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POSIDONIUS AND LUCRETIUS ON THE INVENTION OF METALLURGY

For Martin Ferguson Smith

The article examines two passages from the discussions of Posidonius (Sen. *Ep.* 90. 11–13 = Posid. F 284 Edelstein-Kidd) and Lucretius (5. 1241–1268) about the origin of civilization, dedicated to the discovery of smelting metals. The remarkable similarity between them — in both, the discovery is associated with a forest fire, as a result of which melted ore came to the surface of the earth — has long caused scientific debate whether Posidonius served as the source of Lucretius, or whether both used some common source, regarded as either Democritus or Epicurus. The author of the article argues in favor of the latter option, developing the hypothesis that Epicurus' theory about the emergence of civilization, set out in his work *On Nature*, which Lucretius closely follows, was also used, but in a critical vein, by Posidonius, who polemicized with Epicurean teaching.

Key words: Posidonius, Lucretius, Epicurus, origin of metallurgy, origin of civilization.

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Посидоний и Лукреций о возникновении металлургии

В статье рассматриваются два отрывка из рассуждений Посидония (Sen. *Ep.* 90, 11–13 = Posid. F 284 Edelstein-Kidd) и Лукреция (V, 1241–1268) о возникновении цивилизации, посвященные открытию плавки металлов. Примечательное сходство между ними — в обоих открытии связывается с лесным пожаром, в результате которого на поверхность земли выступила расплавленная руда — давно вызывает научные дискуссии — считать ли, что Посидоний послужил источником Лукреция, или же оба использовали какой-то общий источник — в качестве такового предполагали либо Демокрита либо Эпикура. Автор статьи приводит аргументы в пользу последнего предположения, развивая гипотезу, что теория Эпикура о возникновении цивилизации, изложенная в его сочинении «О природе», которой близко следует Лукреций, была использована, но уже в критическом ключе, также Посидонием, полемизировавшим с эпикурейским учением.

Ключевые слова: Посидоний, Лукреций, Эпикур, возникновение металлургии, возникновение цивилизации.

There are some similar points in accounts of the development of civilization by Posidonius (known mainly from Seneca, *Epistle* 90)¹ and that by Lucretius, in his *On the Nature of Things*, book V. The similarity concerns the details of discoveries, first of all technical ones. In contrast, the tendencies of the two theories are very different. Posidonius ascribed all the achievements of civilization — technical, social, and political — to proto-philosophers, wise persons who existed from the very beginning of humankind; today’s philosophy is only a stage in this development. Lucretius, however, depicts the progress of civilization as the result of the efforts of humankind that initially have the character of half-conscious impulses and accidental observations (a “natural” phase) and only later, together with the mental development of humankind, acquire a rational character.

Posidonius’ account exists for us only in some scraps preserved by Seneca, who cites only the most striking examples of Posidonius’ intellectualism with which Seneca disagrees, holding the view that philosophers are the authors only of moral achievements; technical discoveries have nothing to do with philosophy, being rather the affair of those who currently deal with such things, more mediocre people, and having their source in more trivial experience. This occasional and selective treatment of Posidonius’ theory by Seneca suggests that Posidonius’ theory might have been more comprehensive and contained achievements of the sages apart from those cited by Seneca, e.g. their role in the creation of religion and language, the topics that play the important role in Lucretius².

We don’t know precisely which treatise (or treatises) by Posidonius Seneca used to present his views on the development of culture, but it was probably his *Protrepiticus*, viz., the paraenetic discourse on the value of philosophy, which broadly corresponds to

¹ All evidence for Posidonius is cited according to the edition of Edelstein and Kidd 1989 (E.-K. in what follows), which is notoriously strict in selecting evidence; the editions of Jacoby 1926 and Theiler 1982, which are more generous in their attributions, are referred to where necessary as *FGrH* and Theiler respectively.

² The most recent reconstruction of Posidonius’ theory of the evolution of culture, mainly on the basis of Sen. *Ep.* 90, is Zago 2012. For my own attempt to treat Posidonius’ views on the origin and development of language, and also of his relation to the earlier thinkers like Plato and Epicurus, see Verlinsky 2019.

the character of Seneca's 90th Letter. The reasoning on the ascent of culture and the saviour role of philosophy in it could be an effective introduction to this *laus philosophiae*³.

The most striking example of the similarity between the two accounts was noticed long ago: both Posidonius and Lucretius adduce the same explanation of the invention of mining: once in a remote region, a great fire in the mountain forests burned the soil so that the ores in metal veins melted; this suggested to Posidonius that that metal ores can be melted by fire artificially (Seneca, *Ep.* 90. 11–13 = F 284 E –K.; *Lucr.* 5. 1241–1268).

Taken that this explanation is unusual, scholars suspected that its two instances came from the same source, and it was a natural guess that Lucretius is dependent on Posidonius⁴. The opposite relation can be definitely ruled out, both on chronological grounds (Lucretius' poem was composed when Posidonius was old and was published even later)⁵ and because it is implausible that a first-tier

³ This was a practically unanimous opinion of 19th-century scholars and was endorsed by Zago (Zago: 2012, 213–217). For testimonies for the *Protrepticus* (attested under the titles Προτρεπτικοὶ λόγοι and Περί τοῦ προτρέπεσθαι [in three books!], see F1–3 E.–K. with Kidd 1988: 99–102). Zago convincingly refutes the alternative views: that of K. Reinhardt, who argued that Seneca used a special treatise on *Kulturentstehungslehre* (there is no evidence for such a treatise), but also that of I. Kidd (Kidd 1988: 964 f.), who ascribes the Posidonian material in the 90th letter to various sources, most of all, to Posidonius' *History*, in particular because of the passage that will be discussed in detail in this paper, which has parallels in the historical work of Posidonius (see also Zago 2012: 159 note 34).

⁴ The resemblance was noticed first by Knaack 1881: 593 n. 2, who proposed that Lucretius is dependent on Posidonius; this was accepted by some other scholars after him (see below on the further discussion of this subject).

⁵ For the chronology of Posidonius, see Malitz 1983: 5–33; Kidd 1988: 8 on T 4. It can be maintained only very approximately. According to [Lucian.] *Longaevi* 20.223, he lived for 84 years. If this is credible, then, since he was still alive in 60 BC (T 34), and died before or ca. 43, probably already before 45, he was born between 143 and 129 and died between 59 and 45 BC; he was a pupil of Panaetius, who died in ca. 110; it is thus impossible that he was born later than 130, and it is likely that he was born some years earlier than this date. His span of life is thus between about 143–130 and about 59–46 BC. Posidonius' account of the discovery of Spanish (and possibly also Gallic) mines belongs in all probability to his *History*. This work started at 146/45 BC (the end date of Polybius' *History*)

Greek philosophical author could be dependent on the Latin poetic source for the teaching of an alien and inimical school. It is understandable that most scholars believed that here, as also in the other cases of similarity, Lucretius borrowed the etiology of invention from Posidonius, whose work might have been well known to him. This proposal did not remain undisputed. Already Giussani, in his outstanding commentary on Lucretius, while admitting that this dependence was possible, advanced another proposal, namely that both Posidonius and Lucretius followed Epicurus; he also noticed the similarity between Lucretius and Posidonius in their accounts of the origin of monarchy and suggested that here Lucretius even more certainly followed Epicurus rather than Posidonius, since Epicurus wrote “certo non manco di toccare questa questione”⁶. But this proposal was not accepted; the view of Posidonius’ priority certainly prevailed⁷, and it gained indirect support in further suggestions about Lucretius’ borrowings from Posidonius.

1) P. Rusch argued that the explanations of meteorological phenomena in Lucretius Book VI go back to Posidonius⁸;

2) H. Diels supposed that Lucretius’ account of the use of animals in war (5. 1996–1307) draws on Posidonius⁹.

Both cases of Lucretius’ alleged dependence on Posidonius were dismantled, however.

and extended to 86 BC or maybe somewhat later (see the discussion in Kidd 1988: 277–280), and probably remained unfinished (Malitz 1983: 32). It is thus quite probable that it was a later work than the *Protrepticus*, which will be of some relevance for the relation of ideas I discuss in this paper. The only certain date for Lucretius is February 54 BC, when the brothers Cicero read his still-unpublished poem (Cic. *Ep. Quint.* 2.9), in all probability after his death in 55 BC (Smith 1992: XI).

⁶ Giussani 1901: 149.

⁷ See, for instance, Gerhäuser 1912: 27 f., and other scholars cited by Cole 1967/1990: 17 n. 4.

⁸ Rusch 1882; this proposal was endorsed by some other scholars, including Hermann Diels (Diels 1921/1969: 363)

⁹ Diels 1921/1969: 363–365; Diels relied on the passage from a short treatise on military art by Asclepiodotus who may be identical to the Asclepiodotus whom Seneca calls a pupil of Posidonius and who might have summarized Posidonius’ lost treatise on tactics. However, both the identity of this Asclepiodotus and his dependence on Posidonius are uncertain.

In the case of meteorology, Lucretius' dependence on Posidonius was rejected by E. Reitzenstein, who argued against Rusch that the similarities between Posidonius and Lucretius VI are explained by the fact that both Posidonius and Lucretius' direct source, Epicurus, used Theophrastus' account of meteorological phenomena and their causes, which has been preserved in the Arabic version and which, according to Reitzenstein, was a part of Theophrastus' doxographic work, *Physikai doxai*¹⁰. Later the doxographic character of this text has been disputed, and it has been identified with Theophrastus' treatise on meteorology (Μεταρσιολογικά), which, however, contained not only his own views but also doxography¹¹. But quite recently F. Bakker¹² argued that Theophrastus was not the author of the treatise on meteorology that has been preserved in Syriac and Arabic translations; he suggests instead "that the treatise has a mixed origin, being mostly Epicurean but with an admixture of Peripatetic views" (p. 265), although he does not rule out entirely that the treatise goes back to Theophrastus' *Metarsiology* (p. 147). In spite of this, the authorship of Theophrastus is still defended by other scholars¹³.

¹⁰ Reitzenstein, 1924. The treatise is known today in two versions, the fragmentary Syriac and the fuller Arabic; an abridged version of the Arabic text in a bad manuscript was edited by G. Bergsträsser in 1918; later, a copy of the lost Syriac original of the Arabic translation was found and edited partially in English translation by H. J. Drossaart Lulofs in 1955; then the complete translation of the Syriac version was edited with a commentary by Wagner, Steinmetz 1964, and last, the fuller Arabic version and the fragments of the Syriac version, accompanied by an English translation, were edited by Daiber 1992.

¹¹ Strohm 1937: 249–268; 403–428 has shown that, in many cases, the Arabic text features not doxography, but Theophrastus' meteorological teaching; and the finding of the Syriac version, which is closer to the Greek original than the Arabic version is, confirmed Strohm's view against Reitzenstein (see Wagner, Steinmetz 1964: 5, 9). The Μεταρσιολογικά in two books is attested by the list of Theophrastus' works (D. L. 5. 44 = F 137. 15 a FHS&G; for testimonies, see FHS&G I. 357 ff.); according to Daiber 1992, the Syriac translation reproduces the whole of Theophrastus' treatise, but Mansfeld 1992: 315–317, relying on the texts that he argued used Theophrastus' material, including *Ep. Pyth.* and *Lucr. VI*, made probable that some parts of the original treatise were omitted in the Syriac.

¹² Bakker 2016.

¹³ Daiber 2021: 417–418, in the re-edition of his paper, argues against Bakker in favor of a Theophrasteian authorship of the Syrian Meteorology;

Thus there is no certainty today that we possess the original source of Epicurus' meteorology. Nevertheless, there is little doubt that Lucretius' account of meteorological causes in Book VI goes back entirely or largely to Epicurus' treatment of them in *On Nature*, Book XIII, of which there is almost no evidence preserved, but the contents of which can be restored from the *Letter to Pythocles*, chapters 88–110, which is a summarized version of this book¹⁴. It is also quite probable, inter alia in view of similarity of the arrangement of material in Aetius' version of *Placita*, Epicurus, *Ep. Pyth.*, and *Lucr. VI*¹⁵, that Epicurus' treatment of meteorological phenomena was indebted to Theophrastus, the ultimate source of the later doxographic tradition, both in terms of the causes he adduced for these phenomena and probably also in his methodology of adducing *multiple* causes for these phenomena¹⁶. Lucretius' debt to Epicurus in the meteorology of Book VI evokes either no doubt, even if the scope of his borrowings has been disputed: Jaap Mansfeld and David Runia suppose, on the one hand, that Epicurus could use not only *Physikai doxai*, but also Theophrastus' *Physics*, and, on the other hand, that Lucretius could use doxographic sources independently from Epicurus, including later ones that were not accessible in Epicurus' time, because inter alia Lucretius' treatment of meteorological causes often shows more proximity to the *Placita* tradition than Epicurus' *Letter to Pythocles*¹⁷. David Sedley,

see also against Bakker: Mansfeld, Runia 2020: 30, 1136 f. Verde 2022 a: 29–34 opts for a mixed origin, mainly Epicurean and less Peripatetic, of the Syrian Meteorology.

¹⁴ See Sedley 1998 for a detailed reconstruction of the contents of Epicurus's *On Nature* from the direct evidence on papyri, the *Letters to Herodotus* and *Pythocles* (two epitomes of this treatise), and indirect evidence. Sedley argues that Epicurus' opus magnum was Lucretius' sole doctrinal source in his poem (Lucretian "fundamentalism"). On Theophrastus' impact on Epicurus (and Lucretius via Epicurus), see Sedley 1998: 122 f., 157–160, 179–185.

¹⁵ The disposition of material in the *Letter to Pythocles*, Lucretius Book VI, Aetius III, and the Syrian Meteorology is practically identical, with minor individual peculiarities (Bakker 2016: 137–142).

¹⁶ On Epicurus' use of Theophrastus, see Mansfeld 1992: 315 n. 5 (who supposes that since Epicurus treats in *Ep. Pyth.* not only meteorological, but also celestial phenomena, he may have used also Theophrastus' *De Caelo*) and Mansfeld: 1994/2011, 237–254.

¹⁷ See Runia 2018: 398 f.; 410; 424; Mansfeld, Runia 2020: 1072.

however, argues that the relation has the strict sequence Theophrastus (*Physikai doxai*) — Epicurus — Lucretius¹⁸. Granted that neither Theophrastus' *Physikai doxai* nor the full version of Epicurus' meteorology in his *On Nature* has been preserved, Lucretius' dependence entirely on Epicurus remains quite plausible. The hypothesis of Lucretius's dependence on Posidonius in meteorology, on the contrary, vanished and now appears to be completely forgotten, although Posidonius's relation to Theophrastus and doxography remains to be investigated¹⁹.

Lucretius' dependence on Posidonius in the passage on using animals in war did not remain undisputed, either. It was criticized again by E. Reitzenstein, who argued against Diels that Asclepiodotus' account is systematic, not evolutionist as in Lucretius, and he pointed out that closer to Lucretius than Asclepiodotus is a heurematographic passage on developments in the military field in Pliny, *NH* 7.202 cited by Diels with its Peripatetic, in particular Theophrastean tradition²⁰. The question of Lucretius' sources in this part and in the whole section on technological discoveries needs further investigation²¹, but Reitzenstein is surely right that Asclepio-

¹⁸ Sedley 1998: 179–182, supposes that, in his treatment of meteorological causes in Book VI, Lucretius derives (through Epicurus's *On Nature*) not from Theophrastus' meteorological treatise, but from the treatment of the same material in the latter's *Physical Opinions*; and this appears to be a prevailing view today, see most recently Verde 2022 b: 84–85 with note 218; see Tsouna 2023: 226, who however shows that in the method of *multiple explanations*, Epicurus had many predecessors and that his own version of it owes more to Democritus than to Theophrastus.

¹⁹ Kidd 1992 maintains that Posidonius' meteorology owes much more to Aristotle than to Theophrastus. Hall 2024: 16 f., who following Bakker doubts the Theophrastean authorship of Syriac meteorology, also denies that it can be Posidonius' source.

²⁰ Reitzenstein 1924: 65–69.

²¹ Epicurus surely could use a heurematographic account of the kind Pliny uses and rework it substituting the inventors of tradition by anonymous representatives of early humankind. It is risky but not entirely impossible to suppose that Epicurus, not Lucretius, supplied these inventions with an impressive innovation of his time in European armies, the use of elephants (not mentioned by Pliny in his account of military developments, probably drawing on a pre-Hellenistic source). But Lucretius' attribution of this invention to the Carthaginians at 5. 1302–1304 (the sole reference to a historical era in his account of the progress of culture) is rather his own addition, and it is a mystery why he attributed it to them.

dotus' systematic account of using animals is too brief and lacks any specific details to make us believe that Posidonius' evolutionary account underlies it.

Reitzenstein also briefly supported Giussani that the similarity between Posidonius' and Lucretius' views on the discovery of metallurgy does not imply the dependence of the former on the latter, but rather that this explanation was present already in Epicurus²². He pointed to the principal differences between the two doctrines and also to the fact that Lucretius understood his task as the poetic adaptation of Epicurus' teaching, which makes his drawing on collections of writings implausible²³. This of course cannot be regarded as a conclusive argument against Lucretius' dependence on some other sources along with Epicurus; moreover in the case of metallurgy, one might have suspected that Lucretius did not accidentally borrow from some collection of *heuremata*, but considerably reworked Epicurus' theory with the help of Posidonius' theory. Later, without knowing Reitzenstein's work, C. Bailey disputed in his commentary L. Robin's opinion that Lucretius borrowed the explanation of the invention of metalwork from Posidonius²⁴. Nevertheless, the relation of two remarkably similar accounts of the invention of metallurgy has never been thoroughly

²² Reitzenstein 1924: 64 f.

²³ Later Reitzenstein (1933: 542–549) rejected the attempt of Lück 1932 to revive the hypothesis of Lucretius' use in Books 5 and 6 of the "late Epicurean sources" and also of Posidonius through these sources. The main object of Lück's work was to prove the Lucretius' ultimate use of Posidonius in his treatment of cosmogony in Book V and of meteorological phenomena in Book VI, against Reitzenstein's and also J. Woltjer's earlier view that Lucretius depended mainly directly on Epicurus (Lück, p. 6 f.). Reitzenstein argued that both Lucretius and Posidonius were dependent on Epicurus (p. 542 f.).

²⁴ Bailey 1947: III, 1499 f. rejects L. Robin's view (Ernout, Robin 1928: III, 150–151) that Lucretius "made a concession" to Posidonius' teaching on philosophers as inventors 5. 1105–1135, based on Posidonius' rule of sages in primitive time; he also supposes (III, 1521) that Lucretius' and Posidonius' explanation of how metalwork was discovered goes back to Epicurus; his general view (III, 1472 f.) was that Lucretius closely follows Epicurus in his account of the origin of civilization.

discussed, and the proposal that here Lucretius drew on Posidonius still finds its proponents²⁵.

A new hypothesis has been brought forward by T. Cole in his attempt to reconstruct Democritus' theory of the origins of culture. He argued that the parallel accounts of prehistory in Lucretius and Posidonius, including on the invention of metallurgy, should be explained by the influence of Democritus both on Lucretius (via Epicurus or directly) and on Posidonius²⁶. The Epicurean theory, according to Cole, remained more faithful to Democritus' stress on human inborn capacities, the role of accidental events, observations of them by men, and clever transformation into technical devices and skills. (The Epicureans, however, were more inclined to emphasize the deterministic role of the environment and of human nature). In contrast, Posidonius contaminated Democritus' teaching with intellectualist and teleological elements typical of Plato and Aristotle (the role of sages; the view of *techne* as complementary to nature). Be that as it may, Cole's book retains its importance and his ideas should be carefully discussed²⁷; but in the case of the invention of metallurgy there is no evidence that Democritus treated this subject. Moreover, apart from the *argumentum ex silentio*, which can never be conclusive in the treatment of fragmentary evidence, the considerations of chronology also contradict the proposal that the parallel accounts on metallurgy go back to a thinker as early as Democritus (see below).

Meanwhile, the evaluation of the scope of Lucretius's direct dependence on Epicurus has changed considerably, most of all due to the study of Herculaneum papyri. David Sedley argued, on the basis of the detailed reconstruction of Epicurus' *On Nature*, in favor of Lucretius' "fundamentalism", namely that his main source (including Book V) was this, Epicurus' opus magnum, and that Lucretius was practically unaware of later trends in philosophy, including the development in the Epicurean school itself²⁸. Unfortunately, there are only a few indirect remnants of Book XII of

²⁵ Apart from L. Robin (see the previous note), see De Lacy 1948: 12 f.; Spierri 1959: 134 with notes 13 and 218 (addenda) (he, however, is cautious and cites the proponents of the opposite view).

²⁶ Cole 1967/1990: 17–19; 37–40.

²⁷ See below on Cole's contrasting of Epicurus and Posidonius in the particular case of the invention of metallurgy.

²⁸ Sedley 1998.

On Nature that deal with human culture²⁹; the relevant parts of the *Letter to Herodotus*, which, as Sedley proved convincingly, was the summarized version of *On Nature*, retain only two subjects of human culture: religion and language. For this reason, scholars supposed in the past and still suppose that, in his account of the origins of culture, Lucretius used along with Epicurus' also doctrinal material of other schools, Stoic (Posidonius) and Peripatetic (Dicaearchus) ones³⁰. Nevertheless, the relevant parts of *On Nature* were probably much more detailed and could have included an account of technology, as well. The account of the development of human culture in the inscription of Diogenes of Oinoanda, which is very brief and reached us only in fragmentary form, however mentions the evolution of human clothing, which parallels but is not identical to Lucretius's account in Book V: both Epicurean authors can here draw on Epicurus's *On Nature*, Book XII³¹.

The provenience of Posidonius's and Lucretius's accounts of the invention of metallurgy remains debatable. Zago recently found it plausible that Epicurus' *On Nature*, Book XII was the source of both, but then returned to Cole's hypothesis that the ultimate

²⁹ For the contents of Book XII (there are no papyrus remains of it), see Sedley, 1998: 121–123; I argued that the criticism of theories of the invention of religion and language in Lucretius, Diogenes of Oenoanda, and Sextus Empiricus go back to the same book (Verlinsky 1998).

³⁰ Thus Dicaearchus featured in scholarship as a possible source of an (overstated) idealization of the primitive state of humankind in Lucretius (see, for instance, Schrijvers 1999: 81–101), without sufficient grounds, in my view.

³¹ Lucr. 5. 1350–1353 mentions the stage of plaited clothes (*nexile tegmen*) and the more advanced stage of woven ones, viz., produced with the help of the loom (*textile [te]gmen*); Diogenes fr. 12 col. I–II Smith knows the stage of leaves, grass, and animal skins (compare Lucr. 5. 972 and 1011 resp.), the next of *κασῶται ἐσθῆτες*, and then of *στρεπτοί*; he also mentions the invention of the loom at the next stage. Martin Smith (Smith 1992: 453) points out that *στρεπτοί* corresponds to *nexile* in Lucretius, and *κασῶται* (*hapax*) refers to the stage of felted cloth not mentioned by Lucretius (*κασῶτος* is related to *κασῆς* (*κάσης*), which means felted cloth, not “skin”, as LSJ, see Agatharch. 20 = Phot. *Bibl. Cod.* 250, 445 b 3, *κάσαι*, explained as *στολαὶ πλιηταί*). But Lucretius mentions working wool, too, although not felted clothes, dwelling on the fact that it was initially men's, not women's work (5. 1354–1360). This suggests the original account could be more detailed than relying solely on Lucretius might lead one to think.

common source of Lucretius and Posidonius was rather Democritus; he justifies this idea mainly with Posidonius' hostility to Epicureanism³². This consideration, however, retains its force only if we count only a positive impact of one thinker on another, in the manner of: thinker Y uses thinker X because Y approves of X. In fact, we should take a negative impact into account, as well, when Y uses X's material because the former argues against the latter. According to my hypothesis, Posidonius' theory of the development of culture emerged as a critical reaction to Epicurus' corresponding theory; it discussed in large part the same departments of culture and even the same partial discoveries, but in a vein opposite to Epicurus's.

The indirect evidence for this innovative character of Posidonius's theory of human culture in Stoicism is not only the lack of evidence for the Stoic teaching on this subject before Posidonius, but, even more, two pieces of criticism of Posidonius that seem to reflect the Stoic mainstream position in this field. Posidonius explained ethnic differences, including differences between languages and different capacities to develop various crafts and sciences, by geographic position and corresponding climatic differences, the latter being the manifestations of divine providence (Strab. 2.3.7 = F 49. 317–326 E.-K.). Strabo (*ibid.*) rejected this explanation, seeing in these differences rather the effect of "accident and chance", i.e., of causes that cannot be scientifically accounted for. Seneca (*Ep.* 90.35) objected to Posidonius' claim that philosophical reason played a pivotal role in the discoveries of culture and asserted instead that these discoveries were results of *usus*, viz., practice and trivial experience. These pieces of criticism are different, of course, but there is a common element in both: it is unlikely that the orthodox Stoics who shared Posidonius' opponents view, with their lack of interest in the causes of development, would develop a theory of the development of culture, at least one that, like Posidonius' theory, concentrated on the causes of individual inventions³³.

There are thus some reasons to return to the discovery of metallurgy in Posidonius and Lucretius. First, there is one indisputable case of similarity in both accounts of the development of culture, and the meaning of this similarity remains ambiguous;

³² Zago 2012: 157–166.

³³ For more detail, see Verlinsky 2019: 20–23.

second, the issue sheds light on some aspects of Posidonius' teaching and, as I hope to show, also on the polemical origin of it.

At first glance, Lucretius' dependence on Posidonius in just this case is more plausible than the dependence of both on Epicurus. Posidonius treated the similar subject, the fire in the mountains and the melting of metal ores by it, in his accounts of Spain and Gallia, explaining thus the beginning of mining in these areas and the extraordinary wealth of those who exploited these quarries.³⁴ This story belongs to Posidonius' *History*, rather than to his natural-philosophical or ethical treatises³⁵:

Strabo 3.2.9

οὐ γὰρ ἀπιστεῖν τῷ μύθῳ φησὶν [Ποσειδώνιος] ὅτι τῶν δρυμῶν ποτε ἐμπρησθέντων ἡ γῆ τακεῖσα, ἄτε ἀργυρίτις καὶ χρυσίτις, εἰς τὴν ἐπιφάνειαν ἐξέζεσε διὰ τὸ πᾶν ὄρος καὶ πάντα βουνὸν ὕλην εἶναι νομίσματος ὑπὸ τινος ἀφθόνου τύχης σεσωρευμένην. καθόλου δ' ἂν εἶπε (φησὶν) ἰδῶν τις τοὺς τόπους θησαυροὺς εἶναι φύσεως ἀενάους ἢ ταμειῖον ἡγεμονίας ἀνέκλειπτον· οὐ γὰρ πλουσία μόνον ἀλλὰ καὶ ὑπόπλοτος ἦν (φησὶν) ἡ χώρα, καὶ παρ' ἐκείνοις ὡς ἀληθῶς τὸν ὑποχθόνιον τόπον οὐχ ὁ Ἄιδης ἀλλ' ὁ Πλούτων κατοικεῖ.

Diod. 5.35.3

πολλῶν δ' ὄντων ἐν αὐτοῖς δρυμῶν καὶ πυκνῶν τοῖς δένδρεσι, φασὶν ἐν τοῖς παλαιοῖς χρόνοις ὑπὸ τινων νομέων ἀφέντων πῦρ κατακαῆναι παντελῶς ἄπασαν τὴν ὄρεινὴν χώραν· διὸ καὶ συχρᾶς ἡμέρας συνεχῶς πυρὸς ἐπιφλέγοντος καῆναι τὴν ἐπιφάνειαν τῆς γῆς, καὶ τὰ μὲν ὄρη διὰ τὸ συμβεβηκὸς κληθῆναι Πυρρηναῖα, τὴν δ' ἐπιφάνειαν τῆς κατακεκαυμένης χώρας ἀργύρῳ ῥυῆναι πολλῶ,

³⁴ Strabo (Strab. 3.2.9 C 147 = F 239 E.-K.=*FGrH* II A 87 F 47) and Athenaeus (Athen. 6. 233 d-e = F 240 E.-K. = *FGrH* II A 87 F 48) cite Posidonius as their source; Diodorus (Diod. 5.35.3 = *FGrH* II A 87 F 117 [Anhang], not in E.-K.) does not cite Posidonius, but is usually assigned to him, because of the similarity of its content and significant details to those in the first two texts. There is a difficulty, since Strabo and Diodorus assign the accidental fire and the discovery of mining to Spain (Strabo precisely points to Turdetania), while Athenaeus assigns them to the Alps in Gallia. It seems possible that Athenaeus, who is close in details to two other texts, contaminated two different accounts of Posidonius, as supposed by Schühlein: 1886: 78 f. (or alternatively but less likely, as Kidd 1988: 840 supposes, Posidonius used this etiology of discovery twice in his work).

³⁵ See the discussion of various attributions of these texts: Hahm 1989: 1344.

καὶ χωνευθείσης τῆς φύσεως, ἐξ ἧς ὁ ἄργυρος κατασκευάζεται, ῥύακας γενέσθαι πολλοὺς ἀργύρου καθαροῦ.

Athen. 6. 233 d-e

καὶ τὰ τε πάλαι μὲν Ῥιπαῖα καλούμενα ὄρη, εἴθ' ὕστερον Ὀλβια προσαγορευθέντα, νῦν δὲ Ἄλπια (ἔστι δὲ τῆς Γαλατίας) αὐτομάτως ὕλης ἐμπρησθείσης ἀργύρῳ διερρῦη.

Let us compare the similar etiology of the invention, but now in the context of the origin of culture, one in Posidonius as cited by Seneca and another by Lucretius:

Sen. *Ep.* 90. 11:

In hoc quoque dissentio, sapientes fuisse qui ferri metalla et aeris invenerint, cum incendio silvarum adusta tellus in summo venas iacentis liquefacta fudisset.

Lucret. 5.1252–1257

quicquid id est, qua cumque e causa flammeus ardor
horribili sonitu silvas exederat altis
a radicibus et terram percoxerat igni,
manabat venis ferventibus in loca terrae
concava conveniens argenti rivus et auri,
aeris item et plumbi.

Beyond these texts, the story of the origin of mining in historical time due to accidental fire is known from one more text—a paradoxographic compilation of Pseudo-Aristotle's *De mirabilibus auscultationibus*, 87, 837 a 24–26:

Ἐν τῇ Ἰβηρίᾳ λέγουσι τῶν δρυμῶν ἐμπρησθέντων ὑπὸ τινῶν ποιμένων, καὶ τῆς γῆς διαθερμανθείσης ὑπὸ τῆς ὕλης, φανερῶς ἀργύρῳ ῥεῦσαι τὴν χώραν, καὶ μετὰ χρόνον σεισμῶν ἐπιγενομένων καὶ τῶν τόπων ῥαγέντων πάμπληθες συναχθῆναι ἀργύριον, ὃ δὴ καὶ τοῖς Μασσαλιώταις πρόσοδον ἐποίησεν οὐ τὴν τυχοῦσαν.

They say that in Iberia, when bushes were burned by some shepherds, and the earth has been thoroughly heated by the wood, the ground manifestly

flows with silver, and that after a time, when earthquakes occurred and the area was torn open, a great deal of silver was gathered in, which has produced no insignificant revenue for the Massalians³⁶.

It is a priori more probable that the story of the marvelous melting of metals due to fire originated within historical tradition or semi-scientific paradoxography in relation to Spain with its fabulous treasures of precious metals and then penetrated into philosophical theories of the origin of culture than, vice versa, that a philosophical account of the prehistoric invention of useful metals (and primarily of metallurgy, not mining itself, as we shall see) was transformed into the story of the discovery of gold and silver in Spain. It has been supposed that the story in *De mirab. ausc.* reflects this earliest version and that the source of this information in *De mirabilibus* was the famous historian of the Greek West, Timaeus of Tauromenium (350–264 BC?)³⁷. If this were the case, Democritus could not be the ultimate source of its adaptation into the theory of the origin of culture in Posidonius and Lucretius, as T. Cole suggested. But even if Timaeus drew on some earlier account, it is also on general grounds hardly probable that, in the second half of the 5th century BC, Democritus possessed information about mining in Spain³⁸. Granted that this prehistoric etiology is not attested for Democritus, it is unlikely that Democritus could be the common source for Posidonius and Lucretius (or Epicurus).

³⁶ Wilson 2024: 160.

³⁷ Geffcken 1892: 95, pointed to Poseidonius' words in Strabo οὐ γὰρ ἀπιστεῖν τῷ μύθῳ (see above) and plausibly supposed that Posidonius was referring to some earlier source.

³⁸ The earliest literary evidence of Greeks in Spain is Hdt. 4. 152 on a Samian Kolaios who visited Tartessos about 630 BC; see Dominguez 2006: 433; Herodotus (1. 163.1) mentioned also Phocaeen contacts with Spain in the 6th century BC (Dominguez 2006: 434–442); one contact of interest could be silver mines in Huelva (Southern Spain), *ibid.* p. 439. Nevertheless, it appears that mining in Spain did not attract attention in Greek literature, although there is evidence of contacts, see Dominguez 2006 on the appearance of the Spanish script based on the Ionian, possibly in the second quarter of the 5th century BC (p. 462); the Greek lead letter of the end of the 6th century BC; there were Phocaeen and Massaliote settlements in northern Spain (see Dominguez 2004: 161 ff.), but not in the south where mining was done at this time.

Unfortunately, both the date of *De mirabilibus auscultationibus* and the source of the story about the mountain fire are debatable. H. Flashar, too, proposed that Posidonius rather than Timaeus of Tauromenium was the source of ch. 87 of *De mir. ausc.*³⁹. The date of a patchwork such as *De mirabilibus auscultationibus* is less important for my subject than the provenience of the passage in question. There is little doubt that this part of the treatise draws on old Peripatetic sources and historic authors of the 4th century BC, Timaeus and Theopompus. Just for this reason, Flashar dated the treatise to about mid-3rd century BC⁴⁰. There is no compelling reason to treat our chapter as an exception and to ascribe it to such a late author as Posidonius.

The description of the discovery of mining in *De mirab. ausc.* 87 differs from Posidonius' in two respects: it mentions earthquakes, due to which melted ores were found some time after the fire, while Posidonius says the melted ores immediately flowed on the surface, making Massalians the first users of mines, not the Phoenicians, as Posidonius has it. As for the first difference, it is unlikely that the author or the source of *De mirab. ausc.* substituted Posidonius' Phoenicians with Massalians; on the contrary, it is quite possible that Posidonius corrected either *De mirab. ausc.* or its source in this respect, relying on his own or someone else's erudition in matters

³⁹ Flashar 1990: 45; 110 ascribed chs. 87, 89–94 to Posidonius because of the parallel passages in Strabo, which in his view certainly go back to Posidonius (Flashar, like Geffcken before him, supposed that in some cases Timaeus was Posidonius's source); see also Malitz 1983: 114 in favor of Posidonius as the source of ch. 87 and Wilson 2024, 160: who attributes ch. 87 to Posidonius after Flashar. But Pajón Leyra 2024: 20–23 doubts both Timaeus' and Posidonius' provenience for chs. 85–98, although she admits a certain coherence of this set of stories. See further Schorn 2024: 50–54 against the attribution to Posidonius of *De mirab. ausc.* 93 and Schorn, Mayhew 2024: 7 against the use of Posidonius in the *De mirab. ausc.* on the whole. Flashar's hypothesis on Posidonius as one of the sources for this treatise was earlier rejected by Vanotti 2007: 43–44, and 172 (on ch.87).

⁴⁰ Flashar 1990: 207 (as for Peripatetic sources, the *De mirab. ausc.* shows the influence of Theophrastus, Strato, and the pseudo-Aristotelian *Problemata*). One part of the treatise goes back to Ps.-Plutarch's *De fluviis* and was thus not written earlier than the 2nd century AD, but it was usually thought to be a later addition to the work, which was itself compiled much earlier.

such as the exploiting of Iberian mines⁴¹. The second difference may imply that the version of *De mirab. ausc.* did not contain an important detail that is typical for both the historical and prehistoric versions of Posidonius and for Lucretius's version, too. In all of them, it is crucial that the metals flowed on the surface of the earth, while the author of *De mirab. ausc.*, although also mentioning the earth "flowing with silver", does not consider this important detail; the metals only grew closer to the people due to the fire, but were not known until later, due to earthquakes. I will return to this significant difference in due course.

Considering the scarcity of details in this version, which could hardly be the result of its curtailing by a paradoxographer, I would suppose that it precedes all variants of the story in Posidonius and is more likely borrowed and expanded by him or his predecessors than vice versa⁴². As for this source, it is uncertain, but in spite of the latest critical work, it may be Timaeus of Tauromenium, to whom chs. 78–114 of the *De mirab. ausc.* were usually assigned⁴³; alternatively, it may be Theophrastus⁴⁴ or some other earlier source.

⁴¹ Flashar 1990: 111, claims that the reference to Massalians is understandable only in the context of Diodorus' account (5.35. 3), which is related to Posidonius, in which the Phoenicians' trade in silver with Iberians is mentioned, because "Massilia ist eine phoenizische Pflanzstadt". But in fact Massilia was the colony of Phocaea and has nothing to do with Phoenician trade.

⁴² It is quite possible that Posidonius "corrected" the earlier version of the discovery of mining in Spain, which made its first beneficiaries the Massalians, now substituting the Phoenicians for them, viz., he assigned the discovery to an earlier date than the source of *De mirab. ausc.*: the date of the founding of Massalia was 600 BC according to Timaeus (F 71), while according to Diod. 5. 35. 5, who used Posidonius, the incomes from Iberian metals allowed the Phoenicians to found colonies in various lands, including in all probability Carthage (διόπερ ἐπὶ πολλοὺς χρόνους οἱ Φοῖνικες διὰ τῆς τοιαύτης ἐμπορίας ἐπὶ πολὺ λαβόντες αὐξησιν ἀποικίας πολλὰς ἀπέστειλαν, τὰς μὲν εἰς Σικελίαν καὶ τὰς σύνεγγυς ταύτης νήσους, τὰς δ' εἰς τὴν Λιβύην καὶ Σαρδόνα καὶ τὴν Ἰβηρίαν). Carthage was usually considered to have been founded much earlier than Massalia (814/13 BC, according to Timaeus F 60).

⁴³ For a thorough discussion of Timaeus's material in *De mirab. ausc.*, see Schorn 2024, who demonstrates the fragility of many ascriptions to this historian. There is one more lemma on Massalia in *De mirab. ausc.* 89, on marvelous fish, which is ascribed to Posidonius as its source because Posidonius had a detailed account and discussion of another wonder in the

Thus in spite of many uncertainties, it is still possible that the version of the invention of mining in Spain existed much earlier than the time of Posidonius and was the ultimate source for both kinds of his story: in both a historical and a prehistoric context. But it is also chronologically possible that this short version of the story involving Spain was adapted to prehistory by someone earlier than Posidonius, and while Democritus can be disclaimed both on grounds of chronology and lack of any evidence, Epicurus remains a quite plausible candidate on both grounds, granted that his theory of the origin of culture has been preserved for the most part via Lucretius⁴⁵. However, we still don't have decisive proof that this specific version appeared due to Epicurus rather than to Posidonius.

It may thus appear that Posidonius—who used, possibly more than once, this marvelous invention of mining in his historical work and who obviously drew much attention to this story—transferred this event to the prehistoric epoch and that Lucretius later drew on him in his account of the origin of civilization. Since there is no evidence that Epicurus treated the same subject, Lucretius' dependence on Posidonius may seem to be psychologically plausible and attractive. Nevertheless, there are some objections against Posidonius as Lucretius' source in this case, too, along with the fact that the other cases of alleged dependence have been refuted. Let us now juxtapose and compare two accounts:

Posidonius (Seneca, *Ep.* 90. 11–13 = F 284 E.-K.):

(11) In illo quoque dissentio a Posidonio, quod ferramenta fabrilia excogitata a sapientibus viris iudicat; isto enim modo dicat licet sapientes fuisse per quos

tunc laqueis captare feras et fallere visco

inventum et magnos canibus circumdare saltus.

Omnia enim ista sagacitas hominum, non sapientia invenit. (12) In hoc quoque dissentio, sapientes fuisse qui ferri metalla et aeris

same place (Strab. 4.1.7 = F 229 E.-K. = *FGrH* II A 87 F 90). Flashar 1990: 112 claims Posidonius as its source, while Geffcken 1892: 95 earlier believed that it goes back to Timaeus, whom Posidonius used. But in fact we cannot be certain that Posidonius dwelled on this marvelous thing, too.

⁴⁴ Flashar 1990: 39–44; Wilson 2024: 140 f., who supposes that one of the sources could be a treatise on mines (*περὶ μετάλλων*) by Theophrastus.

⁴⁵ Timaeus worked in Athens in 316–289 BC (Baron 2013: 18) at the same time as when Epicurus wrote his *On Nature*, and thus can be used chronologically in this treatise.

invenerint, cum incendio silvarum adusta tellus in summo venas iacentes liquefactas fudisset. ista tales inveniunt quales colunt.

(13) Ne illa quidem tam subtilis mihi quaestio videtur quam Posidonio, utrum malleus in usu esse prius an forcipes coeperint. Utraque invenit aliquis excitati ingenii, acuti, non magni nec elati, et quidquid aliud corpore incurvato et animo humum spectante quaerendum est. Sapiens facilis victu fuit.

Lucr. 5. 1241–1268:

Quod super est, ae<s at>que aurum ferrumque repertumst
et simul argenti pondus plumbique potestas,
ignis ubi ingentis silvas ardore cremarat
montibus in magnis, seu caelo fulmine misso,
sive quod inter se bellum silvestre gerentes
hostibus intulerant ignem formidinis ergo,
sive quod inducti terrae bonitate volebant
pandere agros pinguis et pascua reddere rura⁴⁶,
sive feras interficere et ditescere praeda;
nam fovea atque igni prius est venarier ortum
quam saepire plagis saltum canibusque ciere.
quicquid id est, qua cumque e causa flammeus ardor
horribili sonitu silvas exederat altis
a radicibus et terram percoxerat igni,
manabat venis ferventibus in loca terrae
concava conveniens argenti rivus et auri,
aeris item et plumbi. quae cum concreta videbant
posterius claro in terra splendere colore,
tollebant nitido capti levique lepore,
et simili formata videbant esse figura

⁴⁶ Usually the sentence is understood as referring to two different actions, acquiring land for agriculture (*pandere agros pinguis*) and acquiring estates suitable for pasture (*pascua reddere rura*). The passage thus implies that agriculture already existed when metallurgy was invented: Manuwald 1980: 43; Zago 2012: 158 note 33. However, since Lucretius associates ploughing with metals (5. 933 f.; 1289), as Zago rightly notices, it is tempting to take the whole sentence as referring to husbandry only, viz., they wanted to clean fertile land of trees (*agros pinguis* is internal accusative) and thus obtain estates for pasture (hendiadys). Although according to Serv. *In Georg.* 2, 412 *agros incultos “rura” dicebant, id est silvas et pascua, “agrum” vero, qui colebatur*, there are enough examples of *ager* as synonym of *campus*, see ThLL, I, col. 1282, 38 ff. At 5. 973; 1104, Lucretius uses the term “ager” in the meaning of camps, “countryside”, for the time when agriculture certainly did not exist yet.

atque lacunarum fuerant vestigia cuique.
 tum penetrabat eos posse haec liquefacta calore
 quamlibet in formam et faciem decurrere rerum,
 et prorsum quamvis in acuta ac tenvia posse
 mucronum duci fastigia procudendo,
 ut sibi tela parent silvasque ut caedere possint
 materiemque dolare et levia radere tigna
 et terebrare etiam ac pertundere perque forare.

First, Posidonius' account cited by Seneca differs seriously from the evidence just adduced from his *History*: all three passages above are about the beginning of gold and silver mining in historical time, as the contrast between the Phoenicians and the uncivilized inhabitants of Spain shows. But in Seneca's letter Posidonius describes the prehistoric era, and has in view not the invention of mining but of metallurgy⁴⁷, and more precisely of working copper and iron, not silver and gold, i.e., of useful metals (the philosophical inventors would not put gold and silver into use, foreseeing the danger they pose for humankind). This technological aspect of the story is much closer to Lucretius than to Posidonius' own treatment of a forest fire and the accidental melting of ores in his historical work⁴⁸. Of course, this by itself cannot exclude Posidonius' priority:

⁴⁷ The opposite has been claimed by Gerhäuser 1912: 17, who takes *ferri metalla et aeris* in Sen. *Ep.* 90.12 as a reference to the invention of mining, because the discovery of metals that trickled up to the surface of the earth would be possible for any unwise person. In fact, although *metalla* can refer both to quarries (mines) and to metal ore (see *OLD*, s.v.), in Seneca it obviously has the latter meaning: it can be seen from the following *venas*, which can imply only *metallorum*: the sages thus discovered metals themselves, but of course in the sense that they simultaneously discovered how they can be worked, just as in a similar story of Lucretius': that Seneca has in view primarily metalworking, not mining, can be seen both from what precedes our passage (90. 11 *in illo quoque dissentio a Posidonio, quod ferramenta fabrilia* [implements of smith] *excogitata a sapientibus viris iudicat*) and what follows it (90.13, the question of priority of smith's hammer and tongs, on which see below); also Seneca's polemical question addressed to Posidonius (90.14) — *quomodo... convenit, ut et Diogenem mireris et Daedalum? qui serram commentus est* ... — shows that metalworking is in focus, not mining.

⁴⁸ The difference between Posidonius' treatment of the subject in his *Histories* according to Strabo, Diodorus and Athenaeus, on the one hand, and in the treatise cited by Seneca, on the other, has been rightly pointed

he was able to adapt the etiology of the invention of mining in Spain, which as we have seen he could find in some earlier historical or quasi-scientific account, to his theory of the origin of culture and to influence Lucretius with this version. Nevertheless, even in this case, it would not be a simple transfer of the same etiology from a historical to a prehistoric context, but its substantial adaptation; and if the history of the forest fire and metals melting was not Posidonius' invention, then its adaptation to prehistory was not original with him, either.

The most important argument in favor of the Epicurean, rather than the Posidonian origin of the explanation of the prehistoric origin of metallurgy from the accidental mountain fire is, first, the much more detailed character of the story in Lucretius. To begin with, he adduces four hypothetical alternative causes of the fire itself, which is in accord with the practice of Epicurus and his school of pointing to multiple probable explanations without giving preference to one of them⁴⁹. He depicts in more detail than any other text the effects of the fire on metal ores: it was an extraordinary fire that made the earth boil (*percoxerat*) and flow together with liquid metals. He maintains that the use of all five basic metals, copper, gold, iron, silver, and lead, were all invented due to such an accident (5. 1241–1244), but his depiction of the invention itself includes only four of them (1256 f.). Iron is excluded, since its invention took place only later, because, as Lucretius maintains, copper is worked more easily than iron, which is correct, and because copper *facilis magis est natura et copia maior* (1286–1288)⁵⁰. Posidonius speaks

out by Cole 1967/1990: 17 with n. 5, although, like other scholars, he does not properly distinguish the invention of metallurgy and the invention of mining. Kidd 1988: 964 f. also failed to notice this difference. In the result, he unduly suspects Seneca of citing Posidonius from various sources and of borrowing this particular passage from his *History*, rather than from his account of the origin of culture; see also Kidd: 1999, 362 n. 393, where he refers to frs. 239 and 240 on the origin of mining in Spain and Gaul, and wrongly infers that the invention of metalwork Seneca reports “had nothing to do with a ‘Golden Age’ theory”. See contra, rightly, Zago 2012: 159 note 34.

⁴⁹ The multiple explanations in the Epicurean theory have been the subject of some important studies in recent years; see Tsouna 2023, who cites the earlier literature.

⁵⁰ On the latter point (*copia maior*), which at first glance is mistaken (copper is on the whole rarer than iron), see Bailey 1947: 1526 ad loc., who

only about the invention of copper and iron mining, thus ruling out any attempts to use the inappropriate metals, and he provides few details beyond the fire itself.

Of course it would be hazardous to draw inferences on the presence or lack of details in Posidonius' narrative, since we have only Seneca's critical notes on it, and we also cannot rule out that Lucretius supplied new details to Posidonius' account. Nevertheless, there are peculiar features in Lucretius' version that make it inherently appropriate to the Epicurean approach and don't look like a simple adaptation of a Stoic version to the tenets of the inimical school. Lucretius adduces the explanation how exactly primitive men appreciated the usefulness of melted metals; they first were attracted by the bright color of congealed pieces and thus are almost automatically struck by impressions, as is appropriate to a "natural" stage of development before reason started playing a role in inventions; they observed that the forms of these pieces corresponded to the holes they occupied and recognized that they themselves could make molds and melt ore to make tools. He further depicts the following trial-and-error process of finding appropriate metals for making tools: copper⁵¹ proved its usefulness, while gold and silver were tried and rejected as unusable. Iron was more difficult to find, and for this reason its working was a later discovery than that of copper.

The algorithm of the discovery is first the immediate observation of something in nature that is useful and second attempting by trial and error to imitate the natural processes by their

adduces the correct understanding by Merrill: "copper is often found pure, iron in the form of ore and therefore less accessible". Just how ironworking was invented is not explained, but left to Memmius as being easy to recognize by himself (1281–1282), which is however by no means obvious. For an attempt to solve this difficulty, see Solmsen 1970, who however leaves us with different variants of explanations of this difficulty (that Lucretius misunderstood his original, presumably Epicurus, or that the relevant chapters were missing in this original). I would tentatively suggest that in Lucretius's view (which is not correct from the modern point of view, of course) ironworking was invented in the same manner as the working of other metals (see 5. 1241), i.e., due to accidental fire and the melting of iron ore, but later because it occurs more rarely in pure form.

⁵¹ Obviously in combination with tin, i.e., as bronze; without tin, copper is as useless as silver and gold, see Smith 1992 ad loc.

own devises and using primitive tools. This is a Lucretius' standard way of explaining inventions: he tries to reduce to a minimum the role of inventiveness and of capacity to foreknow the skills and tools you are searching for—the first step is either a spontaneous, half-conscious reaction to some stimulus (like the first sounds of language, 5.1028, or primitive ways of fighting, 4.843–852) or very elementary observation (like that the warmth of the sun mellows earth's products in wild nature, suggesting the cooking of food, 5.1101–1104). The next, more complicated stages are already improvements on these elementary findings. This in turn corresponds entirely to Epicurus' teaching, which is known to us only in a succinct formulation and in his treatment of language as prime example: at the first stage of cultural progress, the main force of discoveries is human nature itself; reason plays a role only in the later stage and by improving original "natural discoveries" (*Ep. Hdt.* 75–76)⁵².

The tendency of Posidonius was just the opposite: he stressed in contrast the intellectual abilities of inventors, most of all their capacity to take notice of natural processes that were far from obvious and then to discover immediately the artificial tools to imitate these processes. Posidonius's algorithm of invention is known to us from the invention of producing bread: there was no observable analogy of grinding grains, kneading dough, and baking; the sages invented this having recognized how the teeth and stomach treat food in the organism (*Sen. Ep.* 90, 22)⁵³. Only on the surface

⁵² For the decisive impact of Epicurus' division of cultural development into two epochs, the "natural" and the "rational" epochs, on both the teaching and arrangement of *Lucretius*, 5. 1011–1457, see the seminal study Manuwald 1980. I tried to show (Verlinsky 1998) that diminishing human intellectual capacities in the first stage of development and stressing instead the role of accidents and elementary observations in inventions, which is typical of the Epicurean theory of origin of culture, can be traced back to Epicurus himself. I suppose that this emphasis on the triviality of inventions may have been rooted not only in his desire to remove the role of the gods as bringers of culture to humankind, but also in his resistance to the idea of extraordinarily wise *human* inventors.

⁵³ In my view, Cole 1967/1990: 19 with note 9 goes too far when contrasting the invention of a millstone and the cooking of grain as learning from experience, on the one hand (the heritage of Democritus, in his view, which is closer to Lucretius), and as the Aristotelian teleological idea of craft as complementation of nature, on the other. Both inventions are of

does this remind us of inventions by imitation, such as Lucretius uses. Posidonius has in view observations of a far less obvious character than those that Lucretius refers to, and the inventions in Posidonius are far more remote analogies, which demand more inventiveness in making artificial analogies to natural objects. This looks like putting intellect in first place, attributing to it the initial and primary role in the creation of civilization, in opposition to Epicurus's assigning a later and secondary role to it.

Epicurean tradition (presumably Epicurus himself) treated the evolution of making clothes as a gradual process (leaves and grass — skins — felted wool — plaited clothes — weaving and the invention of loom)⁵⁴. The first natural “clothes” are depicted as found spontaneously by natural impulses; using the skins of animals is a natural development from this. The further stages involve much more inventiveness and were probably assigned to the “rational” stage, but there are no traces of the account of how they really happened, because for the Epicurean approach only the initial invention is important; the later ones are simply attributed to improvements made by reason. Posidonius, in contrast, depicted only the invention of the loom, the final stage for Epicureans, and stressed its design. In contrast to Epicureans, he emphasized the difficulty of the invention and the indispensability of philosophical wisdom (Sen. *Ep.* 90.20).

Posidonius' treatment of the invention of metallurgy is to some extent in tune with his general strategy: Posidonius has mentioned the invention of copper and iron only, in contrast to his stories of inventing gold and silver mines in his *History*. The reason for this is that his sages are able to foresee the consequences of their inventions: whatever accidents of melting could occur, they bring to humankind only useful and morally irreproachable inventions. This seems to imply his polemics with the Epicureans, who likewise stressed the usefulness of copper in contrast to gold, but depicted the latter's inventors as incapable of foreseeing the dangerousness of

course based on observations, but the second is more difficult and involves knowledge of anatomy and physiology.

⁵⁴ See note 31 above.

gold in the future: Lucretius mentions briefly that later gold ascended and acquired the first position (5.1273–1275)⁵⁵.

Against the backdrop of Posidonius' intellectualism, it may on the other hand seem startling that, in the context of the development of culture, he used the story of the accidental fire and the resulting invention of metallurgy by proto-philosophers. Although Seneca does not cite this, it is quite certain that the holes filled with metal suggested to his sages the idea of casting metals, as in Lucretius, for otherwise the mention of natural melting of ores would be unexplained in the context of metallurgy. Moreover, as we have seen, Posidonius' standard explanation of some inventions was that a sage observes carefully and imitates natural processes. This concession to an explanation of his opponents is understandable, however. He regarded the accidental fire instead of regular processes as an exception, probably because the usual way of explanation did not work in this case — it is difficult to find a prototype of metalworking in normal conditions — and he had to introduce a specific event, but one that he regarded as quite corresponding to the laws of nature, as his use of it in the *History* shows. This is not a decisive reason, but it is more plausible that Posidonius used here the Epicurean theory with its stress on accidental factors than that, vice versa, Lucretius used Posidonius and transformed the latter's story so radically that it corresponded entirely to the Epicurean way of explanation.

But here we should ask: did he first use the idea of metals melted due to fire and flowing on the surface in his *History*, following an earlier story like the one we know from *De mirab. ausc.*, not claiming that this was the origin to metallurgy, because this art had already existed, or did he first use it in his account of the origin of civilization — and here his or Epicurus' priority does not matter. At first sight, there are reasons to prefer the first option, granted that in all probability there was an earlier version, like that of *De mirab. ausc.* But, as noted earlier, there is one element in all Posidonius' versions and in Lucretius's version that is lacking in *De mirab. ausc.*—the melted metals flowed on the *surface* of the earth, while in *De mirab. ausc.* they remained deep under the earth and

⁵⁵ Bruno 2020: 378 supposes the Hesiodic origin of the idea of arms and tools from gold and silver, but Hesiod associates only the copper and iron ages with the use of corresponding metals.

were found due to an earthquake. It is tempting to think that the idea of metals that flowed on the surface of the earth appeared just because that was relevant for prehistory, for the invention of metallurgy due to holes filled with melted ore, i.e., for that etiology that we know only from Lucretius' version, but that should have been present in Posidonius, too, as I have argued. Only if the pieces of metal appeared on the earth and were found in holes could the molds and casting in them be invented. Granted that Posidonius' *History* was his late and probably incomplete work, it is quite possible that he first used the version with the surface and holes in his theory of the origin of civilization in the *Protrepticus* and later, when he had met the story of the beginning of Spanish mines in some earlier author and wrote the *History*, he "corrected" it and added the elements of the story that were relevant for the origin of metallurgy in the *Protrepticus*, but were less important for the Spanish context. This does not solve the issue of priority between Epicurus and Posidonius in the question of finding these specific elements, but it may show that Posidonius' use of the earlier historical source on Spanish mines is compatible with his use also of another, modified version of the story produced by Epicurus, who had earlier used the same historical source.

The remains of Posidonius' treatment of metallurgy are very scarce. Nevertheless, this treatment has some similarities with Lucretius', apart from the etiology of discovery itself. There is an evident resemblance of their respective contexts: as T. Cole rightly pointed out, both Lucretius and Posidonius depict the immediate result of this discovery — the creation of metal tools and their role in the development of farming and weaving⁵⁶.

It is also possible, although not certain, that there is a further similarity. It is crucial for Lucretius' explanation that the accidental fire took part in the wooden mountains: the fire would have to be very intense to make the veins in the depths of the earth flow with metal ore. He lists a number of accidents that might have caused such a fire, among them hunting with pits and fire (notice that pits are relevant, since melted metals congeal in hollows). It is possible that Seneca refers critically to hunting just before the invention of

⁵⁶ Compare *Lucr.* 5. 1262–1268 and *Sen. Ep.* 90. 11 (invention of tools); *Lucr.* 5. 1289 with 1365–1370 and *Sen. Ep.* 90. 21 (farming); *Lucr.* 5. 1350–1354 and *Sen. Ep.* 90. 20 (weaving); see Cole 1967/1990:17.

metallurgy for the same reason — because it figured in Posidonius as one of the possible sources of the resulting forest fire and the melting of metal ore⁵⁷. And there is one more significant detail: the developed art of working wood with metal tools that Seneca treats as one of the symptoms of moral decadence (90.9), although is not ascribed explicitly to Posidonius, has a very similar counterpart in Lucr. 5. 1266–1268.

There is one further relevant subject in Posidonius that is related to the invention of metallurgy. According to Seneca, he discussed which was historically prior, *malleus*, hammer, or *forcipes*, smith tongs:

⁵⁷ At first glance, Seneca's critical reference to hunting that precedes the discovery of mining (*Ep.* 90. 12) does not belong to Posidonius, since Seneca does not discuss his real, but his hypothetical statement and garbles it with Virgil's verses (*Georg.* 1. 139 f.): *isto enim modo dicat (P.) licet sapientes fuisse, per quos "tunc laqueis captare feras et fallere visco inventum et magnos canibus circumdare saltum.* However, it would be awkward to speak of hunting immediately after the discovery of the tools of the smith and before the discovery of mining, if there were no connection of hunting with both in Posidonius' narrative. It is possible that Seneca substituted Posidonius' exact words on hunting with his own statement in the form of Virgil's citation. This substitution can be explained, as well as in the other cases, apart from ornamental purposes, by Seneca's strategy of arguing against Posidonius; in a given case, he substitutes the tools discussed by Posidonius with those that are morally more suspicious, which he easily associates with decadence and thus proves that they could not be invented by sages. *Laquei* and *viscus*, as well as dogs, to be sure, have nothing to do with metals, but these hunting tools come from Virgil, not Posidonius. It is possible that Posidonius described the invention of hunting after the invention of the smith's instruments, for instance the invention of nets, since the tools fabricated by a smith are essential for making nets (nets were mentioned in the *Georgics*, too, but only as serving for fishing). The transition from hunting to the discovery of mining might thus be similar to Lucretius' idea. He mentioned both the primitive stage of hunting with fire and the advanced one (5. 1250 f.; in Lucretius, the advanced stage with nets and dogs presupposes the development of weaving and thus the discovery of metals and the domestication of animals). In all probability, Posidonius did not mention hunting with fire as a primitive method, but he could mention hunting with nets before the fire that led to the invention of melting in polemics with Epicurus: Posidonius possibly believed that cold metalworking and the invention of nets came first, and only after that came the accidental fire and the invention of melting and metal forms.

Ne illa quidem tam subtilis mihi quaestio videtur quam Posidonio, utrum malleus in usu esse prius an forcipes coeperint. Utraque invenit aliquis excitati ingenii, acuti, non magni nec elati, et quidquid aliud corpore incurvato et animo humum spectante quaerendum est.

This sentence immediately follows Seneca's citation of Posidonius' explanation how mining was invented. Taken together they show that Posidonius was not only interested in inventions in the field of metallurgy, but also tried to build a historical sequence of these inventions, and for this reason analyzed their inner logic. Lucretius also depicts this sequence and inner connection of discoveries, and this seems to be another peculiar feature common to both accounts in contrast to the remnants of literature on inventions that show no interest even in their sequence, a fortiori no interest in interconnections between them⁵⁸.

This similarity of approach suggests by itself that the two accounts did not appear independently of each other. But I suppose that there is an even closer relation between them. The question of the priority of the hammer or the smithing tongs discussed by Posidonius is surprising; both instruments together are the necessary part of a smith's equipment and are so depicted in literature beginning with Homer, where they are, in Greek, σφυρά and πυράγχα (*Il.* 18. 477; *Od.* 3. 434). The prevailing part of metalwork, namely working it in a heated and softened form, is necessarily accomplished by hammer and tongs (the latter hold the worked piece of metal and/or turn it)⁵⁹. The piece from the *Catalogue of the First Inventors* ascribes both inventions to a certain Cinyra from Cyprus, who invented also other implements of metalwork, together

⁵⁸ It would be rash, of course, to draw inferences from late, curtailed, and simplified catalogues, like that of Pliny, on account of the earlier literature of this kind; but notice that his part of the catalogue of inventions of metallic work (7. 197–198), which certainly goes back to good Peripatetic tradition (on sources, see Kremmer 1890: 97–106), attests that the primary interest was to maintain the countries that contributed to the inventions; it is unlikely that such literature could pay attention to the circumstances and psychology of individual inventions, as is typical for Lucretius and in this case for Posidonius.

⁵⁹ Blümner 1887: 289 f. points out that another function of tongs is to bend the heated piece of metal in order to give it a necessary form.

with roof tile⁶⁰. The problem that worried Posidonius and that he said needed a subtle discussion thus seems to be entirely far-fetched.

Nevertheless, it is possible to explain how this difficulty arose. There are three possible ways of metalworking: working metals in a cold state (soft ones, like gold, silver, and copper) with only a hammer; the middle way, working heated and softened metal; and melting metal and casting it in a mold. If you work cold metal you need a hammer, but not tongs⁶¹. Tongs are necessary when working heated metal or metal that has been cast in a mold and after that worked in a warm state with a hammer, as *Lucr.* 5. 1264 f. depicts. Thus the question Posidonius discussed could be the priority of cold or warm working. It is easy to suppose that cold working came first, i.e., that the hammer appeared earlier than tongs, and this probably corresponds to the real historical sequence of inventions, as the scholars think⁶². But it is difficult to see what another horn of this dilemma could mean — how it was possible to suggest that tongs were prior, granted that tongs cannot be used without the hammer?

This, however, would be understandable, if this second alternative was not the proposal Posidonius considered, but rather the inference he drew from someone's account of the stages of metallurgy. Now it is remarkable that Lucretius, who does not mention tongs in his account of the development of metalwork, depicts the historical sequence of inventions that involves the difficulty on which Posidonius could put his finger. Remember that according to Lucretius, before the invention of melting, the metals were not known at all; the melting that was discovered due to an

⁶⁰ *Plin. NH* 7. 195: *tegulas invenit Cinyra, Agriopae filius, et metalla aeris, utrumque in insula Cypro, item forcipem, martulum, vectem, incidem.*

⁶¹ The products of such working were called *σφυρήλατοι*, *ψυχρήλατοι*, etc., see Blümner 1887: 241 f.

⁶² Forbes 1964: 134: "Sometimes metals were used in their native state, but this practically limits their application to ornamental uses. In the overwhelming majority of cases the metal is worked by some process, the earliest group of processes being those of mechanical working and heat treatment. Heat treatment processes include simple heating (for instance before hammering), glowing, case-hardening (cementation or carburisation, so important in iron technology...), hardening, tempering or annealing (used especially in the case of copper and iron) and quenching (so important for the preparation of steel). Subjecting a metal to such an amount of heat that it melts, is the first step in the important process of casting."

accidental event was thus historically the earliest stage; then came working the heated metal with a hammer, probably again due to an accident and only because a hammer could be created by instruments with sharp and thin parts. Lucretius does not mention tongs among these instruments, but Posidonius could easily see the difficulties of such an account: these fine instruments could be produced from heated metal only with the help of tongs, but how it was possible, if in order to produce tongs themselves you need to already have tongs beforehand?

Lucretius' account might encounter also another difficulty, according to Posidonius: if melting is the earliest form of metalworking, how was it possible for the first inventor of the following stage, the working of heated metal, to extract the pig metal, still hot, from its form, without tongs, provided that the latter could not exist before working with a hammer was possible?

Thus, although Lucretius did not state (and probably no one else did, either) that tongs appeared earlier than the hammer, an account like his could provide fuel for polemics — if working heated metal was only an accidental discovery, the result of its natural melting, how was it possible to simultaneously find the complicated instrument, tongs, that are indispensable for this work? Although objections like these refer only to a probability, of course, it appears certain that in an account like Lucretius', that of Epicurus, his source, could presumably be the target of such polemics. On the contrary, it is quite incredible that, if he used Posidonius' account, Lucretius could ignore the difficulties Posidonius put his finger on.

What was Posidonius' own solution to this dilemma of the priority of *malleus* or *forcipes*? We don't know for certain, but it is quite possible that the invention of *ferramenta fabrilis* (90. 11) Seneca cites before the discovery of melting by fire was for Posidonius the earlier stage of working metals, unlike Lucretius' stance that working metal with a *malleus* is the next stage after casting melted metal. Posidonius thus gave priority to the *malleus*, that is to the cold working of metals.

To summarize, the relation of texts on spontaneous fire and the melting of metals thus appears quite complicated. First was probably a short but impressive version referring to fire in the Spanish mountains, which laid the foundations for mining gold and silver there in the 4th century BC (such a version could belong to the historical work of Timaeus of Tauromenium, or alternatively, to

some treatise by Theophrastus, perhaps *On Metals*). This version was used by Epicurus and adapted to the theory of the origins of culture, in his *On Nature*, Book XII; Epicurus transformed it in the etiology of the invention of metallurgy; Lucretius later used Epicurus' treatment of this invention in his Book V. On the other hand, Posidonius used, criticized, and adapted Epicurus' version in his account of the origin of culture, probably in his *Protrepticus*. He was also acquainted (I suppose, later) with the earlier version with fire and the invention of mines in Spain, the same story that Epicurus knew, used it in his *History*, and added to it one significant element of Epicurus' theory, the flowing of metals on the surface of earth, a component he previously used in his own theory of the origin of culture.*

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