fills a gap in the text which corresponds to the 'source' or not.

Attribute : @locusRef

Type:

xlink:href

Used by:

scholarRef

Definition:

This is to refer, via href, to the URI of a locus indicator in a digital source, e.g. 'tei:milestone' or HTML 'p'.

Attribute : @macroThemeTag

Type:

xlink:href

Used by:

macroTheme

Definition:

This is to specify the broad theme (e.g. "historical", "axiological", etc.) of a 'THESIS', 'MISC', or 'PROPOSITION' by means of a tag. The tag must be expressed as an href to the URI of an authorized spelling in an authority record associated with the TheSu document — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@macroThemeTags' specified as "true".

Attribute : @macroThemeTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@macroThemeTag' or not.

Attribute : @metonymy

Type:

xs:boolean

Used by:

metaphor

Definition:

This is to specify whether an annotated metaphor is actually a metonymy or not.

Attribute : @microThemeTag

Type:

xlink:href

Used by:

microTheme

Definition:

This is to specify one of the narrow themes (e.g. "military", "psychological", etc.) of a 'THESIS', 'MISC', or 'PROPOSITION' by means of a tag. The tag must be expressed as an href to the URI of an authorized spelling in an authority record — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@microThemeTags' specified as "true".

Attribute : @microThemeTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@microThemeTag' or not.

Attribute : @name

Type:

xlink:href

Used by:

name

Definition:

This is to refer to the name or group designator of an individual or group that is relevant to the parent element, by means of an href to the URI of an authorized spelling in an authority record associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@nameTags' specified as "true".

Attribute : @nameTags

Type:

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@name' or not.

Attribute : @namely

Type:

xlink:href

Used by:

keyword, keywordRef, keywordSubRef

Definition:

This is to provide a paraphrasis of the annotated keyword by means of a tag. The tag must be expressed as an href to the URI of an authorized spelling in an authority record — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@keywordTags' specified as "true".

Attribute : @object

Type:

xs:string

Used by:

keywordRef

Definition:

This is to specify which siblings of this 'keywordRef' —in relation to the text of the ancestor 'THESIS', 'MISC', or 'PROPOSITION' of both— are its syntactic objects (e.g. in the case it is a verb). To refer to each of them, specify their number in their order of appearance in the same 'keywordsGroup' (i.e. the 'keywordsGroup' which is included in this element's ancestor 'THESIS', 'MISC', or 'PROPOSITION'), starting with 1. Separate each number with a comma (",").

Attribute : @opposedAs

Type:

xlink:href

Used by:

opposedTo

Definition:

This is to specify the kind of semantic opposition (e.g. contrariety or contradiction) through a tag. The tag must be expressed as an href to the URI of an authorized spelling in an authority record associated with the TheSu corpus — i.e. an authority record whose URI is referred to in an 'authorityRecord' with '@oppositionTags' specified as "true".

Attribute : @oppositionTags**Type:**

xs:boolean

Used by:

authorityRecord

Definition:

This is to specify whether an authority record contains the authorized spellings of the tags in '@opposedAs' or not.

Attribute : @original**Type:**

xs:boolean

Used by:

title

Definition:

This is to specify whether a title annotated for a 'source' is identified by the annotator as its original title (or as one of its original titles) or not.

Attribute : @partial**Type:**

xs:boolean

Used by:

matchingProposition

Definition:

This is to specify whether the meaning of the referenced 'PROPOSITION' corresponds to only a part of the meaning of this 'THESIS' (as e.g. in the proposition "temperance benefits our intellect" towards the thesis "temperance benefits our intellect by removing superfluous distractions") or fully.

Attribute : @partialRef**Type:**

xs:string

Used by:

differences

Definition:

This is to specify that only a segment of the variant reading is meant to substitute the text of the digital source, as referenced in this element's ancestor 'text'. For each word in the 'lectio's '@variant' —as delimited by blank space— that is here

relevant, specify its number in the succession of the phrase's words, starting with 1. Separate each number with a comma (",").

Attribute : @personhood

Type:

xs:boolean

Used by:

metaphorComponent

Definition:

This is to specify whether a metaphor component corresponds to words that are best understood when their subject is a human or any other intelligent being (e.g. "thinks", "dishonest", etc.), or not. This is useful to index anthropomorphic terminology.

Attribute : @philological

Type:

xs:boolean

Used by:

uncertainties

Definition:

This is to specify whether the text annotated in this element's parent 'text' is uncertain due to philological reasons (e.g. presence of lacunae) or not.

Attribute : @philologicalNotes

Type:

xs:boolean

Used by:

bibliographyRef

Definition:

This is to specify whether a source referenced in a bibliography is or contains a collection of philological notes on the primary text corresponding to the 'source' or not.

Attribute : @polarity

Type:

xs:string

Used by:

PROPOSITION, THESIS

Definition:

This is to annotate whether the grammatical polarity of a 'THESIS' or 'PROPOSITION' element is affirmative or negative, i.e. whether its message is conveyed in an affirmative or negative way. Use the value "aff" for affirmative polarity (e.g. "Socrates is rational") and "neg" for negative polarity (e.g. "Socrates is not irrational").

Attribute : @propRef

Type:

xlink:href

Used by:

matchingProposition

Definition:

This is to refer to a 'PROPOSITION' element, in the form of an href to its ID.

Attribute : @quantity

Type:

xs:integer

Used by:

THESIS

Definition:

This is to specify the number of individual statements corresponding to the 'THESIS'; which is required in the case of aggregate-theses. To calculate the number, the annotator must count all the statements in the 'THESIS' that are semantically distinct with respects to their autonomous informativity — e.g. "2" in the case of the aggregate-thesis "the sun sends us heat and light", which can be split in "the sun sends us heat" + "the sun sends us light" without changes in meaning (contrast e.g. "the sun keeps us alive by sending us heat and light", which cannot be split in "the sun keeps us alive by sending us heat" + "the sun keeps us alive by sending us light", because according to the formulation of the original statement it may be possible that in its meaning neither heat neither light are sufficient conditions for the sun to keep us alive, so that separating them in two individual statements may alter the original message).

Attribute : @quoted

Type:

xs:boolean

Used by:

matchingProposition

Definition:

This is to specify whether the meaning of the referenced 'PROPOSITION' is included in the meaning of this 'THESIS' as a quotation (as e.g. in the proposition "Aristotle said that temperance benefits our intellect" towards the thesis "temperance benefits our intellect") or directly.

Attribute : @rank

Type:

xs:integer

Used by:

name, alternativeTo, argumentation, authority, contextualization, expansion, exposition, locus, metatext, microTheme, similarTo, supportFunctionsGroup, target

Definition:

Generic attribute to specify a position within a hierarchy or a degree. The annotator must use a number between "1" (always highest degree or rank) and "4" (always lowest degree or rank).

Attribute : @reciprocal

Type:

xs:boolean

Used by:

contextualization

Definition:

This is to specify whether the targets of a contextualizing support are themselves used, by the same speakers, to contextualize the content of the first or not — i.e. whether the contents of multiple, reciprocal, "contextualizing" supports including the current are presented in a symmetrical structure in which they are all equally rhematic and none thematic with respects to the others or not.

Attribute : @ref

Type:

xlink:href

Used by:

elementRef, authorityRecord, bibliographyRef, entailedBy, keywordRef, keywordTagRef, opposedTo, similarTo, source

Definition:

Generic attribute for hyperlinks, to be expressed in the form of an href to a URI.

Attribute : @role

Type:

xs:string

Used by:

metaphorComponent

Definition:

This is to specify the role in a metaphor or metonymy of one of its components. The annotator can only use one of the following values: "vehicle" if the component corresponds to the metaphorically or metonymically used term; "tenor" if it corresponds to the recipient, in the text, of the metaphorically or metonymically conveyed idea; and "meaning" if it corresponds to the meaning of the thesis, as it appears literalized in a text.

Attribute : @string

Type:

xs:string

Used by:

locusFree, title

Definition:

Generic attribute for free-form strings of text.

Attribute : @subQuantity

Type:

xs:integer

Used by:

keywordRef, microTheme

Definition:

In the case this element has an ancestor aggregate-thesis (i.e. a 'THESIS' corresponding to more than one statement and in which its '@quantity' has been given a higher value than "1"), and the annotated core detail of this element is not relevant to all of the statements in the aggregate, this should be used to specify the precise number of statements to which this element is relevant.

Attribute : @subject

Type:

xs:string

Used by:

keywordRef

Definition:

This is to specify which siblings of this 'keywordRef' —in relation to the text of the ancestor 'THESIS', 'MISC', or 'PROPOSITION' of both— are its syntactic subjects (e.g. in the case it is an adjective). To refer to each of them, specify their number in their order of appearance in the same 'keywordsGroup' (i.e. the 'keywordsGroup' which is included in this element's ancestor 'THESIS', 'MISC', or 'PROPOSITION'), starting with 1. Separate each number with a comma (",").

Attribute : @title

Type:

xs:string

Used by:

locus

Definition:

Generic attribute to specify the title of a source.

Attribute : @to

Type:

xlink:href

Used by:

segment

Definition:

This is to refer to the end of a text segment in a digital source, in the form of an href to the URI of a point or segment in the text (e.g. the ID of a 'tei:seg'). It is necessary to use this attribute only if the segment is longer than its referenced beginning in '@from' (e.g. longer than one word).

Attribute : @translation

Type: xs:boolean

Used by:
bibliographyRef

Definition:

This is to specify whether a source referenced in a bibliography is or contains a translation of the primary text corresponding to the 'source' or not.

Attribute : @uncertain

Type: xs:boolean

Used by:
externalRef, uncertainWithComment, macroTheme

Definition:

Generic attribute to specify whether the annotation in an element is notably uncertain or not.

Attribute : @value

Type: xs:boolean

Used by:
ambiguous, conscious, definition, deliberate, spurious

Definition:

Generic attribute to associate boolean values (i.e. "true" and "false") to elements.

Attribute : @variant

Type: xs:string

Used by:
lectio

Definition:

This is to specify the variant reading annotated in a 'lectio', i.e. the different spelling that would replace the text segment referenced in the 'text' of the same 'lectio', if this were accepted.

Attribute : @weakened

Type: xs:boolean

Used by:
limitation

Definition:

This is to specify whether a formula in the text which limits the full commitment of a 'THESIS"s, 'MISC"s, or 'SUPPORT"s speakers towards it

qualifies that 'THESIS', 'MISC', or 'SUPPORT' as a weakened claim or section (e.g. "it is likely that...") or not.

Attribute : @wordsInParaphrasis

Type:

xs:integer

Used by:

keywordRef

Definition:

This is to refer to one or more words in a 'paraphrasis'. To select the words, as delimited by blank space, specify their numbers in their order of appearance in that 'paraphrasis', starting with 1, and separating each number with a comma (",").

Attribute Group : scholarRef

Contains:

biblLocusFree, biblLocusRef, bibliographyRef, extrinsic, implicit, locusRef

Used by:

externalRef

Attribute Group : uncertainWithComment

Contains:

Comment, uncertain

Used by:

speakersGroup, textLocus, SUPPORT, THESIS, ambiguous, analogyMember, assentAuthor, assentSpeaker, assentSupSpeaker, authorityDetails, authorsGroup, comparisonDomain, conscious, deliberate, etiologyMember, historyOnPersons, historyTime, historyType, includedRef, keyword, limitation, metaphor, metatextDetails, microThemesGroup, paraphrasis, spurious, supportForm, supportFunction, targetsGroup, title